Factors influencing sustaining and reporting inoculation injuries in healthcare professionals undertaking exposure prone procedures.

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FACTORS INFLUENCING SUSTAINING AND REPORTING INOCULATION INJURIES IN HEALTHCARE PROFESSIONALS UNDERTAKING EXPOSURE PRONE PROCEDURES

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ABSTRACT

Background: Occupational acquisition of bloodborne infections has been reported following exposure to blood or body fluids. Consistent adherence to standard/universal precautions will reduce the risk of infection. However, compliance with these precautions is variable.

Aims:

- To identify factors associated with adverse exposure to blood and body fluids among those performing exposure prone procedures in the operating theatre.
- To determine factors influencing reporting of such exposures.

Study design: A mixed methods study incorporating an exploratory, cross-sectional survey and a series of qualitative interviews.

Setting: Six NHS trusts across Wales.

Participants: The senior Infection Control Nurse, surgeons and scrub nurses in participating trusts.

Methods: A postal questionnaire survey of all surgeons and scrub nurses was undertaken, response rate 51.47% (n=315). A purposive sample of 16 respondents participated in a series of semi-structured interviews. The senior Infection Control Nurse of each trust was interviewed by telephone (n=6). Bivariate analysis was employed to explore the relationships between key variables. Logistic regression modelling was used to predict the likelihood of sharps injuries.

Findings: The influence of profession dominated the findings in relation to each variable considered. Bivariate analysis demonstrated that surgeons sustain more inoculation injuries, are less likely to adopt appropriate precautions and report fewer injuries than scrub nurses. Surgeons and nurses viewed the risks associated with their roles differently. Logistic regression models indicated that profession and the belief that injuries are an occupational hazard are significant predictors in relation to sustaining sharps injuries.

Conclusion/ implications: The influence of profession on sustaining and reporting exposures to blood and body fluids must be addressed to improve safety and reduce the risk of infection. This change requires altering surgeons' perception of risk to encourage compliance with available policies and procedures.

Key words: Standard precautions; universal precautions; inoculation injury; compliance; reporting.

DECLARATION

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

Signed .... (candidate)

Date ......1.2.10..

STATEMENT 1

This thesis is the result of my own investigations, except where otherwise stated.

A bibliography is appended.

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STATEMENT 2

I hereby give consent for my thesis, if accepted, to be available for photocopying and for inter-library loans **after expiry of a bar on access approved by the Swansea University.**

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CONTENTS

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DEDICATION

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ABBREVIATIONS

AIDS	Acquired Immuno Deficiency Virus
CASP	Critical Appraisal Skills Programme
CDC	Centers for Disease Control and Prevention
CDSC	Communicable Disease Surveillance Centre
CE	Comité Europa
CI	Confidence Interval
CNSSN	Canadian Needlestick Surveillance Network
COREC	Central Office for Research Ethics Committees
COSHH	Control of Substances Hazardous to Health
df	Degrees of freedom
DOH	Department of Health
EPINet	Exposure Prevention Information Network
FIV	Feline Immunodeficiency Virus
FTE	Full time equivalents
GP	General practitioner
HBM	Health Belief Model
HBV/hep B	Hepatitis B virus
HCP	Healthcare professional
HCV/hep C	Hepatitis C virus
HCW	Healthcare worker
HICPAC	Hospital Infection Control Practices Advisory Committee
HIV	Human Immunodeficiency Virus
HPA	Health Protection Agency
HSE	Health and Safety Executive
HSV	Herpes Simplex Virus
ICN	Infection Control Nurse
IRAS	Integrated Research Application System
IRR	Incident rate ratio
M	Manager
MREC	Multi-Centre Research Ethics Committee
n	Number
N	Nurse

N/A	Not applicable
NHS	National Health Service
NICE	National Institute for Health and Clinical Excellence
NIOSH	National Institute for Occupational Health and Safety
NMC	Nursing and Midwifery Council
NPHS	National Public Health Service
NPSA	National Patient Safety Agency
ODP	Operating Department Practitioner
OE	Occupational exposure
OR	Odds ratio/Operating room
OSHA	Occupational Safety and Health Administration
p	Page
P	Probability
PEP	Post exposure prophylaxis
PHLS	Public Health Laboratory Service
phru	Public Health Resource Unit
QAS	Question Appraisal System
RCN	Royal College of Nursing
RCT	Randomised control trials
R	Risk
RR	Relative risk
S	Surgeon
SCT	Social Cognition Theory
Sig	Significance
SIGN	Scottish Intercollegiate Guideline Network
SIROH	Studio Italiano Rischio Occupationale da HIV
SPSS	Statistical Package for Social Sciences
STI	Sexually Transmitted Infection
TRA	Theory of Reasoned Action
TPB	Theory of Planned Behaviour
UK	United Kingdom
US	United States
VIF	Variance inflation factors

vs	Versus
WTE	Whole time equivalent
χ^2	Chi-square

CHAPTER ONE

STATEMENT OF THE PROBLEM

This chapter defines the problem which is being researched. The main sections are:

1.1 SCOPE OF THE STUDY

This research focused on the adoption of standard/universal precautions and the frequency and reporting of inoculation injuries among surgeons and scrub nurses engaging in exposure prone procedures in operating theatres in Wales. The participants were surgeons (registrars, senior registrars, consultants) and scrub nurses (staff nurses and sisters/charge nurses) working in the operating departments of six National Health Service (NHS) trusts in Wales.

The study aimed to identify the frequency of inoculation injuries among healthcare professionals (HCPs) who undertake exposure prone procedures in the operating departments of acute hospitals in Wales and to identify whether standard/universal precautions were adopted during the procedures in which these injuries occurred. Circumstances surrounding inoculation injuries were explored and the frequency of reporting such injuries was identified, together with reasons for under-reporting injuries.

This knowledge will allow appropriate educational initiatives to be directed towards the relevant HCPs, with the intention of reducing accidental exposure to blood and body fluid and reducing the risk of infection where such exposures have occurred (see chapter 6).

The Senior Infection Control Nurse from each Trust was also questioned about the action taken following reported inoculation injuries and local strategies to influence compliance with standard/universal precautions and prevention and reporting of inoculation injuries.

Data were collected between January 2006 and September 2008 by a number of research methods:

1. a postal questionnaire was sent to all relevant surgeons and scrub nurses in the participating trusts (appendix 1);
2. face to face semi-structured interviews were completed with a selection of surgeons and theatre nurses (appendix 2);
3. telephone interviews were conducted with Infection Control Nurses (appendix 3).

The data from all three sources were analysed to identify the level of agreement between all three sample groups on several themes including frequency of reporting inoculation injuries and attendance at training/educational sessions.

1.2 THE RESEARCH QUESTION, AIMS AND OBJECTIVES

Research question

"What factors are associated with the occurrence, frequency and reporting of percutaneous and mucocutaneous exposure to blood and body fluids in the operating theatre?"

Aims of the study

This study aims to investigate, within selected NHS trusts in Wales:

- The factors associated with percutaneous and mucocutaneous exposure to blood and body fluids (inoculation injuries) among health care professionals performing exposure prone procedures in the operating theatre.
- The factors associated with and influencing reporting of such exposures.

Objectives of the study

- To assess the number of and circumstances surrounding inoculation injuries in the one and five years prior to the study among health care professionals undertaking exposure prone procedures in operating departments in Welsh hospitals (Questions 1-4 and 6-12, appendix 1).
- To explore the relationship, if any, between compliance with standard/universal precautions and inoculation injuries (Question 5, appendix 1).
- To assess the proportion of these injuries that are reported (Question 14, appendix 1).
- To explore the reasons for under-reporting of inoculation injuries (Questions 9, 13-15, appendix 1 and interview, appendix 2).
- To explore healthcare professionals' views of their personal risks and adoption of guidelines/protocols on standard/universal precautions and inoculation injury reporting (interview, appendix 2).

1.3 THE ORIGINS OF THE STUDY

1.3.1 Background

Occupational acquisition of bloodborne infections by HCPs can occur either as a result of percutaneous exposure to blood or body fluids via injuries from sharp objects, or mucocutaneous exposure, including splashes of blood to mucous membranes and broken skin (UK Health Departments, 1998).

In order to reduce the risks to both patients and HCPs, healthcare providers should supply HCPs with detailed guidance on how to reduce exposure to blood and body fluids, and procedures for reporting and treatment following inoculation injury (UK Health Departments, 1998). Universal and standard precautions (Centres for Disease Control and Prevention (CDC), 1987; Garner *et al*, 1996) have been devised to protect healthcare workers from infection. Although there are differences between universal and standard precautions, the terms are frequently used interchangeably and both are described in the literature (see section 2.3.2). Therefore, for the purpose of this thesis, both terms will be considered in relation to how they relate to protection against exposure to blood and body fluids.

Strict adherence to standard/universal precautions in all situations where exposure to blood and body fluids are anticipated has been demonstrated to reduce the risk of adverse exposures to blood and body fluids (section 2.3). However, evidence suggests that standard/universal precautions are not consistently adopted (section 2.4). HCPs routinely assess the risk of infection following exposure to blood and body fluids based on their judgements of whether the patient is likely to have a bloodborne viral infection. Precautions are then taken for "high risk" patients rather than all patients (Leliopoulou *et al*, 1991; Ronk and Girard, 1994; Lymer *et al*, 1997; Cutter and Jordan, 2003, 2004). Consequently, avoidable accidents occur, inoculation injuries are neither documented nor treated appropriately and both HCPs and patients are exposed to unnecessary risks.

Furthermore, evidence suggests that only a proportion of injuries is reported, section 1.3.6 (Mangione *et al*, 1991; Burke and Madan, 1997; Cutter and Jordan, 2003, 2004) and therefore treated appropriately. Reasons for under-reporting are many and varied (section 2.7). Consequently, it is important to identify the reasons why HCPs in this sample are reluctant to report such exposures, so that the appropriate action can be taken locally to improve the frequency of reporting and therefore, to reduce occupationally acquired infection.

Although previous studies have identified reasons for lack of compliance with standard/universal precautions and failure to report inoculation injuries, many have concentrated on single professions, for example nurses or doctors (Ramsey *et al*, 1996; Nelsing *et al*, 1997). None have explored the relationship between compliance with standard/universal precautions and sustaining and reporting inoculation injuries. Very few have attempted to compare attitudes and behaviours of a multidisciplinary sample. None, except Cutter and Jordan (2003 and 2004) have been conducted in Wales.

1.3.2 Epidemiology of blood-borne viral infection in healthcare workers

According to the Health Protection Agency (HPA) there were approximately 77,400 people living with Human Immunodeficiency Virus (HIV) in the UK in 2007 and 191,000 people chronically infected with HCV in England and Wales in 2003. Twenty eight per cent of HIV positive individuals are unaware of their diagnosis (HPA 2008a, HPA 2008b). Similarly 75% of hepatitis C (HCV) positive individuals in Wales are thought to be unaware of their diagnosis (Welsh Assembly Government (WAG), 2009). An estimated 55% of persons acquiring HIV in 2007 (n=4620) did so through heterosexual intercourse (HPA, 2008a) and would not therefore fit into a 'traditional' high risk group of homosexual males or intravenous drug users. Only approximately 5.2% of new HIV diagnoses in the UK during 2007 were thought to be the result of injecting drug use (HPA, 2008c) again not matching the commonly held stereotypes. A significant proportion of new HCV cases (90%) are the result of intravenous drug use (HPA 2008b). However, during the 1980's and 1990's transmission of HCV via transfusion of contaminated blood and blood products affected between 5 and 80% of recipients (Healey *et al*, 1996; Widell *et al*, 1997; Dike *et al*, 1998) providing a potential source of infection in individuals who may otherwise not have traditional risk factors.

The risk of contracting HIV following percutaneous exposure to infected blood is thought to be in the order of 0.3% (CDC, 1996; UK Health Departments, 1998). For HCV the risk is approximately 3% and for Hepatitis B virus (HBV), 30% (UK Health Departments, 1998). Mucocutaneous exposure poses a lesser risk, more in the order of 0.03% for HIV (Public Health Laboratory Service (PHLS), 1999). However, as this type of exposure is thought to be more common than percutaneous exposure, the cumulative effect could result in a higher risk (UK Health Departments, 1998).

Frequency of occupational exposure to infected blood in England, Wales and Northern Ireland is monitored by the HPA and Communicable Disease Surveillance Centre (CDSC). Between July 1997 and June 2002, 1550 exposures to infected blood were reported by 250 occupational health departments and genito-urinary medicine clinics across the UK. Almost 82% of these were to a single virus only, the remainder to more than one virus simultaneously. Seven hundred and fifteen HCPs had been exposed to HCV, with one confirmed case of HCV transmission, 411 exposures to HIV and 141 to HBV. Also, 56 were exposed to HIV and HCV, 29 to HBV and HIV, 49 to HCV and HBV and 12 to all three viruses. Nursing-related professions (42%) and doctors (35%) were the two professional groups most commonly affected (CDSC, 2003).

Follow up information was received from 737 HCPs six months after each incident, Of these, 1 HCP was found to be HIV positive, and 3 found to be HCV positive. There were no reports of occupational acquisition of HBV (CDSC, 2003).

Data concerning rates of inoculation injuries are incomplete as it appears that no country monitors every hospital and records every reported inoculation injury. Rates of injury are therefore impossible to calculate accurately. Voluntary reporting does provide some indication of the extent of the problem, but reporting methods vary throughout the world. It is also relevant that where voluntary reporting exists, it is possible that those hospitals that give priority to monitoring inoculation injuries and reporting may be more likely to participate in surveillance schemes such as those discussed in this section. Nevertheless, a review has been completed of available international reports to illustrate sample rates and frequencies.

1.3.3 Review of international reports

United States of America

In the USA, the National Surveillance System for Hospital Health Workers (NaSH) collates exposures reported to the Centers for Disease Control and Prevention (CDC). They reported a total of 5220 exposures between June 1995 and July 1999 from 23 participating hospitals. Of these, 83% were percutaneous injuries, 13% were mucous membrane exposures, 1% bites and 3% skin exposures (CDC, 2001). In total, the CDC estimates that approximately 385,000 percutaneous injuries are sustained by American healthcare workers each year (CDC, 2005) significantly less than suggested by Bell *et al* (1997) who estimate that the total number of needlestick and other sharps injuries could total between 800 000 and 1 million per annum in the US alone.

According to the Exposure Prevention Information Network (EPINet), 1155 needlestick and sharp object injuries were reported by a small number (n=44) of US hospitals in 2003, a rate of 23.87 percutaneous injuries per 100 occupied beds (EPINet, 2004a). Over the same period, 354 skin and mucous membrane exposures to blood and body fluids were reported, i.e. 6.3 per 100 beds (EPINet, 2004b).

Canada

In Canada, since 2000, information on HCPs occupational exposure to blood and body fluids has been collected by the Canadian Needlestick Surveillance Network (CNSSN). Participation in this scheme is voluntary. Once again the number of participating hospitals is low. Between April 1st and March 31st 2001, eight teaching hospitals and four non teaching hospitals providing a combination of adult, paediatric, long term and community care returned data to the CNSSN for all reported exposures. A total of 1436 occupational exposures were reported, 84% of which were percutaneous and 16% mucocutaneous. Of the percutaneous exposures, 78% were needlestick injuries, and of the mucocutaneous exposures, 88% were blood splashes. Overall injury rates were calculated as 4.24 per 100 full time equivalents (FTEs), 16.83 per 100 beds, 0.06 per 100 patient days or 0.54 per patient admissions. Rates were found to be higher in teaching hospitals than non teaching hospitals (4.41 versus 3.45 per 100 FTEs and 21.76 versus 7.03 per 100 beds (CNSSN, 2001).

Australia

In Australia, reporting of occupational exposure to bloodborne pathogens is coordinated by the National Centre in HIV Epidemiology and Clinical Research (NCHECR) in collaboration with state and territory health agencies. In 1997, data were collected from 48 health care facilities comprising teaching hospitals, private hospitals, district or community hospitals and rural hospitals. For the first 6 months of 1997, 1220 percutaneous and mucocutaneous exposures were reported, the largest number of which were reported by teaching hospitals (Perry, 1998).

Italy

The Italian Study Group on Occupational Risks of HIV Infection was established in Italy in 1986 to evaluate the risk of occupational HIV transmission (Ippolito *et al*, 1994). Between 1990 and 1992, 12 acute hospitals, 5 of which were teaching hospitals, participated in a study to determine the number of needlestick injuries by type of hollow bore needle per 100 000 devices used per year. During this period, 2565 injuries were reported of which 2524 were included in data analysis. Nurses accounted for 69.8% of reported injuries, housekeepers for 13% and physicians for 10% (Ippolito *et al*, 1994).

The Italian Study on Occupational Risk of HIV Infection (Studio Italiano Rischio Occupazionale da HIV, SIROH) investigated all percutaneous and mucocutaneous injuries reported between 1994 and 1999 in participating Italian hospitals (Petrisillo *et al*, 2001). A total of 21,118 percutaneous exposures to blood or body fluids were reported, and 6400 mucocutaneous exposures. The highest percutaneous injury rate was among general surgery nurses (15.1 per 100 full time equivalents).

France

In France, a multi-site study of 375 medical facilities accounting for 15% of medical centres and 29% of hospital beds reported 13, 041 blood and body fluid exposures during 2004. Most (63.5%) of these exposures occurred in hospitals and clinics, while 32.7% occurred in university hospitals, 2.2% in psychiatric centres and 0.8% in local hospitals (Venier *et al*, 2007).

United Kingdom

There is little data available on percutaneous or mucocutaneous exposures to blood or body fluids collected during multi-site surveillance in the UK (Royal College of Nursing (RCN), 2001) although a survey of RCN members in 2005 revealed that 35% (985/2813) of nurses who responded had sustained a needlestick injury at some time during their career and 7% (197/2813) during the previous year (RCN, 2006). According to the National Audit Office (2003), needlestick and sharps injuries were responsible for 17% of all accidents in NHS staff, second only to moving and handling injuries.

The HPA compiles a bi-annual report that publishes data on significant exposures i.e. those where there has been exposure to a source known to be HIV, HBV or HCV positive. The most recent report (HPA, 2008d) is based on data from 2000 – 2007. Data were collected from 194 reporting sites across England, Wales and Northern Ireland and during this period, 2296 reports were received. Of these, 1113 (48%) were to HCV, 505 (22%) to HIV and 166 (approximately 7%) to HBV and 158 (approximately 7%) being exposed to two or three viruses during the same exposure. According to the UK Collaborative group for HIV and STI Surveillance (2007), there has been an increase in the number of cases of HIV across the UK that increases the risk of exposure to the virus by personnel working outside London.

The HPA have established that since 1997, percutaneous injuries have been responsible for 76% (2296/3035) of exposures. Between 1997 and 2007, most exposures involved nurses (48%, 1447/3035). However, the latest report indicates that the majority of significant exposures in 2007 were reported by the medical and dental professions (46%

compared to 44% of nurses). Percutaneous exposures among medical staff rose by 21% from 129 reports in 2004 to 156 in 2007 while the number of percutaneous reports reported among nurses in 2007 was 124 compared to 125 in 2004. Mucocutaneous exposures among medical staff rose from 29 in 2004 to 44 in 2007 and among nurses there were 51 reported mucocutaneous exposures in 2004 compared to 65 in 2007. Among the medical profession the report indicates that the majority of injures were reported by senior house officers (271/790) while senior registrars and consultants reported 231/790 (29%) and 166/790 (21%) respectively. The HPA is unclear as to whether this represents a higher incidence of injuries among the lower grades or simply a higher rate of reporting. Doctors experienced a higher rate of injures in theatres (80%, 37/46). Between 2000 and 2007, the HPA report that 20% (76/377) of incidents occurred after the procedure. Theatre incidents accounted for 17% of all exposures in 2007 (62/360) and were felt to be related to more complex and emergency procedures. The HPA stated that safety devices might have prevented some of these injuries (HPA, 2008d).

1.3.4 <u>The risks to professionals and patients</u>

Between 1997 and 2007, there were 14 cases of HCV seroconversions in health care workers reported to the HPA with 23 cases of probable occupational transmission (HPA, 2008d). A summary of published reports indicates that up to June 2002, there have been 106 cases of documented HIV sero-conversion among healthcare workers world-wide, (5 in the United Kingdom) following occupational exposure to blood or body fluid, with a further 238 possible cases, 14 of these in the UK (HPA 2005).

Of the documented HIV cases, nurses and laboratory workers comprised 69% (73/106), doctors and medical students excluding surgeons – 13% (14/106), surgeons <1% (1/106) and dental workers - 0. Of the possible cases, nurses and laboratory workers comprised 39% (94/238), doctors and medical students excluding surgeons – 12% (28/238), surgeons - 7% (17/238) and dental workers - 3% (8/238) (HPA, 2005).

For documented cases, the following causes were recorded:

- Re-sheathing – blood
- Re-sheathing – pleural fluid
- During venepuncture
- Blood splash to hands, eyes and mouth while disoccluding arterial catheter
- Blood splash to mucous membranes
- Phlebotomy
- IV cannulation
- During disposal
- Piercing rubber stopper
- Needle in sharps bin
- Scalpel cut
- Broken glass
- Orthopaedic pin
- Manipulating lid of sharps box

(HPA, 2005)

In the USA, 57 HCPs have confirmed documented occupation acquired HIV infection (CDC, 2001). Of these, 86% had been exposed to blood, and most (88%) had sustained percutaneous injuries (Do *et al*, 2003). Of the 55 source patients, only 69% were known to have acquired immunodeficiency syndrome (AIDS) and 11% to have asymptomatic HIV infection (Do *et al*, 2003) illustrating the need for precautions whether or not the infection status of the source patient is known.

According to Gerberding *et al* (1990), the incidence of HBV infection among HCPs is significantly higher than for HIV as the risk of exposure would suggest. Unpublished data from the National Institute for Occupational Safety and Health (NIOSH, 1999) part of the CDC, estimates that in 1995, 800 HCWs became HBV positive in the United States alone.

There is no world-wide register of occupationally acquired HCV infection (May and Brewer, 2001). However, there were 14 confirmed cases of HCV transmission from patient to HCW in England and one in Scotland between 1997 and 2007 (HPA, 2008d). However, the World Health Organisation (WHO), based on the average numbers of healthcare workers at risk, the average numbers of sharps injuries each year, the prevalence of infection in patients and the general population, HBV vaccine update rates and post exposure prophylaxis take up rates suggest that sharps injuries alone may have resulted in approximately 66000 cases of HBV, 16000 cases of HCV and 200-5000 cases of HIV annually in healthcare workers across the world (Prüss-Üstin *et al*, 2003). Assuming these data are accurate, the number of recorded cases suggests that injuries and infections are significantly under-reported (Schmid *et al*, 2007).

Although the incidence of occupationally acquired infection among HCPs may be low, for those affected the results are devastating. Anecdotal accounts by those infected during their work are testament to the heartbreaking consequences of such infections (Kopfer and McGovern, 1993; Garcés *et al*, 1996; Ames and Akuna, 1999; Algie *et al*, 1999; Worthington *et al*, 2006). Even the threat of infection causes considerable stress while waiting for the 'all clear' (Doody, 2001; Siebert, 2003)

Appropriate action following inoculation injury including appropriate first aid, prophylactic treatment and surveillance can significantly reduce the risk of occupational acquisition of HIV and HBV infection (CDC, 1990; Kennedy and Williams, 2000; US Public Health Service, 2001; CDC, 2001; Gerberding, 2003; Department of Health (DOH), 2008).

Zidovudine has been demonstrated to reduce the risk of HIV transmission following exposure to infected blood (Cardo *et al,* 1997). In HIV positive patients, combination therapy has been more effective than zidovudine alone in reducing viral load. Therefore, it is reasonable to expect a combination of drugs to provide increased protection following exposure to HIV infected blood (HPA, 2003). At present in the UK, antiretroviral agents from three classes of drug are licensed for treatment of HIV. They are nucleoside analogue reverse transcriptase inhibitors, non-nucleoside reverse transcriptase inhibitors and protease inhibitors. None are licensed for post-exposure prophylaxis, and must therefore be prescribed on an 'off label' basis (DOH, 2008). Post exposure prophylaxis (PEP) currently comprises a combination of tenofovir, emtricitabine, lopinavir and ritonavir (DOH, 2008). However, PEP will not entirely eliminate the risk (Beltrami *et al*, 2002). Therefore, if the patient's virus is resistant to any of the drugs, the combination should be amended to include a regimen to which the virus is unlikely to be resistant (CDC, 2001; Gerberding, 2003).

Following exposure to HBV, an un-vaccinated individual may be given hepatitis B immunoglobulin and/or hepatitis B vaccine (HPA, 2008d). For these drugs to be given at the appropriate time, inoculation injuries must be reported promptly to the relevant department. However, one of the most effective methods of protection against HBV is vaccination using inactivated hepatitis B surface antigen, which provides protection in up to 90% of recipients (UK Health Departments, 1998).

No post exposure prophylaxis or vaccination is currently available for hepatitis C virus. However, early detection of the virus offers the opportunity for prompt treatment and improved outcome (Jaeckel *et a*l, 2001).

The risks of transmission of infection from patient to HCP are greater than from HCP to patient (UK Health Departments, 1998) however, patients are also potentially at risk. Transmission of HCV (Esteban *et al*, 1995; CDSC, 2000; Ross *et al*, 2002), HBV (Welch *et al*, 1989; Harpaz *et al*, 1996; Heptonstall, 1996; Sundkvist *et al*, 1998; Spijkerman *et al*, 2002; Laurenson *et al*, 2007) and HIV (Dozozynski, 1997; Blanchard *et al*, 1998; Lot *et al*, 1999; Goujon *et al*, 2000) from healthcare worker to patient have been recorded in case reports. Consequently, the DOH (2008) recommends that patients exposed to the blood of a healthcare worker known or found to be HIV positive should, if considered appropriate following a thorough risk assessment, be prescribed post exposure prophylaxis. According to Tokars *et al* (1992), in 32% of percutaneous injuries to surgeons, the sharp instrument that caused the injury re-contacted the patient making transmission to the patient a real possibility should the surgeon be suffering from a bloodborne viral infection.

Although traditionally, universal precautions have been used to reduce the risk of occupational exposure to HIV, HBV and HCV, there are documented cases of other infections occurring when a lapse in precautions occurred, including malaria due to a failure to change contaminated gloves and necrotizing fasciitis (invasive group A streptococcal infection) following a needlestick injury (Hagberg *et al,* 1997; Piro *et al*, 2001) and Ebola virus following a needlestick injury (Anonymous, 2004).

1.3.5 <u>The importance of reporting inoculation injuries</u>

Reporting of adverse exposures to blood and body fluids is important for the following reasons:

- To ensure that accurate data exists on the numbers and types of exposures sustained by healthcare professionals (HCPs).
- Ignoring inoculation injuries will result in failure to ensure that appropriate prophylaxis is administered to reduce the risk of occupational acquisition of a bloodborne viral infection. Although there is no prophylaxis available against HCV infection, the HCV status of the source patient and exposed HCP should be determined, and the status of the HCP monitored for early detection of infection should the patient be HCV positive so that early treatment can be given to improve prognosis (US Public Health Service, 2001; Jaeckel *et* al, 2001). Prompt treatment with appropriate post exposure prophylaxis consisting of an appropriate combination of drugs is thought to significantly reduce the risk of occupational acquisition of HIV in those exposed to HIV positive blood (Kennedy and Williams, 2000; US Public Health Service, 2001; DOH 2008). Administration of immunoglobulin and vaccine has been demonstrated to reduce the risk of HBV infection following exposure (CDC, 1990; US Public Health Service, 2001).
- Failure to report all injuries sustained could lead to inaccurate information on the overall risk of infection associated with exposure to blood and body fluids, and can

lead to a lack of awareness of risk taking behaviour in the clinical area (Cutter and Jordan, 2004).

- Learning more about individual exposures and the circumstances surrounding them can lead to new exposure prevention strategies and equipment (Gershon *et al*, 2000a) and identification of risk behaviour by HCWs.
- Accurate data on the equipment implicated in inoculation injuries and the activity being undertaken when the injuries occur provide vital information on the risks associated with exposure to blood and body fluids which can be used to support the case for safer working conditions and safety equipment. Hence, under-reporting will result in inaccurate data and may decrease managers' incentives to provide safer working conditions and equipment (Mangione *et al*, 1991).
- Accurate assessment of the cost of inoculation injuries to the NHS. Percutaneous injury represents one of the most common injuries to healthcare personnel (Doebbeling, 2003). No estimate of the cost of inoculation injury is available for Wales or the UK as a whole. However, information from Scotland gives an indication of the financial burden such injuries place on the NHS. The Short Life Working Group on needlestick injuries in the NHS in Scotland estimated that sharps injuries cost the NHS in Scotland £260 000 annually (NHS Scotland, 2001). For those who have experienced such an injury, perhaps resulting in a subsequent infection, legal action may be an option they wish to pursue. Accurate documentation of the circumstances surrounding the accident and subsequent action is essential for medico-legal purposes. Compensation, financed by the State, may be payable to HCPs who sustain certain occupationally acquired illnesses, one of which is viral hepatitis (Harrington, 2000). Compensation payments are often considerable. For example, in 2002, a senior operating department assistant was injured while assisting an anaesthetist, suffered shock and trauma as a consequence and received £58000 and in 1998, £465,000 was paid to a junior doctor following a needlestick injury from a clean needle. The accident resulted in a needlestick phobia which ended her career (National Audit Office, 2004). Failure to report may affect any benefits or compensation payable.

- Accurate assessment of the risk to patients from infected HCPs. When an injury could potentially involve the patient being exposed to the blood of the HCP, the patient must be regarded as the injured party and be offered the same prophylaxis and counselling as the HCP (Heptonstall *et al*, 1999; DOH, 2008). Failure to report all exposures could result in the patient not receiving appropriate support and treatment.

1.3.6 Rates of reporting

Despite compelling reasons to support reporting of all adverse exposures to blood and body fluids, under-reporting is common. Studies suggest that 3%-65% of injuries are reported (Ramsey and Glenn, 1996; Burke and Madan, 1997; Lymer *et al*, 1997; Hettiaratchy *et al*, 1998; Patterson *et al*, 1998; Haiduven *et al*, 1999; Benitez *et al*, 1999; Shiao *et al*, 1999; Alvarado-Ramy *et al*, 2003; Cutter and Jordan, 2003; Sencan *et al*, 2004; Raghavendran *et al*, 2006; Makary *et al*, 2007; Au *et al*, 2008).

It is important to identify the factors influencing under-reporting so that appropriate measures can be taken to improve the number of inoculation injuries reported.

1.3.7 The context of the operating theatre

Percutaneous and mucocutaneous exposure to blood is a significant risk in the operating department because of the frequency of exposure prone procedures, defined by the UK Health Departments (1998, p. 23) as those in which:

> "the worker's gloved hands may be in contact with sharp instruments, needle tips or sharp tissues (e.g. spicules of bone or teeth) inside a patient's open body cavity, wound or confined anatomical space where the hands or fingertips may not be completely visible at all times."

Surgeons are particularly at risk because of the frequent handling of sharps and exposure to comparatively large volumes of blood (Quebbeman *et al*, 1990; Tokars *et al*, 1992; Lynch and White, 1993). Doctors have also been found to be reluctant to follow standard/universal precautions (Stein *et al*, 2003; Trim *et al*, 2003; Cutter and Jordan, 2004; Au *et al*, 2008), section 2.5.5, which may also contribute to the risk.

The majority (51-77%) of reported injuries to surgeons and scrub personnel are associated with suture needles (Tokars *et al*, 1992; Jagger *et al*, 1998; Hunt and Murphy, 2004; Perry and Jagger, 2005; CDC, 2006; Smith *et al*, 2006a; Venier *et al*, 2007). Although suture needles do not have a hollow bore which would allow injection of a significant volume of blood into the wound, injuries during surgery often occur when the hands are concealed within a body cavity and may be undetected for long enough to allow blood to enter the wound thereby exposing the HCP to potential infection.

Injuries during surgery may also arise from scalpels (CDC, 2006). Such injuries are sometimes severe and may also occur when the hands are inside a body cavity. Jagger *et al* (1998) found that scalpel blades caused moderate or severe injury in 64.5% of cases compared to 47.2% of injures caused by suture needles. Consequently, risk of infection may be high.

Mucocutaneous exposure is most likely during exposures that generate an aerosol or splash of blood and body fluids, such as during surgery (Quebbeman *et al*, 1990). The most common area of contamination is the mucosa of the eyes (Ippolito *et al*, 1993; Jagger *et al*, 1998; Gershon *et al*, 2000a; CNSSN, 2001; Puro *et al*, 2001).

Despite being more likely to sustain an inoculation injury than any other group of HCP working in the operating department, surgeons are the least likely to report them (Cutter and Jordan, 2003, 2004). Manian (1996) and Williams *et al* (1994) suggest that this might be because surgeons do not perceive these incidents as significant, perhaps because familiarity breeds contempt. This could put patients at risk. "When a surgeon suffers a needlestick injury, not only is he exposed to the risk of disease but so are his future patients" (Hettiaratchy, 1998, page 440).

1.3.8 Preparatory work

In 2001, as part of a Master in Science (Nursing) degree (Cutter, 2002), the researcher conducted a survey among scrub nurses, surgeons and midwives in two large acute hospitals of an acute NHS Trust in Wales. Factors affecting the uptake of standard/universal precautions and reporting of inoculation injuries were investigated.

A response rate of 72.5% (200/276) was achieved. The results revealed that uptake of standard/universal precautions was poor, with only 1.5% (3/200) of respondents adopting precautions for all patients irrespective of whether their bloodborne viral status was known. Most, (80/200, 40%) admitted doing so only when the patient was suspected as having a bloodborne viral infection. Furthermore, 8/200 (4%) of respondents would only take all the relevant precautions if their patients were known to have a blood-borne infection (Cutter and Jordan, 2003 and 2004).

On average, only half the recommended theatre-specific precautions were always adopted (mean 3.725 of seven, standard deviation = 1.385). Most respondents (63.3%) admitted making judgments related to nationality, lifestyle or sexual orientation when making decisions regarding protective clothing (Cutter and Jordan, 2004).

Many respondents (74%, 145/196) reported sustaining an inoculation injury in the 10 years before the study. However, under-reporting of injuries was common: 32.4% (47/145) of respondents admitted failing to report injuries. Reporting was influenced by profession, with surgeons least likely to report injuries with 52.7% (39/74) of the surgeons who had experienced inoculation injuries reported them, compared to 38/42 (90.5%) of scrub nurses (χ^2=15.479,P<0.001, 95% CI=0.038-0.362) and 91.3% (21/23) of midwives (χ^2=9.506, P=0·002, 95% CI=0.023-0.485) (Cutter and Jordan, 2004).

Extensive awareness and educational sessions followed the completion of the study to feed back the results to the trust managers and participants in the study. Consequently, the following changes were made:

- Trials of safety devices, such as retractable needles were conducted in 2002, in an effort to reduce the number of inoculation injuries sustained.
- All HCPs have been further encouraged to report inoculation injuries.

- Linen drapes and gowns have been replaced with water-repellent drapes and gowns that do not allow passage of blood and body fluids.
- All the infection control policies produced by the Infection Control Team, incorporating standard/universal precautions were reviewed. The policies were distributed to all clinical areas on hard copy and electronically *via* the Trust's Intranet. Terminals are available in all operating theatres, ward areas and staff offices.
- Additional education sessions have been carried out for clinical medical students, surgeons, nurses and midwives.

The findings of this study and the scarcity of other studies investigating the extent of, and reasons for, non-compliance with both local and national guidelines suggest that further work is needed to identify the factors affecting guideline adherence. Without identification of the reasons for non-adherence, strategies aimed at improving compliance and reducing injury and potential infection cannot be developed. This study will attempt to address these deficits.

1.4 RESEARCH DESIGN

1.4.1 Research approach

This study adopted a mixed methods approach. A cross-sectional survey (appendix 1) was undertaken to explore the incidence of inoculation injuries, the extent of compliance with standard/universal precautions and reporting of inoculation injuries. Following data analysis, face to face interviews (appendix 2) were conducted with 16 purposively selected participants to gain a better understanding of the reasons behind their behaviour. To corroborate data related to the number of inoculation injuries reported by profession, the content of educational sessions and the number of educational sessions attended by each professional group participating in the study, telephone interviews were conducted with an Infection Control Nurse (ICN) from each participating trust (appendix 3). This is discussed in detail in section 3.2 and 3.3

1.4.2 Data collection

No standard validated questionnaire was available to collect the data that was required for this study. Therefore, the questionnaire for surgeons and scrub nurses was developed following a review of literature and key studies on standard/universal precautions and inoculation injuries. Each question on the questionnaire related to the objectives of the study (section 3.3). A non-validated questionnaire could be considered to be questionable in terms of reliability and validity (Rudestam and Newton, 2001). Therefore, where possible, questions used in previous studies were included to increase reliability and validity. Questions 5, 9, 11 were incorporated into the questionnaire because not only had they been used in a previous study, but had also been subjected to double blind review on two occasions (Cutter and Jordan, 2003 and 2004). Question 6 and 7 incorporated the themes explored during the EPINet study (2003a and 2003b) and consequently, also contribute to content validity.

The questionnaire was designed to explore the proportion of respondents complying with standard/universal precautions, sustaining inoculation injuries and reporting such injuries. The factors affecting compliance and reporting were explored by closed and open questions.

Following analysis of the questionnaires (see section 1.4.3), a purposive sample of 16 respondents was interviewed. Respondents were selected for interview based on their responses to the questionnaire, and included those with the highest and lowest number of injuries and/or extreme opinions relating to any of the questions asked. The interview schedule can be found in appendix 2.

1.4.3 Data analysis

Variables were set up and data analysed using the Statistical Package for Social Sciences (SPSS) for Windows, version 13. A description of all variables was obtained and cross-tabulation and analysis of key variables was undertaken. The primary outcome variable was 'sustaining an inoculation injury'. This binary categorical variable was analysed by χ^2 tests with calculation of 95% confidence intervals. The results of the bivariate analyses were used to construct a logistic regression model, from which the odds ratio of the contribution of the variables highlighted in the literature was estimated. Where numbers permitted, e.g. when comparing both professions, sub-grouping allowed further exploration of the data.

Information from the ICNs was compared with data from the questionnaires. Qualitative data was subjected to content analysis (Berelson, 1952; Merton *et al,* 1956), and used to explore selected aspects of inoculation injury sustaining and reporting, including compliance, in more depth, taking a thematic approach (Turner, 1981; Strauss and Corbin, 1990). Where possible, themes were followed across the data sets. Adopting Berelson's (1952) approach to content analysis allowed some level of quantifaction of the qualitative data that could be used to indicate how many interviewees held similar opinions before exploring the finer points of the interviews.

A more detailed description of the data analysis methods used can be found in chapter three.

1.4.4 Sample

This was a multi-site study, encompassing all eligible surgeons and scrub nurses in six acute NHS trusts across Wales. A multi-site study offers a robust approach to data collection. Sample size calculation is described in section 3.4.

The personnel departments of the participating hospitals, with the permission of the Chief Executives supplied lists of all surgeons and theatre nurses. The ICNs at each hospital then identified which surgeons were of the required grade for inclusion, and which nurses were scrub nurses practicing at staff nurse or sister/charge nurse level.

Certain specialities of surgeon were excluded from the study. Ophthalmologists were not included, as they do not carry out exposure prone procedures as defined by the UK Health Departments (1998). Cardiac and neurosurgeons were also excluded because of the highly specialised nature of their work. Comparatively few hospitals in Wales perform surgery in these categories therefore, in order to increase the generalisability of the findings the decision was taken not to include them. Furthermore, these surgeons could have been easily identified from the data.

Five trusts were not approached to participate in the study. The first was the Ambulance Trust in which no surgery is performed. The second trust was excluded because it had no acute surgical beds. The third and fourth because they are university trusts and therefore, their practices may not have been typical of hospitals in the Principality either because of the potential for higher rates of injury (Venier *et al*, 2007), compliance with precautions may be higher (Singh *et al*, 2006) or because the causes of injury may vary (Gawande *et al*, 2003). One of these trusts was also excluded because a similar study was conducted in 2001 and several practice changes have been made as a result, and once again its practices may not be typical of Welsh hospitals. Finally, a single speciality oncology trust where no surgery is performed was excluded.

1.4.5 Ethical considerations

An explanatory letter accompanied each questionnaire to provide sufficient information to allow an informed decision to be made as to whether to participate (see appendix 4). Although anonymity could not be guaranteed during the data collection phase as questionnaires were coded to allow for follow up of non-responders, confidentiality was assured. Anonymity for the participants and individual trusts was guaranteed in the dissertation and subsequent publications. For those participants who agreed to be interviewed, not only was a comprehensive information sheet provided (appendix 5), but a consent form was also signed (appendix 6).

Prior to commencing the study, external review of the ethical aspects of the study was carried out by the All Wales Research Ethics Committee (appendix 7). Approval was also granted by the Chief Executive and Research and Development Committee of each Trust.

A comprehensive discussion of the methods employed in the study can be found in chapter three.

1.5 STRUCTURE OF THE THESIS

This thesis is constructed conventionally. Following a review of the literature, the methods of data collection, the findings, discussion and the implications of the work are presented.

1.6 CONCLUSIONS TO CHAPTER ONE

This chapter describes the epidemiology of bloodborne viral infection in HCPs and steps that can realistically be taken to reduce the risk of infection with a bloodborne virus in the event of percutaneous or mucocutaneous exposure to blood and body fluids. A brief summary of contemporary literature illustrates that guidelines, protocols and policies aimed at reducing such exposures are not consistently followed. It also illustrates where gaps in knowledge of this subject exist, and therefore explains the origin of the study.

The study will collect information related to the relationship between frequency of inoculation injuries, uptake of standard/universal precautions and reporting of inoculation injuries for operating departments in acute hospitals in Wales. This will identify where improved safety measures and the development of appropriate educational initiatives can be directed, with the intention of reducing accidental exposure to blood and body fluid and reducing the risk of occupationally acquired bloodborne viral infection where such exposures have occurred (see chapter six).

Chapter two provides a thorough review of the relevant contemporary literature.

CHAPTER TWO

THE LITERATURE

This chapter surveys the relevant literature related to this dissertation. The main sections are:

2.1 INTRODUCTION AND OVERVIEW

This chapter reviews the relevant literature in the fields of:

- protection against adverse exposures to blood and body fluids and occupational acquisition of bloodborne viral infection;
- percutaneous and mucocutaneous exposure to blood and body fluids;
- reporting of exposures to blood and body fluids.

Since 1987, it has been recommended that HCPs who come into contact with blood or other body fluids, protect themselves from infection by employing standard/universal precautions (CDC, 1987; UK Health Departments, 1998). However, evidence suggests that these precautions are not consistently adopted (Henry *et al,* 1994; Williams *et al*, 1994; Nelsing *et al*, 1997; Akduman *et al*, 1999; Kim *et al,* 1999; Chan *et al,* 2002; Cutter and Jordan, 2004). This chapter will discuss the level of non-compliance and factors influencing HCPs decisions to adopt precautions. Research studies used in the compilation of this review have been summarised in appendix 8.

If HCPs sustain percutaneous or mucocutaneous exposure to blood or body fluids, known as inoculation injury, they are potentially at risk of contracting a bloodborne viral infection such as HBV, HCV or HIV. It has been demonstrated that prompt first aid and administration of appropriate post exposure prophylaxis can reduce the risk of acquisition of HBV and HIV, while early identification of HCV will allow prompt treatment to be instigated (Centers for Disease Control and Prevention (CDC) 1990; Kennedy and Williams, 2000; US Public Health Service, 2001). For the appropriate action to be taken, the exposure must be reported to the relevant department, and yet studies show that under-reporting is common (Ramsey and Glenn, 1996; Burke and Madan, 1997; Lymer *et al*, 1997; Hettiaratchy *et al*, 1998; Patterson *et al*, 1998, Haiduven *et al*, 1999; Shiao *et al*, 1999, Benitez *et al*, 1999; Alvarado-Ramy *et al*, 2003; Cutter and Jordan, 2003). Together with common causes of injury, the extent and reasons for under-reporting will be explored in this chapter.

Reported factors affecting compliance with standard/universal precautions and under-reporting of inoculation injuries are often similar, e.g. profession, perception of risk and lack of time. Therefore, consideration was given to discussing them in the same section. However, sufficient differences e.g. unfamiliarity with reporting procedures and speciality exist between these two variables to justify considering them under separate headings.

A brief description of the key studies included in this chapter is presented in appendix 8 and will include the type of study and number of participants. The level of evidence of each study included in the review is presented in appendix 9. This has been assessed using the criteria described by the US Preventative Services Task Force (1996) cited by Grimes and Schulz (2002), table 2.1.

Table 2.1: Levels of evidence (US Preventative Services Task Force (1996) cited by Grimes and Schulz 2002 p57)

Quality of evidence

1	Evidence from at least one properly designed randomized controlled trial
11-1	Evidence from well designed controlled trials without randomization
11- 2	Evidence from well-designed cohort or case control studies, preferably from more than one centre of research group
11-3	Evidence from multiple time series with or without the intervention. Important results in uncontrolled experiments (such as the introduction of penicillin treatment in the 1940s) could also be considered as this type of evidence.
111	Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees

Every effort has been made to include as much statistical information as possible in this review. Where available in the published papers, number of subjects/respondents, test value, 95% confidence intervals (CI) and statistical test results applied to the data are included in appendix 8. Some of the published work did not report this information, and therefore it could not be included in the review. Where the information was missing, this will be stated in appendix 8. Although this information is important in determining the quality of the study and the appropriateness of the data analysis, some research studies have been included in this review where this information is absent if to exclude the studies would be to exclude valuable materials that help to provide an insight into the problem considered in this thesis.

2.2 SEARCH STRATEGY

In compiling this literature review Medline, PubMed, Cumulative Index of Nursing and Allied Health Literature, National Electronic Library of Infection Control and Web of Science databases were searched for applicable research material. Suitable material included research, systematic reviews, standards, masters theses, doctoral theses, journal articles and reports from agencies such as the Public Health Laboratory, Centres for Disease Control and Prevention, Department of Health, Welsh Assembly Government and Health and Safety Executive. Also reference lists in articles/research material were explored for relevant related material.

Key terms used in the search were “clinical guidelines”; “guidelines”; “protocols”; policies and/or procedures”; “compliance with clinical guidelines”; “compliance with guidelines”; “compliance with protocols”; “compliance with policies”; “compliance with procedures”; “doctors and compliance”; “nurses and compliance”; “universal precautions” “compliance with universal precautions”; "standard precautions"; compliance with standard precautions"; “occupational exposure”; “occupational exposure to blood and body fluid”; “percutaneous and mucocutaneous exposure”; "inoculation injury"; "needlestick injury"; "sharps injury"; “occupational infection”; “infection AND healthcare workers”; “reporting injuries”; “reporting exposures to blood and body fluid”, "reporting AND needlestick injuries"; “reporting AND occupational exposure”; “safety devices”, “blunt-tipped needles”; “gloves”; “glove use”; “double gloving”; “glove* AND operating department”; “protective clothing”; personal protective equipment.

Every effort has been made to include a comprehensive range of studies on the subjects under consideration in this study, by a wide range of authors. Several authors emerge as being particularly prominent in the field, either publishing alone or with others. They include Gerberding, Gershon, Jagger, Ippolito, Puro, Cardo and Petrisillo and therefore, the work of these key authors were searched.

Hand searches of the indices of infection control journals were conducted, and local and national policy documents consulted. Public Health Laboratory Service, National Public Health Service; Health Protection Agency, and Government web sites were also conducted.

Inclusion and exclusion criteria

Searches were limited to the English language, human studies, and research published since 1987 to allow for evaluation of standard/universal precautions following their introduction. Material published up to December 2008 was considered. International studies were only included where the results could be applied to healthcare in the UK.

Studies were included in the review if they evaluated the use of standard or universal precautions in the operating theatre; evaluated the efficacy of standard or universal precautions in reducing the risk of inoculation injury; evaluated compliance with and factors affecting compliance with standard or universal precautions in the operating theatre; reviewed compliance with reporting inoculation injuries and factors affecting compliance with reporting injuries in the operating theatre; evaluated interventions aimed at improving compliance with standard and universal precautions and reporting adverse exposure to blood and body fluids in the operating theatre; evaluated compliance with standard or universal precautions or reporting inoculation injuries in other clinical areas where the findings could be applied to the operating theatre.

The literature in this review includes:

- research papers (230)
- opinion papers/editorials (4)
- UK and WAG strategies/Policies/Acts of Parliament (3)
- national guidelines (9)
- international guidelines (12)
- surveillance reports (9)
- reviews (2)

Studies excluded from the review include those not written in English; papers that evaluated compliance with local hospital policies; studies that did not include nurses and/or doctors.

Analysis

Abstracts of all the citations resulting from the literature search were scrutinized and articles rejected if they did not meet the inclusion and exclusion criteria. The quality and methods of the studies included in the review were determined by using the Critical Appraisal Skills Programme (CASP, Public Health Resource Unit (phru), 2006).

2.3 PROTECTION AGAINST EXPOSURE TO BLOOD AND BODY FLUIDS

2.3.1 Universal and standard precautions

The CDC first recommended "universal precautions" in 1987 in response to the increasing number of patients with HIV infection. They were designed to minimize the risk of occupational acquisition of HIV infection, particularly during needlestick injury and skin contamination from patients' blood. These precautions were updated in 1988 (CDC) to include protection against infection from HIV, HBV and other blood-borne pathogens during exposure to body fluids visibly contaminated with blood, semen, and vaginal, cerebrospinal, peritoneal, pericardial, pleural and synovial fluids. Universal precautions require each HCP to treat all blood and body fluids as infectious, irrespective of whether the diagnosis of the source patient is known. In order to reduce the risk of infection, HCPs are required to use appropriate barrier protection or personal protective equipment including gloves, waterproof gown/apron, eye protection and mask whenever they anticipate contact with blood or other body fluids.

Body substance isolation (Lynch *et al* 1987) focuses on the isolation of moist body substances including sputum, urine, saliva, faeces and wound drainage from all patients regardless of their diagnosis primarily through the use of gloves.

Standard precautions also aim to reduce the risk of transmission of infection irrespective of whether the diagnosis of the source patient is known and broadly combine the concepts of universal precautions and body substance isolation to provide a more comprehensive guideline. Standard precautions are included in the guideline 'Standard Precautions and Transmission-Based Precautions' by Garner *et al* (1996) on behalf of the CDC and the Hospital Infection Control Practices Advisory Committee (HICPAC). These precautions have recently been updated by Siegel *et al* (2007). The underlying principle of both universal and standard precautions is the same, since many patients with blood-borne viral infection are not diagnosed, by assuming all body fluids or materials contaminated with body fluids are potentially infectious, and taking appropriate precautions at all times, the risk of transmission of blood-borne viruses will be reduced. Standard/universal precautions apply to all procedures when blood or body fluids may be encountered, not simply exposure prone procedures.

In addition, further protective measures have been subsequently recommended including frequent handwashing, regular glove changes, avoiding use of sharps wherever possible, responsible use of sharps when avoidance is not practical and prompt decontamination of spillages (UK Health Departments, 1998; Garner *et al*, 1996; Siegel *et al* 2007). Other measures recommended by the UK Health Departments (1998) to reduce exposure to blood and body fluids during exposure procedures include having no more than one person working in an open wound or body cavity, announcing the passage of sharps, tying sutures with instruments rather than fingers, using instruments for retraction rather than hands and wearing waterproof gowns, impermeable footwear, protective headgear and masks. Both the CDC (1988) and UK Health Departments (1998) guidelines also recommend vaccination against HBV.

Although originally a North American concept, the use of standard/universal precautions has been recommended in the UK (UK Health Departments, 1998; Health Protection Scotland, 2008). The *epic* and *epic2* guidelines (Pratt *et al*, 2001; Pratt *et al*, 2007) also endorse the use of these preventative measures. Some agencies have proposed alternative names such as 'Standard Principles for preventing healthcare associated infection' (Pratt *et al*, 2007) and 'Standard Infection Control Precautions' (Welsh Assembly Government, 2007; Health Protection Scotland, 2008). However, the principles remain the same.

According to the Health Protection Agency, 20% of the accidents reported in UK operating theatres between 2000 and 2007 were preventable with proper use of universal precautions and safe disposal of clinical waste (HPA, 2008).

2.3.2 Reducing mucocutaneous exposure by personal protective equipment

Splashes of blood to the face frequently occur during surgery. Studies measuring contamination of face shields after surgery have demonstrated that 44-86% were visibly contaminated with blood post-operatively (Bell and Clement 1991; Marasco and Woods, 1998; Collins *et al*, 2000; Singh *et al*, 2006; Endo *et al*, 2007; Holtzman *et al*, 2008), while Singh *et al* (2006) found that 83% were also contaminated by fatty deposits, raising concerns that bone fragments could also reach the eyes. Visual inspection was the method used to identify contamination in the majority of these studies (Collins *et al*, 2000; Singh *et al*, 2006; Holtzman *et al*, 2008). Endo *et al* (2007) found that while only 50.5% of face shields were contaminated with visible blood splatters, 66.0% were found to be contaminated on application of leucomalachite green, a blood detection method used in forensic science. Similarly, Marasco and Woods (1998) found that in only 16% of cases was the blood macroscopically visible, and the remaining 84% were detectable only in the presence of 6.8% diisopropylbenzene dihydroperoxide, suggesting that many studies underestimate the true level of contamination. Singh *et al* (2006) found that over 83% of face shields were contaminated by macroscopic splashes of blood an anomaly perhaps explainable by the variation in surgical procedures explored in each study.

Very few of these splatters were noticed by surgeons. Collins *et al* (2000) found that although 86% of masks were visibly contaminated, surgeons were aware of only 15% of splashes and Marasco and Woods (1998) found that surgeons were aware of contamination in only 8% of cases. Factors contributing to splatter included type of surgery (Marasco and Woods, 1998; Endo *et al*, 2007), experience of operator (Marasco and Woods, 1998; Singh *et al*, 2006; Endo *et al*, 2007), duration of operation (Marasco and Woods, 1998; Singh *et al*, 2006), volume of blood loss (Endo *et al*, 2007), use of anticoagulants (Holtzman *et al*, 2008) and location of wound (Holtzman *et al*, 2008).

Eye protection provides a protective barrier between the operator and blood or body fluids generated during exposure prone procedures and should therefore be worn whenever splashing of body fluids is anticipated (Brearley and Buist, 1989, Bell and Clement 1991; Bryce, 1998; Marasco and Woods, 1998; Wong *et al,* 1998; UK Health Departments, 1998; Collins *et al*, 2000; Singh *et al*, 2006; Endo *et al*, 2007; Holtzman *et al*, 2008). The efficacy of eye protection in reducing the number of incidents involving mucocutaneous exposure to blood and body fluid has been established by several studies including Wong *et al* (1991); Lymer *et al* (1997); Knight and Bodsworth (1998); Wong *et al* (1998); Lee *et al* (1999). Studies estimate a level of potential conjunctival contamination of between 65 and 70.5% in those who don't wear eye protection routinely (Bell and Clement, 1991; Endo *et al*, 2007). In contrast, Gańczak and Szych (2007) found that the incidence of splash injuries to the eyes was not significantly different in those who regularly wore masks and eye protection compared to those who didn't (P=0.7). However, spectacles were included as eye protection for the purpose of this study. It has been shown that ordinary spectacles do not provide sufficient protection from splashes to guarantee protection against infection. Blood splashes can contaminate the inside of spectacles and hence the eyes (Brearley and Buist, 1989). Endo *et al* (2007) demonstrated that spectacles fail to protect against splatter in the exposed upper, left and right sides of eye glasses and Marasco and Woods (1998) found that eye splashes occur even when wearing spectacles. Therefore, rejecting protective eyewear in favour of spectacles could result in unnecessary exposure to blood or body fluid.

In addition to the eyes, the mucous membranes of the mouth and upper respiratory tract and the alveolar macrophages may also allow penetration of blood-borne viruses, although this is not as well described (Heinsohn and Jewett, 1993). The use of face masks is common in the operating theatre, although this has traditionally been in the mistaken belief that they protect against wound infection in the patient (Mitchell and Hunt, 1991; Berger *et al*, 1993). Nevertheless, it is likely that the presence of the mask provides a physical barrier that will absorb blood splashes and protect the wearer and is therefore advised during surgery (UK Health Departments, 1998; Clark *et al*, 2002; Pratt *et al*, 2007; Siegel *et al*, 2007). Heinsholm and Jewett (1993) however, feel more stringent measures are required and recommend respiratory protection until the potential of infection from inhaled aerosols has been established.

2.3.3 Reducing percutaneous exposure with personal protective equipment

Universal precautions have also reduced the frequency of percutaneous exposures to blood and body fluids (Beekmann *et al,* 1994). Most percutaneous injuries are sustained to the hands, commonly the non-dominant hand (Malhotra *et al*, 2004; Bakaeen *et al*, 2006) and are usually the result of sharps injuries. Gloves are the most commonly used item of protective clothing (Wong *et al*, 2001; Gańczak and Szych, 2007). Although not impenetrable to sharps, latex gloves do have the ability to re-seal after puncture (Korneiwicz *et al*, 1989, Korneiwicz *et al*, 1990). However, the major contribution of gloves in reducing percutaneous injury lies in their 'wiping' effect on the external surface of the penetrating item (Krikorian *et al*, 2007). Lefebvre *et al* (2008) estimated that the volume of blood on a cutting needle could be reduced by 65% and on a tapered needle by 97% by the wiping action of a single glove, thereby reducing the risk of infection.

Gloves will also protect abraded skin from exposure to blood. Skin abrasions have been reported by 17.4-50.2% of theatre staff pre-operatively (Thomas *et al*, 2001; Sencan *et al*, 2004; Gańczak and Szych, 2007). Although visible cuts should be covered by a waterproof dressing when contact with body fluids is anticipated, skin abrasions have been found by dermatologists on 34% of HCWs who reported no skin damage (Sencan *et al*, 2004) and so gloves will provide protection when personnel are unaware of skin damage.

Despite the benefits of glove use, the level of protection they offer is incomplete as gloves may be punctured in 10.1-68.8% of operative procedures (Dodds *et al,* 1988; Matta *et al,* 1988; Gerberding *et al,* 1990; Smith and Grant, 1990; Maffulli *et al,* 1991; Green and Gompertz, 1992; Wigmore and Rainey, 1994; Caillot *et al*, 1999; Khoo and Ibester, 1999; Thomas *et al*, 2001; Malhotra *et al*, 2004). As a result of glove puncture, surgeons may have contact with the patient's blood for 42 hours for every 100 hours operating time (Caillot *et al*, 1999).

Protection can be enhanced by wearing two pairs of gloves during exposure prone procedures. Lefebvre *et al* (2008) estimated that two pairs of gloves can remove 71% more blood from a cutting needle than can be removed by a single pair ($P=0.002$), although the volume of contaminant removed from tapered needle was not affected by extra layers ($P<0.05$). Studies examining the benefits of double gloving have identified that even when the outer glove is punctured, the inner glove often remains intact (Matta *et al* 1988; Thomas *et al*, 2001; Malhotra *et al*, 2004; Brasel *et al*, 2007). Thomas *et al* (2001) found that even when 68.8% of outer gloves were damaged only 31.3% of the inner gloves were also punctured. Two studies that examined whether punctures on the inner and outer gloves were in the same place found that only 4.6-18% of gloves had matching punctures on both the inner and outer glove suggesting that even when both pairs of gloves are damaged, 82-95.4% % will still offer some level of protection (Thomas *et al*, 2001; Malhotra *et al*, 2004). Each study detected glove punctures by filling gloves with water and observing for leaks.

As glove perforation may go unnoticed, implementation of a detection method may alert the user to damaged gloves allowing them to change promptly. For example, using a puncture indication system in which the inner glove is coloured with vegetable dye that becomes visible if the outer glove is punctured may be beneficial (Wigmore and Rainey, 1994) as would an electronic detection method (Elper apparatus) that alarms when the protective barrier provided by gloves or gown is breached (Caillot *et al*, 1999).

Rates of perforation are influenced by duration of operation, speciality, emergency procedures (Malhotra *et al*, 2004), complexity of the operation (Caillot *et al*, 1999; Khoo and Ibester, 1999) and the experience of the surgeon (Brasel *et al*, 2007).

Despite considerable evidence that glove punctures are common and that contamination can be reduced by double gloving, the true effect of double gloving on infection is unknown (Tanner and Parkinson, 2007). It must also be remembered that protective clothing will not totally eliminate occupational exposure to blood and body fluids, and hence will not completely eliminate the risk of occupational acquisition of bloodborne viral infection. Karen Daley acquired hepatitis C following a needlestick injury after taking blood in 1998 (Daley, 1999). Lisa Akuna also contracted hepatitis C while injecting blood into a specimen tube (Ames and Akuna, 1999), while Linda Arnold contracted HIV while inserting an intravenous cannula (Algie *et al*, 1999). All three nurses were wearing gloves at the time of their injuries. Therefore, other protective measures must be taken in addition to commonly worn protective clothing.

During the 1990s a glove impregnated with a liquid disinfectant (quarternary ammonium salts and chlorhexidine) was developed and has shown promising results in reducing the number of virus particles transmitted during penetration of glove material. Experiments using herpes simplex virus (HSV), feline immunodeficiency virus (FIV) and bovine viral diarrhoea virus as surrogates for HIV and HCV showed a significant reduction in viral load when in contact with the virucidal gloves (Bricout *et al*, 2003). In 2007, Krikorian *et al* demonstrated an 81% reduction in transmission of HSV with the virucidal gloves compared to the control. Although not in common use at present, these gloves have the potential to offer enhanced protection to theatre personnel. Cut resistant gloves or fingers reinforced with materials such as Kevlar, steel or nylon or a tight woven cotton liner have also demonstrated encouraging results. However, their use is mainly confined to orthopedic or oral and maxillofacial surgery (Pieper *et al*, 1995; Sutton *et al*, 1998, Tanner *et al*, 2006).

2.3.4 Preventing injury during transfer of instruments

From data collated in the United States of America (USA) by the Exposure Information Network (EPINet, 2004a), it was identified that 61% of scalpel injuries in the operating room were inflicted on a co-worker by the user, some of which occurred during instrument passing. Similarly, 35% of injuries that occurred during suturing involved non-users of the needle and that 25% of all injuries occurred between steps of a procedure, mainly during passing (Jagger and Balon, 1997; Castella *et al*, 2003). However, Wright *et al* (1991) found that only approximately 6% of sharps injuries in the operating theatre occur during transfer of sharps.

Utilizing a no-touch technique when performing such tasks as needle changing and removing suture blades and using a neutral or safe zone within the sterile field which avoids hand to hand transfer of sharps is thought to be effective in reducing the rate of percutaneous injury, particularly those accidentally inflicted on co-workers by surgeons. The technique relies on communication, teamwork and identifying a safe container that cannot be tipped over and can be easily moved without placing fingers inside (Perry and Jagger, 2005).

Although utilizing a neutral zone appears an obvious method of reducing sharps injuries in the operating theatre, surprisingly few studies have been conducted to evaluate its effectiveness. Nevertheless, a significant reduction in risk is indicated by the limited available data. In operations where blood loss exceeded 100mls, utilizing a neutral zone for sharps transfer was found to reduce incidents including glove perforation and percutaneous injury by 59%, a reduction in rate from 10% to 3.7% (Stringer *et al*, 2002). Little change was noted in operations where blood loss was less than 100mls (rate of 1.4% when hands free technique was used and 1.5% when it was not). Using a combination of a no touch technique, employing a neutral zone and reducing the number of sharps, Folin *et al* (2000) noted a reduction in reported percutaneous injury rates from 6.8% to 2.7% ($P<0.05$, Fisher's exact test) although the relative contribution of each intervention is not quantifiable.

Wright *et al* (1991) argue that as the number of injuries occurring during sharps transfer is low, the hands free technique would have minimal influence on the overall incidence of accidents during surgery. Nevertheless, despite the limited number of preventable injuries and lack of data, the hands free technique has been recommended as best practice (UK Health Departments, 1998; Folin *et al*, 2000; Occupational Safety and Health Admininstration (OSHA), 2001; Stringer *et al*, 2002; Berguer and Heller, 2004; Perry and Jagger, 2005). However, studies have demonstrated that few operating theatre personnel employ the hands free technique (Stringer *et al*, 2006; Swallow, 2006).

Given the reluctance to employ the hands free technique, lack of evidence concerning its effectiveness and the low numbers of injuries that are preventable by this method, other methods need to be investigated. The feasibility of performing surgery without sharps was investigated by Makary *et al* (2006a) who found that 25% of operations at John Hopkins Hospital in the USA could be accomplished using electrocautery, adhesive, staples and blunt-tipped needles to replace traditional surgical instruments.

2.3.5 "Safety devices"

Safety devices include retractable needles, needles with an advanceable guard, intravenous cannulae and scalpel blades or devices that require either active or passive activation to cover the sharp end after use. In the USA under the Occupational Safety and Health Administration (OSHA) bloodborne pathogen standard (2001), it is mandatory that steps to reduce exposure to blood and body fluids are taken which include the use of engineered sharps protection devices (safety devices), provision of protective clothing required for standard/universal precautions, maintenance of a record of injuries from contaminated sharps and encouraging input from health care workers involved in patient care when evaluating safety devices. The OSHA standard over-rules any individual state requirements which may be less stringent.

The OSHA (1999) report that safety devices have reduced the number of percutaneous injuries by between 23% and 76%, but acknowledge that training and education in their use is necessary to ensure correct use. The UK Health Departments (1998) also advocate these techniques together with universal precautions. However, they are not legislatively enforceable in the UK where fewer safety devices are available, and not all have the Comité Europa (CE) mark which indicates that they have been assessed as fit for purpose when used in accordance with manufacturer's instructions (Short Life Working Group on needlestick injuries in the NHSScotland, 2001).

Evidence supporting the use of safety devices and demonstrating their benefit in reducing injuries mainly derives from studies conducted on replacements for traditional hollow needles, blood lancets, venepuncture devices and intravenous cannulae and there is little doubt that they're useful in preventing percutaneous injury (Castella *et al*, 2003; Sohn *et al*, 2004; Kenny, 2005; Adams and Elliott, 2006; Cullen *et al*, 2006; Lamontagne *et al*, 2007; Valls *et al*, 2007; Whitby *et al*, 2008).

Despite the plethora of instruments in the operating theatre that have the potential to cause injury, research has mainly focused on methods of tissue closure and to a lesser extent scalpels. Scalpels are second only to needles as the most frequent cause of sharps injury (CDC, 2006) and at least two cases of HIV transmission to surgeons have occurred via cuts from scalpels (De Fry, 1993; Jagger and Balon, 1995). Disposable scalpels and engineered safety devices are available, for example, from Swann Morton, arguably the UK's largest supplier of scalpels. However, these are not in common use (Watt *et al*, 2008) and consequently their impact has not been fully evaluated (Elder and Paterson, 2006; Watt *et al*, 2008). However, one estimate of the effect of engineering controls on scalpels was that scalpel blade injuries could be reduced by up to 64% using safety devices (Jagger *et al*, 1998). Tarantola *et al* (2006) found a nine fold decrease in the likelihood of injury when disposable scalpels were available (OR 0.11, 95% CI 0.02-0.76).

The best evidence for reducing percutaneous injuries during surgery relates to blunt-tipped suture needles. Sharp tipped suture needles have been estimated to cause 11-77% of injuries among operating department personnel (Tokars *et al*, 1992; Jagger *et al*, 1998; Hunt and Murphy, 2004; Perry and Jagger, 2005; CDC, 2006; Smith *et al*, 2006a; Venier *et al*, 2007). Although there are no reports of occupational acquisition of infection where suture needles have been directly implicated as the vehicle, HIV infection has been reported in theatre personnel and suture needles are a potential source (Gerberding, 2003).

Several randomized controlled trials have confirmed the protective nature of blunt-tipped or tapered needles. Wright *et al* (1993) found no injuries when using blunt-tipped needles and a reduction in glove punctures from 67% when using sharp tipped needles to 24% when tapered needles were used (P=0.049, chi-squared test for trend). According to

Hartley *et al* (1996) blunt tipped needles caused fewer glove perforations (3/46) than cutting needles (14/39) (P=<0.001) and reduced percutaneous injuries by 68% in emergency abdominal procedures (P<0.02) and 100% during abdominal facia closure (P<0.00004). The participating surgeons agreed that the blunt needles performed as well as cutting needles. Mingoli *et al* (1996) found that needlestick injuries occurred in 19/100 (19%) of operations involving sharp needles compared to 6/100 (6%) involving blunt needles (P<0.02) with an 82% reduction in injuries (P<0.001) and Rice *et al* (1996) were able to demonstrate a reduction in glove perforation from 16% to 0% and skin perforation from 6% to 0% when blunt-tipped needles were used (P=0.025, Fisher's exact test). Tarantola *et al* (2006) demonstrated an 11-fold decrease in the likelihood of injury when blunt needles were available (OR 0.09, 95% CI 0.015-0.60). Other sharps including scissors, clamps and retractors can also be blunted (Jagger *et al*, 1998).

2.3.6 <u>Summary</u>

Studies have demonstrated the benefits of individual precautions in reducing mucocutaneous and percutaneous exposures to blood and body fluids e.g. double gloving, eye protection, passing sharps via a neutral field. However, no research has utilised a multi-centre study in which the use of standard/universal precautions by a multidisciplinary group of participants/respondents working in a variety of specialities and clinical areas has been assessed. Such a study would reduce any element of doubt concerning the validity and generalisability of the studies discussed, particularly if triangulation of data collection methods was employed.

2.4 COMPLIANCE WITH STANDARD/UNIVERSAL PRECAUTIONS

2.4.1 <u>Degree of compliance</u>

Consistent application of standard and universal precautions has been recommended to reduce the risk of adverse exposure to blood and body fluid (UK Health Departments, 1998; Pratt *et al*, 2007; Siegel *et al*, 2007), yet studies almost from the inception of universal precautions in 1987 have indicated that HCWs do not adopt them routinely when anticipating contact with blood and body fluids (Henry *et al,* 1994; Williams *et al*, 1994; Nelsing *et al*, 1997; Akduman *et al*, 1999; Kim *et al,* 1999; Madan *et al*, 2001; Chan *et al,* 2002; Osborne, 2003; Cutter and Jordan, 2004).

Studies that examine compliance with the full range of available precautions are rare and provide conflicting evidence. Cutter and Jordan (2004) for example, found that only 3/200 (1.5%) surgeons, scrub nurses and midwives always donned double gloves, eye protection, mask and water repellant gowns and avoided both the use of sharps where possible and routinely passed sharps by hand during all exposure prone procedures irrespective of whether the bloodborne virus status of the patient was known. Conversely, Raghavendran *et al* (2006) found that 64% of surgeons, nurses and operating department practitioners always complied with universal precautions. A survey conducted by OR (Operating Room) Manager (Anonymous 1993) claimed that 98.8% of personnel working in the operating room followed universal precautions all or most of the time. Each study utilized questionnaire surveys for data collection, but whereas Cutter and Jordan (2004) specified each component individually and asked for responses for each one and then collated all results together to give an overall rate of compliance, Raghavendran *et al* (2006) and the researchers reporting in OR Manager (Anonymous, 1993) simply asked whether participants complied with universal precautions with interpretation of what constituted universal precautions being left to individual participants, perhaps explaining the difference in findings. It is more common for studies to focus on individual precautions which fall under the umbrella of universal of standard precautions. This, together with disparities in data collection methods, means that the true level of compliance with universal or standard precautions is difficult to assess.

It is apparent that rather than adopt all the precautions at all times, healthcare professionals are selective about which precautions to use, so that while compliance with standard/universal precautions as a whole is difficult to determine, compliance with individual precautions is more straightforward. For example, compliance with single glove use ranges from 75% - 83% (Nelsing *et al,* 1997; Chan *et al*, 2002; Gańczak and Szych, 2007); double gloving 15.6% - 81.8% (Akduman *et al,* 1999; Kim *et al*, 1999;

Osborne, 2003; Cutter and Jordan, 2004; Brasel *et al*, 2007; Au *et al*, 2008); eye protection 9% - 76.5% (Akduman *et al*, 1999; Chan *et al* 2002; Osborne, 2003; Cutter and Jordan, 2004; Gańczak and Szych, 2007; Holzmann *et al*, 2008); mask use 32.3% - 46.7% (Akduman *et al*, 1999, Chan *et al,* 2002), employing a neutral zone when passing sharps 8-69.2% (Stringer *et al*, 2002; Cutter and Jordan, 2004; Phillips *et al*, 2007).

Observation studies also suggest that healthcare personnel are often somewhat careless about the safety of their colleagues, for example contaminating the environment with bloody gloves (Ronk and Girard 1994) and failing to announce the passage of sharps (Akduman *et al*, 1999) being reported.

2.4.2 Summary

Despite being introduced in 1987, evidence from surveys and observation studies indicate that universal precautions are still not followed "universally", i.e. in all cases when contact with blood or body fluid is anticipated. Selective use of precautions such as gloves and eye protection and a careless attitude to the safety of one's colleagues could lead to unnecessary exposure to bloodborne viral infection.

2.5 FACTORS AFFECTING COMPLIANCE WITH STANDARD/UNIVERSAL PRECAUTIONS

2.5.1 Knowledge of universal precautions
2.5.2 Length of time since qualifying
2.5.3 Perception of risk
2.5.4 Interference with working practices/perceived pressure of work
2.5.5 Profession
2.5.6 Availability of resources
2.5.7 Other factors
2.5.8 Summary

It has been established that HCPs do not consistently adopt standard/universal precautions and that reporting of exposures to blood and body fluids is often poor (section 2.4.1). Identification of these issues facilitates the appreciation of the magnitude of the problem in relation to the potential occupational acquisition of bloodborne viral infection. However, recognising that compliance is poor does not in itself support efforts to improve compliance. It is important to identify why compliance is poor so that appropriate measures can be adopted to encourage HCPs to take precautions to prevent exposure to blood and body fluids.

2.5.1 Knowledge of universal precautions

One of the basic tenets of universal and standard precautions is that one must assume that all blood and body fluids are potentially infectious and that appropriate precautions must be adopted when contact with all blood or body fluid is anticipated. Therefore, knowledge of patients' bloodborne viral status is unnecessary when deciding which precautions to adopt. Moreover, all HCPs claiming knowledge of universal precautions should be aware of this and base their decisions concerning precautions solely on the type of exposure anticipated, not on perceptions of whether the patient is at "high risk" of having a bloodborne viral infection. Consequently, if knowledge of universal precautions is good, then it would be reasonable to expect compliance to be high. According to many studies (Freeman and Chambers, 1992; Ronk and Girard, 1994; Naing *et al*, 2001; Cutter and Jordan, 2004) the number of HCPs claiming to have knowledge of universal precautions is high (86.9% - 94%).

Conflicting evidence exists concerning the impact of knowledge on adoption of universal/standard precautions. Angelillo *et al* (1999); Huang *et al* (2002), Chan *et al* (2002), and Chan *et al* (2008) found a link between knowledge of universal precautions and compliance. Similarly, knowledge of policies concerning universal and standard precautions has been described as influential in improving compliance (Knight and Bodsworth, 1998; van Gemert-Pijnen *et al*, 2005). However, other studies (Talan and Baraff, 1990; Freeman and Chambers, 1992; Turner, 1993; Ronk and Girard, 1994; Naing *et al*, 2001; Cutter and Jordan, 2004; Askarian *et al*, 2006) have identified that while theoretical knowledge concerning universal precautions may be good, practical application is variable. Cullen *et al* (2006) identified that 12% of personnel who sustained an injury were aware of guidelines but failed to adhere to them. Ronk and Girard (1994) found that while 94% of HCPs claimed to have knowledge of universal precautions, 80% would take extra precautions if they knew their patient had HIV or HBV. Similarly, Cutter and Jordan (2004) found that while 86.9% of HCPs surveyed claimed to have knowledge of universal precautions, only 1.5% (3/200) would adopt all theatre based precautions for every patient, but 40% (80/200) would take extra precautions if their patient was suspected as having a bloodborne viral infection.

It is clear that the relationship between knowledge and compliance is complex and that knowledge of universal precautions does not necessarily improve compliance. What is difficult to determine is whether knowledge has simply not been subsumed into practice or whether there are gaps in knowledge that cause practitioners to take risks.

2.5.2 Length of time since qualifying

Universal precautions were first recommended in 1987 (CDC, 1987). Therefore, it is reasonable to expect that those HCPs who underwent pre-registration or undergraduate training after this would have been fully educated in their use during this training. If this were the case, it would follow that length of time in practice would have a bearing on the degree of compliance with universal precautions. Many of the studies have confirmed this (Ronk and Girard, 1994; Williams *et al*, 1994; Ramsey *et al*, 1996; Jeffe *et al*, 1998; Akduman *et al,* 1999; Au *et al*, 2008). For example, Au et al (2008) found that junior surgeons aged <35 years had a higher double glove usage rate than those aged >35 years (20% compared to 7.7%). Perhaps this reflects the fact that for those who came into practice before the inception of universal precautions, adopting them meant a radical change of behaviour, which can be difficult (Grol, 1997). Akduman *et al* (1999) identified that younger doctors were most likely to comply with certain components of universal precautions. They acknowledged that older doctors may have been trained before the introduction of universal precautions, so the "adoption of the new behaviours and the discontinuation of past behaviours may be more difficult for them" (p 113). This has raised concerns that if senior personnel fail to adopt appropriate precautions, junior staff who follow their example, are also likely to put themselves at risk by failing to adopt precautions (Ficklin *et al*, 1988; Freeman and Chambers, 1992). For HCPs undergoing a probationary period, for example, junior medical staff in their pre-registration year, conflict may arise between practices learned as medical students and those acquired from senior colleagues.

Although these findings have been replicated by some of the more recent research (Osborne, 2003; Raghavendron *et al*, 2006; Singh *et al*, 2006; Au *et al*, 2008; Chan *et al*, 2008), other studies have failed to demonstrate any statistically significant link between experience and compliance (Cutter and Jordan, 2004; Sencan *et al*, 2004). Moreover, other studies have demonstrated that seniority reduces the risk of injury (Brasel *et al*, 2006; Gańczak and Szych, 2007; Makary *et al*, 2007) suggesting that the influence of pre-registration programmes delivered pre-1987 may be waning.

2.5.3 Perception of risk

Increased compliance with universal precautions when caring for patients with known or suspected infection (Ronk and Girard, 1994; Cutter and Jordan, 2004; Au *et al*, 2008) suggests that HCPs perceive the risk of infection from such patients as high, therefore take steps to avoid exposure to their blood and body fluids. This is supported by the fact that in a study where a high proportion (30%) of the patients were perceived to be at risk of having HIV infection, knowledge of the patients HIV or HBV status did not change behaviour (Gerberding *et al*, 1990). This may be because those who constantly work in an environment where the risk of bloodborne infection is high have a "strong incentive" to comply with universal precautions (Gerberding, 1991) and fear may be a strong motivator for HCWs to don protective clothing (Goldmann, 2002). Conversely, where perception of risk is low, HCPs are less likely to adopt precautions (Willy *et al,* 1990; Gerberding, 1991; Gershon *et al*, 1995; Patterson *et al*, 1998; Kim *et al*, 1999; Leliopoulou *et al*, 1999; Naing *et al*, 2001; Hills and Wilkes, 2003). Furthermore, inaccurate perception of risk has led to inadequate follow up of adverse exposures and incomplete utilization of post exposure prophylaxis (Halpern *et al*, 2006).

However, risk perceptions are often inaccurate and the risk of infection following exposure to blood and body fluids has been frequently underestimated (Patterson *et al*, 1998; Duff *et al*, 1999; Scouler *et al*, 2000; Stein *et al*, 2003; Trim *et al*, 2003; Halpern *et al*, 2006). For example, Patterson *et al* (1998) found that only 211/418 (47%) knew the correct seroconversion rate following percutaneous and mucocutaneous exposure to HIV, only 76/536 (14.2%) for HBV and 95/489 (19.4%) for HCV.

It has been suggested that risk perception may be closely related to an individual's health belief model in which variables which influence protective measures will include perception of risk of infection and perception of the severity or consequences of the infection (Osborne, 2003). Lymer *et al,* (2004) in one of the few qualitative studies to explore behaviour in relation to bloodborne virus exposure disagree and report that risk behaviour among nurses is more variable than the health belief model and that it is constant awareness of risk that influences behaviour. However, this study was not undertaken in the operating theatre and the results may not be transferable to this area.

Not only is there an underestimation of the risk of acquiring a bloodborne viral infection, there is also a degree of complacency evident among HCPs which can compound the risks. Manian (1996) found that experienced surgeons were likely to perceive blood and body fluid exposures as unimportant. Also, behaviour may only be partly related to risk and other factors could be more influential in determining behaviour (Shahid *et al*, 2005).

2.5.4 Interference with working practices

One of the most common reasons for failing to adopt universal precautions is the perception by HCPs that they will interfere with working practices (Nelsing *et al*, 1997; Naing *et al*, 2001; Stein *et al*, 2003; Cutter and Jordan, 2004; Tansley *et al*, 2004; Gańczak and Szych, 2007). Glove use in particular, especially double gloving, has been blamed for reducing tactile sensation and dexterity (Wilson *et al*, 1996; Naing *et al*, 2001; Thomas *et al*, 2001; Stein *et al*, 2003; Cutter and Jordan, 2004; Tansley *et al*, 2004; Au *et al*, 2008). However, this perception is often subjective and therefore impossible to quantify (Buerger and Heller, 2004). Despite the widely held belief that double gloving is uncomfortable, Thomas *et al* (2001) found that 63.6% of surgeons had satisfactory tactile sensation with double gloves. Of those who felt that wearing two pairs of gloves reduced dexterity, most found that with repeated use, tactile sensation improved. Similarly Patterson *et al* (1998) found that perception of decreased tactile sensation was significantly higher in those who used double gloves infrequently ($P<0.001$). Paradoxically, infrequent use of double gloves could lead to increased percutaneous injuries as many healthcare workers report taking extra precautions for patients known or suspected as having a bloodborne viral infection (Cutter and Jordan 2004; Tansley *et al*, 2004) and may find that reduced sensitivity due to unfamiliarity could make the user more 'awkward'.

Other protective clothing is not without its perceived problems: eye protection is thought to 'fog' and become uncomfortable (Tansley *et al*, 2004) and many who wear glasses to correct eye defects reject protective eyewear in the mistaken belief that they offer the same level of protection (Nelsing *et al*, 1997; Pearson, 2000; Cutter and Jordan, 2004; Gańczak and Szych, 2007); masks can also interfere with working practices by fogging up glasses and impairing communication (Madan *et al,* 2002); and concerns that utilizing a neutral zone could result shifting the gaze from the surgical field, break the rhythm established during hand to hand passing, potential dulling of sharps when in contact with the side of the container, instability of the neutral zone and instruments too large to fit into a tray or basin have all been identified as reasons for not employing a hands free technique (Stringer *et al*, 2006).

2.5.5 <u>Profession</u>

Few studies consider inter-professional differences in compliance with universal precautions in the operating theatre. Consequently, it is difficult to establish conclusively whether profession has any bearing on compliance. However significantly, where professions have been compared, doctors were found to be less likely to comply with standard/universal precautions than other HCPs (Stein *et al*, 2003; Trim *et al*, 2003; Cutter and Jordan, 2004; Raghavendran *et al*, 2006). In a study that combined non-participant observation with semi-structured interviews, McDonald *et al* (2005) found profound differences in the behaviour of doctors and nurses in one operating department in relation to guideline compliance. Not only were doctors likely to view guidelines as unnecessary or even harmful, nurses were keen to embrace written policies and protocols emphasising their role in preventing adverse events. Lack of compliance with guidelines and protocols has also been noted in other areas of medicine (Cotton and Sullivan, 1999; Lawton and Parker, 1999; Manias and Street, 2000).

2.5.6 Availability of equipment

Unremarkably, Green-McKenzie *et al* (2001) found that individual personal protective equipment and safety devices were more likely to be used when readily available. Therefore, it is not surprising that lack of availability of suitable equipment and protective clothing was described as a factor affecting compliance with universal precautions (Henry *et al*, 1992; Nelsing *et al,* 1997; Naing *et al,* 2001; Cutter and Jordan, 2004; Askarian *et al*, 2006; Gańczak and Szych, 2007). Although lack of equipment is understandable in developing countries (Chelenyane and Endacott, 2006; Phillips *et al*, 2007), there is no reason why this should occur elsewhere. In the UK, there is an obligation on employers to provide appropriate personal protective equipment, free of charge (Health and Safety Executive (HSE, 2002a)

2.5.7 Other factors

Other factors affecting compliance are: lack of time (Henry *et al*, 1992; Williams *et al*, 1994; Ramsey *et al*, 1996; Nelsing *et al*, 1997; Pearson, 2000; Cutter and Jordan, 2004); personality (Rabaud *et al*, 2000); gender (Jeffe *et al*, 1997); speciality (Jeffe *et al*, 1997); embarrassment (Pearson, 2000); uncomfortable equipment (Pearson, 2000); habit (Pearson, 2000); the patient might object (Ramsey *et al*, 1996; Nelsing *et al*, 1997); HCPs forget or can't be bothered to don protective clothing (Henry *et al*, 1992; Williams *et al*, 1994; Nelsing *et al*, 1997); lack of faith in protective measures (Nelsing *et al*, 1997); lack of managerial support (Cutter and Jordan, 2004).

2.5.8 Summary

Although a variety of factors have been found to influence the uptake of universal precautions, a high degree of agreement has been identified by various authors in a variety of settings. Only by recognising these factors can one begin to address the problem in each clinical area by applying strategies to improve compliance based on the reasons why some HCPs are reluctant to comply.

2.6 PERCUTANEOUS AND MUCOCUTANEOUS EXPOSURES TO BLOOD AND BODY FLUIDS - INOCULATION INJURIES

2.6.1 Factors affecting inoculation injuries

The following factors have been found to influence the frequency of inoculation injuries. They are: profession, device, activity and type of procedure being undertaken.

Profession

A variety of healthcare personnel are exposed to blood and body fluids. Gillen *et al* (2003) identified 80 different job titles that had reported such exposures. In general, nurses are most at risk. Studies have demonstrated that nurses sustained 41–74% of reported inoculation injuries (Ippolito *et al*, 1994; Lymer *et al*, 1997; Ling *et al*, 2000; Puro *et al*, 2001; Alvarado-Ramy *et al*, 2003; Gillen *et al*, 2003; EPINet, 2004a, EPINet 2004b; Sencan *et al*, 2004; Mehta *et al*, 2005) which reflects the fact that nurses comprise the single largest profession in healthcare and carry out more procedures involving sharps than other HCPs (Ippolito *et al*, 1994; Lymer *et al*, 1997, Trim and Elliott, 2003). However, when one considers rates of exposure per number of personnel, the rates are highest among doctors. Ling *et al* (2000) found that 55.6% of healthcare workers who reported injuries were nurses compared to 25.1% reported by doctors. When the incidence was calculated however, doctors were shown to experience more injuries: 91.7 per 1000 doctors compared to 31.1 per 1000 nurses ($P<0.001$, OR=3.165, 95% CI, 2.188-4.808). Benitez *et al* (1999) found that between July 1994 and July 1995, doctors sustained inoculation injuries at a rate 2.7 times higher than nurses (22.2 injuries per 100 000 hours compared to 8.4 injuries per 100 000 hours, 95% CI, 1.25-5.67). According to the CNSSN (2001), nurses experienced 52% of exposures, but their exposure rate was only 4.88 per 100 FTEs, compared with a rate of 42.78 per 100 FTEs for phlebotomists, 20.97 per 100 FTEs for medical residents, 13.59 per 100 FTEs for nuclear medical technicians, 12.14 per 100 per 100 FTEs for sterilization assistants and 10.06 per 100 FTEs for medical specialists. Ng *et al* (2002) established that sharps injuries occurred in 11.0 per 100 doctors and 6.9 per 100 nurses.

The frequency of adverse exposures to blood and body fluids in the operating theatre is variable. Quebbeman *et al* (1990) observed that surgeons sustained cuts in 2%, needlestick injuries in 6% and blood splashes in 6% of operations, while nurses sustained cuts in 0.4%, needlestick injuries in 3% and blood splashes in 0.9% of operations (n=234). Cutter and Jordan (2004) found that 87.8% (79/90) of surgeons compared to 79.6% (39/49) of scrub nurses experienced percutaneous or mucocutaneous exposures to blood or other body fluids, but this was not statistically significant ($\chi^2 = 1.081$, P=0.299, OR 1.841, 95% CI = 0.721-4.706). Similarly, Bakaeen *et al* (2006) found that surgeons were injured most frequently (44%) when compared to nurses (29%) but again this did not reach statistical significance (P=0.71). However, these studies did not attempt to calculate rates of exposure.

Where exposure rates have been calculated, results confirm that surgeons sustain more adverse exposures than nurses. In 1992, Tokars *et al* identified that surgeons sustained 2.5 injures per 100 person procedures, compared to 0.2 per 100 for scrub nurses and technicians. Furthermore, they found that surgeons with more than 4 years of training were more likely than any other surgeon to sustain injuries (OR = 1.6, 95% CI = 1.0-2.5, P=0.04). It is likely that this represents the frequency with which each profession handles sharp instruments and the higher proportion of doctors compared to other professions in the operating department compared to general areas of the hospital. Reluctance of doctors to comply with universal/standard precautions has also been identified (Stein *et al*, 2003;

Trim *et al*, 2003; Cutter and Jordan, 2004; Raghavendran *et al*, 2006) and this too could influence the exposure rate (see section 2.5.5).

Unfortunately, it is not only those health care professionals who use sharps who are at risk from adverse exposure. Ancillary staff such as housekeepers and laundry staff is frequently injured: 3%-25% of these healthcare workers have reported inoculation injuries (English, 1992; Ippolito *et al*, 1994; Ling *et al*, 2000; EPINet, 2004a; HPA, 2005). The Health Protection Agency (2005) reported the case of a domestic who contracted HCV following a needlestick injury sustained while cleaning in a GP surgery. This indicates a degree of carelessness or even negligence on behalf of the users, for example not disposing of sharps appropriately.

Device related infection

Although any contaminated sharp instrument has the potential to transmit bloodborne viral infection, some types of injury and devices have been associated with a higher risk of infection than others. The majority of reported infections are related to those associated with deep injury or the potential to inject a comparatively large volume of blood into the wound (English, 1992; Ippolito *et al*, 1993; Ippolito *et al*, 1994; Greene *et al*, 1998; Rabaud *et al*, 2000; Gillen *et al*, 2003; Trim *et al*, 2003) and is therefore, greatest when exposure involves deep injury, a hollow bore needle that has been in contact with the source patient's vein or artery or when there is visible blood on the device causing the injury (Jagger *et al*, 1988; Jagger *et al*, 1990; Ippolito *et al*, 1994; Cardo *et al*, 1997; Holodnick and Barkauskas, 2000). The risk of acquiring HIV infection following a percutaneous exposure to blood or body fluid is most likely if the injury is deep, the needle was used in an artery or vein, there is visible blood on the device or the patient is in the terminal stages of AIDS (CDC, 1995; Cardo *et al*, 1997).

A large proportion of percutaneous injuries fall into one of these categories. Puro *et al* (2001) found that 43.5% (n=10,988) injuries were deep or involved a needle that had been inserted into a patient's vein or artery. Of the nine cases of occupational acquisition of HCV reported between 1997 and 2004, eight were caused by hollow bore needles, the needles visibly contaminated with blood in four of these cases (HPA, 2005).

Instruments such as scalpels often cause severe injuries, for example, causing a gash rather than a stick injury, and are also associated with a high risk of infection (Jagger *et al*, 1998).

Device related injuries

Disposable syringes and needles are the devices causing most reported percutaneous injuries. These account for 23.2–59.3% of reported injuries. Other devices commonly associated with injury are suture needles (7.3-77%); intravenous (IV) cannulae (5.9-54.5%) and scalpels (4-50%). Less commonly involved are skin hooks, retractors, towel clips, vacuum tube blood collectors, pre-filled cartridge syringes, glass tubes, slides and pipettes (English, 1992; Tokars *et al*, 1992; Ippolito *et al*, 1993; Ippolito *et al*, 1994; Jagger and Balon, 1997; Greene *et al*, 1998; Perry, 1998; CNSSN, 2001; Ng *et al*, 2002; Shiao *et al*, 2002; Gillen *et al*, 2003; Smith *et al*, 2006a; Smith *et al*, 2006b; Venier *et al*, 2007).

However, when percutaneous injury rates are calculated, the sharps most commonly associated with injury are winged IV needles. Ippolito *et al* (1994) found that although the highest percentage of reported injuries (59.3%) were caused by disposable syringes and hypodermic needles, this equated to the lowest rate of needlestick injuries (3.8 per 100 000 devices used). The highest injury rate was associated with winged steel IV needles (10.1 per 100 000 devices used, 33.1%). Similarly, Jagger *et al* (1998) found that disposable needles and syringes accounted for the lowest injury rate (6.9 per 100 000 devices purchased) despite being responsible for the greatest overall number. The inconsistency between frequency and rate can be explained by the fact that needles and syringes are the most frequently used sharp instruments.

In the operating department, the majority of injuries to surgeons and scrub personnel are associated with suture needles (see section 2.3.5). For example, according to Smith *et al*

(2006b) suture needles are responsible for 50% of all injuries to scrub personnel. Tokars *et al* (1992) found that 77% of injuries involved suture needles. Although suture needles do not have a hollow bore, injuries during surgery often occur when the hands are concealed within a body cavity and may go unnoticed allowing a significant period of time for the puncture wound to be exposed to the patient's blood and consequently potential infection.

Injuries from scalpels are also potentially "high risk" because these injuries are likely to be more severe than needlestick injuries. They may also occur when the hands are inside a body cavity. Jagger *et al* (1998) found that scalpel blades caused moderate or severe injury in 64.5% of cases compared to 47.2% of injures caused by suture needles.

Activity during injury

The activities that healthcare professionals were undertaking at the time of percutaneous injury can be split into before, during and after use of the sharp object. Most injuries, unsurprisingly, occur during use. Activities such as administering intravenous/intramuscular/subcutaneous/subdermal injections (2-25.8%); suturing (17%); phlebotomy (5-38%), intravenous cannulation or manipulation of intravenous line (10-32.5%) are commonly associated with injury. Injuries are often sustained after use. Re-sheathing caused 10.1-70% of reported injuries, disposal 2.8-13% and after use but before disposal 11.3-42% of injuries (Hussain *et al*, 1988; English, 1992; Greene *et al*, 1998; Ling *et al*, 2000; Puro *et al*, 2001; Phipps *et al*, 2002; ; Gillen *et al*, 2003; Ippolito *et al*, 2003; Trim and Elliott, 2003; Cutter and Jordan, 2004; Rapparini *et al*, 2007). In the operating theatre, injuries occur most frequently during suturing, see section 2.3.5.

Injuries sustained by support staff such as laundry or housekeeping staff is frequently the result of incorrect disposal by healthcare professionals, for example sharps discarded into plastic liners and laundry containers (English 1992). Gillen *et al* (2003) found that 79% (65/82) of injuries sustained by housekeeping and laundry workers were due to sharps left in inappropriate places, for example, the domestic referred to on page 50.

Mucocutaneous exposure is most likely during exposures that generate an aerosol or splash of blood and body fluids, such as during surgery or vaginal delivery. According to Quebbeman *et al* (1990), 118/234 (50%) of operations resulted in contamination of at least one member of the operating team. The most common area of contamination is the mucosa of the eyes 21 - 70% (Ippolito *et al*, 1993; Jagger *et al*, 1998; Gershon *et al*, 2000a; CNSSN, 2001; Puro *et al*, 2001). See also section 2.3.2.

Other factors contributing to inoculation injuries

Adoption of standard/universal precautions is recommended to reduce the risk of inoculation injury (UK Health Departments, 1998; Pratt *et al*, 2007; Siegel *et al*, 2007). Consequently, failure to comply with appropriate precautions is likely to be a significant contributory factor in sustaining an injury (DOH, 2004; HPA, 2008) yet it is clear that compliance is often poor, see sections 2.4 and 2.5.

Fatigue has been associated with injury, particularly in relation to medical trainees (Fisman *et al*, 2007) where self reported fatigue associated with sleep deprivation was associated with a three-fold increase in injury risk. Related to fatigue is the length of time on duty before an injury occurs. Green-McKenzie and Shofer (2007) found that 20% of injuries among medical house-staff and 6% in nursing and technical staff occurred following 12 hours on duty. The difference between professions could be explained by the fact that although length of shift may not be significantly different, nurses and technical staff often work established shift patterns which allow for adequate rest between shifts whereas doctors' working hours are less predictable and will include extended on-call periods where rest is absent or disturbed, thereby increasing levels of fatigue and reduced alertness. This is corroborated by Smith *et al* (2006c) who identified that nurses who work mixed shifts have an increased likelihood of sustaining needlestick injuries compared to those who work exclusively day shifts (OR = 4.0, 95% CI = 1.7-10.4), $P<0.05$) or night shifts (OR = 4.4, 95% CI = 2.0-10.1, $P<0.05$).

Other factors that have been identified in relation to sustaining inoculation injury include working under pressure (Smith *et al*, 2006b); length of surgical procedure (Goldmann, 2002); high blood loss during surgery (Goldmann, 2002; Endo *et al*, 2007); sub-optimal staffing levels (Smith *et al* 2006b); inexperience i.e. having a younger than average age (Smith *et al*, 2006c; Au *et al*, 2008) although Au *et al* (2008) acknowledge that those surgeons in more senior positions spent more hours operating per week; those aged < 27 years (Smith *et al*, 2006c) or those in practice less than three years (Abu-Gad and Al-Turki, 2001) were most likely to experience an injury; working in the operating theatre (Bakaeen *et al*, 2006; Fisman *et al*, 2007), emergency department (Fisman *et al*, 2007) or intensive care unit (Smith *et al*, 2006a); time of day, with most injuries occurring during the period of greatest activity i.e. 08.00hours and 14.00 hours (Abu-Gad and Al-Turki, 2001).

Exemplar study

Shiao *et al* (2002) conducted a survey among healthcare workers comprising nurses, physicians, technicians and supporting staff in 16 Taiwanese hospitals to estimate the risk of contracting bloodborne viral infection following needlestick injury from hollow bore needles. Healthcare workers reported all needlestick injuries sustained during the previous 12 months, whether the device was contaminated, job category of healthcare worker involved and their HBV vaccination status. A response rate of 82.6% was achieved (8645/10,469, 95% CI, 81.9% - 83.3%).

Of 7550 needlestick injuries that were reported, 64.7% involved hollow bore needles. The majority of healthcare workers who participated in the study (87.3%) had sustained a needlestick injury during the 12 month study period (95% CI, 86.6% - 88.0%), 64.7% of these involved a hollow bore needle (95% CI, 63.6% - 65.8%). Of these, 66.7% of the devices involved had been used on a patient (95% CI, 65.3% - 68.0%). The total number of contaminated needlestick injuries per healthcare worker per year was calculated as 0.6. The researchers found that 27.8% of healthcare workers surveyed had no immunity to HBV infection either through past infection or vaccination. All were considered to be at risk from HCV and HIV.

To determine whether patients posed a risk to susceptible healthcare workers, four cross sectional surveys of hospital in-patients were conducted. Blood specimens from all patients over six years old admitted on the first days of September and December 1997 and March and June 1998 were tested for HBV, HCV and HIV. Sera from 1805 patients were tested. HBV infection was the most prevalent with 16.7% of patients testing HBsAG positive (95% CI, 15.0 – 18.4%); 12.7% tested positive for HCV antibodies (95% CI, 11.2% - 14.2%) and 0.8% were HIV antibody positive (CI 95%, 0.4% - 1.2%).

Using this information, the number of personnel at risk of contracting HBV infection was calculated as 543, physicians: 80, technicians: 113, supporting staff: 66. For HCV, the numbers were nurses: 596, physicians: 90, technicians: 84 and supporting staff: 30. Only 1 nurse and perhaps 1 other HCW were at risk from HIV infection. The large number of nurses in comparison to other healthcare workers reflects the larger number of nurses employed and the greater number of procedures carried out by nurses that potentially involve contaminated sharps.

2.6.2 <u>Summary</u>

Identification of the causes of inoculation injuries and those they affect is essential when planning strategies to reduce the incidence of such exposures to blood and body fluids and the potential for acquisition of bloodborne viral infection. Although frequency and rates of exposure are presented in different ways in the studies reviewed, it is clear from the data presented that inoculation injury presents a significant risk for healthcare workers and that many of the injuries are preventable.

2.7 REPORTING OF PERCUTANEOUS AND MUCOCUTANEOUS EXPOSURE TO BLOOD AND BODY FLUIDS

2.7.1 Factors influencing reporting of inoculation injuries

Profession

There is evidence that doctors are less likely to report adverse exposures to blood and body fluids than other HCPs. Between 0 - 85.2% of doctors report inoculation injuries (Burke and Madan, 1997; Lymer *et al*, 1997; Hettiaratchy *et al*, 1998; Patterson *et al*, 1998; Haiduven *et al*, 1999; Benitez *et al*, 1999; Shiao *et al*, 1999; Ng *et al*, 2002; Sohn *et al*, 2002; Alvarado-Ramy *et al*, 2003; Cutter and Jordan, 2003; Tarantola *et al*, 2006; Schmid *et al*, 2007).

Burke and Madan (1997) found that only 9% of doctors (29/274) reported inoculation injuries compared to 46% of midwives (26/63) despite sustaining more injuries. Seventy one per cent (274/384) of doctors claimed to have sustained an inoculation injury compared to 22% (63/293) of midwives. Similarly, Cutter and Jordan (2003) found that doctors (surgeons) sustained more inoculation injuries than midwives, 87.8% (79/90) of surgeons had sustained an inoculation injury in the 10 years prior to the study, compared to 47.3% (27/57) of midwives. This difference was statistically significant (χ^2 26.390, P<0.001, OR 0.125, CI 95%= 0.55-0.284). However, surgeons were less likely to report injuries. Only 52.7% of surgeons (39/74) reported their injuries whereas 90.5% (38/42) of scrub nurses (χ^2 =15.479, P<0.001, OR=0.117, CI 95% = 0.038-0.362) and 91.3% (21/23) of midwives (χ^2 =9.506, P<0.002, OR=0.106, CI 95% = 0.023-0.485) reported injuries during this period.

Shiao *et al* (1999) also found that profession influenced reporting (P<0.001). Overall, 87.3% (7550/8645) of HCPs failed to report inoculation injuries. Doctors failed to report 85.2% of their injuries (CI 95%, 83.2% - 87.2%), nurses failed to report 81.7% (CI 95%, 79.6% - 83.8%), technicians 81.5% (CI 95%, 79.9% - 83.7%) and supporting personnel 74.6% (CI 95%, 70.4% - 78.8%).

Doctors' chosen speciality influenced whether they reported exposures. Predictably, surgeons experience more percutaneous and mucocutaneous exposures than other doctors because of the frequent handling of sharps and exposure to comparatively large volumes of blood (Lynch and White, 1993), yet are the least likely to report them (Hettiaratchy *et al*, 1998). This could put patients at risk. "When a surgeon suffers a needlestick injury, not only is he exposed to the risk of disease but so are his future patients" (Hettiaratchy *et al*, 1998, p 440). Manian (1996) and Williams *et al* (1994) suggest that his might be because surgeons do not perceive these incidents as significant, perhaps because familiarity breeds contempt.

It would appear that this behaviour is learned during medical training as studies have shown that medical students are also reluctant to report adverse exposures to blood and body fluids, with non-reporting rates of 75 – 85% recorded (Choudhury and Cleator, 1992; Kirkpatrick *et al*, 1993, Waterman *et al*, 1994; Schmid *et al*, 2007). This suggests that whatever is learned during formal education and training, students follow the example set by their mentors (Lymer *et al*, 1997). However, Sullivan *et al* (2000) found that all medical students in a study conducted in Birmingham (UK) reported their injuries.

Lack of time

Being too busy and having insufficient time to report percutaneous and mucocutaneous exposures to blood and body fluids has been identified by several authors (Haiduven *et al*, 1999; Benitez *et al*, 1999; Shiao *et al*, 1999, Burke and Madan, 1997; Cutter and Jordan, 2003; Au *et al*, 2008). This trend is more apparent among doctors than among other HCPs with 55.2 - 64% of doctors not reporting injuries for this reason (Burke and Madan, 1997; Cutter and Jordan, 2003) compared to 40% of nurses (Cutter and Jordan, 2003) and 29% of midwives (Burke and Madan, 1997). Related to lack of time was the belief that the reporting mechanism was too cumbersome (77.4% of surgeons and 60% of nurses and midwives, χ^2 = 0.581, OR = 2.286, 95% CI = 0.316-16.512) (Cutter and Jordan 2003) and generated excessive paperwork (57.7% of surgeons) (Au *et al*, 2008).

Van Gemert-Pijnen *et al* (2006) identified that rather than being short of time *per se* HCPs felt that complying with protocols in relation to standard/universal precautions and reporting impacted on the time available to provide patient care.

Perception of risk

Where HCPs believe the risk of contracting a bloodborne viral infection to be low, rates of reporting tend to be poor, with 26 – 90.6% of HCPs citing this as a reason for not failing to report (Mangione *et al*, 1991; Burke and Madan, 1997; Patterson *et al*, 1998; Benitez *et al*, 1999; Cutter and Jordan, 2003; Sohn *et al*, 2004).

According to Cutter and Jordan (2003) assuming that the patient did not pose a risk of infection is more prevalent among doctors than other HCPs. They found that 90.6% of surgeons (29/32) gave their perception that the patient was not "high risk" as a reason for not reporting inoculation injuries compared to 50% of (2/4) nurses and midwives. However, the difference between the 2 groups was not statistically significant (P=0.084, OR=9.667, 95% CUI = 0.977-95.67).

Unfortunately, many HCPs underestimate the risk of infection following exposure to infected blood (Patterson *et al*, 1998; Duff *et al*, 1999; Raghavendran *et al*, 2006). Burke and Madan (1997) found that only 36% of doctors and 32% of midwives correctly assessed the risks of contracting HBV from a needlestick injury; 77% of doctors and 69% of midwives underestimated the risk of contracting HIV from a similar injury; 22% of doctors and 7% of midwives failed to report inoculation injuries based on this perception of risk.

Those who have sustained frequent injuries may be more reluctant to report than those for whom injuries are an isolated occurrence (Trapé-Cardoso and Schenke, 2003). This may be particularly prevalent among students who may feel embarrassed or become desensitized with each injury (Makary *et al*, 2006a) or perhaps be wary of reprimand for being careless.

Familiarity with reporting procedures

There is evidence that knowing the correct action to take following adverse exposure to blood and body fluids encourages reporting and appropriate first aid (Gershon *et al*, 1995; Knight and Bodsworth, 1998). All HCPs should therefore be aware of the appropriate action to be taken. Unfortunately, studies demonstrate that knowledge of appropriate policies and procedures is variable, with 9.4 -90% of HCWs being ignorant of the correct mechanism for reporting inoculation injuries (Burke and Madan, 1997; Shiao *et al*, 1999; Phipps *et al*, 2002; Cutter and Jordan, 2003; Hills and Wilkes, 2003; Trim *et al*, 2003). According to Burke and Madan (1997), 27% of doctors and 29% of midwives did not realise that reporting inoculation injuries was standard procedure. Shiao *et al* (1999) found that 21.2% of doctors, 9.4% of nurses, 25.4% of technical personnel and 32.6% of support personnel were unaware of the reporting requirement or mechanism ($P<0.0001$). However, Cutter and Jordan (2003) found that 100% of nurses and midwives and 78.4% of surgeons were familiar with the inoculation injury reporting procedure yet 32.4% of respondents failed to report their injuries. Similarly, Hills and Wilkes (2003) found that 81% were aware of the appropriate policy and yet only 58.3% of nurses reported all or most of their injuries. Au *et al* (2008) also found a high degree of knowledge of policies with 87.5% of surgeons admitting to knowing the post exposure protocol but only 33.3% reporting their injuries. Therefore, knowledge of policies alone is not sufficient to encourage reporting.

Post-exposure follow up

One of the reasons why reporting is important is to enable appropriate follow up and administration of post exposure prophylaxis (PEP) aimed at reducing the likelihood of sero-conversion with HIV and HBV. The efficacy of this treatment not only relies on prompt follow-up, but efficiency of the service providers in ensuring that the correct steps are taken post exposure. This is particularly important in the case of HIV post exposure prophylaxis which should ideally be given within an hour of the accident for best results

(DOH, 2008). van Wijk *et al* (2006) found that 36% of injuries with a high risk of transmission for HBV and 40% for HCV and HIV were handled incorrectly with insufficient interventions initiated in 123/396 (31.1%) cases. However, over-reaction to an incident is also undesirable and this has also been reported including unnecessary testing of the source patient and prescription of post-exposure prophylaxis when not clinically indicated (Patel *et al*, 2002; van Wijk *et al*, 2006). This can cause unwarranted anxiety for the patient involved and the unnecessary risk of side effects resulting from PEP which may occur in up to 28% of recipients (Kiertiburanakul *et al*, 2006). Inappropriate management of inoculation injuries could potentially lead to dissatisfaction with the service and prevent HCWs reporting subsequent injuries (Cutter and Jordan, 2003; Au *et al*, 2008).

Other factors influencing under reporting

Other reasons for under reporting were cited less frequently or considered in a limited number of studies, but nonetheless must be considered when planning interventions aimed at improving compliance with reporting procedures. They include: concerns about breaches of confidentiality, 4-17% (Mangione *et al*, 1991; Burke and Madan, 1997; Benitez *et al*, 1999), fear of reprisals or adverse affect on career, 3-6% (Mangione *et al*, 1991; Burke and Madan, 1997; Phipps *et al*, 2002; Cutter and Jordan, 2003); inoculation injuries are considered to be an occupational hazard, 0-62.5% (Cutter and Jordan, 2003); length of experience (surgeons aged <35 years were more likely to report injuries than those aged >35 years (9.82% compared to 1.1%, $P<0.001$) (Au *et al*, 2008) and feeling that nothing could be done, 57-68% (Burke and Madan, 1997).

2.7.2 Summary

Reporting adverse exposures to blood and body fluids is not simply a bureaucratic exercise, but can lead to potentially life saving prophylactic or early treatment which can reduce the risk of acquiring a bloodborne viral infection. It is clear that under reporting is common, particularly among doctors, and that interventions must be designed which take into consideration all the factors that discourage reporting and attempt to overcome them.

2.8 IMPROVING GUIDELINE/PROTOCOL ADHERENCE

2.8.1 Guideline adherence/compliance

Guidelines have been described as "systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances" (Institute for Medicine, 1990, p 39). Their purpose is to standardise practice and establish and maintain minimum professional standards. However, not all HCPs welcome guidelines, perhaps because they see them as affecting their ability to use professional judgment (Day *et al*, 1998; Manias and Street, 2000; Heritage *et al,* 2002). They may also be unwilling to change because they are unconcerned about peer or patient pressure (Natsch and van der Meer, 2003). Consequently, compliance with guidelines may be incomplete. Where guidelines are developed externally, such as those issued by bodies such as the UK Health Departments (1998) and introduced with a 'top-down' approach, excluding individual practitioners and current stakeholders from the compilation process, this may reduce personal commitment (Agree Collaboration, 2001; O'Davies & Harrison, 2003).

Guidelines developed in isolation from practice, may be seen as divorced from the complexities and constraints of clinical reality (Manias & Street, 2000) and may therefore be side-lined or even ignored. Those such as standard/universal precautions could be viewed as inconvenient and time consuming and consequently may not be followed (Woolf *et al*, 1999). Guidelines may be perceived as a tool for protecting managers from litigation associated with untoward incidents and reducing insurance premiums, with risk management rather improved standards being the motivator (Lawton & Parker, 1999).

Doctors, more so than nurses, appear to be sceptical of guidelines (Cotton and Sullivan, 1999; Lawton and Parker, 1999; Manias and Street, 2000). Evidence suggests that doctors place more value on their professional autonomy than guidelines, whereas nurses find policies and protocols useful for decision making and feel that they increase rather than reduce their autonomy (Lawton and Parker, 2000;Manias and Street, 2000; Harrison *et al*, 2002). Differences in role, responsibilities, existing working practice, experience, training, culture and decision-making between doctors and nurses could help explain why doctors view guidelines less favourably than nurses (Cotton and Sullivan, 1999; Lawton and Parker, 2000). Whereas doctors rely on scientific knowledge and experience from previous medical placements, nurses tend to communicate their knowledge with reference to policies and protocols (Manias and Street, 2000). Doctors expect to be involved in decision-making, and may therefore find the external imposition of protocols incongruous with their professional socialisation (Kendrick, 1995). This could contribute in some way to the lack of adherence to universal precautions and reporting procedures, particularly by surgeons.

2.8.2 Improving compliance with universal precautions

The purpose of identifying the factors underlying compliance with universal precautions is to devise initiatives that will be effective in improving compliance and hence safety. There is little published work exploring the most effective method of improving long-term compliance with standard/universal precautions as a whole, but strategies aimed at improving other infection control activities, most commonly hand hygiene are relevant. Unfortunately, many studies are insufficiently robust from which to draw firm conclusions. Small sample sizes; lack of detailed description of the study population, settings and interventions; lack of control; poor use of outcome data to measure the efficacy of interventions; poor description and use of statistical methods and little on-going follow up to establish long term impact are common (Aboelela *et al*, 2007; Gould *et al*, 2008).

Due to the varied nature of contributory factors, it is unlikely that any single intervention will be successful in achieving improvements, therefore a multi-factorial approach is necessary (Wensing and Grol, 1994; Corser, 1998; Naikoba and Hayward, 2001; Creedon, 2006). Seto (1995) argues that guideline implementation relies on identifying why staff is resistant to change. Infection control is one such area (Wye and McClenahan, 2000; Cooper, 2007). Persuasion techniques can then be used to effect improvements in situations where attitude change is required before compliance can be improved (Seto, 1995).

Education

Knowledge of universal precautions does not always lead to improved compliance (Farrington, 2007) (see section 2.6.1) and varying degrees of success have been achieved by education and training. A beneficial effect of pre-registration and under-graduate education on uptake of universal precautions is suggested by the fact that medical students, junior doctors and nurses are more likely to adopt universal precautions than those who are older and have been in practice longer (Ronk and Girard, 1994; Ramsey *et al*, 1996; Jeffe *et al*, 1998; Akduman *et al*, 1999; Kim *et al*, 2001).

Several authors have suggested that if infection control education is to be effective, it must be delivered in the workplace (Ching and Seto, 1990; Gould and Chamberlain, 1994, 1997; Teare and Peacock, 1996). However, continuing education in the workplace has had varied results. Some interventions have proved to be effective in improving compliance with standard/universal precautions, for example Huang *et al* (2002) who found that nurses who had received training on universal precautions reported significantly higher knowledge scores (n=49, $P<0.001$) and reported improved compliance compared to those who had not received training (n=49, $P<0.001$). Similarly, Creedon (2006) utilized an education campaign consisting of handouts and posters, provision of alcohol hand-rub, feedback concerning hand hygiene behaviour to successfully improve hand hygiene compliance among Irish nurses from 51% to 83% ($P<0.001$). Long term compliance was not measured. Kim *et al*, (2001) were able to demonstrate an improvement in compliance with universal precautions following workplace education. Furthermore, they were able to maintain the improvement one to two years after the education had taken place. Improved compliance was noted with both protective eyewear, from 54% (332/597) before education to 66% (853/1285) after education ($P<0.0001$); and double gloving from 28% (97/344) to 55% (435/788)

($P<0.0001$). They also found that percutaneous and mucocutaneous exposures to blood and body fluids decreased from 17 per 200 observed hours to 24 per 545 observed hours ($P=0.042$) following training. However, whether the change was sustained beyond two years has not been established.

Other studies have demonstrated less success in increasing compliance following educational interventions (Henry *et al*, 1992; Hersey and Martin, 1994; Williams *et al*, 1994). Although Williams *et al* (1994) reported improved compliance with glove-use ($P<0.05$) and a reduction in re-sheathing needles ($P<0.05$) among those personnel who had undergone three or more training sessions compared to those who had undergone fewer than three sessions, they failed to demonstrate an improvement in use of eye protection, masks and gowns. Gould and Chamberlain (1997) were unable to improve compliance with a range of infection control activities including universal precautions following a ward based education intervention, possibly due to poor attendance at teaching sessions. However, they did identify key problems that may affect the ability of educators to reach their intended audience including workload, shift patterns and other mandatory training taking precedence over infection control. They also raised concerns that as they were not employed by the relevant hospital, the researchers, one of whom was the teacher, may have been viewed as 'outsiders' and therefore the teaching sessions may not have been given priority. These issues must be considered if work based training is to be successful.

Seto *et al* (1991), Seto (1995) and Thompson *et al* (2000) identified that those individuals, known as 'opinion leaders' exert significant social influence on others and can therefore, be useful allies in improving compliance with infection control measures. For example, good practice by senior doctors and administrators has had a positive influence on hand hygiene compliance in nurses (Whitby *et al*, 2006) but poor standards by senior doctors and nurses may also have a negative effect (Lankford *et al*, 2003). This can be exploited by utilizing these opinion leaders to provide training and education at ward and departmental level. Infection control link staff can take on this mantle (Teare

and Peacock, 1996, Dawson, 2003; Cooper, 2007) and have been shown to be more successful at influencing practice than those seen as 'outsiders' (Cooper, 2004).
It has been established that lectures alone are the weakest strategy for disseminating guidelines (Seto *et al*, 1991; Herman *et al*, 1994; Cooper, 2007) and that a more successful approach is to combine education with the influence and support of opinion leaders as adults need to see the relevance of information (Seto *et al*, 1991; Cooper, 2007). Flexibility must be introduced into any programme aimed at influencing compliance and adult learning theories must be incorporated including networking, critical analysis, reflection and questioning (Cooper, 2007) reflecting education rather than training which encourages rigidity and inhibits development (Gould *et al*, 2008). Seto (1995) argues that educators should know their customers by adopting a total quality management approach. In so doing, the educator can identify what the user needs to know and what they can use since adult learners are more likely to be responsive if they can use the information they have been given. It can also not be assumed, that an approach used successfully within one profession will necessarily be successful with other healthcare professionals and must be personalized for each profession (Thomas *et al*, 1999; Farrington, 2007). For example, materials designed for nurses for example may be rejected by medical staff (Farrington, 2007).

Previous studies have identified that perception of risk is a strong motivating factor in determining whether universal precautions are followed (section 2.5.3). For example Goldmann (2002) argues that fear of bloodborne viruses is the prime motivator for wearing protective clothing. Willy *et al* (1990) found that compliance with improved working practices is likely to increase only when education altered perception of risk as opposed to simply increasing knowledge. Ramsey *et al* (1996) noted that nurses are knowledgeable about universal precautions, yet still attempt to assess the risk of HIV/HBV before deciding whether to take precautions, indicating that behaviour modification is difficult to achieve. However, altering perception is difficult to achieve as judgement may be associated with factors that cannot be altered by education, for example, social, racial or ideological factors (Henry *et al*, 1994).

Extreme methods have been suggested, including the use of scare tactics during training sessions, e.g. by highlighting cases of occupational acquisition of bloodborne virus infections (Haiduven *et al*, 1999). However, this approach is probably simplistic and unlikely to be effective if HCPs feel remote from infected individuals. They will therefore, be unaffected by their plight and consequently not modify their behaviour (Nelsing *et al*, 1997).

It is clear that changing behaviour is complex. Several organisational and individual factors affect behaviour, including beliefs, perceived health threat, self-efficacy, attitudes, beliefs, intention, communication, participation, respect and fairness (Kretzer and Larson 1998, Cooper, 2007). Improving compliance involves identifying these variables and incorporating them into interventions that will impact on individual behaviour.

Safety climate

Effective leadership in relation to safety and ensuring adequate supplies of protective clothing and safety devices are available can improve compliance with universal precautions by fostering a culture where safety is respected, staffing levels and resources are adequate and leadership is strong (Clarke *et al*, 2002a; Lymer *et al*, 2003). Workplaces that show a strong commitment to safety in this way have been able to demonstrate fewer workplace injuries than environments that show a lesser commitment (Diaz and Cabera, 1997; Green-McKenzie *et al*, 2001; McCoy *et al*, 2001; Hunt and Murphy, 2004). Once employees recognise that strong management support is evident, non-compliers often improve levels of compliance (Gershon *et al*, 2000b; Lymer *et al*, 2004). For example, not surprisingly, Green-McKenzie *et al* (2001) found that compliance with infection control practices improved when personal protective equipment and safety devices were readily available. According to Gershon *et al* (2000b) HCPs perceptions of safety are related to "management decision making, organizational safety norms and expectations and safety practices, policies and procedures" (p 212).

Exemplar

Gershon *et al* (2000b) conducted a study within a US urban research medical centre to explore the relationship between the hospital safety climate and workplace safety and the occurrence of adverse incidents. Questionnaires were sent to hospital employees (n=1240). The sample comprised nurses, physicians and phlebotomists.

The survey measured safety climate, demographics, self-reported compliance rates and exposure history by using a questionnaire including 46 safety climate items including support for safety programmes, communication and feedback about safety and accessibility, availability and quality of safety equipment.

Statistical analysis was carried out using STATA software and included descriptive statistics. Varimax rotation was used to analyse safety climate constructs and further analysis using Cronbach's α, bivariate associations to examine associations between safety climate and demographics was carried out. Finally, stepwise multiple logistic regression models were used for the relationship between compliance and exposure incidents.

A total of 789/1240 questionnaires were returned (response rate 60%). A strong correlation between safety climate and compliance was demonstrated.

HCPs who reported that the workplace was clean and orderly were more than three times more likely to report adherence to safe work practices (OR=3.3, 95% CI, 2.2-4.9). Compliance with safe work practices was high when senior managerial support was high (n=789, OR=2.3, 95% CI, 1.5-3.4). The authors also found that women, younger employees and employees with <14 years of education were more likely to comply. Furthermore, the frequency of exposure incidents was significantly lower when the support from senior managers was felt to be high (OR=0.56, 95% CI, 3.8-0.82). [N.B. the confidence interval quoted here is as quoted in the published paper. However, it is likely that there has been a typographical error here, as the 95% CI should include the odds ratio, and clearly, in this case it does not.]

Legislation and policy

Level of administrative commitment to safety is often related to the way in which legislation affects clinical practice and employing organisations. In the USA, the Occupational Safety and Health Administration (OSHA) issued the bloodborne pathogen standard and made the use of universal precautions mandatory with effect from 1992 (OSHA, 1991). Yet many studies carried out since 1992, including those by Williams *et al* (1994); Henry *et al* (1994) and Akduman *et al* (1999) reveal that uptake of universal precautions remains poor. Ramsey *et al* (1996) noted an improvement after implementation of the OSHA regulations. Nevertheless, compliance was still disappointing. Since then, the OSHA has continued to issue federally enforceable directives which take precedence over individual state requirements. In 2001, they extended their guidance to include the following:

- Employers must review safer medical devices e.g. needle free systems at least annually to reflect changes in technology. Their findings must be documented;
- Employers must seek input from health care workers when evaluating and selecting safer medical devices;
- A log must be kept of all injuries from contaminated sharps.

In the UK, the use of standard/universal precautions is not legislatively enforceable. However, all employers have a legal duty under the Health and Safety at Work Act (Health and Safety Executive, 1974) to train and protect employees, and are obliged under the Control of Substances Hazardous to Health (COSHH) Regulations (Health and Safety Executive, 2002b) to review procedures involving hazardous substances, including microbiological hazards, and to provide measures which will reduce or eliminate the risk. Failure to comply could lead to prosecution, thereby encouraging employers to ensure that their employees follow safety precautions. Development of local policies that can be enforced by disciplinary action, are intended to increase compliance. However, UK studies demonstrating poor compliance indicate that these measures are largely ineffective (Burke and Madan, 1997 and Leliopoulou *et al*, 1999; Cutter and Jordan, 2004) perhaps because HCPs often feel remote from the development of policies resulting in a lack of ownership and poor compliance (van Gemert-Pijnen *et al*, 2006). Therefore, encouraging participation of key stakeholders in the development of policies and protocols is essential for maximizing compliance.

Kelen *et al* (1991) found that introducing a policy with a monitoring component improved compliance with universal precautions from 47.9% to 81% among emergency department personnel in Baltimore. They report that non-compliance is recorded in employee records in the hospital under study. Persistent failure to comply could potentially lead to termination of employment. This approach, although extreme, appears to be effective as no HCP has been disciplined for repeated lack of compliance since this approach was adopted.

The recent introduction in England of the Health Act (DOH, 2006) has introduced the ability to legally enforce infection control compliance (Farrington, 2007). However, this Act does not apply to the rest of the UK.

Feedback

Recognising strengths as well as weaknesses has been shown to be beneficial in improving compliance. A positive correlation between feedback and compliance has been noted (DeVries *et al*, 1991; McCoy *et al*, 2001; Creedon, 2006). Therefore healthcare practitioners (HCPs) in a supervisory capacity should monitor their colleagues' compliance and give constructive feedback. This has been shown to improve compliance (McCoy *et al*, 2001). Those HCPs not routinely monitored and not given positive reinforcement are less compliant than others (Beekmann *et al*, 2001; van Gemert-Pijnen *et al*, 2006). However, compliance with universal precautions is not always included in HCPs' performance reviews (Hersey and Martin, 1994). Therefore, this opportunity for improvement is often missed.

Infection control practitioners must also be prepared to accept feedback from other HCPs and incorporate their needs into infection control policies, not least in the area of workplace education which has yielded variable results in improving infection control practice.

2.8.3 Improving compliance with reporting procedures

Improving compliance involves identifying the variables that influence reporting and incorporating them into interventions that will impact on individual behaviour. However, changing behaviour is complex. Several organisational and individual factors affect behaviour, including beliefs, perceived health threat, self-efficacy, attitude, intention, communication, participation, respect and fairness (Kretzer and Larson 1998). Since compliance with reporting procedures has been identified as worse among doctors than other HCPs (see section 2.7.1) these factors need to be addressed particularly within this group. Poor compliance with guidelines by doctors has been identified in other areas of healthcare as well as infection control (Cotton and Sullivan, 1999; Manias and Street, 2000; Harrison *et al*, 2002). The difference in level of compliance between doctors and other HCPs may reflect differences in professional socialisation culture and education (Lawton and Parker, 1999). Alvanzo *et al* (2003) acknowledge that some doctors may find attempts to change their behaviour threatening. Consequently, this must be done with some degree of tact and according to Alvanzo *et al* (2003) should include education, motivation through feedback, reward and punishment and facilitation in making it easy for the doctor to make the change. Rashidian and Russell (2003) use a model which comprises six steps to encourage compliance with prescribing guidelines. They are: guideline characteristics, influential people, organisational factors, implementation strategies and adherence monitoring. A similar model might be useful in improving compliance with universal precautions and reporting inoculation injuries.

Education

It has been argued that awareness of the correct mechanism for reporting injuries encourages reporting (Knight and Bodsworth, 1998). It follows then that lack of knowledge concerning when and how to report inoculation injuries may contribute to under-reporting (Smith *et al*, 2006a). Improvements in reporting rates may be made through education and awareness campaigns (Burke and Madan, 1997; Heapy *et al*, 1998; Haiduven *et al*, 1999; Shiao *et al*, 1999; Holodnick and Barkauskas, 2000; Ling *et al*, 2000; Shiao *et al*, 2001) see appendix 8. However, while some authors have achieved success in improving rates of reporting through education (Holodnick and Barkauskas, 2000; Ling *et al*, 2000; Shiao *et al*, 2001, Trim *et al*, 2003), others have had less success and the same limitations apply as have been discussed in section 2.8.2. Several authors (Jagger and Balon, 1995; Roy and Robillard, 1995; Shiao *et al*, 1999; Sohn *et al*, 2004) have indicated that education alone has limited influence on reporting rates. Shiao *et al* (1999) identified that despite a statistically significant increase in reporting following attendance at a prevention programme, the increase was clinically insignificant, with only a 4.1% improvement in reporting among those who had attended the training session.

Reporting can be improved by making HCPs aware of the risks of exposure and seroconversion rates of bloodborne viral infections and the benefits of first aid treatment and prophylaxis (Patterson *et al*, 1998). In a study by Gańczak *et al* (2006) 38% of those who failed to report did so because they assumed the patient was not infected. Holodnick and Barkauskas (2000) feel that education needs to provide the most up to date information about the incidence of bloodborne pathogen disease. However, they also feel that education is unlikely to be effective until HCPs have a colleague affected by such disease.

Williams *et al* (1993) found that reporting was highest among HCPs who had been vaccinated against HBV because those who perceived the risk of infection to be sufficient to warrant vaccination were mindful of the need to obtain the proper advice and treatment. Education should therefore promote and support vaccination programmes. Although it is possible that the converse may apply with those who have been vaccinated being lulled into a false sense of security by the belief that they are protected from infection.

Although education of the HCPs themselves is vital, education of managers is also important so that they can encourage reporting among their staff in the event of an inoculation injury (Gershon *et al*, 2000b).

Following a systematic review of literature concerning implementation of research findings Bero *et al* (1998) report that some interventions are more effective than others in encouraging implementation. Distribution of educational materials and lectures are likely to be ineffective, whereas active educational meetings are more likely to be effective. There is no reason to suppose that adoption of research findings in any other speciality is different to adoption of research findings concerning the risks following inoculation injuries and failure to report. Therefore, a more creative approach needs to be taken rather than simply informing HCPs of the relevant procedure or policy (see section 2.8.2).

Motivation to report injuries

Once an accident has been reported, the follow up must be appropriate, and conducted quickly and with compassion (Gershon *et al*, 2000b) to encourage reporting of future accidents. An insensitive response by those following up the incident e.g. occupational health departments or Accident and Emergency Departments, will discourage future reporting (Gershon *et al*, 2000b).

Details of all reported injuries should be fed back to the relevant committees e.g. risk management committee, and relevant personnel including infection control teams, medical and nursing leaders and those reporting must be made aware that reporting injuries can bring about positive results as those who feel that reporting serves no purpose will not comply (Raghavendran *et al*, 2006). The reports should be reviewed to find common themes and risk behaviours. This will result a clear understanding of the incidents and support the development of reduction strategies (Gershon *et al*, 2000b; Abu-Gard and Al-Turki, 2001; Clough and Collins, 2007).

Streamlining policies and procedures

Debnath (2000) asks whether current reporting procedures are appropriate. "The current system of reporting involves using a common incident form (in quadruple) that incorporates the individual's personal details. Is it really necessary to fill in an A3 sized form?" (p852). Perhaps reviewing these procedures would encourage reporting among those HCPs reluctant to do so because of time constraints. He also questions the need for a copy of the report to remain in the clinical area where the accident took place, as this could be viewed as a possible breach of confidentiality with colleagues and managers alike having access to potentially damaging or personal information.

Managers need to develop reporting procedures which are time efficient and ensure confidentiality (Mangione *et al*, 1991; Ramsey and Glenn, 1997; Shiao *et al*, 1999). For example, 24 hour confidential, anonymous computerised reporting system or telephone 'hotlines' (Shiao *et al*, 1999; Makary *et al*, 2007) or routine prompts in post operative checklists (Makary *et al*, 2007). Furthermore, action following reporting must be consistent as it has been recognised that out of hours management of occupational exposures is inferior to that provided by occupational health departments during the normal working day (Patel *et al*, 2007).

A multi-factorial approach aimed at improving reporting may be beneficial. In addition to an educational campaign, Clough and Collins (2007) improved the service provided to those reporting exposure incidents by devising a form that is used to ensure that all aspects of the management of such injuries are addressed while providing sufficient information for audit purposes. Holodnick and Barkauskas (2000) incorporated a "streamlined body substance exposure kit" (p468) into the workplace to make inoculation injury reporting less cumbersome. The kit included the appropriate laboratory request forms to encourage the injured HCP to undergo the correct blood tests, and information on the reporting procedure. They achieved an increase in the number of injuries reported from 10.15 exposures per 1000 theatre cases in the three months preceding the intervention to 14.10 per 1000 following the intervention.

2.8.4 Summary

Reporting inoculation injuries and obtaining the appropriate first aid has been demonstrated to reduce occupational acquisition of bloodborne viral infection. However, despite the benefits of reporting, under-reporting is common. Strategies to improve reporting rates have met with varying degrees of success hence designing a suitable strategy that incorporates all the variables is likely to be difficult. Improving compliance with guidance on universal precautions presents a similar challenge. Nevertheless, efforts must be made if HCPs are to be encouraged to take the correct action to minimise adverse exposure to blood and body fluids and protect themselves from infection in the event of such as exposure.

2.9 QUALITY OF THE STUDIES REVIEWED

2.9.1 Data collection/internal validity

2.9.2 Statistical methods

2.9.3 External validity

2.9.4 Summary

The level of evidence in the studies considered in this review has been assessed using the criteria devised by the US Preventative Services Task Force (1996, cited by Grimes and Schulz, 2002). These criteria are presented in table 2.1. Appendix 9 presents a summary of the levels of evidence in relation to the subjects considered in this review.

There is a lack of available work fulfilling the criteria for the higher levels of evidence except those where the efficacy of safety equipment has been evaluated and much of the work relating to the uptake of standard/universal precautions falls into category 111 i.e. descriptive studies. Lack of higher level evidence has been noted in the development of the *epic2* guidelines (Pratt *et al*, 2007) although a different classification system was used in the preparation of these guidelines, that devised by the Scottish Intercollegiate Guideline Network (SIGN, 2001).

2.9.1 Data collection

Methods of data collection

All methods for data collection have limitations that might have an adverse effect on the quality of the data (see chapter five) e.g. questionnaires often have low response rates (Burns and Grove, 1993; Polit and Beck, 2004; Bryman, 2008; Polit and Beck, 2008) and may yield superficial data (Polit and Beck, 2004), see chapter 3. The majority of studies discussed employed questionnaires including those by Williams *et al*, (1994); Cutter and Jordan (2003) Cutter and Jordan (2004); Nelsing *et al* (1997); Kim *et al* (1999) Chan *et al* (2002) and Trim *et al* (2003) as many of the factors under investigation could not be observed e.g. perception of risk. These could have been explored through interview, but this method was only occasionally employed (Lymer *at al*, 2004). Postal questionnaires, used by Nelsing *et al* (1997), Cutter and Jordan (2003, 2004) among others, have a notoriously low response rate (Burns and Grove 1993; Bryman, 2004; Polit and Beck, 2004). Nevertheless, the response rates in the studies reviewed were high, see appendix 8.

Direct observation was used in a small number of studies, for example, Williams *et al* (1994), Henry *et al* (1994), Madan *et al* (2001) and Akduman *et al* (1999). Direct observation may cause participants to be influenced by the presence of the researcher, i.e. the Hawthorne effect (Roethlisberger and Dickson, 1939). In an effort to overcome this possible bias, Henry *et al* (1994) followed up their period of observation with a survey of operating room personnel. Only one study utilised observation where the participants were unaware that they were being observed (Madan *et al*, 2001). Although the presence of the observer could not influence the results in this case, one must question the ethics of such a technique. Once again, the similarities in the results from all the studies suggest that the method of data collection had little or no effect on the results.

Studies incorporating more than one method of data collection may eliminate one or more of the limitations associated with individual data collection methods. For example, Wong *et al* (1998) utilized a circulating nurse to collect questionnaire data and perform visual observation of the operating room personnel to corroborate data included in the questionnaire, thus reducing the bias that could have occurred if relying solely on reports from the operating room personnel themselves. Lymer *et al* (1997) conducted a review of occupational injury reports in addition to a questionnaire survey to corroborate evidence from the questionnaires.

Truth telling

Many of the studies reviewed in this chapter rely on self-reported data (Nelsing *et al*, 1997; Folin *et al*, 2000; Chan *et al*, 2002; Cutter and Jordan, 2003; Cutter and Jordan, 2004 among others). Whereas it is unlikely that a deliberate attempt is made to deceive, self-reporting may lead to an inaccurate estimation of compliance Lynch and White, 1993; Folin *et al*, 2000; Smith *et al*, 2006a). This has also been identified in other areas of clinical practice (Wyatt *et al*, 1998). Therefore, corroboration of self-reported practice may be useful. However, it has been identified that discrepancies in the data may emerge when multiple data sets are available. These discrepancies require careful consideration and extensive knowledge of the research subject by the researcher (Bryman and Burgess, 1994). Observation, as used by Henry *et al* (1994) can overcome the problem of inaccurate self reporting (Jordan, 2000). However, in studies incorporating large numbers of participants or procedures, both interview and observation are usually prohibited by cost (Jordan, 2000) and time.

There is no way of knowing whether the respondents in any of the studies truly represent the behaviour and opinions of non-respondents (Murray, 1999; Bryman, 2008). However, the congruence of the findings from diverse settings would seem to indicate that these studies accurately reflect the level of compliance.

2.9.2 Statistical methods

Many of the studies reviewed have given detailed information in the published papers concerning the statistical tests used to determine significance (for example Knight and Bodsworth , 1998; Akduman *et al*, 1999; Chan *et al*, 2002; Stein *et al*, 2003; Trim *et al*, 2003; Cutter and Jordan, 2004; Sohn *et al*, 2004; Makary *et al*, 2006a; Tarantola *et al*, 2006). Where these tests are described in standard reference works, their suitability for analysis can be corroborated.

The statistical method used by some authors e.g. Bauer and Kenney in 1993 (Fischer z-test) is not available in standard reference works. An understanding of the statistical method used gives the reader an idea of the validity of the results, therefore, it is essential that published accounts are accurate, and that if unconventional methods are to be used, they are fully explained in the text.

The size of the study often restricted the statistical methods used during data analysis. Folin *et al* (2000) for example, were restricted to Fisher's Exact Test due to the low number of exposures recorded during the study period. The low number of exposures reported may have influenced the validity of the study and could have been improved by increasing the periods over which the study was conducted.

Unfortunately, in some of the other studies considered here, it is not possible to identify whether firstly any statistical analysis other than calculation of frequencies has taken place resulting in the analysis being at a descriptive level only; and secondly, whether any tests used were appropriate as no details concerning the methods were recorded in the published papers (for example, Brearley and Buist, 1989; Wong *et al*, 1998; Raghavendran *et al*, 2006; Abu-Gard *et al*, 2007). Therefore, their suitability for the study cannot be judged.

2.9.3 <u>External validity</u>

Sample size

The number of respondents or procedures examined in some of the studies considered in this chapter were low, for example Williams *et al*, 1994 (n=30), Folin *et al*, 2000 (13 reported injuries and 11 exposures) Madan *et al*, 2001 (12 resuscitations) which must cast some doubt over the external validity of the findings. Others, however, had larger sample sizes e.g. Ramsey *et al*, 1996 (n=306); Nelsing *et al*, 1997 (n=6005), Wong *et al*, 1998 (9795 operations); Rabaud *et al*, 2000 (n=964).

The level of agreement between the findings various studies suggests that sample size may not be crucial. For example Nelsing *et al* (1997), sample size 6005 and Williams *et al*, (1994), sample size 30, both found that lack of time to don protective clothing was a significant factor in whether universal precautions were adopted.

Response rate

Response rates in the studies reviewed are high, ranging from 55.1% - 72.5% with sample sizes of 30 - 6005 (Williams *et al,* 1994; Bauer and Kenney, 1993; Kim *et al,* 1999; Nelsing *et al,* 1997; Chan *et al*, 2002; Cutter and Jordan, 2003; Cutter and Jordan, 2004). All have demonstrated that compliance with universal precautions is poor (section 2.4).

Sample population

Some studies concentrated on single professions such as doctors (Nelsing *et al* 1997) or perinatal nurses (Bauer and Kenney 1993). Many others represented the behaviour of more than one professional group including nurses, surgeons, anaesthetists, technicians and medical students (e.g. Ippolito *et al,* 1993; Henry *et al,* 1994; Williams *et al*, 1994; Akduman *et al,* 1999; Cutter and Jordan 2003; Cutter and Jordan 2004). This indicates that the findings are likely to be generalisable and relevant to all healthcare personnel.

Clinical setting

The location of the studies contributes to their generalisability, and while many were conducted in single hospitals (e.g. Henry *et al*, 1994; Williams *et al,* 1994; Nelsing *et al,* 1997; Akduman *et al*, 1999; Chan *et al,* 2002), others were conducted in more than one site (e.g. Ippolito *et al,* 1993; Gershon *et al*, 1995; Cutter and Jordan, 2003; Cutter and Jordan, 2004). The results of studies conducted in single hospitals or NHS Trusts may be considered inapplicable in other settings because non-compliance may be due to individual hospital policies, procedures and working practices. However, the consistency in the results of these studies suggests that this is unimportant.

None of the studies reviewed were conducted in paediatric, mental health or learning disabilities units/departments. The clients cared for in these clinical areas have different needs which may increase the risk of some types of inoculation injury e.g. unpredictable movements during phlebotomy compared to those cared for in general, adult environments. Therefore, the findings of the studies considered here may not be applicable to these particular clinical environments.

Most of the studies included in the review related to operating departments. However, where the results could be applied to operating theatres, studies were included from other clinical areas. They included out-patient office (Freeman and Chapman, 1992); emergency room (Henry *et al,* 1994; Williams *et al,* 1994; Kelen *et al*, 1997; Kim *et al*, 1999; Madan *et al*, 2001; Madan *et al*, 2002;); maternity units (Bauer and Kenny 1993; Burke and Madan, 1997; Cutter and Jordan, 2003; Cutter and Jordan 2004); nursing schools (Rabaud *et al*, 2000), and general ward areas (Wong *et al*, 1991; Ronk and Girard, 1994; Ramsey *et al*, 1996; Jeffe *et al*, 1997; Knight and Bodsworth, 1998; Nelsing *et al* 1997; Chan *et al*, 2002; Stein *et al*, 2003; Trim *et al*, 2003). Whereas individually, these studies may lack generalisability to other clinical areas, collectively, the similarity of the generic findings regarding compliance means that the findings are probably applicable to most clinical areas.

Differing medical histories may lead to different exposure risks. Some of the hospitals in which the studies took place have an unusually high caseload of HIV positive patients (e.g. Gerberding *et al*, 1990; Freeman and Chambers, 1992; Knight and Bodsworth, 1998) which could reduce the generalisability of their findings to dissimilar settings. One could expect the personnel in such hospitals to be acutely aware of the need for adequate protection. Consequently, compliance with protective measures could be higher than in the majority of hospitals where there are fewer patients with known bloodborne viral infection.

Country

The similarity of the findings between international studies including those conducted in the UK (Scouler *et al*, 2000; Cutter and Jordan, 2003; Stein *et al*, 2003; Trim *et al*, 2003, Cutter and Jordan, 2004; Elder and Patterson, 2006; Raghavendran *et al*, 2006); Canada (Fisman *et al*, 2007) Australia (Knight and Bodsworth, 1998; Hunt and Murphy, 2004; Smith *et al*, 2006d); France (Tarantola *et al*, 2006; Lamontagne *et al*, 2007; Venier *et al*, 2007); Malaysia (Naing *et al*, 2001); Sweden (Leliopoulou *et al*, 1997; Lymer *et al*, 1997; Lymer *et al*, 2004); the USA (Gerberding *et al*, 1990; Henry *et al*, 1992; Williams *et al*, 1994; Jeffe *et al*, 1997; Jeffe *et al*, 1998; Kim *et al*, 1999; Madan *et al*, 2001; Madan *et al*, 2002; Fisman *et al*, 2007; Green-McKenzie and Shofer, 2007); Denmark (Nelsing *et al*, 1997); China (Huang *et al*, 2002); Hong Kong (Chan *et al*, 2002); Poland (Gańczak *et al*, 2006; Gańczak and Szych (2007); Taiwan (Shiao *et al*, 2001); Singapore (Ng *et al*, 2002) and Japan (Smith *et al*, 2006b) suggest that the findings can be applied to hospitals all over the developed world.

Timing of interventions

In the study conducted by Folin *et al* (2000), not only was the number of recorded injuries low (13 injuries and 11 contamination incidents), but the study is further limited by the fact that the post education study was conducted within 2 weeks of the first survey. It is therefore impossible to determine whether the fall in the number of exposures was due to increased awareness of the risk of injury or due to the change in practice. It is also impossible to determine whether any long term reduction was achieved. Nevertheless, the fact there was a statistically significant reduction in the number of adverse exposures following the introduction of safer working practices indicates that these techniques has the potential to be effective in reducing injuries.

The timing of the study may also have affected the results of the study by Wong *et al* (1998). The study was conducted following training sessions on the nature of the study, and this was found to affect the behaviour of some personnel before the start of the study and may have influenced the results. Participants also had experience of the author's pilot study that may also have influenced behaviour. Hunt and Murphy (2004) implemented an occupational exposure prevention programme within an Australian operating department during 2000 and 2001. Rates of exposure were reported for 1999, 2000 and 2001 and although the rate of exposure fell in 2000 and 2001, it is unclear when these assessments were made in relation to the programme.

Rates versus frequency

Most studies considering numbers of exposures to blood and body fluids report frequency in terms of absolute numbers (Gillen *et al*, 1993; Bell *et al*, 1997; CDC, 2001; EPINet, 2004a; EPINet, 2004b; Hunt and Murphy, 2004; Bakaeen *et al*, 2005; Gańczak and Szych, 2007 for example). However, presentation of data in this way does not allow comparisons and hence it is difficult to assess whether the results are generalisable to other clinical areas. For comparisons to be made, rates of exposure are necessary. Some authors (e.g Tokars *et al*, 1992; Ippolito *et al*, 1994; Gershon *et al*, 1995; Benitez *et al*, 1999; CNSSN, 2001; Puro *et al*, 2001; Alvarado-Ramy *et al*, 2002; Ng *et al*, 2002; Trim and Elliott, 2003; Hunt and Murphy, 2004; Sohn *et al*, 2004; Lamontagne *et al* , 2007) have attempted to calculate rates of exposure. Nevertheless, comparisons remain difficult as inconsistent denominators are used: the number of worked full time equivalents (Gershon *et al*, 1995); number of full-time personnel (Puro *et al*, 2001); rates per 10 000 healthcare workers (Trim and Elliott, 2003); per 100 000 hours worked (Benitez *et al*, 1999); number of injuries per procedure (Alvarado-Ramy *et al*, 2003); per 100 procedures (Hunt and Murphy, 2004); per 100,000 procedures (Lamontagne *et al*, 2007); number of injuries per 100 healthcare workers and per 100 000 devices used (Ippolito *et al*, 1994; Ng *et al*, 2002; Sohn *et al*, 2004); number per 100 FTEs, 100 bed days, 100 patient days and 100 patient admissions (CNSSN, 2001). In addition, comparisons are made difficult by differing research methodologies and time scales (Trim and Elliott, 2003).

Calculation of rates using a consistent denominator is essential if health care providers are to compare their rates with similar health care institutions and benchmark to encourage best practice. "An acceptable standardised method for evaluation should be agreed and introduced nationally to allow comparison and collation of local and national data" (Trim and Elliott, 2003 page 241). However, the resources and expertise required for collection and analysis of multi-institutional surveillance data is considerable and must not be under-estimated (Doebbeling, 2003).

2.10 CONCLUSIONS TO CHAPTER TWO

The studies reviewed in this chapter vary in terms of sample size, sample population, location, methods of data collection and methods of statistical analysis that could affect the validity and generalisability of the findings. However, despite the different research methods used, there is a high level of agreement between the findings of all the studies reviewed.

Several studies included in this review have shown weaknesses that may have placed their findings in doubt, for example sample size and method of analysis. However, the degree of consistency between these and others which employed a larger sample from a diverse range of clinical settings suggests that the results from all the studies considered are valid.

The factors which affect compliance with universal/standard precautions and reporting procedures are varied and improving compliance is less than straightforward. However, adverse exposure to blood and body fluids is known to have caused occupational acquisition of blood borne viral infections whereas appropriate treatment is known to significantly reduce this risk.

It is now over twenty years since universal precautions were introduced in the United States and 13 years since the introduction of standard precautions. It is inevitable that there will be a time lag between the introduction of new methods of work and full implementation. However, little progress seems to have been made, with studies carried out in the 2000s showing similar results to those from late in the 1980s, i.e. that these precautions are not routinely adopted and that HCPs often fail to report inoculation injuries.

Using the evidence gained from the literature review, a study was designed to elicit what factors affect the measures adopted by surgeons and scrub nurses to reduce the risk of percutaneous and mucocutaneous exposure to blood and body fluids and whether such exposures are reported. The study will be carried out in the operating departments of selected acute, non-teaching NHS Trusts in Wales. Chapter three describes the methods used in the study.

CHAPTER THREE

THE METHODS EMPLOYED

3.1 INTRODUCTION TO CHAPTER THREE

This study examined factors affecting, sustaining and reporting percutaneous and mucocutaneous exposure to blood and body fluids among selected surgeons and scrub nurses in six acute NHS trusts within NHS trusts in Wales. The purpose was to identify areas where practices were unsafe and use this information to suggest how educational initiatives may be directed to the needs of the staff, improve compliance with current guidelines and achieve a reduction in risk of exposure to blood and body fluids. Consequently, the study has a practical aim and intends to bring clinical benefits in terms of improved patient and clinician safety.

The critical issue in research is the awareness of the pertinence of particular methods and combinations of methods required to explore each individual issue to ensure the validity of the design and results (Bryman, 1988; Nicoll and Beyea, 1997). It is recognised that all research methods have flaws, and adopting a single method may involve exchanging deficiencies in one area for gains in another. Therefore, in order to achieve a high degree of validity it may be necessary to approach the study with a range of appropriate methods (Burgess 1984). Consequently, this study has adopted some degree of triangulation, achieving collection of both qualitative and quantitative data. The methods utilised were chosen to meet the needs of the study. The following methods were adopted:

1. Surgeons and scrub nurses were asked to complete a questionnaire survey describing their practices in relation to standard/universal precautions and sustaining and reporting inoculation injuries. This approach has been taken by other authors including Ronk and Girard (1994), Ramsey *et al* (1996), Burke and Madan (1997), Haiduven *et al* (1999) and Cutter and Jordan (2003, 2004).
2. Sixteen participants were selected for face to face semi-structured interviews. The qualitative (interview) data was used to add depth and explanation of the quantitative (questionnaire) data in relation to non-compliance with current guidelines and policies.
3. The senior Infection Control Nurse at each participating Trust was asked to take part in a telephone interview concerning provision and attendance at training sessions relating to standard/universal precautions and inoculation injury reporting. These interviews were intended to confirm whether provision of education and training contributed to compliance with guidelines and policies and whether reported attendance by individual professions corresponded to actual attendance.

3.2 THE NATURE OF THE STUDY

This was a mixed methods study. Firstly, an exploratory, cross-sectional survey was conducted, level I in Brink and Wood's taxonomy (Brink and Wood, 1989). Descriptive studies are often the first venture into new areas of study (Brink and Wood, 1989; Grimes and Schulz, 2002) and are intended to provide information on how many of a given sample holds certain opinions. Similarly, information on how certain events and characteristics are associated with each other can be obtained from descriptive surveys (Oppenheim, 1992). Polit and Beck (2004) describe the purpose of descriptive studies as "to observe, describe and document aspects of a situation as it naturally occurs and sometimes to serve as a starting point for hypothesis generation or theory development" (p192). Parahoo (2006) describes descriptive studies as correlational studies. The point of a descriptive correlational study, according to Polit and Beck (2004) is to "describe the relationship between variables" (p192) without attributing causation. However, they cannot be used to demonstrate cause and effect (Grimes and Schulz, 2001; Bowling, 2009). This has led to criticism of descriptive studies (Oppenheim, 1992).

This study aimed to identify the factors contributing to percutaneous and mucocutaneous exposure to blood and body fluids among HCPs who perform exposure prone procedures in the operating theatre and the factors influencing reporting of such exposures. An assessment of associations between the variables was essential to meet these aims. Therefore, the study did not employ an entirely descriptive approach in that some variables were explored with inferential statistical techniques. Consequently, this study went beyond the purely descriptive. It can also be termed cross-sectional as it aimed to determine both exposures and outcomes simultaneously (Grimes and Schulz, 2001). Cross sectional studies are retrospective and report past as well as current behaviours and attitudes (Bowling, 2009). Once again, they cannot be used to establish causality. Consequently, descriptive cross sectional studies are termed observational research because phenomena cannot be tested. Rather, they are observed and no interventions are carried out by the researcher (Mann, 2003).

The study therefore, fulfils Brink and Wood's (1989) description of a level II study i.e. one that describes the relationship between topics never previously studied together to examine the proposition that two variables are related, with reference to statistical analysis, for example the relationship between reporting injuries and believing them to be an occupational hazard.

In addition to the closed questions, space was provided for free text in two of the questions, allowing respondents to offer their own explanations for their behaviour. Oppenheim (1992) describes surveys resulting in an "analysis of causality" as those with an analytical design. Consequently, this part of the study could be described as an exploratory cross sectional survey with comparative and analytical components.

The survey could not fully provide an understanding of what factors influence the actions of the surgeons and scrub nurses. Therefore, following data analysis of the questionnaire data, face to face interviews with a purposive sample of 16 participants were conducted to further explore reasons for their behaviour. Interviews are also useful to access individuals' evaluations, attitudes, interpretations and understandings where situations cannot be directly observed, (Murphy *et al*, 1998) and were therefore useful in this study as observation of practices in the operating theatre is fraught with ethical and practical difficulties (see section 3.3.3).

3.3 DATA COLLECTION

In order to adopt the most appropriate method of data collection for this study, consideration was given to the following data collection methods:

- Postal self administered questionnaire survey;
- Interviews;
- Observation.

In the event, observation was not used to gather data for this study.

3.3.1 The methods employed

A combination of methods was considered the most appropriate way of collecting the data required to answer the research question. A discussion of the limitations of the data collection methods is presented in chapter five.

The questionnaire survey

A survey was undertaken to:

1. Describe the frequency of inoculation injuries in the operating theatres of the participating NHS Trusts and proportion reported, and
2. Explore the relationships between the occurrence and reporting of inoculation injuries (the dependent variables) and independent variables such as profession, length of time since qualification and adoption of standard/universal precautions.

When designing a questionnaire it is essential to consider the information required so that the questions relate to the study objectives (Burns and Grove, 1997). All questions must be appropriate and unambiguous, as there is no opportunity to explain the meaning to the subject, add more questions or invite further comments as during an interview. The fact that there is no interviewer present to create a rapport with respondents means that the questionnaire itself has to keep respondents motivated rather than encouragement from a third person (Oppenheim, 1992). There must be enough questions to elicit the information required without increasing the length of the questionnaire to a level that will discourage responses.

The questionnaire was developed following a review of literature and key studies on standard/universal precautions and inoculation injuries and was designed to explore the proportion of respondents complying with standard/universal precautions, sustaining inoculation injuries and reporting such injuries. The factors affecting compliance and reporting were explored by closed and open questions. Questionnaires were accompanied by an introductory letter (appendix 4), a copy of the approval letter from the All Wales Research Ethics Committee (appendix 7) a copy of the approval letter from the Research and Development Committee at the relevant trust.

No standard validated questionnaire was available to collect the data that was required for this study. A non-validated questionnaire could be considered to be questionable in terms of reliability and validity (Rudestam and Newton, 2001). Therefore, in an effort to increase validity by utilising questions previously used in validated studies, authors of previous studies were contacted and asked if they would provide copies of their questionnaires and give permission for these to be used in the study. Full acknowledgement was promised to the authors of the questionnaires in the dissertation and any resulting publications. However, only two authors did so, to whom written thanks were extended, but unfortunately none of the questions proved suitable either in their entirety or in part as none focussed on the exact same issues as this study. It was possible though to use some questions used in previous work by the author of this thesis to increase reliability and validity.

In addition to questions relating to demographic information (1–4), questions 5, 13 and 15 were incorporated into the questionnaire because not only had they been used in a previous study, but had also been subjected to double blind peer review on two occasions when submitting for publication (Cutter and Jordan, 2003, 2004). Question 11 incorporated the themes explored during the EPINet study (2003a and 2003b) and consequently contributes to content validity. Not only did this contribute to the validity and reliability of the questionnaire, it allowed direct comparisons to be made with other studies (Bryman, 2008).

Questions 2, 3 and 6 asked for responses related to length of time qualified, in present position and number of inoculation injuries within specified time spans. These periods are important and may influence uptake of precautions and frequency of subsequent injuries. In question 2, nurses who had been qualified <1 year were assumed to be undergoing a period of mentorship for newly qualified nurses. No doctors included in the study would be undergoing any similar mentorship as only the grades of registrar to consultant were included. The periods between 0 and 5 years after qualification are key milestones in the transition from nursing novice to expert (Benner, 1984). Universal precautions were introduced into healthcare in 1987, therefore, it is reasonable to assume that those who had completed their undergraduate or pre-registration training before this time may not have been trained in their use as students and this may have influenced knowledge and/or compliance

Advantages of surveys

- Surveys are useful when a researcher wishes to consider knowledge, behaviour and attitudes (Passmore *et al*, 2002; Bowling, 2009). Structured questions can be used to collect unambiguous data that lends itself well to data analysis using computerized statistical packages (Bowling, 2009) and are therefore suited to areas where little research exists such as infection control.
- Surveys tend to concentrate on "data more than theory" (Denscombe, 2003, p27) and lend themselves to the collection of empirical, quantitative data that can be subjected to statistical analysis (Denscombe, 2003) and are important in exploring relationships such as that between profession/time qualified/surgeons'speciality and adoption of standard/universal precautions/reporting.
- Use of a self administered postal questionnaire allows distribution to a large number of geographically spread participants easily (Oppenheim, 1992; Guiffre, 1997; Polit and Beck, 2004; Bryman, 2008; Bowling, 2009) while minimizing the social desirability and interview response (Bowling, 2009). In addition, the cost of other data collection methods i.e. interview and observation are avoided (Denscombe, 2003; Bryman, 2008) and results can be achieved over a relatively short time span (Denscombe, 2003). Consequently, data collection by survey was the only suitable strategy for this study in which approximately 700 healthcare professionals in 10 hospitals in six NHS Trusts were included.
- As participants may assume that anonymity is more likely to be assured in a postal survey than with other methods of data collection, it may produce information that is more truthful, albeit less socially desirable (Guiffre, 1997). Respondents may be more prepared to discuss their prejudices related to sex, race, risk of HIV etc than during face to face interviews (Guiffre, 1997). However, guarantees of anonymity may not be sufficient to allay fears of some respondents where numbers of potential

respondents is low, e.g. small numbers of surgeons within one given speciality. Therefore, these were excluded.

- Interviewer bias is less of a problem with questionnaires than other methods of data collection, such as face to face interviews and direct or participant observation (Oppenheim, 1992; Bowling, 2009) as the use of a questionnaire offers respondents some degree of freedom in their answers without fear of judgment by the researcher. They may therefore, be less likely to exhibit social desirability bias (Bryman, 2008) which is important during disclosure of sub-optimal practice such as failure to follow standard/universal precautions.
- Questionnaires are more convenient for the respondents as they can be completed when they want (Bryman, 2008) and take less of their time.

Despite the possible threats to validity and reliability the questionnaire was retained as the method for collecting the quantitative data required for the study for the following reasons:

- The questionnaire comprised mainly closed questions requiring the respondent to tick the appropriate box(es) (appendix 1, questions 1, 5-14) or insert a short answer (questions 2, 3 and 4). This format gives respondents a structured way to answer the question, is easily understood and quick to complete and provides data which are easily understood and analysed, of uniform length and comparable (Oppenheim, 1992; Passmore *et al*, 2002; Denscombe, 2003; Hall and Hall, 2004; Bryman, 2008). Data generated by this method are categorical and are therefore, suitable for using non-parametric statistical tests (Boynton and Greenhalgh, 2004). However, they don't allow for spontaneity or expression and the inclusion of list of fixed responses from which to choose may introduce bias (Oppenheim, 1992).
- Question 5, 7 and 15 (see appendix 1) incorporated both semi-structured and structured questioning techniques. Firstly, participants were asked to follow a structured format using the pre-coded response sets and then asked to add individual comments to provide more comprehensive and rich data. Where premature closure might have curtailed the responses, space for free text was included. This was also deemed necessary in both these questions and in question

16 to allow participants to suggest strategies that they felt could contribute towards reducing inoculation injuries and increasing reporting. These open questions allowed each participant the opportunity to respond in greater depth than with standardised closed questions, provides richness, describes the complexity of the respondent's views and reduces limitation of responses (Oppenheim, 1992; Passmore *et al*, 2002; Denscombe, 2003; Bryman, 2008). Furthermore, they allow for unusual answers that the researcher may not have considered including in a standardised closed question (Bryman, 2008).

- Questions 7 and 15 utilise a five point Likert -type scale to measure attitude and generates ordinal data that can be subject to non-parametric statistical tests (Boynton and Greenhalgh, 2004). Distance between the points on the five-point scale ranging from very likely to very unlikely cannot be quantified. However, using this type of scale, it is acceptable to treat the scale as if it was based on equal intervals, thereby treating ordinal data as interval data, which allows parametric statistical tests to be carried out where the data are normally distributed (Knapp, 1990; Banks, 1999a, 1999b; Bryman and Cramer, 2001). The scale allowed degrees of opinion to be expressed and an odd number of points allows a neutral opinion to be expressed (Passmore *et al,* 2002; Hall and Hall, 2004) and allows fine distinctions to be made between individual's points of view (Polit and Beck, 2004). Ease of analysis is an important consideration, and because the use of structured questionnaires leads to relatively simple data collection and analysis (Bowling, 2009), this type of question was used extensively. Many of the questions were structured using a response set that included a prescribed list of responses from which the respondents could choose. Each variable was set up as a field to aid analysis of the quantitative data using the Statistical Package for the Social Sciences (SPSS), for Windows, version 13. Where numbers of responses to various points on the scales were low, categories were collapsed when appropriate to facilitate statistical analysis
- Question 16 allowed space for free text and gave participants the opportunity to express opinions related to the questionnaire or reducing inoculation injuries and improving their reporting.

Each question on the questionnaire related to the study's objectives, see table 3.1.

Table 3.1: Questionnaire survey - relationship between objectives, questions and current literature.

Objective	Question	Literature and key studies
1. To assess the frequency of and the circumstances surrounding inoculation injuries in the 1 and 5 years prior to the study among health care professionals undertaking exposure prone procedures in operating departments in Welsh hospitals.	1,2,3,4,5,6 and 7	Alvarado-Ramy *et al*, 2003 Bell *et al*, 1997 Cardo *et al*, 1997 CDC, 2001 CNSSN, 2001 Cutter and Jordan, 2004 English, 1992 EPINet 2003a, 2003b Gershon *et al*, 2000a Gillen *et al*, 2003 Green *et al*, 1998 Holodnick and Barkausas, 2000 Ippolito *et al*, 1993 Ippolito *et al*, 1994 Jagger and Balon, 1997 Jagger *et al*, 1988 Ling *et al*, 2000 Lymer *et al*, 1997 Perry, 1998 Phipps *et al*, 2002 Puro *et al*, 2001 Quebbeman *et al*, 1990 Rabaud *et al*, 2000 Benitez *et al*, 1999 Shaio *et al*, 2002 Stein *et al*, 2003 Tokars *et al*, 1992 Trim and Elliot, 2003
2. To determine the relationship between compliance with universal precautions and inoculation injuries.	8	Beekmann *et al*, 1994 Bell and Clement, 1991 Brearley and Buist, 1989 Bryce, 1998 Dodds *et al*, 1988 Folin *et al*, 2000 Gerberding *et al*, 1990 Green and Gompertz, 1992 Hartley *et al*, 1996 Jagger and Balon, 1997 Knight and Bodsworth, 1998

		Leliopoulou *et al*, 1999 Lymer *et al*, 1997 Mast *et al*, 1993 Mingoli *et al*, 1996 OSHA, 1999 Short Life Working Group on needlestick injuries in the NHSScotland, 2001 Smith and Grant, 1990 UK Health Departments, 1998 Wigmore and Rainier, 1994 Wong *et al*, 1991 Wong *et al*, 1998
3. To assess the proportion of these injuries that is reported.	10	Alvarado-Ramy *et al*, 2003 Burke and Madan, 1997 Cutter and Jordan, 2003, 2004 Haiduven *et al*, 1999 Hettiaratchy *et al*, 1998 Lymer et al, 1997 Patterson *et al*, 1998 Ramsey and Glenn, 1996 Benitez *et al*, 1999 Shiao *et al*, 1999
4. To explore the reasons for under-reporting of inoculation injuries.	9,11,12 and 13 and interview	Alvarado-Ramy *et al*, 2003 Burke and Madan, 1997 Choudhury and Cleator, 1992 Cutter and Jordan, 2003, 2004 EPINet 2003a, 2003b Haiduven *et al*, 1999 Hettiaratchy *et al*, 1998 Kirkpatrick *et al*, 1993 Lymer *et al*, 1997 Lynch and White, 1993 Mangione *et al*, 1991 Manian, 1996 Phipps *et al*, 2001 Benitez *et al*, 1999 Shiao *et al*, 1999 Sullivan *et al*, 2000 Trim *et al*, 2003 Waterman *et al*, 1994 Williams *et al*, 1994
5. To explore healthcare professionals views of their personal risks and adoption of guidelines/protocols on	Interview	See table 3.2

universal precautions and inoculation injury reporting.		

Improving response rates

Despite the advantages of surveys, one of the major limitations is that of low response rate. This is discussed further in section 5.2.6. Bearing in mind the consideration that non response may create bias, every attempt was made to achieve as high a response rate as possible. Edwards *et al* (2002) conducted a systematic review of randomised control trials to identify the factors that increased response rates to postal questionnaire surveys. This review identified that the following strategies could increase response rates:

- Incentives (odds ratio (OR) 2.02; 95% Confidence Interval (CI) 1.79 to 2.27). Although evidence suggests that the sum need not be particularly large (Oppenheim, 1992; Bryman, 2008), monetary incentives were not used in this study because of lack of resources.
- Length of questionnaire (OR 1.86, 95% CI.1.55 to 2.24). Long questionnaires may deter respondents from answering all the questions (Bryman, 2008) and a difficult balance exists between the need to obtain as much relevant information as possible and compiling a questionnaire which deters potential respondents from participating in the study because of its length. The questionnaire filled almost 4 sides of A4 paper and included 16 questions. It has been suggested that long questionnaires may deter some potential participants from completing them (McColl *et al*, 2001; Denscombe, 2003). However, when conducting a questionnaire survey, the researcher has only one opportunity to collect the information required and so sufficient questions must be asked to provide a reasonable amount of data. However, short questionnaires have been used to collect useful data, notably, the study into the smoking habits of General Practitioners in the UK (Doll and Peto, 1976). Determining what constitutes a long questionnaire is controversial (McColl *et al*, 2001). It may be that perceived importance or interest in the subject of the questionnaire is more important than length with those with strong opinions on the topic being more likely to participate (Sudman and Bradburn, 1982). Should participants become fatigued or bored towards the end of the questionnaire, it is possible that they may become

careless, particularly in respect to questions in the latter part of the questionnaire (Sudman and Bradburn, 1982). Although short questionnaires tend to achieve better response rates than long ones, this tends to be less of an issue if respondents are interested in the topic under consideration (Oppenheim, 1992; Bryman, 2008). The topic of this study should have been of interest to all potential respondents.

- Making letters and questionnaires personal (OR 1.16, 95% CI 1.06 to 1.28). As the researcher is absent when respondents complete postal questionnaires, clear instructions are required (Boynton and Greenhalgh, 2004; Bryman, 2008). A personalised introductory letter (appendix 4) accompanied each questionnaire (except in the two trusts where the researcher did not know the names of potential respondents) which, according to Oppenheim (1992, p104) "has a better chance of being opened and read if it is addressed to the respondent personally, if it has a stamp on it (that is, not commercially franked)". The letter included not only brief details of the study and researcher, but reassurance of confidentiality. Copies of the letters of approval from the All Wales Multi-Centre research Ethics Committee (MREC) and the individual Research and Development Committees of each participating Trust were also included to reassure potential participants that permission had been given.
- Recorded delivery (OR 2.21, 95% CI 1.51 to 3.25). This was rejected due to financial constraints.
- Stamp addressed return envelope included (OR 1.26, 95% CI 1.13 to 1.41). All participants were sent an addressed freepost envelope in which to return completed questionnaires, but a stamp was not included. Although the inclusion of a stamp addressed envelop may indicate a level of trust that the respondent will not attempt to 'steal' the stamp (Oppenheim, 1992), the researcher used her employer's freepost address to reduce cost as postage only had to be paid on those questionnaires that were returned .
- Questionnaires sent by first class post (OR 1.12, 95% CI 1.02 to 1.23) – all questionnaires in this study were sent by first class post.

- Contacting participants before sending questionnaires (OR 1.54, 95% CI 1.24 to 1.92). This was rejected because of the increased cost of sending an extra communication.
- Follow up contact (OR 1.44, 95% CI 1.22 to 1.70). Four weeks after the first mailing, a second questionnaire and covering letter was sent to non-responders, and 4 weeks later a third mail-shot was sent to those who failed to respond to the second request. In trusts 3 and 4 where they agreed to participate, but were unwilling to reveal the names of surgeons and scrub nurses, letters and questionnaires were sent to non-responders via the General Manager of the Clinical Governance Directorate and the operating theatre manager respectively. Although more costly in terms of stationery and postage, this allowed non-responders to be contacted without breaching the hospitals rules on confidentiality.

Other factors have also been identified that may contribute to non-response:

- Question order - Demographic questions were listed at the beginning of the questionnaire. These questions are considered non-threatening questions that will encourage respondents to participate (Passmore *et al*, 2002). However, Boynton and Greenhalgh (2004) consider that such questions may be perceived as "sensitive and upsetting" (p1434) and should therefore be included at the end of the questionnaire. Similarly, Bowling (2009) suggests that questions related to demographic data, when included near the start of a questionnaire might impair the flow of the questionnaire and deter some individuals from completing the questionnaire if they perceive these questions as sensitive. Nevertheless, this study included demographic questions at the beginning of the questionnaire as they related to professional demographics e.g. profession, length of time qualified rather than more sensitive issues such as sexual orientation or income. Questions which participants may have perceived as invasive or personal e.g. relating to breaches of trust guidelines, non-compliance with policy were placed later in the questionnaire. "By that time, the subject is feeling comfortable and familiar with the survey format and is more likely to respond honestly" (Passmore *et al*, 2002, p285). Questions were grouped into subjects to add clarity and assist respondents' thought processes (Passmore *et al*, 2002). A "funnel" approach was used (Oppenheim, 1992) starting with broad questions for all respondents and narrowing the focus by use of "filter" questions (Oppenheim, 1992) to those who had experienced an inoculation injury.

- The appearance of the questionnaire - A questionnaire that appears cluttered or crowded may discourage respondents (Sudman and Bradburn, 1982; Polit and Beck, 2008) while questionnaires utilising a simple design and clear layout have been shown to increase response rates (Puleo *et al*, 2002). Denscombe (2003) suggests that respondents find it easier to complete questionnaire printed on one side of each sheet rather than to fold back each page to complete both sides. Therefore, the questionnaire was printed on one side of the paper only for clarity, despite the fact that this increased the cost of stationery. Although individual questions were numbered, pages were also numbered sequentially. A balance had to be struck between devising a questionnaire with sufficiently large print to be clear, allowing sufficient space for answers and devising a questionnaire that did not appear too lengthy as it has been suggested that the longer the questionnaire, the lower the response rate (McColl *et al*, 2001). However, determining what constitutes a long questionnaire is controversial (McColl *et al*, 2001). All sections on the questionnaire were printed in Times New Roman, size 12 font thereby achieving a "relatively 'conservative' but pleasant appearance" (Oppenheim, 1992, p105).
- Anonymity and confidentiality – confidentiality was assured and only the researcher and academic supervisor had access to the data and subsequent publication of the results contained no identifying information. Anonymity could not be guaranteed, (with the exception of trusts 3 and 4) because contact names and addresses were required for contact and re-contact although anonymity may well have increased the response rate (Oppenheim, 1992). However, only the researcher had access to the codes used to identify respondents and it was considered more likely that sacrificing anonymity for the ability to contact and re-contact respondents personally would have a beneficial effect on response rate.

- Third party administration of questionnaires in trust 3 may have adversely affected the response rate (Hall and Hall, 2004) as potential respondents may have had concerns regarding confidentiality when returning questionnaires to an employee of their own trust. However, a compromise had to be made between losing all respondents from these two hospitals and losing some because of these concerns.
- Clear instructions on how to respond – where questions offered the choice of more than one answer, respondents were given clear instructions e.g. "please tick as many boxes as apply" (Bryman, 2008).
- Barriball and While (1999) acknowledge that some respondents may be reluctant to answer questions on certain topics whether or not the topic appears particularly sensitive. Therefore, although every effort was made to ensure that questions were not overly sensitive or personal through rigorous piloting, there can be no guarantee that each respondent felt comfortable answering all questions. Incomplete questionnaires adversely affect external validity.

Face to face interviews

Advantages of interviews

- Interviews are particularly useful when participants are required to provide detailed information on a given phenomenon e.g. reasons why surgeons fail to double glove routinely. Participants can voice their views without being restricted by a questionnaire and can therefore respond with "richness and spontaneity" (Oppenheim, 1992, p81).
- Interviews offer the opportunity to provide the respondent with a more detailed explanation of the study than can often be accomplished in an introductory letter or information leaflet (Oppenheim, 1992) and offer the opportunity to explain or clarify ambiguous questions (Polit and Beck, 2004), thus reducing misinterpretation or misunderstanding. Interviews also offer the opportunity for the researcher to probe and clarify the data (Guiffre, 1997) e.g. on circumstances contributing to inoculation injury.

- Data associated with feelings, emotions and experiences need to be explored and are therefore well suited to collection during interviews. Similarly, when data relates to sensitive issues e.g. non-compliance with policies, bias based on value judgments related to sexuality, nationality, risk of bloodborne viral infection, interviews are useful (Denscombe, 2003). Interviews can be particularly successful in revealing true feelings if the interviewer is perceived as sympathetic (Guiffre, 1997).
- Response rates are high compared to other data collection methods (Oppenheim, 1992; Polit and Beck, 2004). A well structured interview may achieve a response rate of around 90% (Denscombe, 2003; Polit and Beck, 2004). However, in this study only 16 of 110 who were requested to take part in the interviews responded (14.5%).
- Questions are usually answered in the order the researcher intends (Polit and Beck, 2004; Bryman, 2008).
- During face to face interviews, and to a lesser extent, telephone interviews, the researcher can be sure that the interviewee is the intended respondent (Polit and Beck, 2004).

Between May 14th and August 8th 2008, 110 letters were sent to those who had completed questionnaires inviting them to participate in a semi-structured interview (appendix 10). Potential interviewees were purposively selected either because they had indicated on the questionnaire a high level of compliance with precautions or guidelines or they had sustained large number of inoculation injuries and/or shown disregard for standard precautions or guidelines. In four trusts, respondents were contacted directly. As Trust 3 would not provide the names and workplace address of either surgeons or scrub nurses, invitations to be interviewed were issued via a theatre manager. No surgeons and scrub nurses agreed to be interviewed, although a theatre manager, who was also a scrub nurse was interviewed from this trust. In trust 4, only surgeons were contacted directly by the researcher, scrub nurses were contacted via the theatre manager. All questionnaires were coded to allow for re-contact. However, during the period of time between completing the questionnaire survey and commencing the interviews, the theatre manager had destroyed the codes allocated to the nurses. Therefore, it was impossible to 'marry up' the interview transcripts with the questionnaires for these nurses. However, all the interviewees had completed questionnaires.

All letters were accompanied by information sheets (appendix 5) and two copies of the consent form (appendix 6) one of which was retained by the interviewee and one returned to the interviewer. Pre paid envelopes were included for replies to be sent to the researcher. Twenty two respondents replied to the invitations, eighteen indicating a willingness to be interviewed and four declining the invitation, one of them had recently retired. Of those who were happy to be interviewed, two were not included, one because the signature and handwriting on the consent form was illegible and the respondent could not therefore be contacted and one who did not respond to requests for an appointment. In addition, two further replies were sent from secretarial staff indicating that the intended recipients of the letters were no longer employed by the organisation and could not be contacted.

In this study, the purpose of the interviews was clear, i.e. to improve the richness of data surrounding behaviour in the operating theatre and inclusion of interviews in the data collection process was used to contribute to the understanding of the concepts under consideration thereby gaining an emic perspective i.e. gaining an impartial view of the participants world (Carter and Henderson, 2005). Furthermore, interviews allowed the interviewees to provide a narrative concerning their experiences that was not constrained by necessarily rigid nature of the questionnaire. Such qualitative data contextualizes the evaluation and improves the generalisability of the findings (Murphy *et al*, 1998).

A semi-structured approach was used which utilized an interview schedule (appendix 2). Despite the fact that unstructured interviews may be considered to provide more depth and detail than semi-structured interviews (Gibson, 1998) the semi-structured approach ensured that all interviewees discussed the same topics, while responding in their own words, using as much or as little detail as they wished. They also allowed the researcher to probe to provide more detail or improve clarity (Polit and Beck, 2004; Carter and Henderson, 2005). The interview schedule contained an agenda of questions which are developed in the course of a conversation allowing for the emergence of novel findings from the perspective of those studied (Wragg, 1978; Bryman, 1988) and hence this type of interview can be described as a "conversation with a purpose" (Burgess, 1984). However, viewing an interview simply as a conversation may lead to complacency concerning the complexity of this method of data collection. In reality, interviews require detailed planning, preparation and practice (Bell, 1987) as they involve mutual understandings and assumptions between interviewer and interviewee not required during 'normal' conversation including:

- Informed consent is required;
- The interviewees words are treated as "on the record" and as such are to be taken seriously even if not intended to be so by the interviewee;
- The agenda is set by the researcher (Denscombe, 2003).

After reiterating the aim of the research, the confidential nature of the interview session and the purpose of the interview (Carter and Henderson, 2005) the interview incorporated relatively closed introductory questions i.e. biographical details to establish rapport. Unless rapport can be established, some respondents may decide to terminate an interview early or change their mind about being interviewed (Bryman, 2008).

Understanding and depth of response were achieved by open-ended questions, for example: "Can you please describe the inoculation injuries that you can best remember" and "To what extent do you consider yourself to be at risk from bloodborne viral infection resulting from such injuries?" The flexibility of interviews allows open-ended questions resulting in unanticipated answers, which suggested relationships previously unconsidered by the researcher. This allows the interviewee to develop ideas and elaborate on the issues under discussion (Denscombe, 2003). Therefore, the interviewer must be prepared to demonstrate a degree of flexibility during the interview and accept that she must occasionally move away from the agenda albeit within available time constraints.

Specific prompts and recapitulation were given as needed, to seek the information required for the research. However, every attempt was made to keep the wording of the questions fairly constant as it has been found that even small variations in wording can impact on replies (Schuman and Presser, 1981). Question order was kept the same for all respondents as far as possible to prevent accidental omissions and variation in question order that may affect the responses given (Bryman, 2008) (see appendix 2).
The human memory is fallible (Denscombe, 2003). Consequently, failure to record replies accurately can result in inaccurate representation of the respondents' replies and the introduction of error (Bryman, 2008). Therefore, interviews were audio-taped and transcribed, with the consent of the participant. Silverman (2001, p 162) identified three benefits of taping interviews:

1. "Tapes are a public record.
2. Tapes can be replayed and transcripts improved.
3. Tapes preserve sequences of talk."

Taping also allows for audit and authentication by the research supervisor. However, tape recording does not record non-verbal cues, movement and other contextual factors (Denscombe, 2003). Therefore, during and after the interviews field notes were made. Long-hand notes ensured that the interviewer was kept in touch with the data and enhanced the interviewers' understanding.

The interviews were conducted on a one to one basis between the researcher and the interviewee. While alternative approaches such as the use of joint interviews have advantages in terms of cost and time savings (Polit and Beck, 2008) and have been shown to provide data of a similar quality to individual interviews (Kidd and Parshall, 2000) the geographical location of the participants precluded these approaches. The interviews took place in a location specified by the interviewee.

Although interviews have been used in studies relating to factors influencing the occurrence and reporting of other adverse incidents in the operating theatre (Williams, 2002; McDonald *et al*, 2005; Undre *et al*, 2006; Nestel and Kidd, 2006), utilisation of a semi-structured interview for collecting data in relation to compliance with universal/standard precautions and sustaining and reporting inoculation injuries is unusual (see chapter 2 and appendix 2). Therefore, currently individual narrative accounts of healthcare professionals' experiences and viewpoints are not available. This study will help to fill this gap in current available knowledge.

Those chosen to be interviewed were the HCPs whose answers in the survey suggested extreme views or behaviour, for example, those who had experienced a comparatively high or low frequency of inoculation injuries and those who consistently refused to adopt local policies.

Authors of the few studies that have incorporated interviews have commented on the level of detail that can be revealed through the interview process and therefore justified the choice of including this data collection method (Jagger *et al*, 1988).

Exemplar

In 1988, Jagger *et al* conducted structured interviews with the healthcare personnel who had reported 326 needlestick injuries to the employee health department in the University of Virginia Hospitals between January 1st – October 31st 1986. The interview allowed "a detailed description of each incident" to be recorded (Jagger *et al*, 1988, p 284) and encouraged participants to be spontaneous, for example in relation to reporting reasons for undertaking a contra-indicated procedure i.e. re-capping needles.

Each question in the semi- structured interview also related to the study's objectives, see table 3.2.

Table 3.2: Semi structured interview - relationship between objectives, questions and current literature.

Objective	Question	Literature and key questions	Results
1. To assess the frequency of and the circumstances surrounding inoculation injuries in the 1 and 5 years prior to the study among health care professionals undertaking exposure prone procedures in operating departments in Welsh hospitals.	2. Frequency of injuries/reporting	Alvarado-Ramy *et al*, 2003 Bell *et al*, 1997 Cardo *et al*, 1997 Cutter and Jordan, 2004 English, 1992 Gershon *et al*, 2000a Gillen *et al*, 2003 Green *et al*, 1998 Holodnick and Barkausas, 2000 Ippolito *et al*, 1993 Ippolito *et al*, 1994 Jagger and Balon, 1997 Jagger *et al*, 1988 Ling *et al*, 2000 Lymer *et al*, 1997 Perry, 1998 Phipps *et al*, 2002 Puro *et al*, 2001 Quebbeman *et al*, 1990 Rabaud *et al*, 2000 Benitez *et al*, 1999 Shaio *et al*, 2002 Stein *et al*, 2003 Tokars *et al*, 1992 Trim and Elliot, 2003	
2. To determine the relationship between compliance with universal precautions and	4. Personal protection	Beekmann *et al*, 1994 Bell and Clement, 1991 Brearley and Buist, 1989	

inoculation injuries.		Bryce, 1998 Dodds *et al*, 1988 Folin *et al*, 2000 Gerberding *et al*, 1990 Green and Gompertz, 1992 Hartley *et al*, 1996 Jagger and Balon, 1997 Knight and Bodsworth, 1998 Leliopoulou *et al*, 1999 Lymer *et al*, 1997 Mast *et al*, 1993 Mingoli *et al*, 1996 Smith and Grant, 1990 Wigmore and Rainier, 1994 Wong *et al*, 1991 Wong *et al*, 1998	
5. To explore healthcare professionals views of their personal risks and adoption of guidelines/protocols on universal precautions and inoculation injury reporting.	3. Interpretation of risk 4. Personal protection 5. The workplace 6. Education and training 7. Way forward	Burke and Madan, 1997 Clarke *et al*, 2002a Clarke *et al*, 2002b Cotton and Sullivan, 1999 Cutter and Jordan, 2003, 2004 Day *et al*, 1998 Devers *et al*, 2004 Heritage *et al*, 2002 Institute for Medicine, 1990 Kendrick *et al*, 1995 Lawton and Parker, 1999 Mangione *et al*, 1991 Manias and Street, 2000 McDonald *et al*, 2005 Natch and Van der Meer, 2003	

		Nestel and Kidd, 2006 O'Davies and Harrison, 2003 Benitez *et al*, 1999 Undre *et al*, 2006 Williams, 2002 Woolf *et al*, 1999	

Telephone interviews

Telephone interviews were conducted among the senior ICNs at each participating Trust and were for factual information and corroboration only. No attempt at in-depth examination was made as this would be difficult over the telephone. The questions (see appendix 3) were first emailed to the ICNs so that they could locate the information required. Each ICN was informed in the email that they would be contacted by telephone approximately a week later for the interview. These interviews were intended to provide data on the current provision, content and attendance at training sessions on the prevention and management of inoculation injuries, the provision of policies and the number of injuries reported during one calendar year. The purpose of conducting a short interview over the telephone rather than a postal questionnaire was to allow the ICN to use descriptions and explanations as required to describe these programmes while avoiding the cost and time associated with travelling to the relevant hospitals to conduct face to face interviews.

3.3.2 Mixed methods

It has been argued that the two main theoretical perspectives of research i.e. the positivist and interpretive perspectives require different approaches (Mason, 1993) and are therefore incompatible. The debate surrounds whether hard data (statistical results) have more validity than soft data e.g. qualitative case studies (Patton, 1997). It has been suggested that the terms positivist and empiricist are represented by quantitative research, while qualitative research represents the ethnographic or phenomenological i.e. interpretive approach and is concerned with studying meaning (Duffy, 1985; Leininger, 1985; Bryman, 2008). In short: "Numbers are parsimonious and precise: words provide detail and nuance" (Patton, 1997, p273).

However, the qualitative and quantitative paradigms are not completely incompatible (Clark, 1998; Bryman, 2008) and few studies are completely qualitative or quantitative in nature (Corner, 1991). Indeed, Pope and Mays (1993) and Burgess (1992) consider that single method studies are of limited value. Hence, the two approaches should be combined (Bryman, 1988) to offset the weaknesses of one method with the strengths of another (Polit and Beck, 2004). Researchers must be able to use wide range of tools to match the appropriate research methods to the nuances of particular evaluation questions (Patton, 1997). Findings generated by each method provide different, non-competing knowledge (Foss and Ellefson, 2002). However, qualitative and quantitative methods are not always given equal priority (Barbour, 1999).

Triangulation involves collecting data from numerous different, independent sources, possibly by different means (Mays and Pope, 1995). The different kinds of data obtained may reinforce each other by mutual confirmation (Bryman, 1988). "Every data gathering class – interviews, questionnaires, observations, performance records, physical evidence, is potentially biased and has specific to it certain validity threats" (Denzin, 1970, p450). The aim of triangulation therefore, "is to overcome the intrusive bias that comes from single-method, single-observer and single-theory studies" (Denzin, 1989, p313) and balance the weakness of one method with the strengths of another, to try to achieve convergent validity (Cowman, 1993). It is a useful method by which credibility can be enhanced (Polit and Beck, 2004) and hence can provide a more comprehensive account of reality and increase the understanding of a phenomenon (Bryman, 1988; Corner, 1991; Cowman, 1993; Taylor, 1993; Malterud, 2001). Triangulation can juxtapose diverse strands of evidence, so that they may be compared, contrasted or inter-related (Elliott, 1990). Agreement between different sources of evidence increases validity (Malterud, 2001) and checks not only whether inferences are valid, but which inferences are valid (Hammersley and Atkinson, 1983). Triangulation may be of data, method, investigator and theory (Denzin, 1970, 1989).

This study attempted to redress this imbalance and employed triangulation of method and data:

- Method triangulation involves the use of varying methods of data collection. In this study, questionnaire survey, face to face semi-structured interviews and telephone interviews were utilised to enhance validity and evaluate the consistency of the picture of the phenomenon (Polit and Beck, 2004). Collection of data by different techniques is also known as between methods or across methods triangulation (Duffy, 1987; Denzin, 1989; Mitchell, 1989). The results of the questionnaire survey guided the use of the interviews to allow a greater understanding of the results of the survey (Malterud, 2001). Sandelowski (2000) refers to this as the "development" purpose of mixed method research.

- Data triangulation - according to Polit and Beck (2004) there are three types of data triangulation: time, space and person. This study utilised space triangulation in that data were collected from participants across multiple sites and person triangulation in that data were collected from two professions and grades within those professions. Data analysis triangulation was also implemented. Qualitative and quantitative data were analysed using techniques appropriate to the data (see section 3.7) and the results combined at the interpretive level (Sandelowski, 2000). However, each data set remained analytically separate. No attempt was made to quantitize qualitative data or qualitize quantitative data as described by Sandelowski (2000).

This approach whereby more than one type of triangulation is used is known as multiple triangulation (Denzin, 1970; Mitchell, 1989).

Few studies employ method triangulation when studying uptake of standard/universal precautions and sustaining and reporting inoculation injuries. Those that do have combined a survey with observation (Henry *et al*, 1994) or survey with checking of corroborating data such as injury reports (e.g. Lymer *et al*, 1997). None have combined a survey with an interview in the way that this researcher intended. However, other nursing studies have used interviews to corroborate and strengthen data obtained during a survey (e.g. Morris and Turnbull, 2004; Sandison *et al*, 2004).

3.3.3 <u>Alternative methods of data collection</u>

Alternative methods of data collection

The following methods of data collection were considered and rejected:

Randomised controlled trial

Randomised controlled trials (RCTs) are considered the 'gold standard' study design in healthcare research (Grimes and Schulz, 2001; Tilling *et al*, 2005). They allocate participants to categories purely by chance thereby reducing the likelihood of bias (Grimes and Schulz, 2001; Martin, 2005) and move forward in time, hence reducing bias caused by faulty memory. Therefore, since they measure what they purport to measure, RCTs are high on internal validity. However, as the findings may not be generalisable to populations other than those studied, they often do not have external validity (Grimes and Schulz, 2001).

In theory, an RCT could be undertaken to test the relationship between those HCPs who adopted universal/standard precautions and those who sustained an inoculation. injury. In such an experiment, the experimental group would be provided with appropriate protective measures and the control group denied that protection. Each group would then be exposed to blood and body fluids during exposure prone procedures and the number of percutaneous and mucocutaneous injuries sustained by each group monitored and compared.

Similarly, an experiment could be conducted to determine how many HCPs who had sustained an inoculation injury and followed the relevant guidelines, and consequently obtained appropriate first aid and post exposure prophylaxis developed a blood-borne viral infection compared to those who had received no treatment. Those in the experimental group would be provided with appropriate first aid and post exposure prophylaxis following inoculation injury, while the control group would be denied the treatment. Both groups would be monitored over time to determine whether there was a difference in the number of HCPs in each group who went on to develop a blood-borne viral infection.

There would be ethical and logistical difficulties with both these experiments. Firstly, large numbers of participants would be required to achieve a sample that would be free of type I and type II sampling errors (Bowling, 2005) and provide results that are generalisable to the population. Secondly, a large number of inoculation injuries and sero-conversions to HIV, HBV or HCV would be required to demonstrate a high degree of internal validity. It is known that up to June 2002, there have been only 106 cases of documented HIV sero-conversion among healthcare workers world-wide, (5 in the United Kingdom) following occupational exposure to blood or body fluid, with a further 238 possible cases, 14 of these in the UK (Health Protection Agency, HPA, 2005). Therefore, a long-term study with an extremely large number of participants would be required to determine cause and effect. Both of these difficulties would be insurmountable given the time and financial constraints imposed by the rules of a PhD.

Far more important than the logistical difficulties are the ethical issues, which in both of these experiments would be insurmountable. The most fundamental ethical principle is that no harm should come to those taking part, a concept known as beneficence (Polit and Beck, 2004). It has already been established that following available guidelines will reduce the risk of adverse exposure to blood and body fluids and consequently the risk of occupational acquisition of blood-borne viral infection (Brearley and Buist, 1989; Bell and Clements, 1991; Wong *et al,* 1991; Mast *et al*, 1993; Beekmann *et al*, 1994; Lymer *et al*, 1997; Bryce, 1998; Knight and Bodsworth, 1998; Wong *et al*, 1998; UK Health Departments, 1998; Lee *et al*, 1999). This is fully discussed in chapter two. Therefore, to deny HCPs access to available protection would be negligent and expose them to an already identified risk.

Similarly, it is known that appropriate first aid and administration of appropriate post exposure prophylaxis following an inoculation injury will reduce the risk of sero-conversion to HIV and HBV (CDC, 1990; Kennedy and Williams, 2000; CDC, 2001; US Public Health Service, 2001; Gerberding, 2003). Once again, it would be negligent to deny HCPs proven beneficial treatment.

Observation

Whereas an RCT was out of the question, a more realistic alternative to the survey may have been observation. Observation is often a suitable method of data collection where participants may not report behaviour or events accurately, (Bryman, 2008; Polit and Beck, 2008) and is particularly suitable for observing non-verbal behaviour (Parahoo, 2006). It therefore allows the researcher to observe behaviour directly rather than having to rely on reported behaviour (Polgar and Thomas, 1991; LaBiondo-Wood and Haber, 1997). Where behaviour may contravene local Trust policies or national guidelines in relation to adoption of precautions, participants could be reluctant to accurately report their behaviour for fear of reprisals or criticism, whereas during observation, the researcher could witness at first hand practices adopted during surgery. Furthermore, near misses could be observed that would not have been reported. Consequently, at first glance, observation might seem a suitable method for collecting data that could identify operating theatre personnel's behaviour in relation to prevention and reporting of inoculation injuries. This method has been used successfully in a number of studies (Quebbeman *et al*, 1990; Henry *et al*, 1994;

Williams *et al*, 1994; Knight and Bodsworth 1998; Akduman *et al*, 1999; Madan *et al*, 2001; Coe and Gould, 2008). However, there are problems associated with employing observation as a data collection tool that precluded its use in this study.

The role of observer can be difficult. Where the researcher acts in the capacity of complete observer by observing the participants without intervening in any way and without being noticed (Gold, 1958; Adler and Adler, 1994) or complete participant by participating in events without revealing that he/she is undertaking research (Parahoo, 2006), ethical difficulties arise in that the observation must be covert. None of the participants are aware that they are being observed, and while this might yield data that accurately reflects true behaviour, this type of data collection might be interpreted as deceptive (Johnson, 1992). Furthermore, a study utilising such methods would be unlikely to be passed by an ethics committee which demands that participants are informed that they are being studied and that appropriate consent is obtained prior to commencing the study (Royal College of Nursing, 1998; Lynes, 1999; Central Office for Research Ethics Committees (COREC), 2004).

Ethical concerns may also surface if unsafe practices are observed (Casey, 2004). Is it negligent to continue to observe without intervention if safety is compromised? Although the researcher would be present as a student and not in the capacity of registered nurse, it would be difficult to ignore one's professional responsibility if unsafe practices were observed. Under the direction of the Nursing and Midwifery Council (NMC, 2008), a nurse must safeguard the interests of patients, but to intervene may influence behaviour being observed and compromise the research study.

When the researcher becomes a participant as observer or observer as participant (Gold, 1958), his/her presence is likely to influence the behaviour of those being studied, a phenomenon commonly known as the Hawthorne effect first described by Roethlisberger and Dickson (1939). For example, in this study the presence of the researcher may have improved compliance with standard/universal precautions, reduced inoculation injuries or improved adherence to reporting procedures due to the fact that she has a background in infection control. Henry *et al* (1994) conceded that healthcare workers observed in their study may have been more likely to adopt correct procedures because they knew they were being observed. It has been suggested however, that eventually those being studied become accustomed to the presence of the researcher and begin to behave naturally (Pretzlic, 1994; Lynes, 1999). Time constraints meant that allowing for this period of acclimatization in each Trust studied would have been prohibitive although it has been achieved by other researchers (Quebbeman *et al*, 1990; Henry *et al*, 1994; Williams *et al*, 1994; Knight and Bodsworth 1998; Akduman *et al*, 1999; Madan *et al*, 2001; Coe and Gould, 2008).

Some participants may be reluctant to have their working practices observed and could misconstrue the researcher's motives (Parahoo, 2006). Once again, the question of whether to intervene during episodes of unsafe practice is an issue.

These considerations notwithstanding, it is recognised that direct observation would have enhanced the study by providing observed behaviour rather than relying purely on self reported data concerning compliance with standard/universal precautions and reporting and the differences in practice between surgeons and scrub nurses. Interviewer bias and the social desirability response would have been reduced.

3.4 THE SAMPLE

The study was conducted among surgeons and scrub nurses employed in ten hospitals within six acute Trusts within Wales distributed across rural and urban areas.

This was intended to be a population-wide survey, encompassing all surgeons and scrub nurses in participating Welsh hospitals whose work involved frequent, regular contact with blood and body fluids, and undertaking exposure prone procedures. A whole-population study would offer a robust approach to data collection. It was not possible to estimate the likely response rate prior to commencement of the study. From previous work (Cutter & Jordan, 2003, 2004), it was estimated that 74% of theatre personnel have sustained inoculation injuries within the last 5 years. A sample of 297 theatre personnel would therefore be required to obtain a 95% confidence interval of +/- 5% around a prevalence estimate of 70% (Bland *et al*, 2002). However, this calculation did not take into consideration any possible clustering effects that could arise due to the nature of team working (Uitenbroek, 1997). No information on the possible effects of clustering in this situation is available.

Those invited to participate in a face-to-face interview were those deliberately selected according to their responses to the questionnaire survey. Sampling of these responses could therefore be described as purposive or judgmental, that is "a type of non-probability sampling method in which the researcher selects participants for the study on the basis of personal judgement about which will be most representative or informative" (Polit and Beck, 2004, p 729).

Lists of HCWs to be included in the study were obtained from the personnel departments in each hospital and relevant heads of department. In total, 612 questionnaires were distributed as follows:
surgeons: 325
scrub nurses: 287

Certain specialities of surgeon were excluded. Ophthalmologists were not included, as they do not carry out exposure prone procedures as defined by the UK Health Departments (1998). Cardiac, plastic, and neurosurgeons, were also excluded because of the highly specialised nature of their work. Comparatively few hospitals in Wales perform surgery in these categories, therefore, in order to increase the generalisability of the findings the decision was taken not to include them. Furthermore, these surgeons could have been easily identified from the data.

Operating Department Practitioners were also excluded from the study as the number who participate in exposure prone procedures in Wales is low.

Participants were aged between 21 and 65 years, included both males and females, and were employed within NHS trusts in Wales.

Although only Welsh trusts were included in the study, there is no reason to suggest that these trusts are atypical of NHS trusts within the UK.

It was intended that this would be an all-Wales study and requests for approval to conduct the study were sent to the Research and Development Committees in 10 Welsh trusts. Five Welsh trusts were not approached for the following reasons:

- The Welsh Ambulance Service NHS Trust does not undertake surgery;

- One trust performs very little surgery and uses the services of a neighbouring, participating trust to provide many of its surgeons;
- One trust is a single speciality oncology trust and undertakes no surgery;
- Two trusts are tertiary referral centres and therefore, are not representative of Welsh trusts. In addition, they are both university trusts and there is some evidence to suggest that adverse exposures to blood and body fluids may be higher in university trusts (Venier *et al*, 2007). Even where injury rates have been found not to differ between non-teaching and teaching hospitals the causes of injury may vary (Gawande *et al*, 2003). Furthermore Singh *et al* (2006) suggest that compliance with precautions may be higher in university hospitals. Results from these two Trusts may not therefore be typical of general acute hospitals and could skew the data. Finally, one of these Trusts participated in a similar study (Cutter and Jordan 2003, 2004) since when significant investment has been made into education and provision of protective clothing again making the results atypical of Welsh Trusts

Six out of ten trusts approached gave approval to undertake the study in their hospitals. Reasons for refusal by the remaining four are as follows:

- A similar project was being conducted by another researcher;
- The Research and Development Committee felt that the time taken to complete the questionnaires and potentially participate in interviews was too great;
- The reviewer suggested a large number of amendments that would have meant significantly altering the questionnaire and possibly re-submitting to MREC;
- The fourth trust did not reply to a request for approval.

Each trust and respondent has been coded in such a way that only the researcher can identify individual respondents and their employing trust. At the same time, readers can identify which profession has given an explanation or opinion on any given topic. The participating trusts have been coded from 1–6. Surgeons have been allocated the sub-code S, scrub nurses are identified by the letter N and managers by M. Every surgeon and scrub nurse has also been allocated a unique number according to the list provided by each trust. For example, 2.S.33 represents surgeon number 33 from trust number 2 and 3.N.2 represents nurse number 2 from trust 3.

3.5 PILOT WORK

Prior to commencing the study, pre-pilot and pilot work on the questionnaires, semi-structured interview schedule and telephone interview schedule was undertaken. The purpose of piloting was to ensure that both the questions and research instruments worked well (Bryman, 2008) and not simply to field test the questionnaire. Piloting was used to:

- Determine the adequacy of questions in terms of clarity, understanding and language;
- Consider how the questions flowed;
- Provide an early indication of the reproducibility the responses;
- Aid in procedural matters, including ordering of question sequences, reduction of non-responders, sampling and analysis, thereby increasing reliability and validity (Oppenheim, 1992; Murray, 1999; Passmore *et al*, 2002; Bryman, 2008).

Pilot studies are also useful in examining the validity and reliability of the research instrument, (Burns and Grove, 1997) and are necessary whether utilising questionnaires from previous studies, an existing instrument or constructing one's own questions (Oppenheim, 1992; Boynton, 2004). Passmore *et al* (2002) recommend at least two pilot tests.

Before conducting field tests, the questions were read aloud by the researcher to herself, taped and played back to identify differences between spoken and written language. Next the researcher completed the questionnaire to identify difficulties in the question answer process (Campanelli, 2008). This process did not reveal any potential difficulties to the researcher, and so a systematic review of the questionnaire was conducted.

3.5.1 <u>Expert review</u>

In August, 2004, the questionnaire for surgeons and scrub nurses was subjected to expert review. Three Infection Control Nurses and two Infection Control Doctors were asked to complete the questionnaire and comment on content, layout, clarity of the questions and time taken to complete it. Although none of these staff fulfilled the criteria of the sample chosen for the study, they all worked in the same Trust as the researcher, and had an intimate knowledge of standard/universal precautions and procedures for reporting inoculation injuries. The purpose of the expert review study was to "pre-test" the questionnaire, check the accuracy of statements and contribute to face validity.

Results from the expert review indicated that there were few significant changes required in the wording or the layout of the questionnaire. The questionnaire took, on average, 10 minutes to complete, a period of time felt to be reasonable by the respondents.

3.5.2 Field test pilot – postal questionnaire

In order not to reduce the sample size for the actual study, the pilot study was conducted in two acute hospitals in an NHS trust that was not included in the actual study. This trust was excluded from the study because a similar project had been undertaken within the Trust in 2001 (Cutter, 2002; Cutter and Jordan 2003, 2004). This study was followed by extensive education and replacement of all existing cotton drapes and gowns with water impermeable alternatives. Consequently, those who had participated in the 2001 study were excluded from this study, in case familiarity with some of the questions may have led to a lack of objectivity and an inability to constructively criticise the questionnaire.

Purposive sampling was used to ensure that the sample was as similar as possible to the sample in the main study. A total of 20 questionnaires were sent out, and included 10 surgeons and 10 scrub nurses, 50% to one hospital and 50% to the other.

Potential respondents were sent a questionnaire labelled "Draft to be piloted" to distinguish them from those in the pre-pilot and actual studies. An explanatory letter using Trust headed notepaper that outlined the purpose of the actual study and the pilot study, accompanied all questionnaires. In order to elicit constructive criticism that would enhance the main study, respondents were asked to comment on the layout, clarity and wording of the questionnaire.

The researcher mailed questionnaires via the internal mailing system in March 2005 and respondents were asked to return the questionnaires to the researcher in a sealed self- addressed envelope, once again via the internal mailing system.

SPSS for Windows, version 13, was used to analyse the results from the pilot study to test the ease of analysis of the questionnaires.

Thirteen questionnaires were returned giving an overall response rate of 65%. However, the return rate was not equal in both hospitals, with eight questionnaires being returned from Hospital 1 (four surgeons and four scrub nurses) and only five from Hospital 2 (three surgeons and two scrub nurses).

It was possible that the high response rate in the Hospital 1 was due in part to the fact that the researcher was well known to the majority of participants in this hospital and that participants responded out of loyalty. According to Thompson *et al* (2000), opinion leaders can influence the practice of health professionals and it has been speculated that this influence may also apply to surgeons' participation in surveys (Bhandari *et al*, 2003). It is possible that in the Hospital 2, a negative influence was exerted by one surgeon who declined to participate. This consultant surgeon expressed concerns over the ethics of asking personnel to describe details of injuries and breaches of Trust policy. The surgeon also queried whether the study had been approved by the Local Research Ethics Committee. A letter was sent to the surgeon by the researcher indicating that the project had been approved by both the Multi-Centre Research Ethics Committee for Wales (MREC) and the Trust Research and Development Committee. Copies of the relevant approval letters were enclosed. No further communications were received from the surgeon. He did not participate in the pilot study. No other participant offered any reason for not participating.

Although the surgeon could not be persuaded to participate in the pilot study, his views were considered. As he had expressed concerns regarding ethical approval, it was possible that other potential participants would share these concerns. As a consequence, copies of approval letters from MREC and the relevant Research and Development Committee were enclosed with each subsequent invitation to participate both the pilot study and actual study.

Following the first field test pilot study, several changes were made to the questionnaire:

1. In question 5, the categories "patients suspected as having a blood borne viral infection e.g. HIV, hepatitis B or C" and patients known to have a blood borne viral infection e.g. HIV, hepatitis B or C" were merged as 6/11 (54.5%) ticked both boxes.
2. Question 11 was removed, as only 2/11 (18.2%) of respondents could remember how long they had been on duty when their accident occurred.
3. Questions 15 and 16 were moved to become questions 8 and 9 so that, with the exception of the final question which allowed general comments, all remaining questions related only to those who had sustained an injury. All previous questions were relevant to all respondents. This was done to 'streamline' the questionnaire and to minimise the risk that respondents who had not sustained an injury would disregard the final questions.

In May, 2005, the revised questionnaire was field tested. In order to minimise any anxieties concerning ethical issues, a copy of the All Wales Multi-site Research Ethics Committee (MREC) approval letter and permission from the Trust Research and Development Committee was included with the information letter and questionnaire. Ten further potential participants were selected from the hospital in which fewest questionnaires were completed to determine whether concerns regarding the ethics of the study were prevalent among other personnel. Revised questionnaires were also sent to 4 of the non-respondents from the first pilot study (the surgeon who queried the ethics of the project during the first field test was not sent a further questionnaire at this stage because he had already been given a second opportunity to participate and had declined). Hospital 1 was not included. In addition to the approval letters, a revised information letter included a request for those who did not want to respond to give reasons. However, none did so. Nine respondents participated in the second field test (64%). No changes were made to the questionnaire as a result of the second field test.

3.5.3 Pre-testing by interview

In order to determine whether the potentially sensitive nature of some of the questions may be a deterrent to participation and to increase face and content validity, the survey questions were subjected to testing by interview (Campanelli, 2008).

Five volunteers working in the operating department of one Hospital 1 were interviewed. A standard introduction was read to all interviewees (appendix 11), consent forms (appendix 12) were signed and the interviews taped with the permission of the interviewees. The interviews were transcribed. All interviewees were asked to complete draft 2 of the questionnaire and comment verbally on their overall impression of the questionnaire including content, layout, legibility and clarity. They were then interviewed using a modified version of the "Question Appraisal System" (QAS 99): coding form (Willis and Lessler, 1999), appendix 13. The QAS 99 coding form was designed to elicit opinions on each individual question relating to an interview. In this case, each QAS 99 coding form was used to elicit opinions on a complete questionnaire. Question 5d was inappropriate for this pre-test and was not asked. The advantages, according to Campanelli (2008) of such a systematic review are:

- "Quick
- Cost effective
- Can uncover a wide range of problems
- Covers cognitive aspects for respondent
- Can cover possible difficulties for the interviewer
- Can generate hypotheses for testing with other methods
- If a specific appraisal form is used, the method yields quantitative data" (p199).

Results of pre-testing

Two of those interviewed felt that in question 5, an extra category was required as either occasionally double gloving would be adopted for reasons other than those suggested i.e. if the scrub nurse had a cut on her hands, or instruments may be passed from hand to hand at the surgeon's assistance and was therefore out of the nurse's control. Consequently, a fourth category: "Other", was added with an area for participants to add comments.

Question Appraisal System (first application)

None of the interviewees felt that the questions were of such a sensitive nature as to deter participants from taking part and none identified any problems that had not previously been identified.

Following the testing phase, in June 2005, the questionnaire was once more amended and five further participants this time from Hospital 2 were interviewed and amended QAS forms completed.

During the second taped pre-test interview, one interviewee indicated that in question 14, one of the options on the five-point scale "Had no effect" was not entirely appropriate in a question relating to influence on reporting of inoculation injuries. This was therefore changed to "Had no effect/influence". This change was considered too minor to require further field testing.

Question Appraisal System (second application)

Once again, the QAS indicated that none of the respondents found the questions so sensitive that they would have been deterred from answering.

The final version of the questionnaire used for the study can be found in appendix 1.

3.5.4 <u>Interview pilot</u>

To refine the interview technique, pilot work was undertaken with a scrub nurse from the pilot site to ensure sensitivity and appropriate phrasing and sequencing of interview questions.

3.5.5 <u>Telephone survey pilot</u>

Four ICNs in the pilot site were asked to pilot the questions used for the telephone interviews. A verbal explanation was given of the purpose of the study and pilot study. Once again, respondents were asked to comment on layout, clarity and wording. No changes were necessary following the pilot study.

3.6 THE STUDY - PROCEDURES FOR DATA COLLECTION

Following approval by the All Wales MREC (see appendix 7) questionnaires were sent to each eligible surgeon and scrub nurse identified as performing exposure prone procedures and having frequent contact with blood and body fluids. Participants in any research study must be able to decide whether to participate and should therefore be given sufficient information to assist in the decision making process (RCN, 2004) see section 3.7. A comprehensive information sheet, printed on Swansea University headed notepaper, outlining the purpose of the study and inclusion criteria (appendix 4) accompanied each questionnaire. In addition, the information sheet included a guarantee of confidentiality and anonymity both in the completed dissertation and in any resulting publications. Anonymity during the data collection process could not be guaranteed as questionnaires were coded to allow follow up of non-responders. All information relating to the codes and names of respondents were held in a separate password protected file on a computer sited in the researcher's workplace in order to maintain confidentiality (RCN, 2004). Only the researcher had access to the codes. Following completion of the study, these records were deleted from the computer. A bar disallowing access to the data for five years via the University of Wales library was implemented because of the sensitive nature of some of the information collected to reassure the participants.

Consent forms were not considered necessary in the questionnaire and telephone interview phases of the study as returning the completed questionnaire or agreeing to be interviewed implied consent. All respondents had sufficient cognitive abilities to make a decision on whether to participate and the sample did not include traditionally vulnerable groups such as children and the mentally or terminally ill. Consent forms were used during the face to face interviews (appendix 6).

Questionnaires were distributed via the Royal Mail. Included with the questionnaire and information sheet was a freepost envelope addressed to the researcher to encourage return of completed questionnaires. Questionnaires were distributed between January 21st 2006 and August 5th 2007.

The right to refuse to participate must be respected and pressure to participate must not be brought to bear (Oppenheim, 1992). This must be delicately balanced with the need to follow up non-responders to obtain as much data as possible and have a significant sample size, in this case to effectively organise appropriate educational initiatives where practice is in most need of change.

Four weeks after the initial mailing, a further copy of the information sheet and questionnaire were sent to non-responders. After a further four weeks, checks were made on the whereabouts of non-responders through the relevant heads of department and secretarial staff to ensure that follow up questionnaires were not sent to those on long term sick leave or those who may have left the employ of the Trusts. Where appropriate, a third copy of the information sheet and questionnaire were sent to those who failed to respond to the first reminder.

Trusts 3 and 4 indicated a reluctance to allow the names of their personnel to be released. Therefore, questionnaires were distributed by the General Manager of the Clinical Governance Directorate in Trust 3 and questionnaires distributed to the nurses in Trust 4 by the Senior Nurse (Operating department). Questionnaires for the surgeons were mailed directly to them by the researcher.

3.7 DATA ANALYSIS

The variables were set up using SPSS for Windows, version 13. The data were mainly of the nominal type, which restricted the range of appropriate statistical techniques (Reid, 1987). A descriptive statistical analysis was undertaken, utilising univariate techniques. Univariate techniques were used to summarise the data when only one variable was considered, and included descriptive statistics such as frequency and percentage (Reid, 1987).

A description of all variables was obtained. Cross-tabulation and analyses of key variables were undertaken. The relationships between many of the dependent and independent variables in the study have been explored by other researchers, see chapter two. Cross tabulation was used in order to determine whether the same relationships were present in this study.

Cross tabulations were all r x c. In 2 x 2 tables, both variables have two levels, e.g. profession and knowledge of inoculation injury reporting procedures. In others, at least one variable has more than two levels e.g. reporting inoculation injuries and use of double gloves (Campbell and Machin, 1999).

Bivariate analysis was undertaken to consider two variables and focus on the relationships between the variables, including tests of significance and measures of association (Reid, 1987; Polit and Beck, 2008). In this study, bivariate analysis was employed to investigate associations and explored relationships within the data set. A sample SPSS print out of some of the bivariate analyses calculated can be found in appendix 14.

For interval data the choice of statistical tests depends on whether data are normally distributed (Altman, 1991). Distribution was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Normal distribution was assumed where the Sig value > 0.05.

The primary outcome variable was 'sustaining an inoculation injury'. This binary categorical variable was analysed by Chi-square (χ^2) non-parametric testing with calculation of 95% confidence intervals in the first instance to determine the relationship between this and the other categorical variables. An adequate sample size is essential to explore the significance of the relationship between the variables under discussion. Categories must be mutually exclusive and a sound theoretical basis for the categorisation of the variables must exist (Munro, 1993). Where interval data were not normally distributed, the Mann-Whitney U and Kruskall-Wallis non-parametric tests were employed to determine whether the relationship between variables reached statistical significance.

Results were considered statistically significant where the α (Asymptotic significance 2-sided) was <0.05 indicating that there was only a 1 in 20 likelihood that the results could have occurred purely by chance. Where tables were not 2x2, the linear by linear test was applied to determine whether a trend existed. Again, a P value of <0.05 was considered significant. When describing non-parametric tests Asymptotic significance 2-sided will be quoted. No difference in significance was found when using the Monte Carlo method to estimate significance. According to Field (2009), where numbers are small as in this study, it is preferable to use an exact method i.e. the Asymptotic method.

A concern when testing multiple relationships in this way is that a type 1 error may occur i.e that a relationship exists when in reality it does not (Polit and Beck, 2008). To account for this, it is sometimes recommended that a Bonferroni correction is applied to establish a more conservative level of significance (α). This involves dividing α by the number of comparisons (Field, 2009). However, this type of correction may increase the risk of type 11 errors, i.e. concluding that a relationship doesn't exists when it does (Polit and Beck, 2008; Field, 2009). In this study, the Bonferroni correction was not applied as construction of logistic regression models reduced the risk of type 1 errors occurring by taking account of the confounding variables.

The results of the bivariate analyses were used to construct logistic regression models, from which the odds ratio of the contribution of the variables highlighted in the literature was estimated. A sample model can be found in appendix 15. Where numbers permitted, sub-grouping allowed further exploration of the data. For example, surgeons were examined separately in relation to sharps injuries sustained at five years (section 4.4).

Regression analysis aims to explain variation in a single outcome variable, in this case, sustaining an inoculation injury, taking into consideration a range of possible confounders and predictors (Draper & Smith, 1998). Multiple logistic regression or logistic regression analyses the relationship between a categorical dependent variable and independent or predictor variables to predict whether a given event (the categorical dependent variable or outcome variable) will occur and transforms the probability of this event occurring into its odds (Altman, 1991; Anthony 1999; Miles and Shevlin, 2001; Polit and Beck, 2008). Odds ratios are generated that allow the risk of the event occurring under one condition to be compared to the risk of the same event occurring under another condition (Miles and Shevlin, 2001; Polit and Beck, 2004) thereby indicating the relative importance of each of the variables. The purpose of the logistic regression model in this study is to identify the variables most likely to predict sharps injuries. These variables can then be used to inform the content of and target education programmes aimed at reducing the frequency of such injuries.

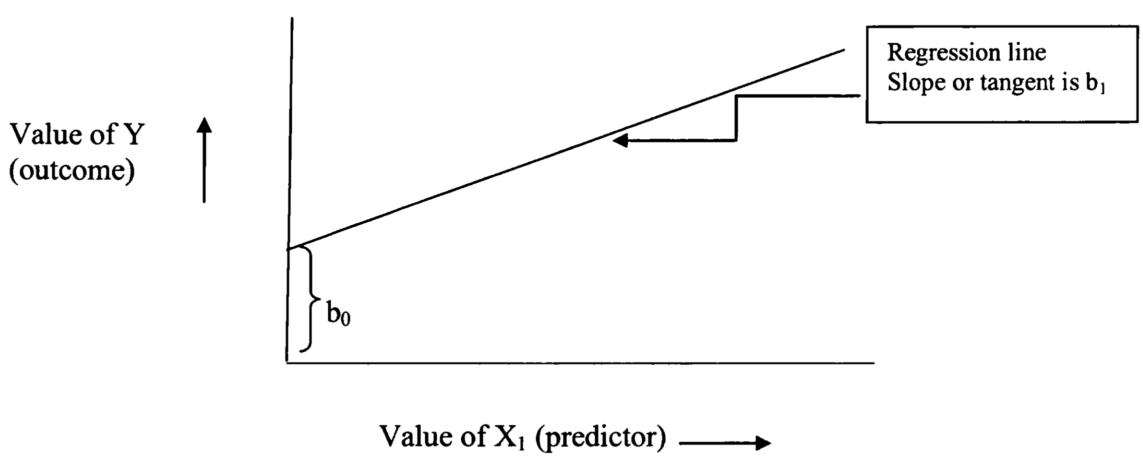
In this case the outcome/dependent variables that have been chosen are sustaining a sharps injury at one and five years and logistical regression was conducted using a backwards likelihood ratio criterion. This method was chosen to allow observation of the relative importance of each of the variables as the variable with the least impact on the fit of the model will be removed first and so on (Field, 2009). Automatic removal therefore reduces subjective selection of the variables.

The chosen variables are dichotomous, an injury is either sustained or it is not. In addition to being identified as statistically significant in this study, many of these predictor variables have also been identified as significant in other studies.

Regression equation

The aim of the regression equation is to quantify the relationship between a single outcome variable (Y) and predictor variables (X_1, X_2 etc). If the outcome of interest is an interval variable, a straight line equation can be formulated, as in graph 1. By entering varying values for each predictor variable, the value of the outcome variable (Y) can be calculated from an equation derived or modelled from the data (Field 2009).

Graph 1 Diagram of linear regression equation for X_1



Y= equation = ($b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4$ etc), where b_0 is the intercept on the Y axis (the constant in the equation) and b_1 etc are the slopes or gradients of the lines for X_1, X_2, X_3 and X_4 etc.

However, if the outcome (Y) variable is binary as in this study (either an injury is sustained or it is not), the outcome variable is modified or transformed to a straight line before an equation is generated. Here the outcome variable (Y) is related to the probability or odds of the binary event occurring. The technique used for this analysis is termed 'logistic regression'.

In logistic regression, the outcome variable (Y) is the logit function, which is related to the odds and the probability of an event occurring.

If P is the probability of an event occurring, then the odds, i.e. the probability of the event occurring divided by the probability of the event not occurring is P/(1-P), and
Odds = P/(1-P)
Therefore, by manipulating:
P=odds/(1+odds).

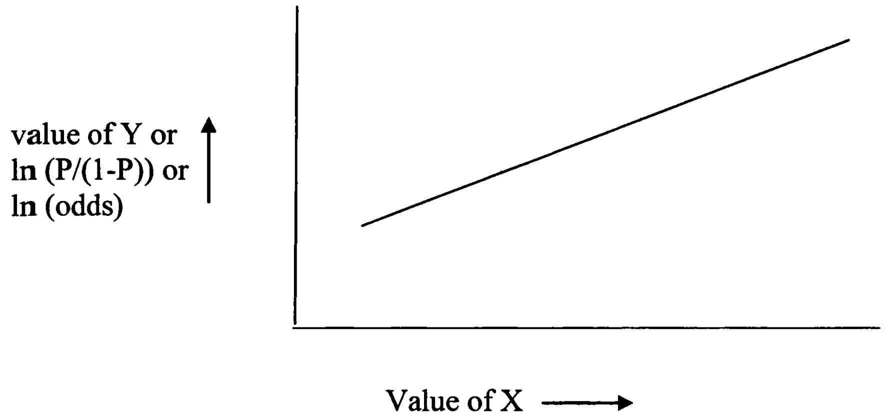
To form a linear equation the odds or P/(1-P) function is transformed by taking the natural logarithm (ln). This gives the 'logit' or log odds function, which becomes the outcome variable value on the Y axis (graph 2 below). So that,

Logit P = ln (P/(1-P)) or the natural logarithm of the odds, and

Y= Logit P = ln (P/(1-P)) = ln (odds)

This gives a linear equation on the logit scale, graph 2.

Graph 2 Diagram of logistic regression equation



The value of Y is also given by the equation. Therefore,

$Y= \ln (P/(1-P)) = \ln (odds) = equation = (b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 \text{ etc})$

And ln (odds) = equation

Therefore, if the exponent is taken for both sides of the equation:

$odds = e^{(equation)}$

Substitution of this value in P=odds/(1+odds) gives:

$P= e^{(equation)} / (1+ e^{(equation)})$

Therefore, the logistic regression equation allows the calculation of a value for the probability of the binary event occurring as follows:

$$P = \frac{e^{(b_0 + b_1X_1 + b_2X_2)}}{1 + e^{(b_0 + b_1X_1 + b_2X_2)}}$$

where e is the base of natural logarithms, b_0 is the equivalent of the intercept on the y axis (the constant in the equation), X_1 and X_2, are the values of the predictor variables in the final model (model 1). In this model, X_1 = profession, X_2 = the belief that injuries are an occupational hazard, and b_1 and b_2 are the coefficients attached to the predictors (Field, 2009), see section 4.4.

By substituting differing values for X_1, and X_2, into the equation the probability of the binary event (sharps injury) can be predicted for each case.

Data analysis – interviews and qualitative data from questionnaires

Content analysis

Qualitative data i.e. comments provided on the questionnaire in relation to questions 5, 15 and 16 and interview data were analysed using content analysis to firstly provide an objective, systematic and quantitative description of the responses (Berelson, 1952) and then to make appropriate inferences from the data (Weber, 1990). This involves assigning codes to provide descriptions of qualitative data in terms of predetermined categories (Weber, 1990; Coffey and Atkinson, 1996; Ryan and Bernard, 2000; Donovan and Bryman, 2004). Although coding cannot in itself be considered analysis, it is a useful method of categorising qualitative data to aid the "organisation, retrieval and interpretation of data" (Coffey and Atkinson, 1996 p27). The analysis involves examining patterns in the content of the themes and sub-categories and the relationship between them (Miles and Huberman, 1994; Wolcott, 1994; Coffey and Atkinson, 1996).

Content analysis has been described as reductionist in that coding reduces texts to units that can be analysed quantitatively (Denzin and Lincoln, 2000; Stemler, 2001). However, there is a rationale for a degree of quantification since conclusions are often related to the frequency of which something is said or observed (Bryman and Burgess, 1994). Furthermore, content analysis has been criticised for being unable to capture the context in which comments are made and that analysing allocated categories deflects attention away from events that have not been categorised (Atkinson, 1992; Manning and Cullum-Swan, 1998) and it has been suggested that ambiguity concerning word meanings and category definitions could affect reliability and validity (Weber, 1990).

Miles and Huberman (1994) maintain that data reduction is only the first stage in content analysis leading to the process of drawing and verifying conclusions. Coffey and Atkinson (1996) argue that coding can also result in data complication in that it allows the researcher to question and think creatively about the data thereby allowing theories to develop. They acknowledge that in practice, content analysis can result in both data reduction and data complication, both of which will be demonstrated in this study.

In this study, current theory already exists but requires further explanation. Therefore, the research follows a deductively oriented design, described by Huberman and Miles (1998) as one in which the researcher is well acquainted with the subject and has a fund of applicable concepts with which to explain behaviour involving many, comparable cases. Consequently, it is likely that context will be well understood by the researcher and unlikely that categories are overlooked. The fact that, in this study, only the researcher will be categorising the data ensures that no misunderstandings of the meaning of codes, categories and words will occur and that reliability and validity are preserved. The existing theory was used to determine codes or the relationship between them, a concept described as directed content analysis by Hsieh and Shannon (2005) and deductive category application by Mayring (2000).

Attempts have been made to classify content analysis by the 'type' of qualitative research being undertaken e.g. the constant, comparative analysis of grounded theory or ethnographic content analysis (Tesch, 1990; Bluff, 2005). However, it is recognised that qualitative research is being conducted that does not at present have a name of its own yet still may employ content analysis (Morse, 1991; Miles and Huberman, 1994). This generic approach to content analysis has been used successfully in other healthcare research (Chuang and Huang, 2007; Koivunen *et al*, 2007; Tod *et al*, 2007) and will be taken in this study.

The first stage in the process of content analysis in this study was to record all the comments from the questionnaires and code them. Comments were transcribed and sorted into categories. Each category was assigned a master code. Within each category, the comments were then allocated into themes and a sub code assigned to each theme as suggested by Miles and Huberman (1994). For example, the category that related to comments concerning injuries being an occupational hazard was called 'occupational hazard' and allocated the master code 'OCC'. Within this category themes were allocated a sub code, e.g. unavoidable occupational hazard – OCC/UNAV. A total of 10 categories and 104 themes were identified from the questionnaires with a further two categories and 29 themes identified from the semi-structured interviews (appendix 17).

Several computer programmes that assist qualitative data analysis are available, for example The Ethnograph, QUALPRO and NUD*IST. These packages, collectively known as computer assisted qualitative data analysis software or CAQDAS (Lee and Fielding, 1991) can be useful in assisting coding, locating, storing, sorting, cross indexing and retrieving data. They can also assist with developing theoretical models, examining textual and semantic features of the data, linking text and isolating negative or deviant cases (Coffey and Atkinson, 1996; Richards and Richards, 1998; Denzin and Lincoln, 1998; 2000; Ryan and Bernard, 2000; Weitzman, 2000). However, none of these programmes perform automatic data analysis in the way that packages such as SPSS can perform statistical tests (Coffey and Atkinson, 1996; Weitzman, 2000).

CAQDAS has received criticism that it may impose hierarchical patterns on the data that are artificially created by the software rather than occurring within the data itself and that use of such software could lead to data being quantified (Denzin and Lincoln, 2000; Weitzman, 2000; Bryman, 2008). Furthermore, these programmes may distance the researcher from the data, encourage shortcuts and cannot take into consideration situational and contextual factors (Denzin and Lincoln, 2000; Weitzman, 2000; Bryman, 2008).

Consideration was given to using one such package, i.e. N6, the current version of NUD*IST. A tutorial on the use of N6 was attended in which existing data from this study was used to demonstrate the capabilities of N6 and extensive reading on the use of CAQDAS was undertaken. However, it was decided not to use the programme for the reasons already discussed and the following:

- As discussed, the study follows a deductively oriented design (Huberman and Miles, 1998). Therefore, the researcher has intimate knowledge of the subject under consideration which enabled codes to be applied that did not necessarily simply rely on words and phrases within the text but included her knowledge of the theatre environment, procedures, personnel and situation (see also section 5.2.8). This ensured that categories were unlikely to be ignored and meanings of codes, categories and words were understood contributing to rigour. Therefore, locating data using N6 was not required;

- Logistically, gaining access to the programme was difficult with all available licences being in use by others in the university department at the time of data analysis.

The categories and themes were used in the development of the interview schedule or used to form prompts to encourage the narrative. To some extent, the comments made in the questionnaires also guided the selection process for the interview phase of the study. Those who expressed views on their own or others' behaviour, together with those who exhibited either a lack of or total compliance with the concepts under discussion were asked if they would consent to being interviewed as these participants could offer a useful insight into issues surrounding compliance and have demonstrated a willingness to offer their own experiences or opinions by adding comments in the free text fields of the questionnaires.

During the interview process, new themes were identified and all the codes were constantly reviewed and amended as necessary. Following transcription of the interviews, the transcripts were scrutinised and the relevant codes assigned to the narrative.

Content analysis is discussed in relation to the questionnaire and interview findings in chapter four and to the existing literature in chapter five.

3.8 DEMONSTRATING RIGOUR IN QUANTITATIVE RESEARCH

3.8.1 Reliability

Reliability is a necessary component of validity (Oppenheim, 1992), and has been described as the degree of consistency with which a measurement tool measures what it is designed to measure (Oppenheim, 1992; Polit and Beck, 2004). It relates to both the instrument of data collection, i.e. the questionnaire, and the conditions under which it is administered (Oppenheim, 1992), and can be measured by its level of purity, consistency and accuracy (Oppenheim, 1992; Polit and Beck, 2004).

Reliability may be considered as having two aspects – external and internal reliability (Anthony 1999; Bryman and Cramer, 2001). External reliability has been described as the "degree of consistency of a measure over time" (Bryman and Cramer, 2001, p63). One of the strengths of quantitative research is its repeatability (Greenhalgh, 1997; Anthony, 1999) in that the same measurement tool should provide the same information whenever it is administered. However, the stability or external reliability of the questionnaire used in a survey, or the extent to which it will yield the same results on repeated administrations (Polit and Beck, 2004) cannot be tested in a single survey as it will not be applied and re-applied over time within the same population. To a limited extent the stability of the questionnaire was demonstrated by re-testing the questionnaire on a participant. A scrub nurse completed the questionnaire on two occasions four months apart. On both administrations, the answers were the same. Although testing and retesting is a convenient way of estimating reliability, it must be recognised that traits and opinions change over time and experiences between each test may alter the participant's responses (Bryman and Cramer, 2001; Polit and Beck, 2004). Consequently, lack of correlation may not necessarily be due to an unreliable research instrument. It may be influenced by the participant's memory of the first test, boredom when faced with the same questionnaire twice or the fact that respondents have actually changed in the time span between the two tests and test/re-test is more appropriate for instruments measuring constant characteristics e.g. personality, physical traits than behaviour or compliance (Polit and Beck, 2004).

As external reliability relates to the degree of consistency achieved by a research instrument over time (Bryman and Cramer, 2001), a reliable measurement tool should provide the same information whenever it is administered (Greenhalgh, 1997; Anthony, 1999). A questionnaire similar to the one used in this study was used in a study in 2001 (Cutter and Jordan, 2003, 2004) and so can be considered to have demonstrated a degree of external reliability. In addition, utilising questions used in previous work i.e. question 11 (EPINet, 2003a; 2003b), and questions 5, 7, 8 and 15 (Cutter and Jordan; 2003, 2004) and piloting the questionnaire to ensure that the questions are unambiguous, contributes to stability and reliability in the same way as it improves content and face validity (section 3.8.2).

Internal reliability relates to whether a scale is comprised of consistent indicators (Bryman, 2008). Internal reliability or consistency may also relate to the "extent to which different subparts of an instrument are equivalent in measuring the critical attribute" (Polit and Beck, 2004, p420). Cross checking between questions on the questionnaire i.e. questions 5 and 12 contributes to internal reliability. The purpose of this was to gain a more accurate measure of compliance with guidelines concerning appropriate use of protective clothing.

The method of sampling can also contribute to the reliability. Sampling error can result in the sample not being truly representative of the population under consideration. According to Bowling (2005) two types of sampling error exist: systematic error where sampling is carried out incorrectly and random error where an unusually unrepresentative sample is chosen. The result of sampling error when testing a hypothesis could be that either a true hypothesis is rejected (Type 1 error), or a null hypothesis is accepted (Type II error) (Bowling, 2005). Therefore, sampling strategies may differ considerably. In this study, a purposive sample of all eligible professionals (surgeons, registrar to consultant and scrub nurses, staff nurses and above) in participating hospitals who perform exposure prone procedures or have frequent and regular contact with blood and body fluids was chosen to participate in the survey. Therefore, sampling errors were minimised and as far as possible, the results were considered representative of the opinions of these groups of staff adding to the study's reliability. However, there can be no guarantee that all participants interpret the questions in the same way. The inclusion of semi structured interviews can be used to identify whether this has occurred. In addition, non-response bias may have occurred (see 5.2.6)

3.8.2 <u>Validity</u>

Validity indicates the degree to which a measurement tool measures what it sets out to measure (Oppenheim, 1992). To improve validity, some experts and journals encourage authors to construct their questionnaires around previous work in the field (Anthony, 1999). Therefore, a search of contemporary literature was undertaken and the independent and dependent variables drawn from this material (see chapter 2 and appendix 8).

Content validity is where each item on a questionnaire or interview schedule is examined for relevance (Anthony, 1999). It has been described as a measure of the balance of the construct under consideration (Oppenheim, 1992), and is inevitably, to some extent, based on the judgment of practitioners and academics (Oppenheim, 1992; Anthony, 1999; Polit and Beck, 2004; Bryman, 2008). Content validity was strengthened both by the extensive literature review resulting in including questions used in previous studies (see table 3.1) and the intimate knowledge of the subject by the researcher and infection control colleagues. Ambiguous or poorly understood questions can adversely affect the quality of data obtained (Anthony, 1999) and was therefore minimized by extensive field testing.

A subset of content validity is face validity (Anthony, 1999). Face validity refers to whether the data collection tool looks as if it measures the construct under question (Polit and Beck, 2004; Bryman, 2008). An instrument can be said to have face validity if "stakeholders can look at the items and understand what is being measured" (Patton, 1997, p253). In this study, face validity was enhanced by consultation with experts in the field in the pre-pilot stage, namely four ICNs and three Infection Control Doctors.

Criterion-related validity relates to how well a new instrument compares with some well tried older measure (Anthony, 1999). According to Patton (1997), although the validity of a new instrument is difficult to establish, agreement is often reached concerning the relative validity of frequently used instruments. Unfortunately, no standardized questionnaires exist that could be utilised in this study. There were however, individual questions used in previous studies (Cutter and Jordan, 2003, 2004; EPINet 2003a, 2003b) that were incorporated into a new data collection instrument, which addressed this issue to a limited extent.

Construct validity, also referred to as measurement validity refers to whether the questionnaire yields results that confirm expected statistical relationships derived from existing theory (McColl *et al*, 2001) and relates to assumptions made on theoretical knowledge (Oppenheim, 1992). National and internationally recognised guidelines on which local policies are based, exist in order to reduce healthcare professionals undertaking exposure procedures from occupational acquisition of blood-borne viral infection (CDC, 1987, 1988; Lynch *et al*, 1987; UK Health Departments, 1998; Pratt *et al*, 2007; Siegel *et al*, 2007). These guidelines relate to protective measures required when undertaking exposure procedures and the action to be taken in the event of percutaneous or mucocutaneous exposure to body fluids. In this study, the theoretical knowledge underpinning the study and consequently the theory on which construct validity was measured was that related to guideline adherence. Guideline adherence is fully discussed in sections 2.8.1 – 2.8.3.

It is known that profession is a significant factor in whether healthcare professionals comply with guidelines related to the uptake of universal/standard precautions (Stein *et al*, 2003; Trim *et al*, 2003; Cutter and Jordan, 2004) and reporting of inoculation injuries (Burke and Madan, 1997; Lymer *et al*, 1997; Hettiaratchy *et al*, 1998; Haiduven *et al*, 1999; Benitez *et al*, 1999; Shiao *et al*, 1999; Alvarado-Ramy *et al*, 2003; Cutter and Jordan, 2003), with doctors less likely to comply with current guidelines than nurses. Therefore, a realistic prediction in this study would be that differences will become apparent between professional groups and compliance with guidelines. The resulting fulfillment of this prediction was a measure of construct validity.

Using profession as a criterion, one can also demonstrate concurrent validity, which uses a contemporary criterion on which subjects are known to differ and that is pertinent to the subject under investigation (Anthony, 1999; Bryman and Cramer, 2001; Bryman, 2008). Therefore, in this study, concurrent validity was established by the degree to which profession corresponds with adopting precautions and reporting appropriately.

It is recognised that compliance with standard/universal precautions can prevent or reduce the incidence of inoculation injuries (Brearley and Buist, 1989; Bell and Clements, 1991; Wong *et al,* 1991; Mast *et al*, 1993; Beekmann *et al*, 1994; Lymer *et al*, 1997; Bryce, 1998; Knight and Bodsworth, 1998; Wong *et al*, 1998; Lee *et al*, 1999; UK Health Departments, 1998). The predictive validity of the questionnaire in this study can therefore be measured by the extent to which the results demonstrate that those healthcare professionals who comply with guidelines relating to adoption of universal/standard precautions later go on to sustain inoculation injuries. However, as is not intended to subject the sample to re-testing during the course of this study, predictive validity cannot be fully tested.

When attempting to establish causality between dependent and independent variables, it is first necessary to establish an empirical relationship between them (Polit and Beck, 2004). One way in which statistical conclusion validity can be enhanced is by including a large sample, thereby ensuring high statistical power (Polit and Beck, 2004). Consideration was given to calculating sample size using statistical power calculation. However, on the advice of a statistician, this was rejected for the following reason: at the outset of the study, it was not possible to estimate the likely response rate. From previous work (Cutter and Jordan, 2003; 2004), it was known that 74% of theatre personnel within one NHS Trust in Wales had sustained at least one inoculation injury within the five years preceding the study. A sample of 297 theatre personnel was required to obtain a 95% confidence interval of +/- 5% around a prevalence estimate of 70% (Bland *et al*, 2002). However, this calculation did not take into consideration any possible clustering effects that could have arisen due to the nature of team working (Uitenbroek, 1997). No information on the possible effects of clustering in this study was available.

Ecological validity is the extent to which findings are applicable to participants' natural social settings (Bryman, 2008). One could assume that those HCPs participating in a questionnaire survey would have no reason to report their behaviour in any way other than truthfully. In which case, this study should exhibit a high degree of ecological validity. However, Bryman (2008) suggests that the falseness of having to complete a questionnaire could mean that ecological validity is compromised. Similarly, the social desirability response or the tendency to provide answers consistent with the participants view of what is desirable (Bryman, 2008) could affect ecological validity in this study as their responses may not reflect accurately their behaviour in the operating theatre.

Internal validity relates to the degree to which cause and effect can be demonstrated (Bryman and Cramer, 2001). Although this is not an experimental study, hence the independent variables cannot be manipulated to enhance internal validity (Wood and Brink, 1989; Polit and Beck, 2004), internal validity was enhanced by multi-method approaches/triangulation. Responses to questionnaires were compared with information obtained from infection control nurses. Certain responses were checked with interviewees and the internal consistency was tested by the level of agreement between responses to questions 5 and 12.

In the same way as the social desirability response could adversely affect ecological validity, it could also adversely affect internal validity – will the participants tell the researcher what they think she wants to hear rather than what actually happens? For a variety of reasons, reported behaviour may not correspond with actual behaviour (Jordan, 2000; Bryman, 2008). For example, some respondents may be reluctant to report their failure to comply with established guidelines for fear of reprisals. Similarly, some questions may appear threatening and fail to elicit an honest response (Bryman, 2008).

Although confidentiality was assured, concerns over loss of anonymity could have affected the candour with which participants answered, particularly as the responses were potentially sensitive e.g. prejudices, lack of compliance with established policies/guidelines (Guiffre, 1997; Polit and Beck, 2004) hence social desirability bias could be introduced (Bryman, 2008).

External validity, or "the extent to which the opinions of the population surveyed represent the opinions or behaviour of another population" (Guiffre, 1997, p361) will be increased but not guaranteed by a large sample and compromised by a low response rate (Barriball and While, 1999; Passmore *et al*, 2002) as there is no way of knowing conclusively that the opinions of the population surveyed are generalisable to the population. Similarly, the respondents may not be typical of the sample. It is impossible to state with absolute certainty that the demographics of the non-responders are close to those of the responders in this study as they may differ considerably in age, nationality, speciality and level of experience.

3.8.3 Summary

The following table describes the methods used in this study to demonstrate rigour.

Table 3.3: Methods to demonstrate rigour.

Criteria	**Method**
External reliability (stability)	Test – retest of questionnaire Use of similar questionnaire in previous study (Cutter and Jordan, 2003; 2004) Extensive pre-pilot and pilot studies
Internal reliability	Cross checking of questions Purposive sampling Cognitive interviews
Content validity	Literature review Level of knowledge of subject by researcher and infection control colleagues Extensive field testing
Face validity	Pre pilot study
Criterion related validity	Use of similar questionnaire in previous study (Cutter and Jordan, 2003;2004) (issue addressed to a limited extent)
Construct validity	Literature review Underlying theory (guideline adherence)
Concurrent validity	Establish degree to which profession related to adherence to guidelines e.g. DOH (1998)
Predictive validity	Establish extent to which those who comply with precautions are likely to sustain inoculation injuries (issue addressed to limited extent only)
External validity	Large sample size Response rate 51.47%

3.9 Demonstrating rigour in qualitative research

In quantitative research, rigor is determined through the concepts of reliability and validity. Some authors (LeCompte and Goetz, 1982; Goodwin and Goodwin, 1984; Morse, 1999; Silverman, 2001) also support the application of these criteria for determining rigor in qualitative research. However, many others "especially in nursing, are vocal in denouncing reliability and validity as the most appropriate criteria of rigor in qualitative research – notwithstanding a continuing commitment to the value of criteria *per se*" (Emden and Sandelowski, 1998, p208).

Even among those who agree that criteria for identifying rigor in qualitative research should be defined, there is disagreement regarding their definition, not least because qualitative research is a term that describes a variety of research methodologies arising from "the traditions of philosophy, anthropology, psychology, history and sociology" (Koch, 1996, p175). Furthermore, there are profound differences between the methodologies in relation to philosophy, theory, ontological and epistemological orientations, common understandings and goals (Lincoln and Guba, 1985). Therefore, despite numerous terms having been suggested to define the criteria necessary to determine rigour in qualitative research, none have been universally adopted (Whittemore *et al*, 2001), although those suggested by Lincoln and Guba (1985) are considered the 'gold standard' (Whittemore *et al*, 2001). Lincoln and Guba (1985) suggest that an appropriate measure of the merit of a qualitative study is trustworthiness. Within the concept of trustworthiness, there are parallels with quantitative research criteria credibility with internal validity, transferability with external validity, dependability with reliability and confirmability with objectivity (Lincoln and Guba, 1985). Leininger (1994) offers a different set of criteria, that of credibility, confirmability, meaning in context, recurrent patterning, saturation and transferability.

Despite every effort, interview data and hence the semi-structured interviews in this study, may be more vulnerable to subjective interpretation and consequently considered less reliable than quantitative data because data are likely to be inconsistent and viewed subjectively (Hall and Hall, 2004). Indeed, it has been suggested that reliability in qualitative research is unimportant since because social reality is in a constant state of flux there is no need to concern ourselves with whether or not our research instruments measure accurately (Marshall and Rossman, 1989). According to Greenhalgh (1997) in qualitative research, the strength lies in its closeness to the truth.

It is possible that each informant may understand the questions in a different way and that the researcher may be unable to code qualitative answers with certainty (Silverman, 2001). The involvement of different individuals and the influence of the researcher will all have a bearing on the quality of the data collected and the interpretation of such data (Denscombe, 2003; Bryman, 2008). Those chosen to be interviewed in a qualitative study are unlikely to be representative of a population (Bryman, 2008). Indeed in this study, the participants who were interviewed were deliberately chosen for their atypical views or actions. Thus the data generated during qualitative research may be ungeneralisable and difficult to replicate. According to Bryman (2008), the purpose of qualitative research findings is not to generalise to populations but to theorize.

According to Guba and Lincoln (1994) the term dependability in qualitative research, can be considered synonymous with reliability in quantitative research. To improve dependability, Lincoln and Guba (1985) recommend that field notes, transcripts, data analysis decisions and conclusions should be audited by a third party to ensure that correct procedures have been followed. Silverman (2001) who also feels that standardised methods should be used for recording field notes supports this view. However, this may be a demanding task as the volume of material generated during qualitative research is extremely large (Bryman, 2008). Nevertheless, as there were only 16 interviews conducted, the researcher's academic supervisor performed an audit of all information generated during the interviews.

Dependability may be compromised if there is a failure to accurately transcribe tape recorded interviews including pauses, body movements and overlaps (Silverman, 2001). Every effort was made to increase dependability by thorough piloting of the interview schedule. Careful transcription of interview tapes, inviting the supervisor as well as the researcher to listen to audio tapes, presenting extracts of data in the dissertation and audit were utilised to increase dependability (Lincoln and Guba, 1985; Silverman, 2001).

Sandelowski (1993) believes that applying criteria for measuring validity in qualitative research stifles sensitivity and artfulness. Whittemore *et al* (2001) however, maintain that while the importance of creativity in qualitative research must be recognised this must compromise the quality of the science and have identified a series of primary criteria necessary to all qualitative research: credibility, authenticity, criticality and integrity. However, as these may be insufficient, secondary criteria, applicable to particular investigations are also suggested to provide ensure quality. They are: explicitness, vividness, creativity, thoroughness, congruence and sensitivity. Morse (1994) ascertains that as the researcher is the research instrument, the quality of the research is only as good as that of the researcher and that this is measured using criteria such as good people skills, resilience, patience and meticulousness, creativity and the degree of meticulousness when carrying out the project. Consequently, according to Angen (2000), the concept of validity as truth and certainty must be forgotten and replaced with the notion of trustworthiness "within a human community" (p392). She suggests that validation rather than validity better describes the process of establishing rigor within qualitative research.

It would appear that there is a lack of agreement concerning how to demonstrate rigour in qualitative research. Therefore, Koch (1996) suggests that all the researcher need do is to describe the way in which one attempts to define rigour in a qualitative study and allow the reader to reach their own conclusions on the believability of the study.

3.10 <u>Data checking</u>

With a large data set, such as this, it is important to guard against errors in data entry (Altman, 1991). Therefore, a third person check on 115 randonly selected questionnaires for clerical errors and implausible values and outliers was undertaken. Initially, a secretary entered the data from 50 questionnaires into an SPSS database and using 'Data Builder', the academic supervisor compared the files created by the researcher and the secretary for errors. Minimal errors were detected following a check on the first 50 questionnaires and these were corrected. The process was repeated on a further 65 questionnaires and no errors detected.

The academic supervisor carried out an audit of qualitative data to ensure that that correct procedures were followed. The audit included a review of field notes, transcripts, data analysis decisions and conclusions and listening to audio tapes (Silverman, 2001; Lincoln and Guba, 1985).

3.11 Ethical considerations

In order to conduct a study ethically it is essential that the study has scientific and medical value, poses minimal or no risk to participants (or compensates for risks by possible benefits), ensures adequate informed consent for participants, does not cause undue offence or trauma, does not breach confidentiality and does not waste money (Boynton and Greenhalgh, 2004; Wald, 2004). The most fundamental ethical principle is that no harm should come to those taking part, a concept known as beneficence, which also seeks to "prevent exploitation of, and maximise benefits for, study participants" (Polit and Beck, 2004, p712). Participants have the right to expect that their information will be used lawfully and ethically and personal information should not be used without consent of the individual (RCN, 2005). This applies not only to the process of data collection, but must extend to the final written report and publications.

Research governance was designed to ensure that research is conducted in such a manner as to achieve high scientific and ethical standards (Medical Research Council, 1997; Welsh Assembly Government (WAG), 2001). It aims to improve research quality and protect the public through:

- "Enhancing ethical and scientific quality
- Promoting good practice
- Reducing adverse incidents and ensuring lessons are learnt
- Preventing poor performance and misconduct" (WAG, 2001, p3).

In a mixed method study such as this, ethical principles have to be observed through both the quantitative (survey) and quantitative (interview) data collection phases.

It is paramount that potential participants know exactly what subject will be covered, which may be sensitive or distressing (Hunn 2006) and should be approached with sufficient time for them to reflect on the implications of participating, and not to feel pressurised into taking part. Therefore, initial contact was made by letter for both phases of the study. For the survey, participants were able to take as much time as needed before responding and prior to the interviews, each participant was asked to make contact with the researcher to arrange a mutually convenient time and place.

Researchers should attempt to be realistic in any claims relating to the study's capacity to make change (Polit and Beck, 2008). The aims and objectives of the study were explained in the invitation letter and information sheet (appendices 4 and 5). In addition, honest responses were given to the four interviewees who asked what would be done with the information collected.

Informed consent helps to ensure that participants are not deceived or coerced into participating in research while ensuring participants' understanding of the study and is a major factor in protecting them from harm (RCN 2005). Prior to the interviews, signed informed consent was obtained. Two copies of the consent form were signed; one each retained by the researcher and the interviewee. The participants' right to withhold information or withdraw from the study was emphasised on the information sheet and verbally prior to the interview (RCN, 2005: Hek and Moule, 2006). Similarly, the right to stop recording should anything be said that the interviewee may not want 'on the record' was stressed verbally prior to the interviews. Participants were provided with the contact details of the researcher in case they had any questions relating to the research and those of the academic supervisor in the event of any complaints relating to the research (Hek and Moule, 2006). However, no such contact was made. For the questionnaire survey, a completed questionnaire was presumed to represent consent.

To protect anonymity and maintain confidentiality, names and the identity of participants were not and will not be revealed during any communication with any individual (including the academic supervisor), in the final thesis or any resulting publications. Nothing will be included that could identify the participating NHS Trusts. All questionnaires and interviewees are referred to by an identity number (Hek and Moule, 2006). On completion of the study i.e. examination of the thesis and after allowing time for feedback from publication of the findings, all identifiable material will be removed from the tape and transcript and questionnaires will be destroyed (Tod, 2006). During the study, all hard copies of any research material were stored in locked, secure storage and electronic data were be stored in a password protected computer retained for the researcher's own use (Hek and Moule, 2006; Tod, 2006).

Research Ethics Committee Approval

Application for ethical approval was made via the Central Office for Research Ethics Committees (COREC). Following electronic submission of the COREC form, the first review of the study was carried out by the Dyfed Powys Research Ethics Committee in September 2004 at which the researcher and academic supervisor were present. Following this meeting approval was denied as the statistician on the committee had concerns that the application did not contain definitive details concerning the statistical tests to be undertaken. Following this refusal, an appeal was lodged against the decision and on November 12th 2004 a meeting of the Multi-Centre Research Ethics Committee for Wales (MREC) held in Cardiff without the presence of the researcher and academic supervisor, overturned the decision. A full account of the procedure for obtaining ethical approval can be found in chapter five.

As the study progressed, it was clear that the response rate to the survey was not as high at 51.47% as originally hoped. Therefore, to improve the volume and quality of data collected an increase in the number of semi-structured interviews and the numbers of questions in the interview schedule were required. A submission was made to the MREC in August 2006 to amend the research protocol to incorporate the increase in number of interviews and the revised interview schedule. Approval was granted at the meeting held in Cardiff on August 10th 2006.

3.12 CONCLUSIONS TO CHAPTER THREE

The methods used to conduct this study were chosen to gain maximum information on the behaviour of HCWs in relation to universal precautions and inoculation injury reporting. After carefully considering the objectives of the study, a questionnaire was designed for eliciting information from the surgeons and scrub nurses that utilised previous studies to increase the validity and reliability of the instrument. Postal questionnaires were chosen as the most suitable method for collecting information from large numbers of respondents without an excessive time commitment and without bias from the interviewer affecting the quality of the results. The fact that this method of data collection had proved successful for other authors was also considered. Face to face interviews were conducted with a sample to improve the richness of the data, while telephone interviews with the Infection Control Nurses were used to verify information provided by the surgeons and scrub nurses.

Extensive pre-piloting and piloting of the data collection tools, in particular, the questionnaires for surgeons and scrub nurses, ensured that the questions were understandable and that the tools were capable of eliciting the required information. Analysis of the returned pilot questionnaires demonstrated that the results were suitable for analysis using SPSS for Windows.

While every effort was made to ensure that the study was as comprehensive as possible, there were limitations in the study, its design and data collection methods that could have affected the interpretation of the results. These will be discussed in relation to this study in chapter five.

Chapter four describes the results of the survey.

CHAPTER FOUR
PRESENTATION OF FINDINGS

4.1 INTRODUCTION

This chapter discusses the findings from each of the three data sets. These findings will be presented separately at first before being discussed together to identify differences and similarities in the data. The findings will be considered as follows: telephone interviews of senior ICNs, questionnaire survey of surgeons and scrub nurses, semi-structured interviews with surgeons and scrub nurses.

4.2 TELEPHONE INTERVIEWS, INFECTION CONTROL NURSES

All six Trusts included in the study had a policy for the prevention and management of inoculation injuries. Each one advised the use of standard/universal precautions for all exposures to blood and body fluids. In addition, all the policies advised on the appropriate reporting procedures following accidental exposure to blood and body fluids. Dissemination of the policies in every Trust was via hard copy and Trust intranet.

Five of the ICNs received reports of all percutaneous and mucocutaneous exposures to blood and body fluids within their Trust. Two of these received copies automatically (Trusts 3 and 4), while one had to request the information via DATIX (Trust 6), and two Trusts accessed the information via unspecified Health and Safety databases (Trusts 1 and 5). One ICN (Trust 2) received notification of percutaneous exposures only

Five ICNs reported the number of reports they had received during the year January 1st – December 31st 2004. The numbers ranged from 29-276 as follows:

- Trust 1 – 29;
- Trust 2 – 276;
- Trust 3 – 47 sharps injuries and 6 blood splash injuries;
- Trust 4 - 30;
- Trust 5 – no data;
- Trust 6 – 65.

Only Trust 6 was able to determine how many surgeons (3) and scrub nurses (3) had reported exposures during this period.

In five Trusts (Trusts 1, 2, 4, 5 and 6) incidents were followed up by the Occupational Health Department. Incidents in Trust 3 were followed up at directorate level. However, if a breakdown in procedure was identified, the ICNs in Trusts 1 and 5 would be asked to investigate. Analysis of inoculation injury reports was used in Trusts 2, 3, and 5 to provide a basis for evaluation of current preventative measures, policy compliance, education and audit.

All ICNs provided training sessions on the prevention and management of inoculation injuries for healthcare personnel of all professions. Frequency of sessions ranged from twice monthly during staff inductions and twice monthly infection control sessions (Trust 1), monthly (Trusts 4 and 5), 4 times a year (Trust 3), 8 times a year plus *ad hoc* sessions (Trust 6) and as necessary (Trust 2). Training was mandatory in Trusts 1, 3, 4 and 6.

The content of the training sessions was as follows:

- Trust 1 - policy awareness, risk assessment, sharps safety, testing for blood-borne viruses in patients and staff and injury prevention;
- Trust 2 – best practice in relation to sharps safety and handling, procedure to be followed in the event of an inoculation injury;
- Trust 3 – sharps safety, policy awareness, prevention of injuries;
- Trust 4 – policy awareness, prevention of injuries, post exposure treatment;
- Trust 5 – standard precautions, prevention strategies, policy awareness, the role of the Occupational Health and Accident and Emergency Departments;
- Trust 6 – sharps safety, correct disposal of sharps, management of inoculation injuries.

Attendance at training sessions throughout 2004 varied widely:

- Trust 1 – 48 to sessions related to needlestick injuries, 20 to sessions concerning the use of universal precautions, 20 -30 at new staff induction;
- Trust 2 – 411
- Trust 3 – 385
- Trust 4 – uncertain of numbers but only approximately 25% of available staff attended
- Trust 5 – no data
- Trust 6 – 284.

Only three Trusts had data concerning the number of scrub nurses and surgeons who attended the training sessions during 2004. In Trust 1 no surgeons and 3 scrub nurses attended sessions on sharps injuries and standard precautions although all new staff attend induction; Trust 3 – no surgeons, 73 scrub nurses; Trust 4 – no surgeons and 30 scrub nurses.

Section 4.3 discusses the results of the questionnaire survey.

4.3 RESULTS – QUESTIONNAIRE SURVEY

Introduction

This section presents the results of analysis of the quantitative data from the questionnaire survey. Results are first presented as frequency tables related to each individual question and then in relation to the objectives of the study (see section 1.2). They are reported in the following order: description, bivariate analysis and logistic regression models where the primary outcome variables were 'sustaining a sharps injury at one and five years' from which the odds ratios of the contribution of the variables highlighted in the literature was estimated. Sample SPSS print-outs can be found in appendices 15 and 16. Only statistically significant results are presented in this chapter, non significant results are presented in appendix 16.

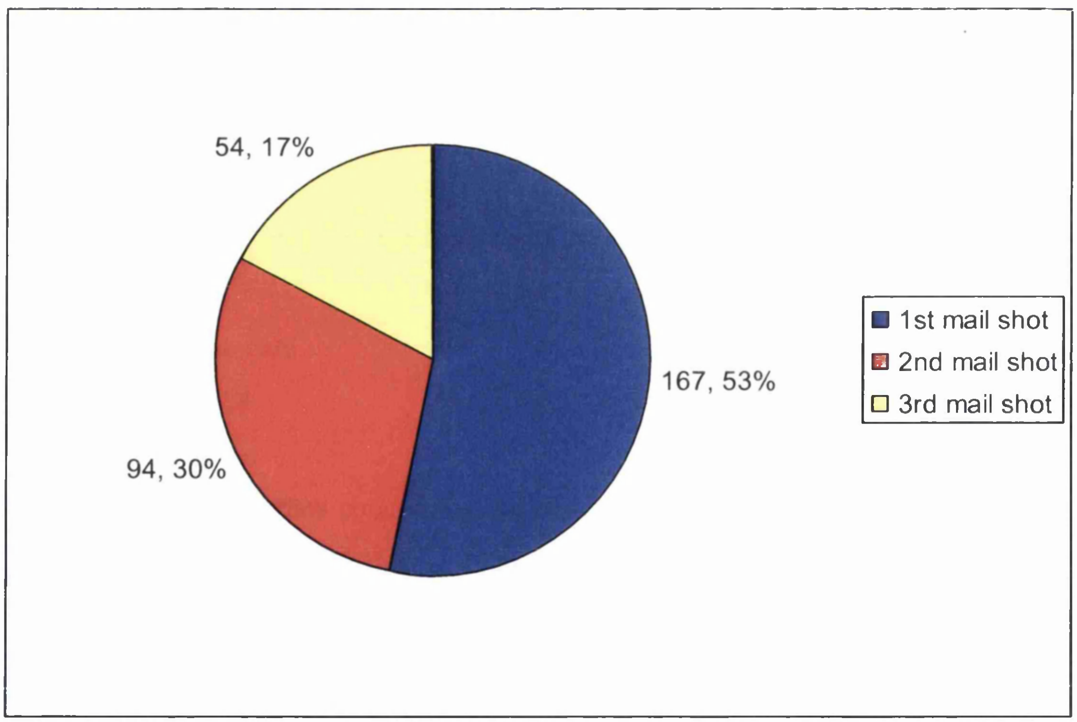
Results

4.3.1 Response rate

A total of 612 questionnaires were distributed within the six participating NHS Trusts in Wales, 287 to scrub nurses and 325 to surgeons. In total, 315 questionnaires were returned giving an overall response rate of 51.47%. Within the sample, 180/315 respondents were surgeons (57%) and 135/315 were nurses (43%). The difference in response rate between professions was statistically significant. However, the result was borderline (χ^2 3.923, p=0.048, 95% CI 0.52-0.98).

In this study, reminders were sent to those who failed to respond to the first mail shot to improve the response rate. The response rate increased from 27.28% following the first mail shot to 42.64% following the second mail shot to 51.47% by the third mail shot. The frequency of those responding to first second and third mail shots respectively can be seen in chart 4.3.1

Chart 4.3.1: Respondents replying to first, second and third mail shots



The demographic characteristics of those replying to each mail shot were examined. There were no statistically significant differences between professions responding to each mail shot when tested using the χ^2 test (χ^2 1.694, p=0.429). The relationship between length of time qualified, length of time in current speciality, surgeons' speciality and mail shot were tested using the Kruskal-Wallis test where the grouping variable was mail shot and 1=1st mail shot, 2=2nd and 3=3rd. In each case, no statistically significant relationship was demonstrated as follows: χ^2 1.352, p=0.509 in relation to length of time qualified; χ^2 1.971, p=0.373 in relation to length of time in current speciality; and χ^2 3.04, p=0.219 in relation to surgeons' speciality (see tables A16.2-A16.5).

The questionnaire was divided in two sections, part one was intended for all respondents (n=315) and part two only for those who had sustained one or more inoculation injuries within the last five years (n=219).

Every questionnaire was examined for completion rate. To identify completion rate, each question (with the exception of question 16 which required a qualitative response) was examined to see how many components it contained. Where a question could be broken down into components each of which demanded a unique answer, i.e. questions 5, 6, 7 and 15, each component was considered as one question, giving a total of 37 questions, 23 in part one and 14 in part two.

Two hundred and forty one questionnaires (76.5%) were 100% complete. A further 35 respondents (11.1%) had completed between 90 and 99% of questions and 16 (5%) had completed between 80 and 89% of questions. Therefore, a total of 92.7% (292/315) of respondents had answered in excess of 80% of the questions. These questionnaires were considered complete. A total of 23 respondents (7.3%) completed between 50 and 79% of the questionnaire. The partially completed questionnaires are listed in table 4.3.1.

The definitions of complete (>80%) and partially complete (50-80%) were taken from the American Association for Public Opinion Research (2004).

Table 4.3.1: Questionnaire completion proportion – partially completed or incomplete

Questionnaire number	Total number of questions answered	Proportion completed
117	29	78.4%
168	29	78.4%
301	29	78.4%
80	28	75.7%
113	28	75.7%
225	28	75.7%
268	28	75.7%
26	27	72.3%
197	27	72.3%
241	27	72.3%
284	27	72.3%
183	26	70.3%
83	25	67.7%
2	23	62.2%
13	23	62.2%
135	23	62.2%
147	23	62.2%
209	23	62.2%
260	23	62.2%
275	23	62.2%
287	23	62.2%
309	23	62.2%
219	21	56.6%

Completion rates were also calculated for both part one and part two of the questionnaire. Three hundred and one respondents completed all of part one (301/315, 95.6%), 12/315 (3.8%) completed between 90 and 99% of questions in part one and 2/315 (0.6%) completed between 50 and 79%. Therefore, for part one, 313/315 questionnaires (99.4%) were considered complete and 2/315 (0.6%) considered partially complete, none were incomplete (table 4.3.2)

Table 4.3.2: Part one partial completion rate

Questionnaire number	Number of questions answered in part 1	Proportion completed in part 1
309	14	60.9%
219	13	56.5%

In part two of the questionnaire, 169/219 of eligible respondents i.e. those who reported sustaining an inoculation injury within the last five years (77.2%) answered all questions, 12/219 (5.5%) answered 90-99% of questions and 1/219 (0.5%) answered 80-89%. Therefore, in 182/219 of questionnaires (83.1%) part two was considered complete. Seventeen respondents (17/219, 7.8%) answered 50-79% of questions in part two and these questionnaires were considered partially complete for part two. However, 20/219 (9.1%) were considered incomplete as <50% of questions were answered. Of these 8/20 (40%) failed to answer any questions in part two (table 4.3.3). These cases were used for analysis within part one only.

Table 4.3.3: Part two completion proportion – partially completed or incomplete

Questionnaire number	Number of questions answered in part 2	Proportion completed in part 2
5	11	78.6%
112	11	78.6%
28	10	71.4%
74	10	71.4%
114	10	71.4%
127	9	64.3%
184	9	64.3%
273	9	64.3%
176	8	57.1%
220	8	57.1%
228	8	57.1%
246	8	57.1%
277	8	57.1%
297	8	57.1%
226	7	50%
168	7	50%
284	7	50%
70	6	42.9%
80	6	42.9%
117	6	42.9%
113	5	35.7%
209	5	35.7%
241	5	35.7%
256	5	35.7%
268	5	35.7%
287	5	35.7%
26	4	28.6
183	3	21.4
83	2	14.3
2	0	0%
16	0	0%
135	0	0%
147	0	0%
197	0	0%
212	0	0%
260	0	0%
275	0	0%

4.3.2 Interval variables

Respondents had been qualified between 1.75 and 44 years (surgeons 3-40 years, scrub nurses, 1.75-44 years). These data were not distributed normally (Sig. 0.01) and are presented in tables 4.3.4 and 4.3.5, histogram 4.3.1.

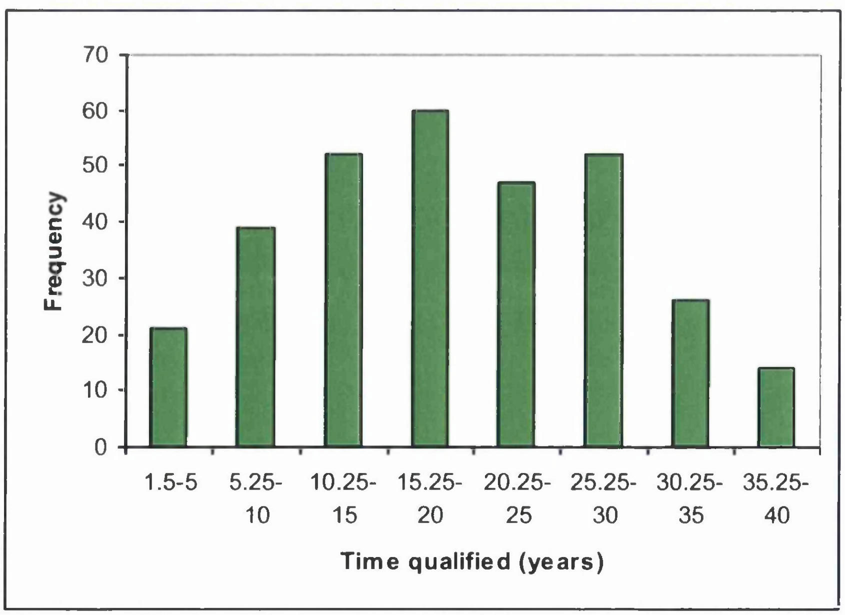
Table 4.3.4: Length of time qualified - all respondents (response rate to question 2 = 313/315, 99.4%)

Number	Mean (5% trimmed mean)	Median	Range in years (Minimum-maximum)	Standard deviation
313	19.71 (19.60)	20.00	42.25 (1.75-44.0)	9.52

Table 4.3.5: Tests of normality: qualified (all respondents)

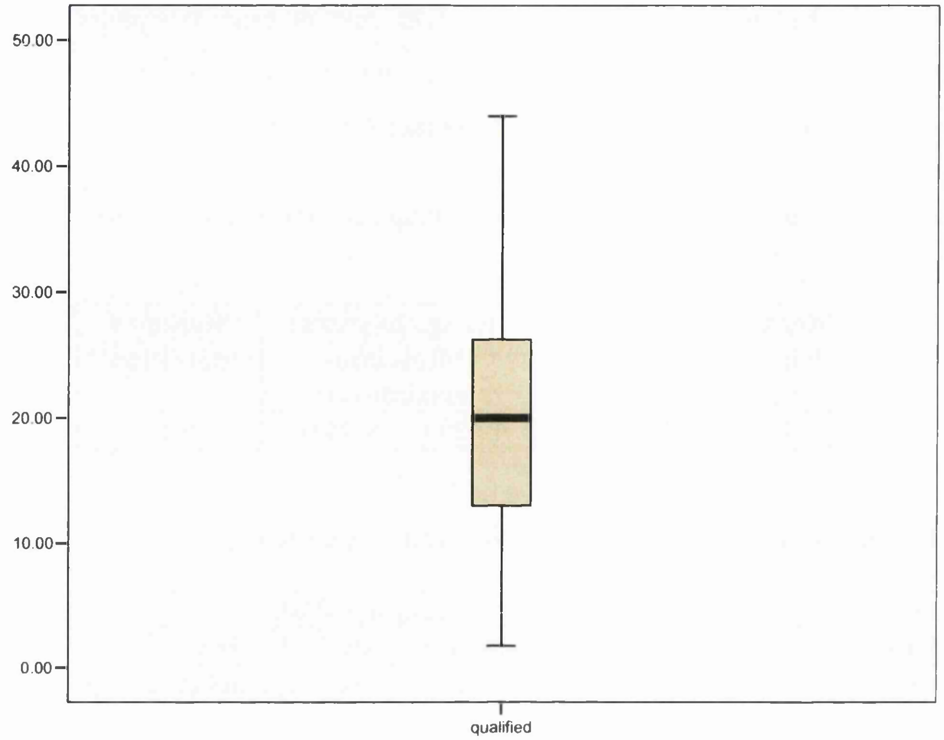
Kolmorrov-Smirnov			Shapiro-Wilk		
Statistic	df	Sig.	Statistic	df	Sig.
0.059	313	0.010	0.982	313	0.000

Histogram 4.3.1: Length of time qualified -all respondents



No outliers were identified (boxplot 4.3.1 where the *y* axis represents time qualified in years).

Boxplot 4.3.1: Length of time qualified (all respondents)



When considering length of time since qualification by profession, data for surgeons were not normally distributed (Sig value 0.00) but were for scrub nurses (Sig. 0.2). See tables 4.3.6 and 4.3.7, histograms 4.3.2 and 4.3.3.

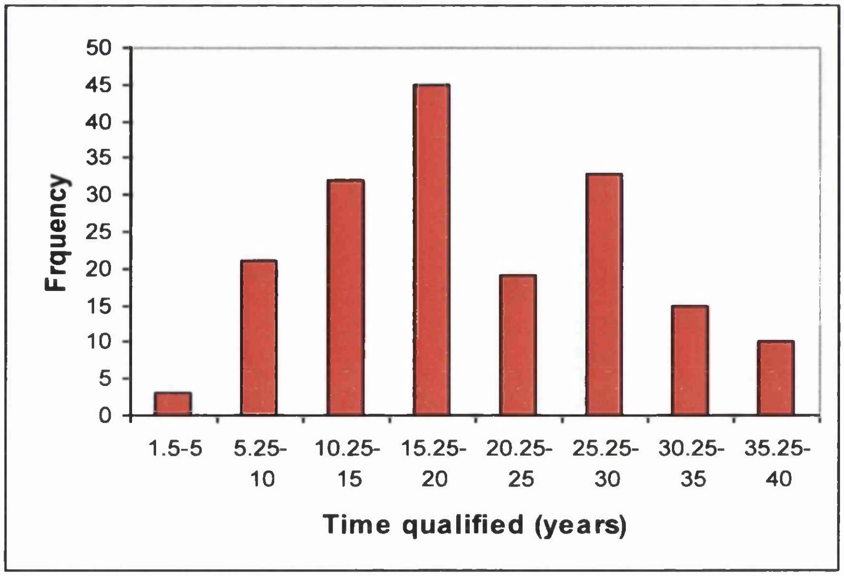
Table 4.3.6: Length of time qualified by profession

Profession	Number	Mean (5% trimmed mean)	Median	Range in years (Minimum-maximum)	Standard deviation
Surgeon	178	20.73 (20.63)	20	37 (3 – 40)	8.73
Scrub nurse	135	18.37 (18.11)	19.5	42.25 (1.75 – 44)	10.35

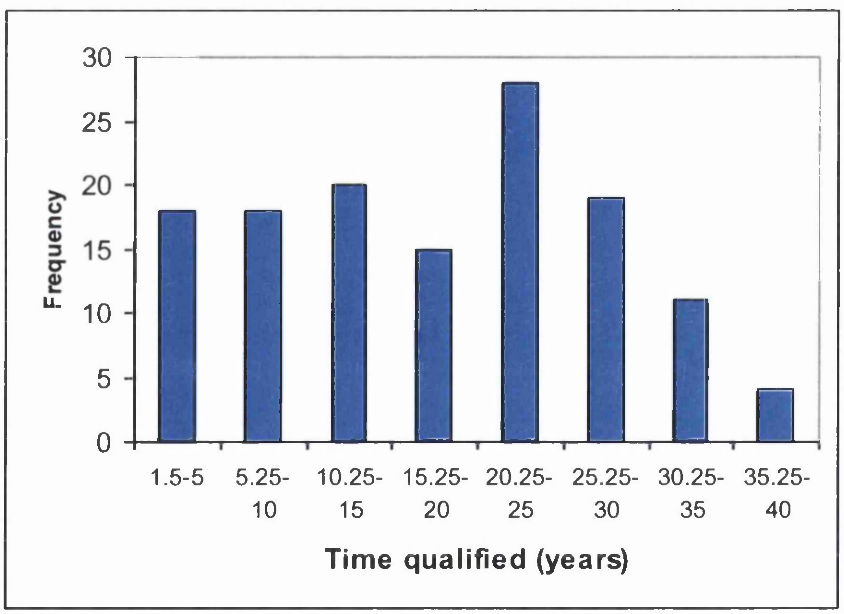
Table 4.3.7: Tests of normality qualified by profession

	Kolmorrov-Smirnov			Shapiro-Wilk		
Profession	Statistic	df	Sig.	Statistic	df	Sig.
Surgeons	0.101	178	0.000	0.971	178	0.001
Scrub nurses	0.165	135	0.200	0.968	135	0.003

Histogram 4.3.2: Length of time qualified by profession – surgeons

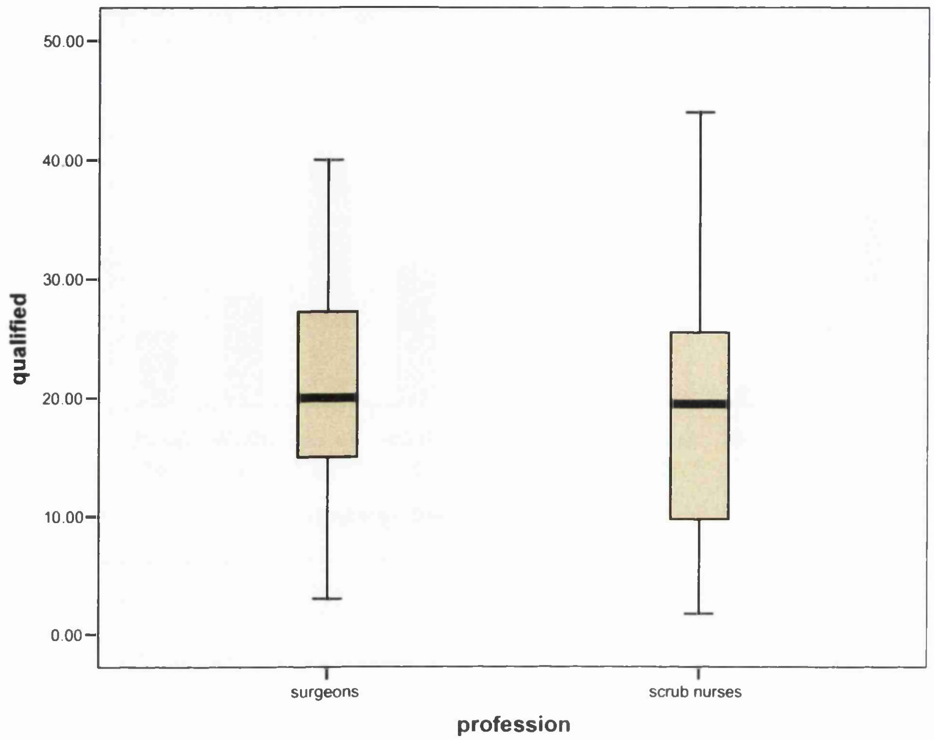


Histogram 4.3.3: Length of time qualified by profession – scrub nurses



No outliers were identified (boxplot 4.3.2 where the *y* axis represents time qualified in years).

Boxplot 4.3.2: Length of time qualified by profession



Length of time working in current speciality ranged from 0-37 years (tables 4.3.8 and 4.3.9, histogram 4.3.4). These data were not normally distributed. No outliers were identified (boxplot 4.3.3 where the *y* axis represents time working in current speciality in years).

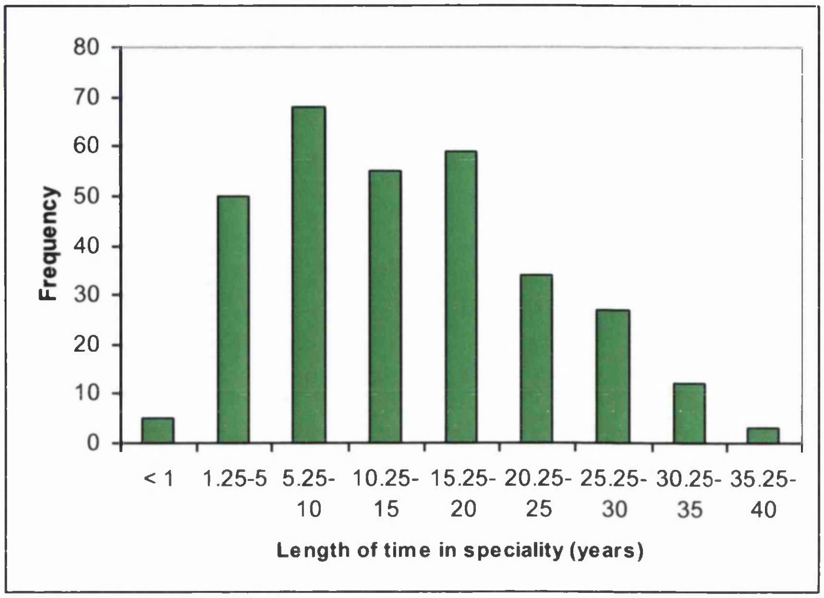
Table 4.3.8: Length of time working in current speciality (response rate to question 3 = 313/315, 99.4%)

Number	Mean (5% trimmed mean)	Median	Range in years (Minimum-maximum)	Standard deviation
313	14.57 (14.24)	13.75	37.0 (0-37.0)	8.83

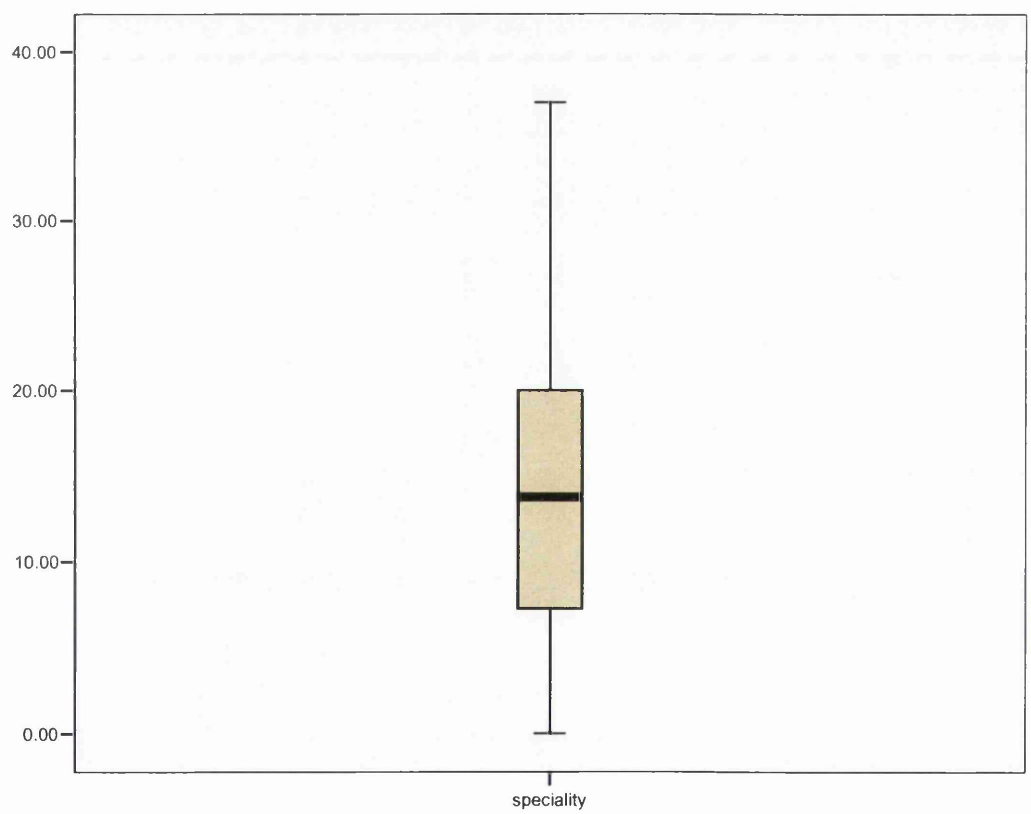
Table 4.3.9: Tests of normality: length of time working time in current speciality (all respondents)

Kolmorrov-Smirnov			Shapiro-Wilk		
Statistic	df	Sig.	Statistic	df	Sig.
0.091	313	0.000	0.963	313	0.000

Histogram 4.3.4: Length of time working in current speciality (all respondents)



Boxplot 4.3.3: Outliers – time in current speciality (all professions)



When considered by profession, length of time in current specialty ranged from 0 – 37 years for surgeons and 0 -36 years for scrub nurses. These data were not normally distributed for either profession (tables 4.3.10 and 4.3.11, histograms 4.3.5 and 4.3.6).

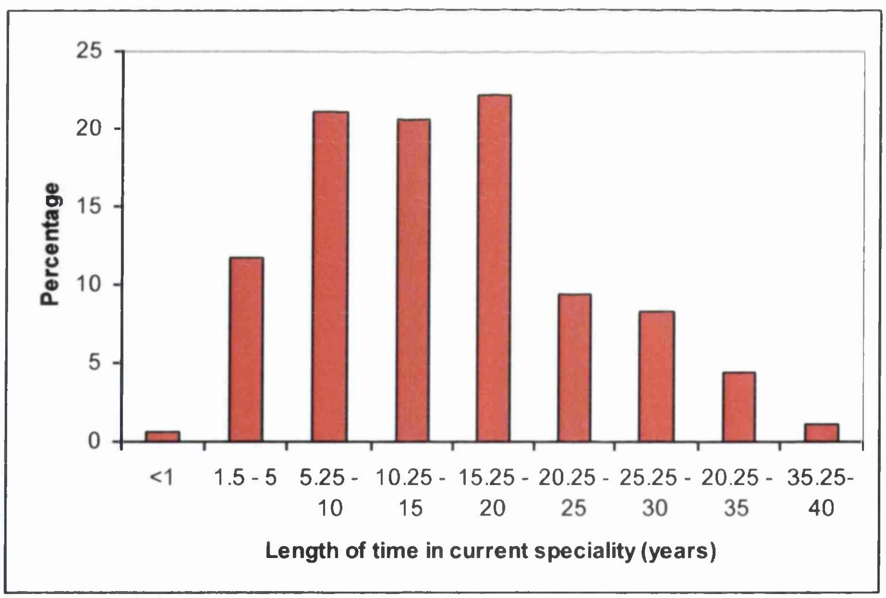
Table 4.3.10: Length of time in current speciality by profession (response rate to question 3 = 313/315, 99.4%)

Profession	Number	Mean (5% trimmed mean)	Median	Range in years (Minimum-maximum)	Standard deviation
Surgeon	179	15.49 (15.17)	15.0	37 (0-37)	8.49
Scrub nurse	134	13.33 (12.97)	11.0	36 (0-36)	9.16

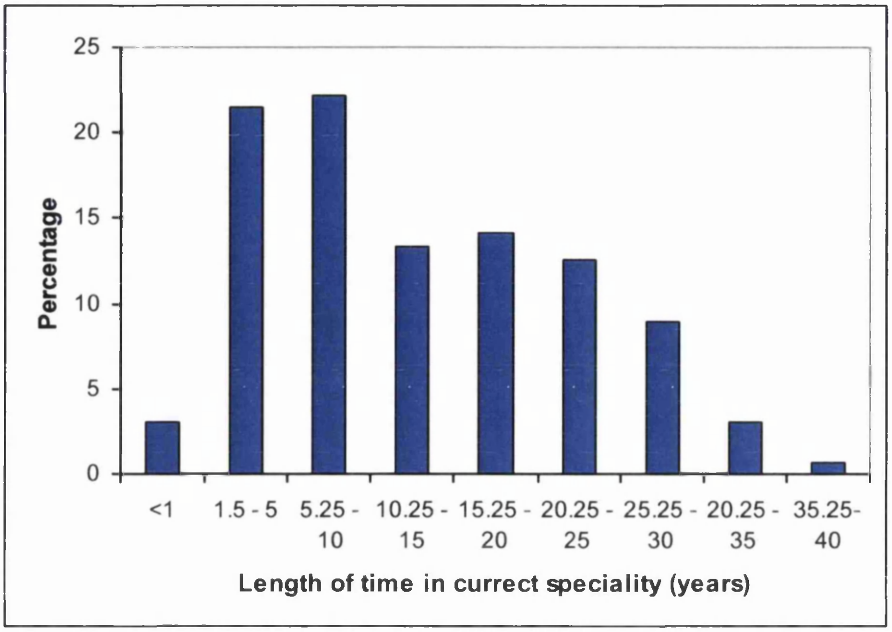
Table 4.3.11: Tests of normality length of time in current speciality by profession

	Kolmorrov-Smirnov			Shapiro-Wilk		
Profession	Statistic	df	Sig.	Statistic	df	Sig.
Surgeons	0.143	179	0.000	0.943	179	0.000
Scrub nurses	0.187	134	0.000	0.930	134	0.000

Histogram 4.3.5: Length of time in current speciality - surgeons

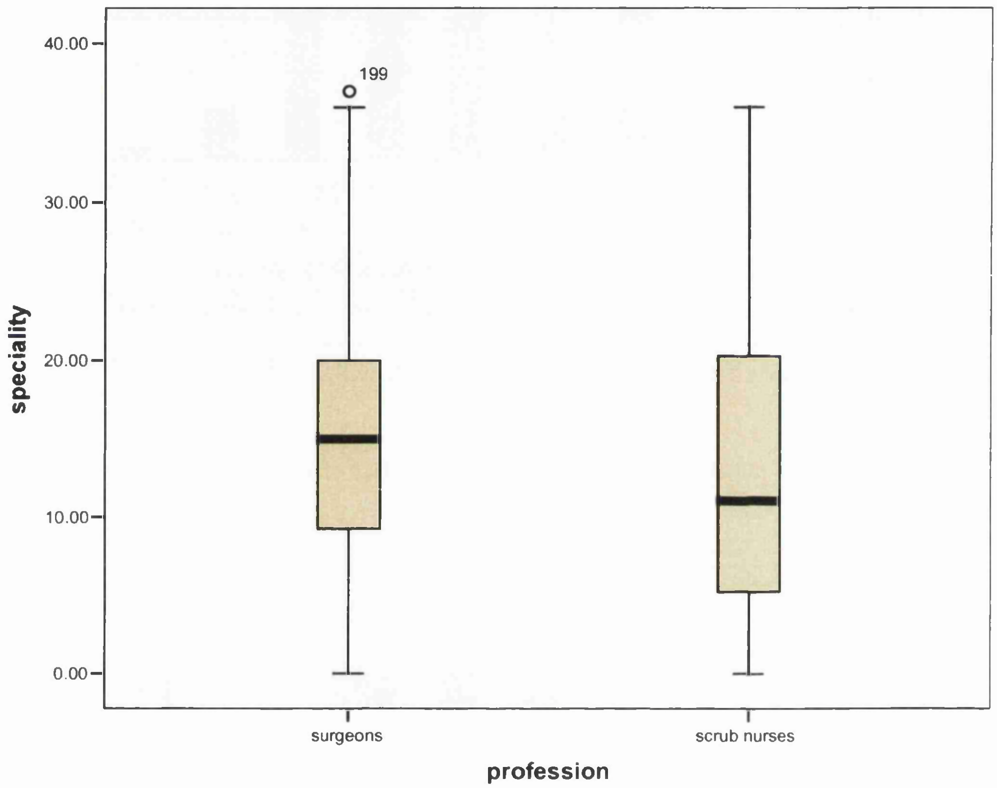


Histogram 4.3.6: Length of time in current speciality – scrub nurses



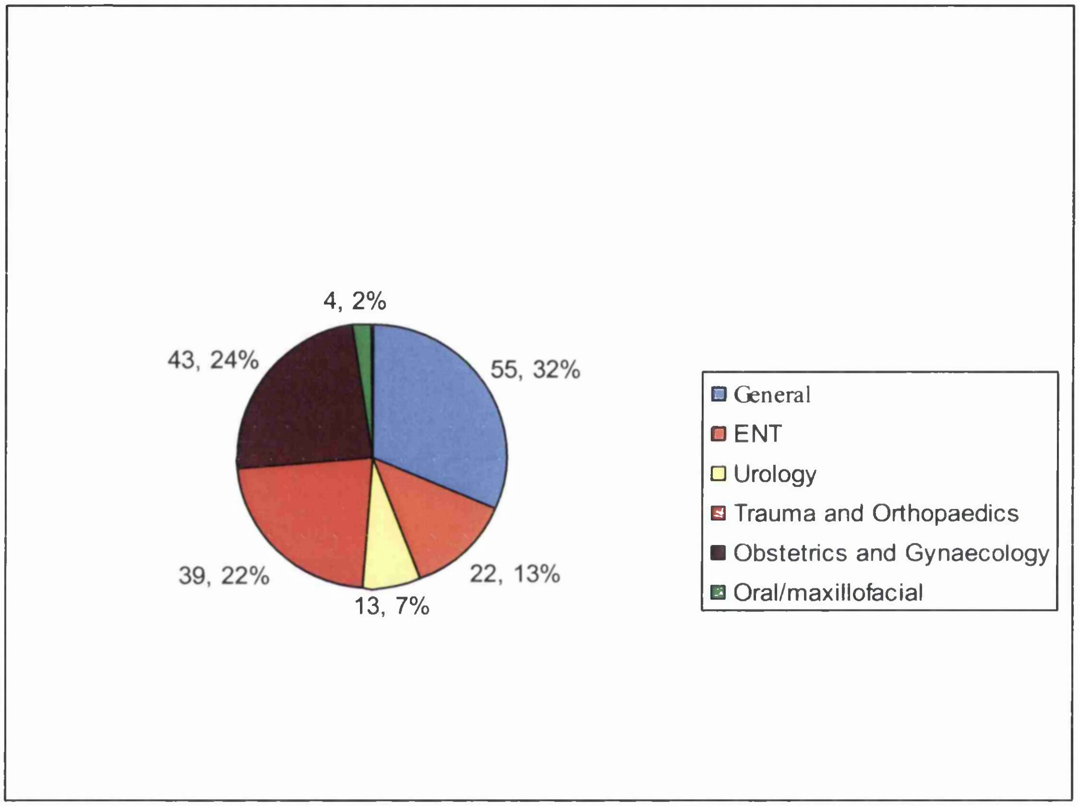
One outlier was identified – respondent number 199, a surgeon (boxplot 4.3.4 where the *y* axis represents time working in current speciality in years). According to Anthony (1999) outliers can affect the correlation coefficient with parametric tests. However, as these data were not normally distributed, parametric tests cannot be conducted including this variable. Therefore, case number 199 was retained.

Boxplot 4.3.4: Outliers - profession by length of time in current speciality



Surgeons were asked in which speciality they were employed (chart 4.3.2). This was not asked of scrub nurses as they usually work across a range of specialities. The largest single speciality was general surgery, however, within this category were those who 'sub-specialised' in breast, endocrine, colo-rectal, gastrointestinal and vascular surgery.

Chart 4.3.2: Surgeons' speciality



Compliance with a range of precautions for minimising contact with blood and body fluid during exposure prone procedures were examined in the survey. They were: use of double gloves, eye protection, avoiding passing sharps from hand to hand and use of safety devices. Of these, only the first three variables are under the control of all theatre personnel. This will be discussed further in sections 4.6 and 5.6. Only 10.3% of respondents to the questionnaire survey (31/302) adopted all precautions for every patient (13 missing values). See table 4.3.12.

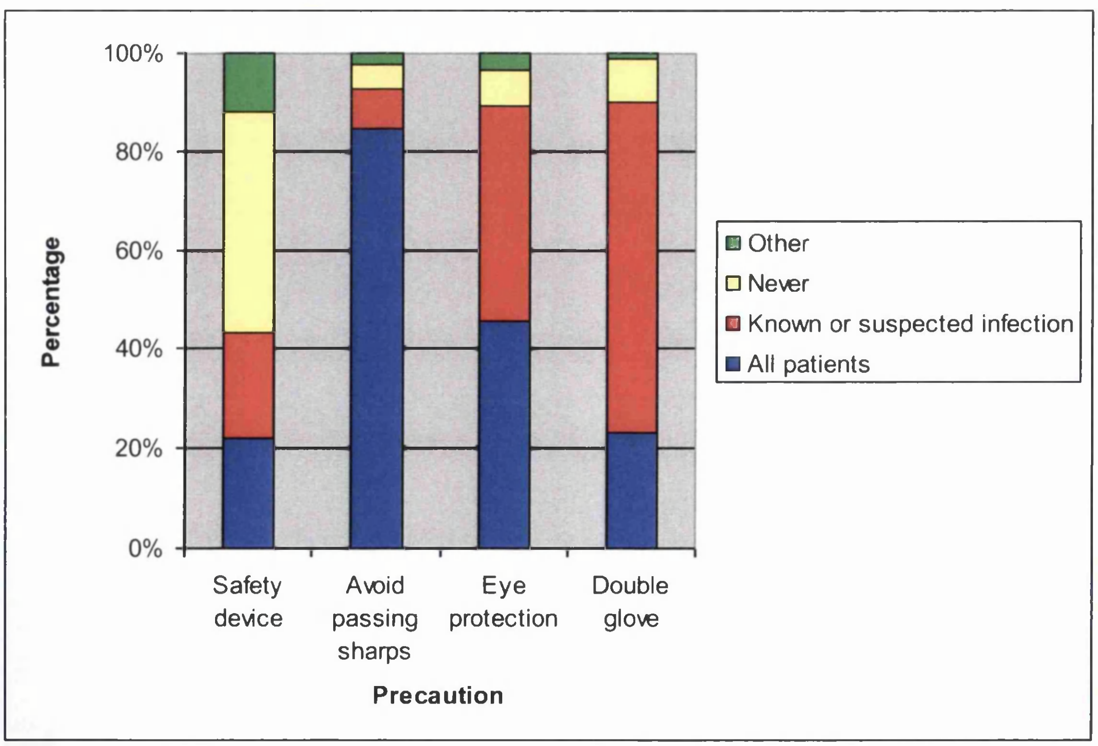
Table 4.3.12-: Number of respondents adopting combination of protective measures

Avoid passing sharps			Visor/eye protection worn: All patients	Suspected or known blood-borne viral infection	Never	Other	Total
All patients	Double glove	All patients	**31**	16	1	0	48
		Suspected or known infection	73	87	12	6	178
		Never	12	8	5	0	25
		Other	3	0	0	0	3
		Total	119	111	18	6	254
Suspected/known	Double glove	All patients	4	5	0		9
		Suspected or known infection	4	9	3		16
		Never	0	1	0		1
		Total	8	15	3		26
Never	Double glove	All patients	4	3	0	1	8
		Suspected or known infection	1	5	0	0	6
		Never	0	0	1	0	1
		Total	5	8	1	1	15
Other	Double glove	All patients	1			1	2
		Suspected or known infection	3			1	4
		Never	0			1	1
		Total	4			3	7

Histogram 4.3.7 describes the frequency of measures taken by surgeons and scrub nurses to protect themselves against inoculation injury. In each case, the category 'other' was justified by a comment from the participant and included instances where precautions were adopted for reasons other than those offered in the question e.g. surgeons' preference or for certain operations.

The suspicion or knowledge that patients may have a bloodborne viral infection was the biggest motivator towards double gloving (207/310, 65.7%). Eye protection was adopted more frequently than double gloving with 44.8% (141/310) respondents indicating that they would adopt this precaution for all patients. The precaution adopted by most respondents for every patient regardless of what is known or suspected about their blood-borne viral status is avoidance of passing sharps from hand to hand (259/307, 82.2%). Results suggest that safety devices are not commonly used among the healthcare professionals surveyed, with 131/293 (41.6%) indicating that they are never used.

Histogram 4.3.7: Use of precautions



A total of 219/315 (69.5%) of respondents had sustained at least one inoculation injury within the last five years. Most common were sharps injuries with 96/315 (30.5%) reporting at least one sharps injury within one year and 193/315 (61.3%) reporting such injuries within five years (table 4.3.13).

Table 4.3.13: Sharps injuries within past year (n=315) and past five years (n=315)

Number of injuries	Frequency of sharps injuries within past year	Valid %	Frequency of sharps injuries within past 5 years	Valid %
Valid 0	219	69.5%	122	38.7%
1	48	15.2%	74	23.5%
2	20	6.3%	47	14.9%
3	6	1.9%	17	5.4%
4	2	0.6%	5	1.6%
5	3	1.0%	6	1.9%
6	1	0.3%	1	0.3%
7	0	0%	1	0.3%
8	0	0%	3	1.0%
10	2	0.6%	6	1.9%
12	1	0.3%	1	0.3%
15	0	0%	1	0.3%
20	1	0.3%	2	0.6%
25	0	0%	1	0.3%
30	0	0%	1	0.3%
36	1	0.3%	0	0%
50	1	0.3%	2	0.6%
unspecified	8	2.5%	11	3.5%
don't know	2	0.6%	11	3.5%
numerous	0	0%	1	0.3%
60	0	0%	1	0.3%
250	0	0%	1	0.3%
Total	**315**	**100.0%**	**315**	**100.0%**

The majority of respondents had not sustained a splash to the mucous membranes at either one or five years (275/315, 87.3% and 241/315, 76.5% respectively), see table 4.3.14.

Table 4.3.14: Splash of blood to mucous membranes within past year and five years (n=315)

Number of injuries	Frequency of splashes to mucous membranes within past year	Valid %	Frequency of splashes to mucous membranes within past 5 years	Valid %
Valid 0	275	87.3%	241	76.5%
1	24	7.6%	27	8.6%
2	4	1.3%	13	4.1%
3	2	0.6%	6	1.9%
4	0	0%	4	1.3%
5	1	0.3%	1	0.3%
6	0	0%	1	0.3%
10	1	0.3%	6	1.9%
20	0	0%	1	0.3%
unspecified	4	1.3%	6	1.9%
don't know	3	1.0%	8	2.5%
numerous	1	0.3%	1	0.3%
Total	**315**	**100.0%**	**315**	**100.0%**

Blood splashes to broken skin were reported least often 6/315 (1.9%) and 18/315 (5.7%) within one and five years respectively (table 4.3.15).

Table 4.3.15: Splash of blood to broken skin within past year (n=315) and five years (n=315)

Number of injuries	Frequency of splashes to skin within past year	Valid %	Frequency of splashes to skin within past 5 years	Valid %
Valid 0	309	98.1%	297	94.3%
1	0	0%	5	1.6%
2	0	0%	3	1.0%
3	1	0.3%	0	0%
unspecified	2	0.6%	3	1.0%
don't know	1	0.3%	6	1.9%
numerous	2	0.6%	1	3%
Total	**315**	**100.0%**	**315**	**100.0%**

When considering injuries at five years, it is important to establish whether the respondents had been employed within healthcare for this period. Questions related to inoculation injuries within five years were not intended to encompass only those that had taken place during their employment within the operating departments but could have included injuries sustained within other specialities or during their nursing or medical training. Given that medical staff will have been students for five years prior to graduating, the surgeons presented no problems in this respect. Nurses only undergo a three year programme and potentially may not have been engaged in healthcare for five years if qualified for less than two years. However, only one nurse had been qualified for less than two years (case number 288, qualified 1.75 years) and had not sustained an inoculation injury. Therefore, all cases were retained in respect of injuries sustained within five years.

Respondents were asked to identify to what extent they agree with certain statements concerning factors contributing to inoculation injuries. Two hundred and eight respondents (208/313, 66.3%) agreed or strongly agreed that operating under emergency conditions contributed to inoculation injuries.

Table 4.3.16: Inoculation injuries are more likely to occur during emergency procedures, where time is of the essence.

		Frequency (% of all respondents)	Valid % (n=313)
Valid	Strongly agree	59 (18.8%)	18.7%
	Agree	149 (47.3%)	47.6%
	Uncertain	27 (8.6%)	8.6%
	Disagree	70 (22.2%)	22.4%
	Strongly disagree	8 (2.5%)	2.6%
Total		**313 (99.4%)**	**100.0%**
Missing		2 (0.6%)	
Total		**315 (100.0%)**	

Similarly, 241/313 (77%) agreed or strongly agreed that working under pressure contributed to injures.

4.3.17: Inoculation injuries are more likely to occur when staff is working under pressure

		Frequency (% of all respondents)	Valid % (n=313)
Valid	Strongly agree	85 (27.0%)	27.2%
	Agree	156 (49.5%)	49.8%
	Uncertain	29 (9.2%)	9.3%
	Disagree	40 (12.7%)	12.8%
	Strongly disagree	3 (1.0%)	1.0%
Total		**313 (99.4%)**	**100.0%**
Missing		2 (0.6%)	
Total		**315 (100.0%)**	

Fifty three point eight per cent (168/312) agreed or strongly agreed that undertaking unfamiliar procedures contributed to injuries (table 4.3.18).

Table 4.3.18: Inoculation injuries are more likely to occur when staff undertake procedures with which they are not familiar

		Frequency (% of all respondents)	Valid % (n=312)
Valid	Strongly agree	44 (14.0%)	14.1%
	Agree	124 (39.4%)	39.7%
	Uncertain	52 (16.5%)	16.7%
	Disagree	86 (27.3%)	27.6%
	Strongly disagree	6 (1.9%)	1.9%
Total		**312 (99.0%)**	**100.0%**
Missing		3 (1.0%)	
Total		**315 (100.0%)**	

It is clear that healthcare professionals make judgements concerning the risk of patients having a blood-borne viral infection with 182/313 (58.2%) stating that they agreed or strongly disagreed with the statement that "staff take fewer precautions when patients are not viewed as 'high risk'" (table 4.3.19).

Table 4.3.19: Staff take fewer precautions when patients are not viewed as 'high risk'

		Frequency (% of all respondents)	Valid % (n=313)
Valid	Strongly agree	30 (9.5%)	9.6%
	Agree	152 (48.3%)	48.6%
	Uncertain	25 (7.9%)	8.0%
	Disagree	81 (25.7%)	25.9%
	Strongly disagree	25 (7.9%)	8.0%
Total		**313 (99.4%)**	**100.0%**
Missing		2 (0.6%)	
Total		**315 (100.0%)**	

However, despite the majority admitting that they take fewer precautions when patients are not viewed as 'high risk', only 34/313 (10.9%) agreed or strongly agreed that this was acceptable.

Table 4.3.20: It is acceptable to take fewer precautions when patients are not "high risk"

		Frequency (% of all respondents)	Valid % (n=313)
Valid	Strongly agree	3 (1%)	1.0%
	Agree	31 (9.8%)	9.9%
	Uncertain	23 (7.3%)	7.3%
	Disagree	144 (45.7%)	46.0%
	Strongly disagree	112 (35.6%)	35.8%
Total		**313 (99.4%)**	**100.0%**
Missing		2 (0.6%)	
Total		**315 (100.0%)**	

It is apparent that many surgeons and scrub nurses in the participating trusts view inoculation injuries as inevitable with 205/312 (65.7%) stating that they agree or strongly agree that inoculation injuries are an occupational hazard.

Table 4.3.21: Inoculation injuries are an "occupational hazard" for staff working in an operating department

		Frequency (% of all respondents)	Valid % (n=312)
Valid	Strongly agree	64 (20.3%)	20.5%
	Agree	141 (44.8%)	45.2%
	Uncertain	27 (8.6%)	8.7%
	Disagree	51 (16.2%)	16.3%
	Strongly disagree	29 (9.2%)	9.3%
Total		**312 (99.0%)**	**100.0%**
Missing		3 (1.0%)	
Total		**315 (100.0%)**	

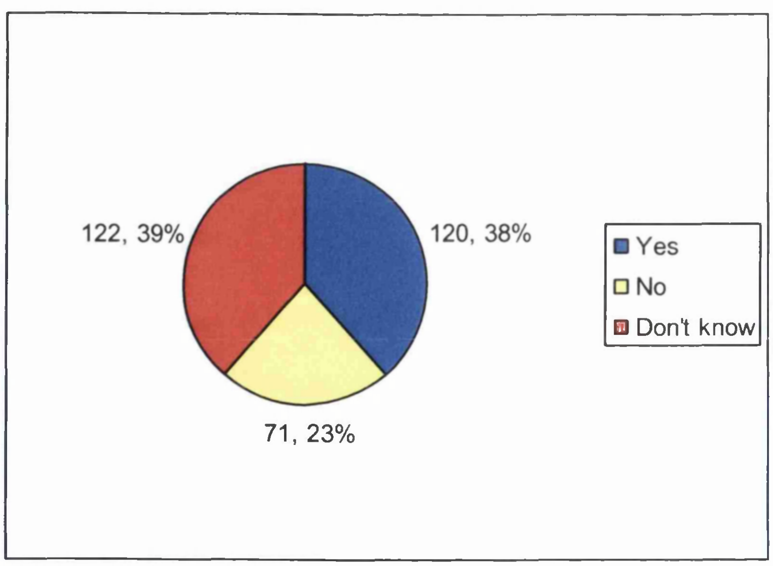
One hundred and eighty two (58.9%) agreed or strongly agreed that the availability or lack of availability of safety equipment influenced the occurrence of inoculation injuries.

Table 4.3.22: The availability (or otherwise) of safety devices/equipment influences the occurrence of inoculation injuries

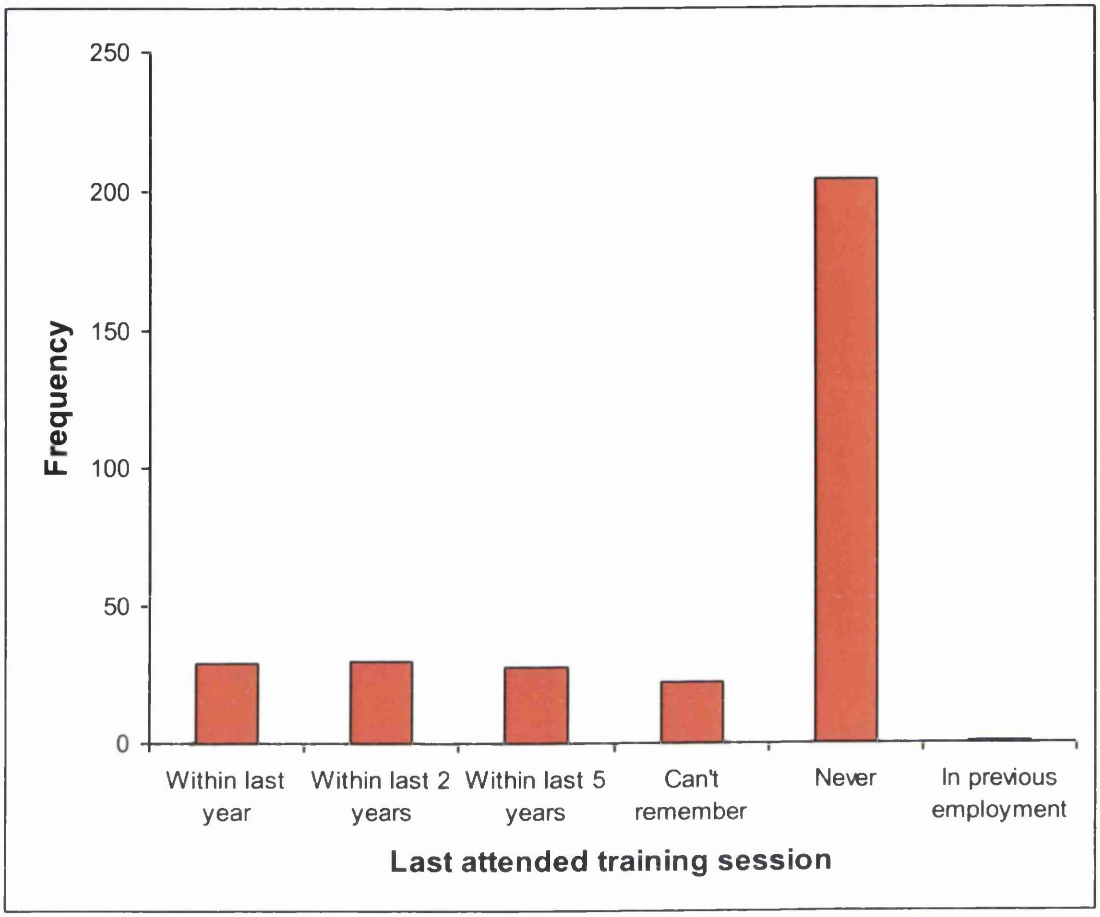
		Frequency (% of all respondents)	Valid % (n=319)
Valid	Strongly agree	38 (12.1%)	12.3%
	Agree	144 (45.7%)	46.6%
	Uncertain	64 (20.3%)	20.7%
	Disagree	60 (19.0%)	19.4%
	Strongly disagree	3 (1.0%)	1.0%
Total		**309 (98.1%)**	**100.0%**
Missing		6 (1.9%)	
Total		**315 (100.0%)**	

Respondents were asked whether their employing trust provided training on the prevention and management of inoculation injuries. Only 38.3% (120/313) were aware of training sessions held by their trust, while 39% (122/313) did not know whether or not these sessions were held (chart 4.3.3). Most respondents (204/314 65%) had never attended such a training session (histogram 4.3.8).

Chart 4.3.3: Awareness of trust training sessions on the prevention and management of inoculation injuries

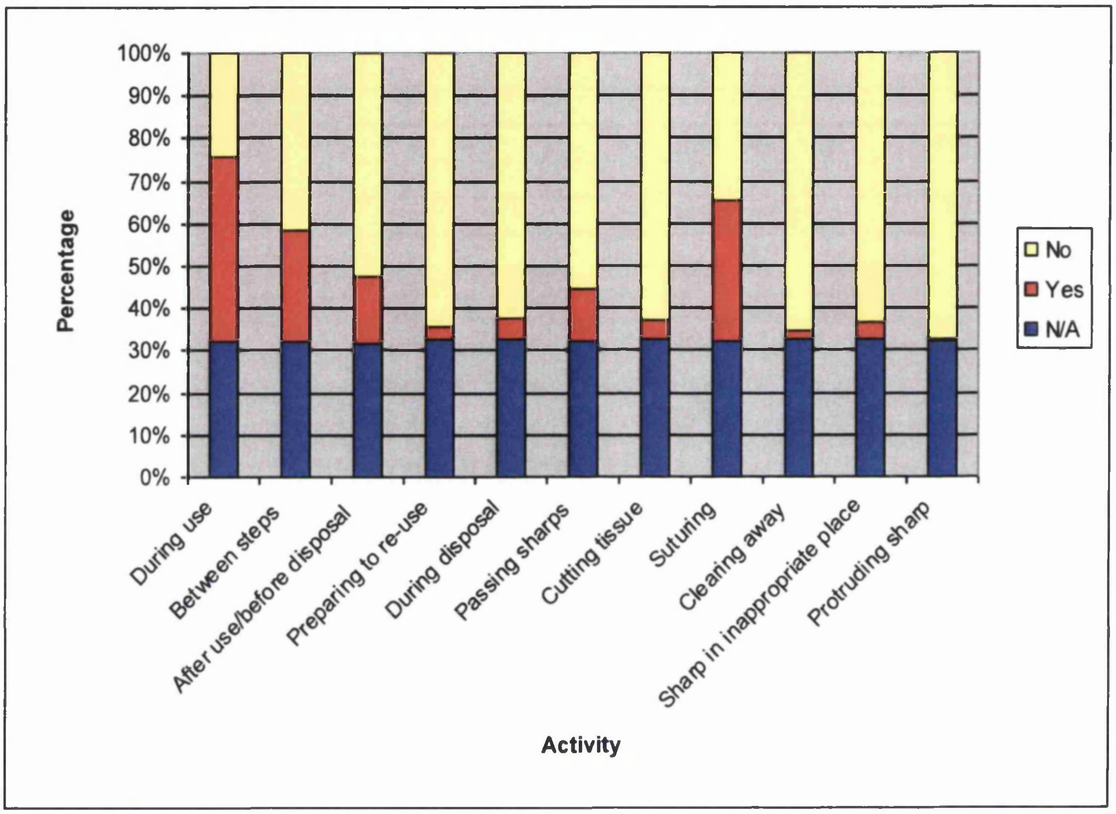


Histogram 4.3.8: Duration since last training session



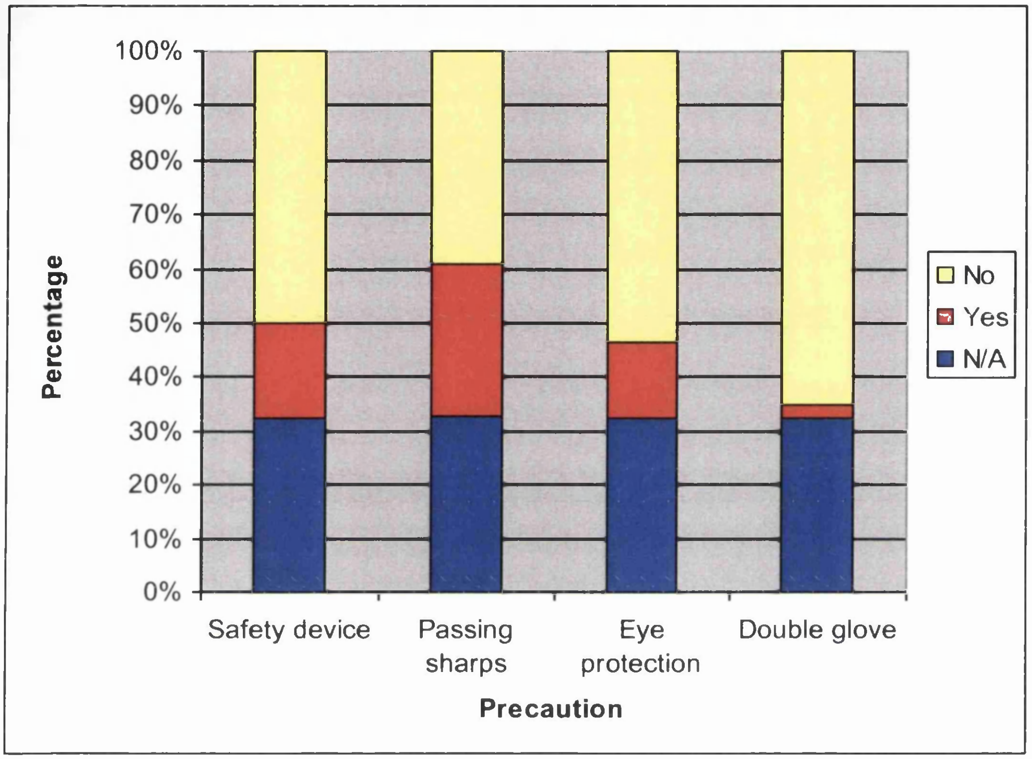
Of those respondents (n=219) who had sustained an inoculation injury within the last five years, 126/219 (57.5%) were the users of any sharp instruments involved. Histogram 4.3.9 illustrates the activities respondents were engaged in or the hazard they were exposed to at the time of their accident. One hundred and thirty-three (133/217, 61.3%) injuries occurred during the use of a sharp item with the most common cause of injury being suturing (101/217, 46.6%).

Histogram 4.3.9: Activities engaged in/ exposure to hazard at time of accident



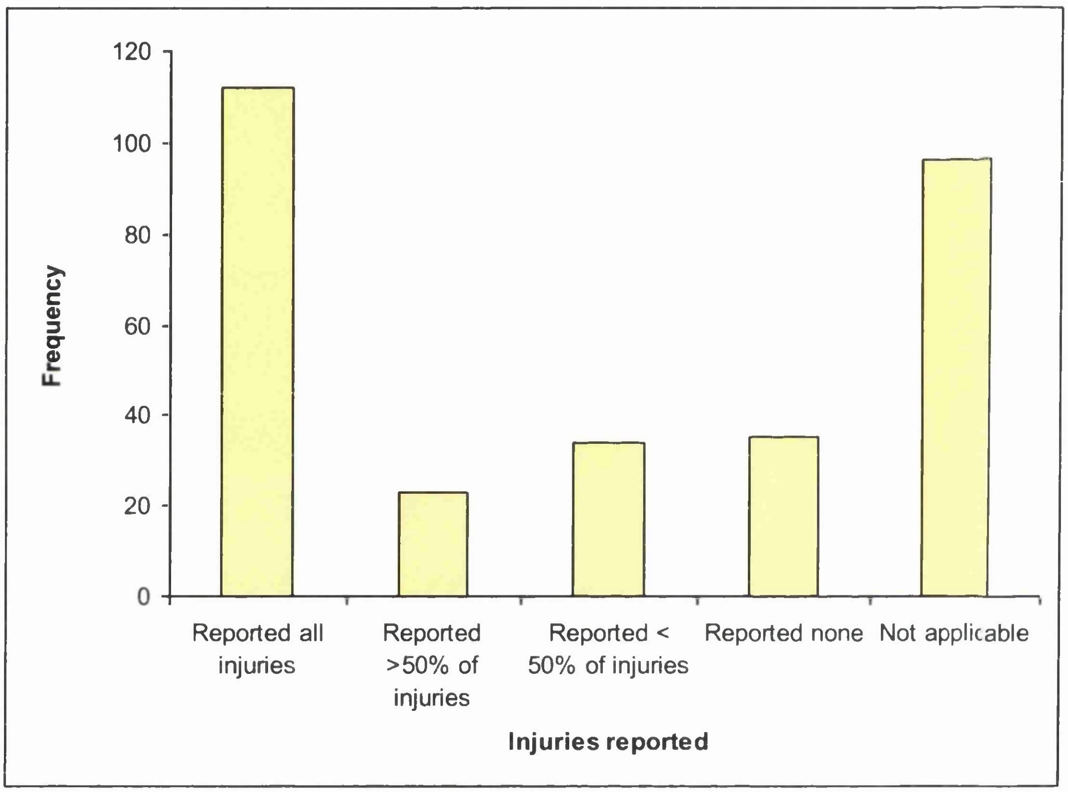
Respondents were asked what measures they took to protect themselves from inoculation injuries during their most recent injuries (histogram 4.3.10). The most common protective measure adopted was the use of eye protection (86/216, 39.8%) while the least common was use of safety devices (7/205, 3.2%).

Histogram 4.3.10: Precautions taken during most recent injury



Of the 220 respondents who had sustained an inoculation injury in the past five years, 186 (84.5%) knew the mechanism by which injuries were reported in their employing trust while 22 (15.6%) did not. However, not all injuries were reported, with only 112/204 (54.9%) of respondents reporting all injuries and 35/204 (17.2%) admitting that they never report injuries and a further 34/204 (16.7%) reporting less than 50% of their injuries. Reporting rates are listed in histogram 4.3.11.

Histogram 4.3.11: Rate of inoculation injury reporting



Participants were asked their level of agreement with reasons why inoculation injuries may not be reported. The answers are displayed in tables 4.3.23-4.3.31. The most common reason for not reporting was that the reporting mechanism was too cumbersome with 96/219 respondents (43.8%) saying that it was very likely or likely to influence their decision.

Table 4.3.23: Didn't know what action to take

		Frequency (% of all respondents)	Valid % (n=315)	Frequency among those completing question (n=219)
Valid	Not applicable	96 (30.5%)	34.0%	
	Very likely	20 (6.3%)	7.1%	20 (9.1%)
	Quite likely	22 (7.0%)	7.8%	22 (10.0%)
	Had no effect/influence	44 (14.0%)	15.6%	44 (20.1%)
	Quite unlikely	29 (9.2%)	10.3%	29 (13.2%)
	Very unlikely	71 (22.5%)	25.2%	71 (32.4%)
Total		**282 (89.5%)**	**100.0%**	**186 (84.9%)**
Missing		33 (10.9%)		33 (15.1%)
Total		**315 (100.0%)**		**219 (100.0%)**

Table 4.3.24: Didn't know where to find policy

		Frequency (% of all respondents)	Valid % (n=315)	Frequency among those completing question (n=219)
Valid	Not applicable	96 (30.5%)	34.0%	
	Very likely	17 (5.4%)	6.0%	17 (7.8%)
	Quite likely	20 (6.3%)	7.1%	20 (9.1%)
	Had no effect/influence	44 (14.0%)	15.6%	44 (20.1%)
	Quite unlikely	35 (11.1%)	12.4%	35 (16.0%)
	Very unlikely	70 (22.2%)	24.8%	70 (31.9%)
Total		**282 (89.5%)**	**100.0%**	**186 (84.9%)**
Missing		33 (10.5%)		33 (15.1%)
Total		**315 (100.0%)**		**219 (100.0%)**

Table 4.3.25: Pressure of work

		Frequency (% of all respondents)	Valid % (n=315)	Frequency among those completing question (n=219)
Valid	Not applicable	96 (30.5%)	33.8%	
	Very likely	34 (10.8%)	12.0%	34 (15.5%)
	Quite likely	41 (13.0%)	14.4%	41 (18.7%)
	Had no effect/influence	45 (14.3%)	15.8%	45 (20.5%)
	Quite unlikely	24 (7.6%)	8.5%	24 (11.0%)
	Very unlikely	44 (14.0%)	15.5%	44 (20.1%)
Total		**284 (90.2%)**	**100.0%**	**188 (85.8%)**
Missing		31 (9.8%)		31 (14.2%)
Total		**315 (100.0%)**		**219 (100.0%)**

Table 4.3.26: Reporting mechanism too cumbersome

		Frequency (% of all respondents)	Valid % (n=315)	Frequency among those completing question (n=219)
Valid	Not applicable	96 (30.5%)	33.3%	
	Very likely	48 (15.2%)	16.7%	48 (21.9%)
	Quite likely	48 (15.2%)	16.7%	48 (21.9%)
	Had no effect/influence	34 (10.8%)	11.8%	34 (15.5%)
	Quite unlikely	21 (6.7%)	7.3%	21 (9.6%)
	Very unlikely	41 (13.0%)	14.2%	41 (18.7%)
Total		**288 (91.4%)**	**100.0%**	**192 (87.7%)**
Missing		27 (8.6%)		27 (12.3%)
Total		**315 (100.0%)**		**219 (100.0%)**

Table 4.3.27: Dissatisfied with follow up procedure last time an injury was reported

		Frequency (% of all respondents)	Valid % (n=315)	Frequency among those completing question (n=219)
Valid	Not applicable	96 (30.5%)	34.5%	
	Very likely	28 (8.9%)	10.1%	28 (12.8%)
	Quite likely	29 (9.2%)	10.4%	29 (13.2%)
	Had no effect/influence	49 (15.6%)	17.6%	49 (22.4%)
	Quite unlikely	25 (7.9%)	9.0%	25 (11.4%)
	Very unlikely	51 (16.2%)	18.3%	51 (23.3%)
Total		**278 (88.3%)**	**100.0%**	**192 (83.1%)**
Missing		37 (11.7%)		37 (16.9%)
Total		**315 (100.0%)**		**219 (100.0%)**

Table 4.3.28: Patient was not "high risk"

		Frequency (% of all respondents)	Valid % (n=315)	Frequency among those completing question (n=219)
Valid	Not applicable	96 (30.5%)	33.6%	
	Very likely	31 (9.8%)	10.8%	31 (14.2%)
	Quite likely	51 (16.2%)	17.8%	51 (23.3%)
	Had no effect/influence	36 (11.4%)	12.6%	36 (16.4%)
	Quite unlikely	21 (6.7%)	7.3%	21 (9.6%)
	Very unlikely	51 (16.2%)	17.8%	51 (23.3%)
Total		**286 (90.8%)**	**100.0%**	**190 (86.8%)**
Missing		29 (9.2%)		29 (13.2%)
Total		**315 (100.0%)**		**219 (100.0%)**

Table 4.3.29: The injury was too minor to report

		Frequency (% of all respondents)	Valid % (n=315)	Frequency among those completing question (n=219)
Valid	Not applicable	96 (30.5%)	33.3%	
	Very likely	28 (8.9%)	9.7%	28 (12.8%)
	Quite likely	58 (18.4%)	20.1%	58 (26.5%)
	Had no effect/influence	33 (10.5%)	11.5%	33 (15.1%)
	Quite unlikely	23 (7.3%)	8.0%	23 (10.5%)
	Very unlikely	50 (15.9%)	17.4%	50 (22.8%)
Total		**288 (91.4%)**	**100.0%**	**192 (87.7%)**
Missing		27 (8.6%)		27 (12.3%)
Total		**315 (100.0%)**		**219 (100.0%)**

Table 4.3.30: Inoculation injuries are an occupational hazard

		Frequency (% of all respondents)	Valid % (n=315)	Frequency among those completing question (n=219)
Valid	Not applicable	96 (30.5%)	33.3%	
	Very likely	40 (12.7%)	13.9%	40 (18.3%)
	Quite likely	34 (10.8%)	11.8%	34 (15.5%)
	Had no effect/influence	44 (14.0%)	15.3%	44 (20.1%)
	Quite unlikely	25 (7.9%)	8.7%	25 (11.4%)
	Very unlikely	49 (15.6%)	17.0%	49 (22.4%)
Total		**288 (91.4%)**	**100.0%**	**192 (87.7%)**
Missing		27 (8.6%)		27 (12.3%)
Total		**315 (100%)**		**219 (100%)**

Table 4.3.31: Managers discourage reporting

		Frequency (% of all respondents)	Valid % (n=315)	Frequency among those completing question (n=219)
Valid	Not applicable	96 (30.5%)	34.0%	
	Very likely	2 (0.6%)	0.7%	2 (0.9%)
	Quite likely	4 (1.3%)	1.4%	4 (1.8%)
	Had no effect/influence	32 (10.2%)	11.3%	32 (14.6%)
	Quite unlikely	33 (10.5%)	11.7%	33 (15.1%)
	Very unlikely	115 (36.5%)	40.8%	115 (52.5%)
Total		**282 (89.5%)**	**100.0%**	**186 (84.9%)**
Missing		33 (10.5%)		33 (15.1%)
Total		**315 (100.0%)**		**219 (100.0%)**

Bivariate analyses

Bivariate analysis, defined by Polit and Beck (2008, p748) as "statistics derived from analysing two variables simultaneously to assess the empirical relationship between them" was undertaken in relation to the variables relating to sustaining and reporting inoculation injuries. Only statistically significant relationships are presented in this section. Non-statistically significant relationships are presented in appendix 16. Where the Kruskal-Wallis and Mann-Whitney tests have been applied, data have been treated as ordinal.

4.3.3 <u>Objective 1 - To assess the number of and circumstances surrounding inoculation injuries in the one and five years prior to the study among health care professionals undertaking exposure prone procedures in operating departments in Welsh hospitals</u>

The number of inoculation injuries sustained by the participants is shown in tables 4.3.13 to 4.3.15. In order to identify some of the contributory factors to and circumstances surrounding these injuries, bivariate analysis was undertaken. For this purpose, the number of injuries were not considered, rather whether or not an injury had occurred. The first variable to be considered in relation to whether inoculation injuries were sustained was profession (tables 4.3.32-4.3.35).

Sixty five surgeons compared to 29 scrub nurses reported sustaining a sharps injury within the previous year. This difference was statistically significant (χ^2 7.20, P=0.007, df=1, odds ratio (OR) 0.48, 95% confidence interval (CI) 0.29-0.81).

Table 4.3.32: Relationship between sustaining sharps injury within last year and profession (response rate 315/315, 100%).

		Sharps injury sustained within 1 year		Total
		None	1 or more	
Surgeons	Count (% within profession)	115 (63.9%)	65 (36.1%)	180 (100%)
Scrub nurses	Count (% within profession)	106 (78.5%)	29 (21.5%)	135 (100%)
Total	Count (%)	221 (70.2%)	94 (29.8%)	315 (100%)

Thirty out of 180 surgeons (16.7%) and 7/135 scrub nurses (5.2%) reported splashing blood or body fluids to the mucous membranes within the past year (table 4.3.33). The difference between professions was found to be statistically significant using the χ^2 test (χ^2 8.73, P=0.003, df=1, odds ratio (OR) 0.27, 95% confidence interval (CI) 0.12-0.64).

Table 4.3.33: Relationship between sustaining splash to mucous membranes within last year and profession (response rate 315/315, 100%).

		Splash to mucous membranes sustained within 1 year		Total
		None	1 or more	
Surgeons	Count (% within profession)	150 (83.3%)	30 (16.7%)	180 (100%)
Scrub nurses	Count (% within profession)	128 (94.8%)	7 (5.2%)	135 (100%)
Total	Count (%)	278 (88.3%)	37 (11.7%)	315 (100%)

Only a total of 5 respondents reported splashing blood or body fluid onto broken skin within the last year 3/180 surgeons (1.7%) and 2/135 scrub nurses (1.5%) (table A16.12). The expectation that 80% of cells had an expected frequency >5 was not fulfilled, therefore the χ^2 test could not be used (Altman, 1991). Consequently, Fisher's Exact Test was used to explain statistical significance. This test was interpreted with caution due to the sample size, but confirmed that this relationship was not statistically significant (Exact sig. 2-sided=1.0, df=1, odds ratio (OR) 0.88, 95% confidence interval (CI) 0.15-5.39).

A statistically significant difference was identified between surgeons (119/180, 66.16%) and scrub nurses (64/135, 47.4%) in relation to sharps injuries sustained within the last 5 years (χ^2 9.68, P=0.002, df=1, odds ratio (OR) 0.47, 95% confidence interval (CI) 0.3-0.75) (table 4.3.34).

Table 4.3.34: Relationship between sustaining sharps injury within last 5 years and profession (response rate 315/315, 100%).

		Sharps injury within 5 years		Total
		None	1 or more	
Surgeons	Count (% within profession)	61 (33.9%)	119 (66.1%)	180 (100%)
Scrub nurses	Count (% within profession)	71 (52.6%)	64(47.4%)	135 (100%)
Total	Count (%)	132 (41.9%)	183 (58.1%)	315 (100%)

A statistically significant difference was demonstrated between surgeons (51/180, 28.3%) and scrub nurses (16/135, 11.9%) who reported sustaining a splash of blood to mucous membranes within the last 5 years (χ^2 11.55, P=0.001, df=1, odds ratio (OR) 0.34, 95% confidence interval (CI) 0.18-0.63), see table 4.3.35.

Table 4.3.35: Relationship between sustaining splash to mucous membranes within last 5 years and profession (response rate 315/315, 100%).

		Splash to mucous membranes sustained within 5 years		Total
		None	1 or more	
Surgeons	Count (% within profession)	129 (71.7%)	51 (28.3%)	180 (100%)
Scrub nurses	Count (% within profession)	119(88.1%)	16 (11.9%)	135 (100%)
Total	Count (%)	248 (78.7%)	67 (21.3%)	315 (100%)

Only 10/180 surgeons (5.6%) and 2/135 of scrub nurses (1.5%) reported sustaining a blood splash to broken skin within the last 5 years (table A16.14). One cell had an observed count of 2. However, as 0 cells had an expected count of <5 and 80% of cells had an expected frequency of >5, the χ^2 test could be used to explore statistical significance (Altman, 1991). This relationship was not statistically significant (χ^2

2.27, P=0.116, df=1, odds ratio (OR) 0.26, 95% confidence interval (CI) 0.06-1.19). Using Fisher's exact test cautiously, although statistical significance is not apparent a trend in favour of the relationship was indicated at best (Exact sig, 2-sided = 0.077).

A further factor that may contribute to inoculation injuries is that of length of time since qualification. These data were not normally distributed. Therefore, the Mann-Whitney U test was used to explore significance where the grouping variable was sustaining inoculation injuries and 1=none, 2=one or more. However, length of time qualified did not influence whether any type of inoculation injury was sustained within either one or five years: sharps injury within one year (P=0.484), splash to broken skin within one year (P=0.221), splash to mucous membranes within one year (P=0.109), sharps injury within five years (P=0.548), splash to broken skin within five years (P=0.403), splash to mucous membranes within five years (P=0.099), tables A16.8 and A16.9.

The role of surgeons' speciality may also contribute to the risk of sustaining inoculation injuries. The Kruskal-Wallis test was used to determine significance where the grouping variable (independent variable) was surgeon's speciality (the data were considered ordinal). Nurses were excluded from this analysis. Maxillo-facial surgeons were also excluded from all analyses involving surgical speciality due to small numbers (n=4). However, it was identified that speciality did not influence sustaining an inoculation injury for any speciality: sharps injury within one year (P=0.137), splash to broken skin within one year (P=0.058), splash to mucous membranes within one year (P=0.832), sharps injury within five years (P=0.40), splash to broken skin within five years (P=0.056), splash to mucous membranes within five years (P=0.66), tables A16.10 and A16.11.

Only 120/313 respondents (38.1%) stated that their employing trust provided training on the prevention and management of inoculation injuries (chart 4.3.3), while 64.8% (204/314) had never attended such a session (histogram 4.3.8). Scrub nurses were more likely than surgeons to attend training sessions (table 4.3.36). This relationship was statistically significant (χ^2 70.768, P<0.001, df=1, odds ratio (OR) 0.111, 95% confidence interval (CI) 0.061-0.19).

Table 4.3.36: Relationship between profession and attending training sessions (response rate 314/315 99.7%)

	Attended training		Total
Profession	**Yes**	**No**	
Surgeon	27 (15.1%)	152 (84.9%)	179 (100%)
Scrub nurse	83 (61.5%)	52 (38.5%)	135 (100%)
Total	110 (35%)	204 (65%)	314 (100%)

Those who attended a training session were less likely to have sustained a sharps injury within the past year than those who had not (χ^2 4.358, P=0.037, df=1, odds ratio (OR) 1.82, 95% confidence interval (CI) 1.07-3.09), table 4.3.37.

Table 4.3.37: Relationship between sustaining a sharps injury within the past year and attending training session on the prevention and management of inoculation injury (response rate 314/315, 99.7%).

	Attended training		Total
Sharps injury within 1 year	**Yes**	**No**	
Yes (%)	85 (39.0%)	133 (61.0%)	218 (100%)
No (%)	25 (26%)	71 (74.0%)	96 (100%)
Total	110 (35.0%)	204 (65.0%)	314 (100%)

Respondents who had attended training sessions were less likely to have sustained a sharps injury within the previous five years (χ^2 4.265, P=0.039, df=1, odds ratio (OR) 1.68, 95% confidence interval (CI) 1.05-2.69), table 4.3.38.

Table 4.3.38: Relationship between sustaining a sharps injury within the past 5 years and attending training session on the prevention and management of inoculation injury (response rate 314/315, 99.7%).

Sharps injury within 5 years	Attended training		Total
	Yes	No	
Yes (%)	55 (42.0%)	76 (58.0%)	131 (100%)
No (%)	55 (30.1%)	128 (69.9%)	183 (100%)
Total	110 (35.0%)	204 (65%)	314 (100%)

Fewer respondents who attended training sessions sustained splashes of blood to mucous membranes within the past five years than those who did not (χ^2 5.711, P=0.017, df=1, odds ratio (OR) 2.22, 95% confidence interval (CI) 1.19-4.17), table 4.3.39.

Table 4.3.39: Relationship between sustaining splash to mucous membranes within last 5 years and attending training session on the prevention and management of inoculation injury (response rate 314/315, 99.7%).

Splash to mucous membranes within 5 years	Attended training		Total
	Yes	No	
Yes (%)	95 (38.6%)	151 (61.4%)	246 (100%)
No (%)	15 (22.1%)	53 (77.9%)	68 (100%)
Total	110 (35.0%)	204 (65.0%)	314 (100%)

Attending a training session did not influence sustaining a splash to broken skin within one year. When the relationship was tested, the expectation that 80% of cells have an expected frequency >5 was not fulfilled as two cells (50%) had an expected frequency count of <5. Therefore the χ^2 test could not be used (Altman, 1991). Consequently, Fisher's Exact Test was used with caution due to the large sample size to explain statistical significance. This test confirmed that this relationship was not statistically significant (Exact sig. 2-sided=0.358, df=1, odds ratio (OR) 0.35, 95% confidence interval (CI) 0.06-2.15), table A16.12.

Similarly, attending a training session did not influence sustaining a splash to mucous membranes within one year (χ^2 1.912, P=0.167, df=1, odds ratio (OR) 0.186, 95% confidence interval (CI) 0.85-4.09), table A16.13.

When exploring the relationship between attending training sessions and sustaining a splash to broken skin within the previous five years, one cell (25%) had an expected count of <5 and so χ^2 was not used (Altman, 1991). Using Fisher's exact test cautiously, it was determined that this relationship was not statistically significant (Exact sig. 2-sided=0.759, df=1, odds ratio (OR) 0.75, 95% confidence interval (CI) 0.23-2.14), table A16.14.

Respondents were asked to indicate their level of agreement with statements concerning circumstances that might contribute to sustaining an inoculation injury. These results are presented in tables 4.3.40 to 4.3.45. When considering the relationship between working under pressure and profession, no statistical significance was identified (χ^2 4.748, P=0.093). In the remainder of cases, surgeons were more likely to agree or strongly agree with the statements. Each of these relationships was statistically significant.

Surgeons were more likely than nurses to agree/strongly agree that injuries are more likely during emergency procedures (χ^2 6.799, P=0.033, df=2), tables 4.3.40.

Table 4.3.40: Relationship between the belief that inoculation injuries are most likely during emergency procedures and profession (response rate 313/315, 99.4%)

		Inoculation injuries are more likely during emergency procedures			
Profession		**Strongly agree/agree**	**Uncertain**	**Strongly disagree/ disagree**	**Total**
Surgeons	Count within profession (%)	126 (70.4%)	18 (10.1%)	35 (19.6%)	**179 (100%)**
Scrub nurses	Count within profession (%)	82 (61.2%)	9 (6.7%)	43 (32.1%	**134 (100%)**
Total	Count (%)	208 (66.5%)	27 (8.6%)	78 (24.9%)	**313 (100%)**

Surgeons were more likely than nurses to feel that injures are more likely during unfamiliar procedures (99.0%, χ^2 24.665, P<0.001, df=2).

Table 4.4.41-: Relationship between the belief that inoculation injuries are most likely when staff undertake unfamiliar procedures and profession (response rate 312/315)

Profession		Inoculation injuries more likely when undertaking unfamiliar procedures: Strongly agree/agree	Uncertain	Strongly disagree/ disagree	Total
Surgeons	Count within profession (%)	108 (60.7%)	37 (20.8%)	33 (18.5%)	**178 (100%)**
Scrub nurses	Count within profession (%)	60 (44.8%)	15 (11.2%)	58 (44.0%)	**134 (100%)**
Total	Count (%)	168 (53.8%)	52 (16.7%)	92 (29.5%)	**312 (100%)**

Surgeons were most likely to agree/strongly agree that staff take fewer precautions when the patient is not 'high risk' (χ^2 32.751, P<0.001, df=2).

Table 4.3.42: Relationship between the belief that staff take fewer precautions when patients are not 'high risk' and profession (response rate 313/315, 99.4%)

Profession		Staff take fewer precautions when patients are not 'high risk': Strongly agree/agree	Uncertain	Strongly disagree/ disagree	Total
Surgeons	Count within profession (%)	126 (70.4%)	16 (8.9%)	37 (20.7%)	**179 (100%)**
Scrub nurses	Count within profession (%)	56 (41.8%)	9 (6.7%)	69 (51.5%)	**134 (100%)**
Total	Count (%)	182 (58.1%)	25 (8.0%)	106 (33.9%)	**313 (100%)**

While surgeons were more likely to agree/strongly agree that it is acceptable to take fewer precautions when patients are not high risk, nurses were more likely to disagree/strongly disagree (χ^2 33.290, P<0.001, df=2).

Table 4.3.43: Relationship between the belief that it is acceptable to take fewer precautions when patients are not 'high risk' and profession (response rate 313/315, 99.4%)

Profession		It is acceptable take fewer precautions when patients are not 'high risk'			Total
		Strongly agree/agree	Uncertain	Strongly disagree/ disagree	
Surgeons	Count within profession (%)	30 (16.8%)	22 (12.3%)	127 (70.9%)	**179 (100%)**
Scrub nurses	Count within profession (%)	4 (3%)	1 (0.7%)	129 (96.3%)	**134 (100%)**
Total	Count (%)	34 (10.9%)	23 (7.3%)	256 (81.8%)	**313 (100%)**

Surgeons were more likely than scrub nurses to believe that inoculation injuries are an occupational hazard (χ^2 43.644, P<0.001, df=2).

Table 4.3.44: Relationship between the belief that inoculation injuries are an occupational hazard for staff working in operating theatres and profession (response rate 313/315, 99.4%)

Profession		Inoculation injuries are an 'occupational hazard'			Total
		Strongly agree/agree	Uncertain	Strongly disagree/ disagree	
Surgeons	Count within profession (%)	144 (80.9%)	11 (6.2%)	23 (12.9%)	**178 (100%)**
Scrub nurses	Count within profession (%)	61 (45.5%)	16 (11.9%)	57 (42.5%)	**134 (100%)**
Total	Count (%)	205 (65.7%)	27 (8.7%)	80 (25.6%)	**312 (100%)**

Surgeons were also most likely to believe that availability of safety devices influences inoculation injuries (χ^2 18.95, P<0.001, df=2).

Table 4.3.45: Relationship between the belief that the availability of safety devices influences inoculation injuries and profession (response rate 309/315, 98.1%)

Profession		The availability of safety devices influences inoculation injuries: Strongly agree/agree	Uncertain	Strongly disagree/ disagree	Total
Surgeons	Count within profession (%)	109 (61.6%)	46 (26.0%)	22 (12.4%)	**177 (100%)**
Scrub nurses	Count within profession (%)	73 (55.3%)	18 (13.6%)	41 (31.1%)	**132 (100%)**
Total	Count (%)	182 (58.9%)	64 (20.7%)	63 (20.4%)	**309 (100%)**

No statistically significant relationship was determined when considering the belief that inoculation injuries are more common when working under pressure and profession (χ^2 4.748, P=0.093, df=2), table A16.17.

The same statements were considered in relation to the length of time the healthcare worker had been qualified. Using the Kruskal-Wallis test for each relationship where the grouping variable was level of agreement with statements and 1 = agree/strongly agree, 2=uncertain, 3=disagree or strongly disagree, it was determined that only in relation to injuries increasing when undertaking unfamiliar procedures (χ^2 6.351, P=0.042, df=2) and the belief that fewer precautions are taken when patients are not perceived to be 'high risk' was the length of time since qualification significant (χ^2 7.812, P=0.020, df=2). See tables 4.3.46 to 4.3.48.

Table 4.3.46: Relationship between agreement that inoculation injuries are more likely when personnel are unfamiliar with procedures and length of time since qualification

Level of agreement	Number of years qualified		
	n	**median**	**range**
Agree/strongly agree	167	17.5	1.75 – 39 (37.25)
Uncertain	52	21.75	3.75 – 40.75 (37.0)
Disagree/strongly disagree	91	20.0	2 – 44 (42.0)

These data suggest that those qualified longer are more likely to be uncertain that inoculation injuries are likely when personnel are unfamiliar with procedures (χ^2 6.351, P=0.042, df=2), table 4.3.46.

Table 4.3.47 Relationship between agreement that personnel take fewer precautions when the patient is not 'high risk' and length of time since qualification

Level of agreement	Number of years qualified		
	n	**median**	**range**
Agree/strongly agree	33	20.0	2.5 – 38 (35.5)
Uncertain	23	22.5	6 – 35 (29.0)
Disagree/strongly disagree	254	18.75	1.75 – 44 (42.25)

These data suggest that those qualified for longer are most likely to be uncertain that personnel take fewer precautions when the patient is not high risk (χ^2 7.812, P=0.020, df=2), table 4.3.47.

In relation to the length of time spent in current speciality, availability of safety devices was the only statistically significant relationship (χ^2 6.331, P=0.042, df=2.). The Kruskal-Wallis test was also applied to explore significance where the grouping variable was level of agreement with the statements and 1=agree/strongly agree, 2=uncertain, 3=disagree or strongly disagree (table 4.3.48). Those working in their current speciality for longer were more likely to be uncertain that the availability of safety devices influences inoculation injuries.

Table 4.3.48 Relationship between agreement that availability of safety devices influences inoculation injuries and length of time in current specialty

Level of agreement	Number of years in current speciality		
	n	median	range
Agree/strongly agree	181	12.0	0 -35 (35.0)
Uncertain	64	16.13	2 – 36 (34.0)
Disagree/strongly disagree	62	14.0	0 – 37 (37.0)

When considering the level of agreement with the statements provided in relation to surgeons' speciality, no statistically significant relationships were identified when applying the Kruskal-Wallis test except in relation to the statement that is acceptable to take fewer precautions when the patient is not 'high risk', where level of agreement was considered ordinal data (χ^2 0.167, P=0.038, df=4.). The grouping variable here was surgeons' speciality. Obstetricians and gynaecologists were more likely to disagree or strongly disagree with the statement that it is acceptable to take fewer precautions if the patient is not high risk (35/43, 81.4%).

Table 4.3.49: Relationship between belief that it is acceptable take fewer precautions when patients are not 'high risk' and surgeons' speciality

Surgeon's speciality	It is acceptable take fewer precautions when patients are not 'high risk'			
	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
General	17 (31.5%)	4 (7.4%)	33 (61.1%)	54 (100%)
Ear, nose, throat	2 (9.1%)	3 (13.6%)	17 (77.3%)	22 (100%)
Urology	4 (30.8%)	2 (15.4%)	7 (53.8%)	13 (100%)
Trauma and orthopaedics	3 (7.7%)	7 (17.9%)	29 (74.4%)	39 (100%)
Obstetrics and gynaecology	2 (4.7%)	6 (14.0%)	35 (81.4%)	43 (100%)
Total	28 (16.4%)	22 (12.9%)	121 (79.8%)	171 (100%)

The same statements were considered in relation to attendance at staff training sessions. Statistically significant differences were identified in the level of agreement with the following statements: "Staff take fewer precautions when patients are not viewed as 'high risk'"; "It is acceptable to take fewer precautions when patients are not 'high risk'"; "Inoculation injuries are an occupational hazard for staff working in operating theatres"; and, "The availability of safety devices/equipment influences the occurrence of inoculation injuries" depending on whether training sessions had been attended (tables 4.3.50 to 4.3.53).

Respondents who failed to attend at least one training session were most likely to agree or strongly agree with the statement that staff take fewer precautions when patients are not 'high risk' (table 4.3.51). This difference was statistically significant 133/204, 65.2%, (χ^2 6.275, P<0.001, df=2).

Table 4.3.50-: Relationship between belief that staff take fewer precautions when patients are not 'high risk' and attending training sessions

	Staff take fewer precautions when patients are not 'high risk'			
Attended training	**Agree or strongly agree (%)**	**Uncertain (%)**	**Disagree or strongly disagree (%)**	**Total (%)**
Yes (%)	49 (45%)	7 (6.4%)	53 (48.6%)	109 (100%)
No (%)	133 (65.2%)	18 (8.8%)	53 (26%)	204 (100%)
Total	182 (58.1%)	25 (8%)	106 (33.9%)	313 (100%)

The majority of respondents disagreed or strongly disagreed that fewer precautions are acceptable when caring for patients not perceived to be 'high risk' (table 4.3.51). However, this belief is more common among those who had attended training 103/108, 94.5% compared to 153/204, 75%). This difference was statistically significant (χ^2 8.185, P<0.001, df=2), table 4.3.51.

Table 4.3.51: Relationship between belief that it is acceptable take fewer precautions when patients are not 'high risk' and attending training sessions

	It is acceptable take fewer precautions when patients are not 'high risk'			
Attended training	**Agree or strongly agree (%)**	**Uncertain (%)**	**Disagree or strongly disagree (%)**	**Total (%)**
Yes (%)	4 (3.7%)	2 (1.8%)	103 (94.5%)	109 (100%)
No (%)	30 (14.7%)	21 (10.3%)	153 (75%)	204 (100%)
Total	34 (10.9%)	23 (7.3%)	256 (81.8%)	313 (100%)

Those who had not attended training sessions were most likely to agree or strongly agree that inoculation injuries are an occupational hazard for theatre personnel (147/204, 72.1%, χ^2 2.057, P=0.002, df=2), table 4.3.52.

Table 4.3.52: Relationship between belief that inoculation injuries are an occupational hazard for staff working in the operating theatre and attending training sessions

	Inoculation injuries are an occupational hazard for staff working in the operating theatre			
Attended training	**Agree or strongly agree (%)**	**Uncertain (%)**	**Disagree or strongly disagree (%)**	**Total (%)**
Yes (%)	58 (53.7%)	10 (9.3%)	40 (37%)	108 (100%)
No (%)	147 (72.1%)	17 (8.3%)	40 (19.6%)	204 (100%)
Total	205 (65.7%)	27 (8.7%)	80 (25.6%)	312 (100%)

More respondents who attended training strongly disagreed or disagreed that the availability of safety devices influences the occurrence of inoculation injury (32/107, 29.9% compared to 31/202, 15.3%). This relationship was statistically significant (χ^2 14.401, P=0.001, df=2). See table 4.3.53.

Table 4.3.53: Relationship between belief that the availability of safety devices/equipment influences the occurrence of inoculation injuries and attending training sessions

	The availability of safety devices/equipment influences the occurrence of inoculation injuries			
Attended training	**Agree or strongly agree (%)**	**Uncertain (%)**	**Disagree or strongly disagree (%)**	**Total (%)**
Yes (%)	63 (58.9%)	12 (11.2%)	32 (29.9%)	107 (100%)
No (%)	119 (58.9%)	52 (25.7%)	31 (15.3%)	202 (100%)
Total	182 (58.9%)	64 (20.7%)	63 (20.4%)	309 (100%)

Statistical significance was not determined in relation to attending training sessions and the belief that inoculation injuries are more likely to occur during emergency procedures (χ^2 1.278, P=0.528, df=2); when working under pressure (χ^2 1.645, P=0.439, df=2); or when staff undertake procedures with which they are not familiar (χ^2 3.39, P=0.184, df=2) table A16.19.

To determine whether sustaining an inoculation injury was related to the level of agreement with statements concerning the likelihood of inoculation injury, bivariate analysis was performed. Those that are statistically significant or indicate trends are shown (tables 4.3.54–4.3.62). However, the remaining cross tabulations describing the relationship between all inoculation injuries at one and five years and each of the statements can be seen in tables A16.20-A16.35.

Those respondents who had sustained one or more sharps injuries within the last year were most likely to believe that staff take fewer precautions when patients are not 'high risk' (64/95, 66.7%, χ^2 9.696, P=0.008, df=2).

Table 4.3.54: Relationship between sustaining a sharps injury within 1 year and belief that staff take fewer precautions when patients are not 'high risk' (response rate 313/315, 99.4%)

	Staff take fewer precautions when patients are not 'high risk'			
Sharps injury within 1 year	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
None	118 (54.4%)	14 (6.5%)	85 (39.2%)	217 (100%)
1 or more	64 (66.7%)	11 (11.5%)	21 (21.9%)	95 (100%)
Total	182 (58.1%)	25 (8.0%)	106 (33.9%)	313 (100%)

No statistical significance was demonstrated between those who had sustained at least one sharps injury within the past year and those who felt that sustaining an inoculation injury was an occupational hazard (χ^2 5.524, P=0.063, df=2) (table 4.3.55). However, a trend was present suggesting agreement (Linear by linear association 5.448, P=0.02, df=1).

Table 4.3.55: Relationship between sustaining a sharps injury within past year and belief that inoculation injuries are an occupational hazard (response rate 312/315, 99%)

	Inoculation injuries are an occupational hazard for staff working in the operating theatre			
Sharps injury within 1 year	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
None	133 (61.6%)	20 (9.3%)	63 (29.2%)	216 (100%)
1 or more	72 (75%)	7 (7.3%)	17 (17.7%)	96 (100%)
Total	205 (65.7%)	27 (8.7%)	80 (25.6%)	312 (100%)

Those who had sustained one or more splashes to their mucous membranes were most likely to agree that inoculation injuries are more likely when staff undertake procedures with which they are not familiar (χ^2 6.735, P=0.034, df=2).

Table 4.3.56: Relationship between sustaining a splash to mucous membranes within the past year and the belief that inoculation injuries are more likely when staff undertake procedures with which they are not familiar (response rate 312/315, 99%)

	Inoculation injuries are more likely when staff undertake procedures with which they are not familiar			
Splash to mucous membranes within 1 year	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
None	141 (51.3%)	47 (17.1%)	87 (31.6%)	275 (100%)
1 or more	27 (73%)	5 (13.5%)	5 (13.5%)	37 (100%)
Total	168 (53.8%)	52 (16.7%)	92 (29.5%)	312 (100%)

One hundred and fifteen (62.8%) of those who had sustained a sharps injury within the past five years agreed or strongly agreed that staff take fewer precautions when patients are not 'high risk' (χ^2 7.285, P=0.026, df=2) (table 4.3.57).

Table 4.3.57: Relationship between sharps injury within past 5 years and the belief that staff take fewer precautions when patients are not 'high risk' (response rate 313/315, 99.4%)

	Staff take fewer precautions when patients are not 'high risk'			
Sharps injury within 5 years	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
None	67 (51.5%)	8 (6.2%)	55 (42.3%)	130 (100%)
1 or more	115 (62.8%)	17 (9.3%)	51 (27.9%)	183 (100%)
Total	182 (58.1%)	25 (8.0%)	106 (33.9%)	313 (100%)

Of those who had sustained no sharps injuries within the past five years, 112/130 (86.2%) disagreed or strongly disagreed that it is acceptable to take fewer precautions when patients are not 'high risk' (χ^2 8.299, P=0.016, df=2).

Table 4.3.58: Relationship between sustaining a sharps injury within 5 years and belief that it is acceptable to take fewer precautions when patients are not 'high risk' (response rate 313/315, 99.4%)

	It is acceptable to take fewer precautions when patients are not 'high risk'			
Sharps injury within 5 years	**Agree or strongly agree (%)**	**Uncertain (%)**	**Disagree or strongly disagree (%)**	**Total (%)**
None	15 (11.5%)	3 (2.3%)	112 (86.2%)	130 (100%)
1 or more	19 (10.4%)	20 (10.9%)	144 (78.7%)	183 (100%)
Total	34 (10.9%)	23 (7.3%)	256 (81.8%)	313 (100%)

Those respondents who had sustained at least one sharps injury within the past five years were most likely to agree or strongly agree that inoculation injuries are an occupational hazard for staff working in the operating theatre (χ^2 11.95, P=0.003, df=2).

Table 4.3.59: Relationship between sustaining a sharps injury within past 5 years and belief that inoculation injuries are an occupational hazard (response rate 312/315, 99%)

	Inoculation injuries are an occupational hazard for staff working in the operating theatre			
Sharps injury within 5 years	**Agree or strongly agree (%)**	**Uncertain (%)**	**Disagree or strongly disagree (%)**	**Total (%)**
None	72 (55.4%)	12 (9.2%)	46 (35.4%)	130 (100%)
1 or more	133 (73.1%)	15 (8.2%)	34 (18.7%)	182 (100%)
Total	205 (65.7%)	27 (8.7%)	80 (25.6%)	312 (100%)

The belief that inoculation injuries are more likely to occur during emergency procedures was most common among respondents who had suffered at least one splash to the mucous membranes within the past five years, see table 4.3.60 (54/68, 79.4%, χ^2 6.649, P=0.036, df=2).

Table 4.3.60: Relationship between sustaining splash to mucous membranes within past 5 years and belief that inoculation injuries are more likely to occur during emergency procedures (response rate 313/315, 99.4%)

	Inoculation injuries are more likely to occur during emergency procedures			
Splash to mucous membranes within past 5 years	**Agree or strongly agree (%)**	**Uncertain (%)**	**Disagree or strongly disagree (%)**	**Total (%)**
None	154 (62.9%)	24 (9.8%)	67 (27.3%)	245 (100%)
1 or more	54 (79.4%)	3 (4.4%)	11 (16.2%)	68 (100%)
Total	208 (66.5%)	27 (8.6%)	78 (24.9%)	313 (100%)

No statistical significance could be determined in relation to those who have sustained a splash to mucous membranes within the past five years and the belief that inoculation injuries are more likely when staff undertake procedures with which they are not familiar (χ^2 5.314, P=0.07, df=2). However, the linear by linear association (5.275) suggests that there was a trend in favour of those who had sustained one or more such injuries being more likely to hold the view that they are more likely when staff undertake unfamiliar procedures (linear by linear association 5.275, P=0.022, df=1), table 4.3.61.

Table 4.3.61: Relationship between sustaining a splash to mucous membranes within the past 5 years and the belief that inoculation injuries are more likely when staff undertake procedures with which they are not familiar (response rate 312/315, 99%)

	Inoculation injuries are more likely when staff undertake procedures with which they are not familiar			
Splash to mucous membranes within past 5 years	**Agree or strongly agree (%)**	**Uncertain (%)**	**Disagree or strongly disagree (%)**	**Total (%)**
None	124 (50.6%)	42 (17.1%)	79 (32.2%)	245 (100%)
1 or more	44 (65.7%)	10 (14.9%)	13 (19.4%)	67 (100%)
Total	168 (53.8%)	52 (16.7%)	92 (29.5%)	312 (100%)

Those who agreed or strongly agreed that staff take fewer precautions when patients are not 'high risk' were most likely to have sustained a splash of body fluid to the mucous membranes within the last five years (52/68, 76.5%, χ^2 13.087, P=0.01, df=2).

Table 4.3.62: Relationship between splash to mucous membranes within the past 5 years and the belief that staff take fewer precautions when patients are not 'high risk' (response rate 313/315, 99.4%)

	Staff take fewer precautions when patients are not 'high risk'			
Splash to mucous membranes within past 5 years	**Agree or strongly agree (%)**	**Uncertain (%)**	**Disagree or strongly disagree (%)**	**Total (%)**
None	130 (53.1%)	20 (8.2%)	95 (38.8%)	245 (100%)
1 or more	52 (76.5%)	5 (7.4%)	11 (16.2%)	68 (100%)
Total	182 (58.1%)	25 (8.0%)	106 (33.9%)	313 (100%)

Those respondents who had sustained an inoculation injury within the last five years were asked questions surrounding the injury and were encouraged to tick as many boxes as applied (question 11, appendix 1). The majority of those injured (126/204, 61.8%) were the users of the sharp instrument involved in the injury. This was most common among surgeons (105/126, 83.3%, (χ^2 39.254, P<0.001, df=1, OR 7.58, 95% CI 4.00–14.55), table 4.3.63

Table 4.3.63: Relationship between being the user of a sharp instrument during an injury and profession

		User of instrument during injury		Total (%)
		Yes	No	
Surgeons	Count (% of users)	105 (83.3%)	31 (39.7%)	136 (66.7%)
Scrub nurses	Count (% of users)	21 (16.7%)	47 (60.3%)	68 (33.3%)
Total	Count (% of users)	126 (100%)	78 (100%)	204 (100%)

Surgeons were also more likely to be injured during the use of a sharp instrument (97/136, 71.3%, χ^2 7.76, P=0.005, df=1, OR 2.42, 95% CI 1.33–4.39).

Table 4.3.64: Relationship between being injured during the use of a sharp instrument and profession

		Injured during the use of a sharp instrument		Total (%)
		Yes	No	
Surgeons	Count (% injured during use)	97 (72.9%)	39 (52.7%)	136 (65.7%)
Scrub nurses	Count (% injured during use)	36 (27.1%)	35 (47.3%)	71 (34.3%)
Total	Count (% injured during use)	133 (100%)	74 (35.7%)	207 (100%)

Nurses were more likely than surgeons to be injured after an instrument had been used (25/48, 52.1%, χ^2 7.773, P=0.005, df=1, OR 0.38, 95% CI 0.19–0.73).

Table 4.3.65: Relationship between being injured after an instrument had been used and profession

		Injured after an instrument had been used		Total (%)
		Yes	No	
Surgeons	Count (% injured after use)	23 (47.9%)	113 (71.1%)	136 (65.7%)
Scrub nurses	Count (% injured after use)	25 (52.1%)	46 (28.9%)	71 (34.3%)
Total	Count (% injured after use)	48 (100%)	159 (100%)	207 (100%)

Disposal of sharp instruments was not a major cause of injury among the respondents. However, of those who were injured in this way, the majority were nurses (11/15, 73.3% χ^2 9.36, P=0.002, df=1, OR 0.16, 95% CI 0.05–0.53).

Table 4.3.66: Relationship between being injured while disposing of sharps and profession

		Injured disposing of sharps		Total (%)
		Yes	No	
Surgeons	Count (% injured disposing of sharps)	4 (26.7%)	132 (69.1%)	136 (66.0%)
Scrub nurses	Count (% injured disposing of sharps)	11 (73.3%)	59 (30.9%)	70 (34%)
Total	Count (% injured disposing of sharps)	15 (100%)	191 (100%)	206 (100%)

Nurses were also more likely to be injured when instruments were passed from hand to hand (25/37, 67.6% χ^2 20.37, P<0.001, df=1, OR 0.18, 95% CI 0.08–0.38).

Table 4.3.67: Relationship between being injured while passing instruments from hand to hand and profession

		Injured passing sharps		Total (%)
		Yes	No	
Surgeons	Count (% injured passing sharps)	12 (32.4%)	124 (72.9%)	136 (65.7%)
Scrub nurses	Count (% injured passing sharps)	25 (67.6%)	46 (27.1%)	71 (34.3%)
Total	Count (% injured passing sharps)	37 (100%)	170 (100%)	207 (100%)

Surgeons were more likely than nurses to be injured while suturing (88/101, 87.1%, χ^2 38.353, P<0.001, df=1, OR 8.18, 95% CI 4.08–16.42).

Table 4.3.68: Relationship between being injured while suturing and profession

		Injured while suturing		Total (%)
		Yes	No	
Surgeons	Count (% injured while suturing)	88 (87.1%)	48 (45.3%)	136 (65.7%)
Scrub nurses	Count (% injured while suturing)	13 (18.3%)	58 (54.7%)	71 (34.3%)
Total	Count ((% injured while suturing)	101 (100%)	108 (100%)	207 (100%)

The relationship between profession and being injured between the steps in a procedure was not statistically significant (χ^2 3.725, P=0.054, df=1). Also no statistical significance was demonstrated in relation to profession and preparing to re-use an instrument. As one cell (25%) had an expected count of <5 (minimum expected count is 3.4) χ^2 could not be used to test for significance. However, this relationship was found not to be statistically significant when applying the Fisher's exact test (Exact sig. 2-sided=0.092), table A16.36.

Neither was significance demonstrated in relation to cutting tissue and profession. As one cell (25%) had an expected count of <5 (minimum expected count is 4.83) χ^2

could not be used to test for significance. However, Fisher's exact test identified no statistically significant relationship (Exact sig. 2-sided=0.145), table A16.37.

In relation to the relationship between being injured while clearing away and profession, no tests for significance were applicable. Two cells (50%) had an expected count of <5. The minimum expected count was 2.07. The minimum observed count was 0.

When considering the relationship between being injured by a sharp object left in an inappropriate place and profession, one cell (25%) had expected count of <5. The minimum expected count was 4.48. Therefore χ^2 could not be used to test for significance. However, when using Fisher's exact test a statistically significant relationship was identified. Nurses were more likely to be injured by a sharp object being left in an inappropriate place (Exact sig. 2-sided<0.001, OR 0.082, 95% CI 0.018-0.382). See table 4.3.69.

Table 4.3.69: Relationship between being injured by sharp object being left in an inappropriate place and profession

		Injured by sharp object in inappropriate place		Total (%)
		Yes	No	
Surgeons	Count (% injured by sharp in inappropriate place)	2 (15.4%)	133 (68.9%)	135 (65.5%)
Scrub nurses	Count (% injured by sharp in inappropriate place)	11 (84.6%)	60 (31.1%)	71(34.5%)
Total	Count (% injured by sharp in inappropriate place)	13 (100%)	193(100%)	206 (100%)

No test of significance could be applied to the relationship between being injured by a sharp object protruding from a sharps box and profession as two cells (50%) had expected count of <5. The minimum expected count was 0.34. The minimum observed count was 0, table A16.39.

The Mann-Whitney U test was used to explore the relationship between the length of time qualified and activities engaged in at the time of inoculation injury. The grouping variables were the relevant activities and 1=yes, 2=no. Only injuries sustained when suturing and clearing away were significant in relation to length of time qualified, tables 4.3.70 and 4.3.71.

Table 4.3.70: Relationship between injury sustained while suturing and length of time qualified

Injuries sustained while suturing	Number of years qualified		
	n	median	range
Yes	101	19.0	37.5-40.0 (2.5)
No	106	16.25	2-44 (42)

Those qualified for longer were more likely to sustain an injury while suturing (Mann Whitney U 4369.0, Z value -2.076, Asymp. 2 sided sig. 2 tailed=0.038).

Table 4.3.71: Relationship between injury sustained while clearing away and length of time qualified

Injuries sustained while clearing away	Number of years qualified		
	n	median	range
Yes	6	9.5	4.5-15 (10.5)
No	200	18	2-44 (42)

Those qualified longer were less likely to injure themselves while clearing away (Mann Whitney U 193.5, Z value -2.813, Asymp. 2 sided sig. 2 tailed=0.005).

No statistical significance was demonstrated in relation to length of time qualified and being injured during use (P=0.350), between steps in a procedure (P=0.56), after use (P=0.603), while preparing to re-use an instrument (P=513), during disposal (P=0.157), while passing instruments (P=0.441), while cutting (P=0.88), by sharp object left in an inappropriate place (P=0.942) or sharp object protruding from a sharps box (P=0.288), table A16.41.

The Mann-Whitney U test was also used to explore significance between length of time in current speciality and activities in which respondents were engaged at the time of their accident. The grouping variable was engagement in an activity where 1=yes and 2=no. Length of time in current speciality was only statistically significant in relation to sustaining an injury between steps in a procedure, preparing to re-use a sharp instrument and suturing. Those working in their current speciality for longer were more likely to sustain an injury between steps in a procedure (Mann Whitney U 4121.5, Z value -2.153, Asymp. 2 sided sig.=2 tailed 0.031), table 4.3.72.

Table 4.3.72: Relationship between injury sustained between steps in a procedure and length of time in current speciality

Injuries sustained while clearing away	Number of years in current speciality		
	n	median	range
Yes	79	10.5	1-35.5 (34.0)
No	128	15.0	37.0-37.0 (0)

Respondents working in the speciality longer were more likely to sustain an injury while preparing to re-use an instrument (Mann Whitney U 580.5, Z value -2.158, Asymp. 2 sided sig. 2 tailed=0.031), table 4.3.73.

Table 4.3.73: Relationship between injury sustained while preparing to re-use sharp instrument and length of time in current speciality

Injuries sustained while clearing away	Number of years in current speciality		
	n	median	range
Yes	10	22.5	30.0-35.0 (5.0)
No	195	12.0	37.0-37.0 (0)

Those working in their chosen speciality longer were more likely to sustain an injury while suturing (Mann Whitney U 4171.0, Z value -2.648, Asymp. 2 sided sig. 2 tailed=0.008), table 4.3.74.

Table 4.3.74: Relationship between injury sustained while suturing and length of time in current speciality

Injuries sustained while suturing	Number of years in current speciality		
	n	median	range
Yes	101	15.0	37.0-37.0 (0)
No	105	10.0	29.0-30.0 (1.0)

There was no statistical significance demonstrated with respect to time in current speciality and being injured during the use of a sharp instrument (P=0.120), after use (P=0.652), during disposal (P=0.238), while passing instruments (P=0.107), or while cutting tissue (P=0.69) (tables A16.42 and A16.43).

The Kruskal-Wallis χ^2 test was used to explore the relationship between surgeons' speciality and activities in which respondents were engaged at the time of inoculation injury. The grouping variable was surgeons' speciality. However, no statistical significance was identified.

Those who had attended a training session were less likely to be injured after an instrument had been used than those who had not (20/48, 41.7%, χ^2 4.113, P=0.043, df=1, OR 2.125, 95% CI 1.08–4.18), table 4.3.75.

Table 4.3.75: Relationship between being injured after an instrument had been used and attending training session

Attended training session		**Injured after an instrument had been used**		**Total (%)**
		Yes	**No**	
Yes	Count (% injured after use)	20 (41.7%)	40 (25.2%)	60 (29.0%)
No	Count (% injured after use)	28 (58.3%)	119 (74.8%)	147 (71.0%)
Total	Count (% injured after use)	48 (100%)	159 (100%)	207 (100%)

Those who had attended a training session were more likely to sustain an inoculation injury while disposing of sharps than those who hadn't. Once again, χ^2 could not be used to test for significance as one cell (25%) had an expected count of <5. The minimum expected count was 4.3. However, when Fisher's exact test was used, the relationship was found to be statistically significant (Exact sig. 2-sided =038). See table 4.3.76.

Table 4.3.76: Relationship between being injured while disposing of sharps and attending training session

Attended training session		Injured disposing of sharps		Total (%)
		Yes	No	
Yes	Count (% injured disposing of sharps)	8 (53.3%)	51 (26.7%)	59 (28.6%)
No	Count (% injured disposing of sharps)	7 (46.7%)	140 (73.3%)	147 (71.4%)
Total	Count (% injured disposing of sharps)	15 (100%)	191 (100%)	206 (100%)

Those who had not attended a training session were more likely to sustain an injury while suturing (81/101, 80.2%, χ^2 7.233, P=0.007, df=1, OR 0.407, 95% CI 0.218–0.763). See table 4.3.77.

Table 4.3.77: Relationship between being injured while suturing and attending training session

Attended training session		Injured while suturing		Total (%)
		Yes	No	
Yes	Count (% injured while suturing)	20 (19.8%)	40 (66.7%)	60 (29.0%)
No	Count (% injured while suturing)	81 (80.2%)	66 (62.3%)	147 (71.0%)
Total	Count ((% injured while suturing)	101 (100%)	106 (100%)	206 (100%)

Attending a training session was not statistically significant in relation to being injured during the use of a sharp instrument (χ^2 0.113, P=0.737); between the steps in a procedure (χ^2 3.12, P=0.077); passing instruments from hand to hand (χ^2 3.646, P=0.056) tables A16.44-A16.47.

Not all the relationships could be tested using χ^2 as some cells had an expected count of <5. In these cases Fisher's exact test was used instead. However, no statistical significance was identified in the relationship between attending a training session and being injured while preparing to re-use an instrument (Exact sig. 2-sided = 0.154); while cutting tissue (Exact sig. 2-sided=0.762); while clearing way (Exact sig. 2-sided=0.36) and due to a sharp object being left in an inappropriate place (Exact sig. 2-sided=0.058). No test of significance could be applied to the relationship between attending training sessions and being injured by a sharp object protruding from a sharps box as the minimum observed count in two cells was 0, see table A16.51.

4.3.4 Objective 2 - To determine the relationship between compliance with universal precautions and inoculation injuries

Bivariate analyses were performed for sustaining a sharps injury within the last year and double gloving (97.1%, χ^2 2.165, P = 0.339, df=2), passing sharps from hand to hand (χ^2 5.037, P=0.081, df=2) and using a safety device (χ^2 0.495, P=0.781, df=2) to establish whether any relationship existed between the variables. However, statistical significance was not demonstrated in relation to any of these variables. Similarly, when sustaining a sharps injury within the last five years was cross tabulated with the same variables, no statistical significance was found: double gloving (χ^2 3.698, P=0.157, df=2), passing sharps from hand to hand (χ^2 3.698, P=0.157, df=2) and using a safety device (χ^2 1.189, P=0.552, df=2), tables A16.52-A16.57.

The relationship between sustaining a splash of body fluid to the face and wearing eye protection/full face visor, was explored for injuries sustained with the past year and five years but no statistical significance was found. In relation to a splash to the mucous membranes within one year, one cell had an expected count of <5. The minimum expected count was 2.5 however, the actual count was 3.0. Therefore, the χ^2 test was used to explain statistical significance (Altman, 1991). This relationship was not statistically significant ($\chi^2$1.228, P=0.541, df=2). Similarly when considering splashes to the mucous membranes within five years, one cell had an expected count of <5. The minimum expected count was 4.56 however, the actual count was 2.0. However, as >80% of cells had an expected count of >5, χ^2 could be used to explore significance (Altman, 1991). However, no statistical significance was found (χ^2 3.772, P=0.152, df=2), tables A16.63 and A16.64.

It could be argued that if appropriate protective clothing is not worn on all occasions, HCWs may be considered non-compliant. Therefore, statistics were re-calculated considering the relationship between sustaining an injury and absolute compliance i.e. by combining the categories 'Suspected or known blood-borne viral infection' and 'Never'. These 2x2 tables also allowed risk to be calculated. The only variable that influenced sustaining a sharps injury within one year was avoidance of passing sharps from hand to hand ((χ^2 4.083, P=0.043, df=1, odds ratio (OR) 2.113, 95% confidence interval (CI) 1.08-4.15), table 4.3.78.

Table 4.3.78 -: Relationship between sustaining a sharps injury within 1 year and compliance with avoiding passing sharps from hand to hand (response rate 300/315, 95.3%)

		Avoid passing sharps from hand to hand		
	Sharps injury within 1 year	**Full compliance**	**Partial or non compliance**	**Total (n=300**
None	Count (% of those who have had sharps injury in past year)	189 (89.2%)	23 (10.8%)	**212 (100%)**
1 or more	Count (% of those who have had sharps injury in past year)	70 (79.5%)	18 (20.5%)	**88 (100%)**
Total	Count (% of those who have had sharps injury in past year)	259 (86.3%)	41 (13.7%)	**300 (100%)**

In relation to sustaining a sharps injury within one year and compliance with using safety devices no statistical significance was identified (χ^2 0.18, P = 0.669, df=1, odds ratio (OR) 1.21, 95% confidence interval (CI) 0.64-2.23) and avoiding passing sharps from hand to hand (χ^2 0.00, P=1.000, df=1, odds ratio (OR) 1.04, 95% confidence interval (CI) 0.53-2.03). Sustaining a sharps injury within five years was not influenced by either avoiding passing sharps from hand to hand (χ^2 0.00, P = 1.000, df=1, odds ratio (OR) 1.04, 95% confidence interval (CI) 0.53-2.03) or compliance with using safety devices (χ^2 0.88, P=0.348, df=1, odds ratio (OR) 1.37, 95% confidence interval (CI) 0.78-2.42), tables A16.60 to A16.62.

The categories 'Suspected or known blood-borne viral infection' and 'Never' were also combined to reconsider the relationship between sustaining a blood splash to mucous membranes and wearing a eye protection or full face visor. However, no statistical significance was found at either one year (χ^2 0.86, P=0.355, df=1, odds ratio (OR) 1.51, 95% confidence interval (CI) 0.73-3.14) or five years (χ^2 6.12, P=0.434, df=1, odds ratio (OR) 1.31, 95% confidence interval (CI) 0.74-2.30), tables A16.63-A16.64.

Bivariate analyses were also undertaken to determine whether compliance with the protective measures including double gloving, use of eye protection/full face visor, avoiding passing sharps directly from hand to hand and use of safety devices was influenced by profession, length of time since qualifying as surgeon or scrub nurse and surgeons' speciality. Partial/non compliance includes those who never comply or those who would comply only if the patient is known or suspected to have a blood-borne viral infection. Scrub nurses were more likely to wear eye protection/full face visor than surgeons (χ^2 22.384, P<0.001, df=1, odds ratio (OR) 0.31, 95% confidence interval (CI) 0.20-0.51) and most likely to use safety devices (χ^2 3.976, P = 0.046, df=1, odds ratio (OR) 0.54, 95% confidence interval (CI) 0.30-0.95). The relationship between profession and these variables is illustrated in tables 4.3.79 and 4.3.80 where compliance has been assumed as either full compliance or partial/non compliance.

More scrub nurses than surgeons would wear eye protection/full face visors. This relationship was statistically significant (χ^2 22.384, P<0.001, df=1, odds ratio (OR) 0.31, 95% confidence interval (CI) 0.20-0.51).

Table 4.3.79: Relationship between wearing eye protection/full face visor and profession

Profession		Eye protection/full face visor		Total
		Full compliance	Partial or non compliance	
Surgeons	Count (% within profession)	57 (34.5%)	108 (65.5%)	165 (100%)
Scrub nurses	Count (% within profession)	84 (62.7%)	50 (37.3%)	134 (100%)
Total	Count (%)	141 (47.2%)	158 (52.8%)	299 (100%)

Nurses were more likely than surgeons to use safety devices. This difference was statistically significant (χ^2 3.976, P=0.046, df=1, odds ratio (OR) 0.54, 95% confidence interval (CI) 0.30-0.95).

Table 4.3.80: Relationship between using safety devices and profession

Profession		Use safety device		Total
		Full compliance	Partial or non compliance	
Surgeons	Count (% within profession)	23 (20.4%)	129 (79.6%)	162 (100%)
Scrub nurses	Count (% within profession)	31 (32.3%)	65 (67.7%)	96 (100%)
Total	Count (%)	64 (24.8%)	194 (75.2%)	258 (100%)

The relationship between profession and double gloving was not statistically significant (χ^2 0.34, P=0.854, df=1, odds ratio (OR) 0.92, 95% confidence interval (CI) 0.54-1.56) neither did profession influence whether sharps were passed directly from hand to hand (χ^2 1.842, P=0.175, df=1, odds ratio (OR) 0.58, 95% confidence interval (CI) 0.29-1.17), tables A16.65 and A16.66.

To determine whether length of time since qualifying influenced the protective measures used by personnel, the relationship between this variable and each of the protective measures was tested. The Mann-Whitney U test was used to explore statistical significance where the grouping variable was compliance and 1=full compliance and 2=partial or non compliance. There was no statistical difference identified between length of time since qualifying and double gloving (P=0.136), wearing eye protection/full face visor (P=0.347), avoidance of passing sharps from hand to hand (P=0.257), or using a safety device (P=0.803), table A16.67.

Neither was any statistically significant relationship identified between length of time spent in current speciality and adoption of protective measures when the Mann-Whitney U test was applied: double gloving (P=0.2446), wearing eye protection/full face visor (P=0.909), avoidance of passing sharps from hand to hand (P=0.231), or using a safety device (P=0.257), table A16.68.

The effect of surgeons' speciality (excluding nurses) was also considered in relation to measures used to protect against inoculation injury, tables 4.3.81 to 4.3.82. The χ^2 test was used to explore significance. It can be seen from these tables that surgeons' speciality was influential in wearing eye protection and avoiding passing sharps by hand. In relation to double gloving and use of safety devices, χ^2 could not be used to test for significance because there was a 0 present in one of the cells (tables A16.69 and A16.70).

Trauma and orthopaedic surgeons were most likely to comply with eye protection (17/35, 48.6%, χ^2=10.636, P=0.031, df=4).

Table 4.3.81: Relationship between wearing eye protection/full face visor and surgeon's speciality

Speciality	Eye protection/full face visor		
	Full compliance (%)	Partial or non compliance (%)	Total (%)
General	16 (30.8%)	36 (69.2%)	52 (100%)
Ear, nose and throat	2 (10.5%)	17 (89.5%)	19 (100%)
Urology	3 (23.1%)	10 (76.9%)	13 (100%)
Trauma and orthopaedics	17 (48.6%)	18 (51.4%)	35 (100%)
Obstetrics and gynaecology	17 (44.7%)	21 (55.3%)	38 (100%)
Total	55 (35%)	102 (65%)	157 (100%

Obstetricians and gynaecologists were most likely to avoid passing sharps from hand to hand (39/40, 97.5%, χ^2=15.78, P=0.003, df=4).

Table 4.3.82: Relationship between avoiding passing sharps from hand to hand and surgeon's speciality

Speciality	Avoid passing sharps from hand to hand		
	Full compliance (%)	Partial or non compliance (%)	Total (%)
General	46 (86.8%)	7 (13.2%)	53 (100%)
Ear, nose and throat	15 (68.2%)	7 (31.8%)	22 (100%)
Urology	12 (92.3%)	1 (7.7%)	13 (100%)
Trauma and orthopaedics	25 (69.4%)	11 (30.6%)	36 (100%)
Obstetrics and gynaecology	39 (97.5%)	1 (2.5%)	40 (100%)
Total	137 (83.5%)	27 (16.5%)	164 (100%)

The relationship between attending training and compliance with precautions was explored and found to be significant only in relation to using safety devices. See table 4.3.83. Thirty six point five per cent (31/85) of respondents who had attended training would always use a safety device compared to 33/172 (19.2%) of those who had not received training. This relationship was statistically significant (χ^2 =8.187, P=0.004, df=1, OR= 2.418, 95% CI = 1.351-4.329).

Table 4.3.83: Relationship between using safety devices and attending training

Attended training session	**Use safety device**		**Total**
	Full compliance	**Partial or non compliance**	
Yes (%)	31 (36.5%)	54 (63.5%)	85 (100%)
No (%)	33 (19.2%)	139 (80.8%)	172 (100%)
Total	64 (24.9%)	193 (75.1%)	257 (100%)

The relationships between attending training and double gloving (χ^2 =0.046, P=0.830, df=1, OR= 0.904, 95% CI = 0.517-1.58), wearing eye protection (χ^2 =1.128, P=0.288, df=1, OR= 1.33, 95% CI = 0.829-2.136) and passing sharps from hand to hand (χ^2 =3.132, P=0.077, df=1, OR= 2.142, 95% CI = 0.981-4.679) were not statistically significant (tables A16.69-A16.71).

4.3.5 Objectives 3 and 4 - To assess the proportion of these injuries that are reported and to explore the reasons for under-reporting of inoculation injuries

It has been established that not all inoculation injuries are reported via the mechanism set down by the employing trusts, with only 112/204 (54.9%) reporting all injuries (see histogram 4.3.11). A variety of reasons were identified contributing to failure to report injuries. The following factors were found to be statistically significant in relation to failure to report: pressure of work, reporting mechanism is too cumbersome, dissatisfaction with the procedure the last time an injury was reported, the patient was low risk, the injury was too minor to report, injuries are an occupational hazard, see tables 4.3.84 to 4.3.89.

Those respondents who reported none or <50% of their injuries were most likely to believe that pressure of work influenced reporting (33/73, 45.2%). However, this was unlikely or very unlikely to influence those (56/66, 80.9%) who reported all or >50% of their injuries, (χ^2 =26.063, P<0.001, df=3), table 4.3.84.

Table 4.3.84: Relationship between reporting an inoculation injury and pressure of work

	Injuries reported (%)				
	All	>50%	<50%	None	Total
Very/quite likely	26 (35.6%)	14 (19.2%)	19 (26.0%)	14 (19.2%)	73 (100%)
Very/quite unlikely	51 (77.3%)	5 (7.6%)	3 (4.5%)	7 (10.6%)	66 (100%)
Total	77 (55.4%)	19 (13.7%)	22 (15/.8%)	21 (15.1%)	139 (100%)

Believing that the reporting mechanism is too cumbersome was most common among those who reported none or <50% of their injuries (49/93, 52.7%) but unlikely or very unlikely to influence those (55/61, 90.1%) who reported all or >50% of their injuries χ^2 50.832, P<0.001, df=3).

Table 4.3.85: Relationship between reporting an inoculation injury and belief that the reporting mechanism is too cumbersome

	Injuries reported (%)				
	All	>50%	<50%	None	Total
Very/quite likely	25 (26.9%)	19 (20.4%)	29 (31.2%)	20 (21.5%)	93 (100%)
Very/quite unlikely	52 (85.2)	3 (4.9%)	2 (3.3%)	4 (6.6%)	61 (100%)
Total	77 (50.0%)	22 (14.3%)	31 (20.1%)	24 (15.6%)	154 (100%)

Dissatisfaction with the reporting procedure following previous injuries was very likely or likely to influence reporting in those who failed to report injuries or reported fewer than 50% of their injuries (22/55, 40%). This did not influence the respondents (64/75, 85.5%) who reported all or more than 50% (χ^2 18.795, P<0.001, df=3).

Table 4.3.86: Relationship between reporting an inoculation injury and dissatisfaction with the procedure the last time an injury was reported

	Injuries reported (%)				
	All	>50%	<50%	None	Total
Very/quite likely	22 (40.0%)	11 (20.0%)	13 (23.6%)	9 (16.4%)	55 (100%)
Very/quite unlikely	56 (74.9%)	8 (10.7%)	3 (4.0%)	8 (10.7%)	75 (100%)
Total	78 (60%)	19 (14.6%)	16 (12.3%)	187 (13.1%)	130 (100%)

Perception that the patient was low risk was likely or very likely to affect reporting in 48/79 (60.7%) of respondents who reported none or fewer than 50% of their injuries. Those (65/72, 90.2%) who reported all or <50% of their injuries were unlikely or very unlikely to be influenced by this (χ^2 56.533, P<0.001, df=3).

Table 4.3.87: Relationship between reporting an inoculation injury and the patient was low risk

	Injuries reported (%)				
	All	>50%	<50%	None	Total
Very/quite likely	18 (22.8%)	13 (16.5%)	20 (25.3%)	28 (35.4%)	79 (100%)
Very/quite unlikely	60 (83.3%)	5 (6.9%)	3 (4.2%)	4 (5.6%)	72 (100%)
Total	78 (51.7%)	18 (11.9%)	23 (15.2%)	32 (21.2%)	151 (100%)

Forty four of 83 respondents (53%) who reported none or <50% of injuries were likely or very likely to be influenced by the fact that the injury was minor. However, the extent of injury was not influential in reporting for the 63/73 respondents (86.3%) who reported all or >50% of injuries (χ^2 42.242, P<0.001, df=3).

Table 4.3.88: Relationship between reporting an inoculation injury and the injury was too minor to report

	Injuries reported (%)				
	All	>50%	<50%	None	Total
Very/quite likely	23 (27.2%)	16 (19.3%)	20 (24.1%)	24 (28.9%)	83 (100%)
Very/quite unlikely	58 (79.5%)	5 (6.8%)	6 (8.2%)	4 (5.5%)	73 (100%)
Total	81 (51.9%)	21 (13.5%)	26 (16.7%)	28 (17.9%)	156 (100%)

Believing that inoculation injuries are an occupational hazard was likely or very likely to influence reporting in 33/71 (46.5%) of respondents who reported none <50% of their injuries but unlikely or very unlikely to influence those who reported all or >50% (58/73, 79.4%), (χ^2 23.992, P<0.001, df=3).

Table 4.3.89: Relationship between reporting an inoculation injury and the belief that injuries are an occupational hazard

	Injuries reported (%)				
	All	>50%	<50%	None	Total
Very/quite likely	26 (36.6%)	12 (16.9%)	11 (15.5%)	22 (31.0%)	71 (100%)
Very/quite unlikely	55 (75.3%)	3 (4.1%)	8 (11.0%)	7 (9.6%)	73 (100%)
Total	81 (56.3%)	15 (10.4%)	19 (13.2%)	29 (20.1%)	144 (100%)

Reporting inoculation injuries was not influenced by familiarity with reporting procedures, not knowing what action to take, being unable to find the relevant policy or being discouraged by managers to do so (tables A16.72-A16-75).

A total of 186 (61.2%) were aware of the procedure for reporting injuries in their trust. A statistically significant majority of scrub nurses (69/71, 97.2%) compared to surgeons (117/137, 85.4%) were familiar with the mechanism (χ^2 5.674, P=0.017), see table 4.3.90.

Table 4.3.90: Relationship between familiarity with reporting procedures and profession (response rate 208/220, 94.5%)

Profession		Familiar with reporting procedure		Total
		Yes	No	
Surgeons	Count within profession (%)	117 (85.4%)	20 (14.6%)	**137 (100%)**
Scrub nurses	Count within profession (%)	69 (97.2%)	2 (2.8%)	**71 (100%)**
Total	Count (%)	186 (89.4%)	22 (10.6%)	**208 (100%)**

Although one cell in table 4.3.90 had an observed count of 2, no cells had a minimum expected count of <5 (minimum expected count is 7.51). Therefore, the χ^2 test could be used to explore significance. This relationship was statistically significant with scrub nurses being more likely to be familiar with the procedure for reporting inoculation injuries than surgeons.

The χ^2 test could not be used to test the relationship between profession and failure to report injuries because of pressure of work (table A16.81), reporting mechanism is too cumbersome (table A16.82) and dissatisfaction last time an injury was reported as >20% of cells had an expected count of <5 (table A16.83).

Significance could not be tested in relation to profession and not knowing what action to take (table A16.79), not knowing where to find the policy (A16.80), the patient was low risk (table A16.84), the injury was too minor (A16.85), inoculation injuries are an occupational hazard (table A16.86) and managers discourage reporting as the minimum observed count in some cells was 0 (table A16.87).

Knowledge of the reporting mechanism was not found to be influenced by length of time since qualification (P=0.457) or length of time in current speciality (P=0.587) when the Mann-Whitney U test was applied where the grouping variable was familiarity with reporting.

Unsurprisingly, given the difference in knowledge of reporting mechanisms, a statistically significant majority of scrub nurses (65/71, 91.5%) compared to surgeons (70/133, 52.6%) reported >50% of injuries: scrub nurses (χ^2 =51.317, P<0.001), table 4.3.91.

Table 4.3.91: Relationship between reporting inoculation injuries and profession

		Percentage of injuries reported				
Profession		**All**	**> 50%**	**< 50%**	**None**	**Total**
Surgeons	Count within profession (%)	49 (36.8%)	21 (15.8%)	33 (24.8%)	30 (22.6%)	**133 (100%)**
Scrub nurses	Count within profession (%)	63 (88.7%)	2 (2.8%)	1 (1.4%)	5 (7.0%)	**71 (100%)**
Total	Count (%)	112 (54.9%)	23 (11.3%)	34 (16.7%)	35 (17.2%)	**204 (100%)**

On applying the Kruskal-Wallis test to the relationship between incidence of reporting inoculation injuries and length of time since qualification and length of time in current speciality, it was identified that statistical significance was demonstrated in relation to both variables where the grouping variable was reporting injuries and 1=reported all injuries, 2=reported>50%, 3=reported<50% and 4=reported none (χ^2 7.192, P=0.007, df=3). See tables 4.3.92 and 4.3.93.

Table 4.3.92: Relationship between reporting inoculation injuries and length of time since qualification, length of time in current speciality

	Length of time since qualifying	**Length of time in current speciality**
Chi-square	12.127	7.192
df	3	3
Asymp. Sig. (2 tailed)	0.007	0.066

Table 4.3.93: Relationship between reporting inoculation injuries and length of time since qualification

Injuries reported	Number of years qualified		
	n	median	range
All	112	18.0	1.75-40.75 (42.0)
> 50%	23	13.0	2-44 (31.0)
< 50%	33	18.0	5-36 (35.0)
None	34	20.0	2.5-35 (32.5)

These data suggest that those qualified longest less likely to report injuries.

The relationship between surgeons' speciality and reporting injuries due to lack of familiarity with procedure, not knowing where to find the policy, pressure, reporting mechanism too cumbersome, being dissatisfied with the reporting procedure, injuries are an occupational hazard and managers discourage reporting could not be tested as >80% of cells had an expected count of 5, table A16.93-A16.99.

Failure to report because of patient being considered low risk and injuries were too minor were statistically significant when considered in relation to surgeons' speciality. In each case 20% of cells had an expected count of <5. Nevertheless 80% had an observed count of 80% and χ^2 was used to test for significance (Altman, 1991), tables 4.3.93 and 4.3.94.

Obstetircians and gynaecologists were most likely to believe that failure to report is related to the patient being 'low risk' (16/21, 76.2%, χ^2 14.251, P=0.007, df=4).

Table 4.3.94: Relationship between failure to report because patient considered low risk and surgeon's speciality

Surgeon's speciality	Patient was 'low risk'		
	Very/quite likely	Very/quite unlikely	Total
General	13 (56.5%)	10 (43.5%)	**23 (100%)**
ENT	3 (30.0%)	7 (70.0%)	**10 (100%)**
Urology	3 (60.0%)	2 (40.0$)	**5 (100%)**
Trauma and orthopaedics	10 (52.6%)	9 (47.4%)	**19 (100%)**
Obstetrics and gynaecology	16 (76.2%)	5 (23.8%)	**21 (100%)**
Total	45 (57.7%)	33 (42.3%)	**78 (100%)**

General surgeons were most likely not to report because the injury was too minor (34/38, 89.5%, χ^2 17.795, P=0.001, df=4).

Table 4.3.95: Relationship between failure to report because injuries were too minor and surgeon's speciality

Surgeon's speciality	Patient was 'low risk'		
	Very/quite likely	Very/quite unlikely	Total
General	34 (89.5%)	4 (10.5%)	**38 (100%)**
ENT	4 (40.0%)	6 (60.0%)	**10 (100%)**
Urology	3 (37.5%)	5 (62.5%)	**8 (100%)**
Trauma and orthopaedics	11 (50.0%)	11 (50.0%)	**22 (100%)**
Obstetrics and gynaecology	18 (64.3%)	10 (35.7%)	**28 (100%)**
Total	70 (66.0%)	36 (34.0%)	**106 (100%)**

The influence of training on whether inoculation injuries are reported is considered in table 4.3.96. Among the respondents who had sustained an inoculation injury, those who attended training sessions on the prevention and management of inoculation injuries were most likely to report between 50% and all of their inoculation injuries than those who had not (χ^2 19.890, P=0.001, df=4).

Table 4.3.96: Relationship between reporting inoculation injuries and attending training sessions on the prevention and management of inoculation injuries

Attended training session	Reported injuries				Total
	All	> 50%	< 50%	None	
Yes (%)	43 (71.7%)	7 (11.7%)	5 (8.3%)	5 (8.3%)	60 (100%)
No (%)	69 (47.9%)	16 (11.1%)	29 (20.1%)	30 (20.8%)	144 (100%)
Total (%)	112 (54.9%)	23 (11.3%)	34 (16.7%)	35 (17.2%)	204 (100%)

Those 77 respondents who reported 50% or less of their injuries were asked to state their agreement with some statements suggesting reasons why this might be the case. However, due to the small number giving each answer, no tests of significance could be applied.

No statistical significance was demonstrated in relation to length of time qualified, length of time in current speciality and any of the possible reasons why inoculation injuries may not be reported when the Kruskal-Wallis test was applied. The grouping variable in each case was the level of agreement with statements where 1=agree/strongly agree, 2=uncertain, 3=disagree/strongly disagree: did not know procedure (χ^2 3.835, df=2, P=0.147); could not find procedure (χ^2 0.695, df=2, P=0.706); pressure of work (χ^2 0.509, df=2, P=0.775); procedure too cumbersome (χ^2 2.207, df=2, P=0.332); dissatisfied last time (χ^2 0.350, df=2, P=0.840); patient was low risk (χ^2 5.014, df=2, P=0.081); injury was too minor (χ^2 2.575, df=2, P=0.276); injuries are an occupational hazard (χ^2 2.575, df=2, P=0.276); managers discourage reporting (χ^2 0.188, df=2, P=0.910), tables A16.88 to A16.89.

The following relationships with length of time in current speciality and suggested reasons why inoculation injuries may not be reported were not statistically significant when the Kruskal-Wallis test was applied: did not know procedure (χ^2 3.261, df=2, P=0.196); could not find procedure (χ^2 1.254, df=2, P=0.534); pressure of work (χ^2 1.487, df=2, P=0.147); procedure too cumbersome (χ^2 2.391, df=2, P=0.0.303); dissatisfied last time (χ^2 1.168, df=2, P=0.558); patient was low risk (χ^2 4.660, df=2, P=0.097); injury was too minor (χ^2 0.599, df=2, P=0.741); injuries are an occupational hazard (χ^2 1.826, df=2, P=0.401); managers discourage reporting (χ^2 1.076, df=2, P=0.584), tables A16.90 to A16.91.

In each of the following relationships with attending training sessions and failure to report injuries, statistical significance could not be tested as cells had an expected count of <5 in each: not knowing what action to take, not knowing where to find relevant policy, pressure of work, reporting mechanism is too cumbersome, dissatisfaction with follow up after reporting previous injury, the patient was low risk, the injury was too minor, injuries are an occupational hazard and managers discourage reporting, tables A16.92-A16.100.

The relationship between surgeons' speciality and suggested reasons why inoculation injuries may not be reported were tested. However, none were found to be statistically significant when applying the χ^2 test as cells had an expected count of <5 (tables A16.93-A16.99).

Of the respondents who reported fewer than half their inoculation injuries 59/69 (85.5%) had failed to attend at least one training session. However, this was not statistically significant ($\chi^2 <0.001$, P=1.00, df=1). Due to the low numbers sustaining an inoculation injury, it was not possible to calculate statistical significance in relation to the statements regarding reasons for not reporting and attendance at training sessions.

Summary

The questionnaire survey identified that inoculation injuries, in particular sharps injuries were common among personnel working in the operating departments. Injuries are more common in surgeons. Compliance with standard precautions and reporting of inoculation injuries was variable, with surgeons reporting lower compliance with protective measures and reporting mechanisms. Reporting inoculation injuries was also influenced by the length of time qualified. Attending training sessions had a positive impact on the number of injuries sustained, compliance with standard precautions and reporting.

All statistically significant results are presented in tables 4.3.97 and 4.3.98. Those relating to sustaining sharps injuries where sufficient respondents answered the relevant questions were used to develop a logistic regression model to predict risk of sustaining a sharps injury at one and five years. The purpose of this was to inform the content of educational programmes aimed at improving compliance and reducing injury.

Table 4.3.97: Summary of statistically significant relationships

Table	Relationship tested	Test	P value	OR	95% CI
†4.3.32	Sustaining sharps injury within 1 year and profession	χ^2	0.007	0.48	0.29-0.81
4.3.33	Sustaining splash to mucous membranes within 1 year and profession	χ^2	0.003	0.27	0.12-0.64
††4.3.34	Sustaining sharps injury within 5 years and profession	χ^2	0.002	0.47	0.3-0.75
4.3.35	Sustaining splash to mucous membranes within 5 years and profession	χ^2	0.001	0.34	0.18-0.63
4.3.36	Relationship between profession and attending training sessions	χ^2	0.001	0.111	0.061-0.19
†4.3.37	Sustaining sharps injury within 1 year and attending training session	χ^2	0.037	1.82	1.07-3.09
††4.3.38	Sustaining sharps injury within 5 years and attending training session	χ^2	0.039	1.68	1.05-2.69
4.3.39	Sustaining splash to mucous membranes within 5 years and attending training session	χ^2	0.017	2.22	1.19-4.17
4.3.40	Belief that inoculation injuries are more likely in an emergency procedure and profession	χ^2	0.033	N/A**	N/A**
4.3.41	Belief that inoculation injuries are more likely when staff undertake unfamiliar procedures and profession	χ^2	<0.001	N/A**	N/A**
4.3.42	Belief that staff take fewer precautions when patients are not 'high risk' and profession	χ^2	<0.001	N/A**	N/A**
4.3.43	Belief that it is acceptable to take fewer precautions when patients are not 'high risk' and profession	χ^2	<0.001	N/A**	N/A**
4.3.44	Belief that inoculation injuries are an occupational hazard and profession	χ^2	<0.001	N/A**	N/A**
4.3.45	Belief that the availability of safety devices influences inoculation injuries and profession	χ^2	<0.001	N/A**	N/A**
4.3.46	Belief that inoculation injuries are more likely when staff undertake unfamiliar procedures and length of time qualified	Kruskal-Wallis	0.042	N/A**	N/A**
4.3.47	Belief that staff take fewer precautions when patients are not 'high risk' and length of time qualified	Kruskal-Wallis	0.02	N/A**	N/A**
4.3.48	Belief that the availability of safety devices influences inoculation injuries and length of time in current speciality	Kruskal-Wallis	0.042	N/A**	N/A**

Table	Relationship tested	Test	P value	OR	95% CI
4.3.49	Belief that it is acceptable to take fewer precautions when patients are not 'high risk' and surgeon's speciality	Kruskal-Wallis	0.038	N/A**	N/A**
4.3.50	Belief that staff take fewer precautions when patients are not 'high risk' and attending training session	χ^2	<0.001	N/A**	N/A**
4.3.51	Belief that it is acceptable to take fewer precautions when patients are not 'high risk' and attending training session	χ^2	<0.001	N/A**	N/A**
4.3.52	Belief that inoculation injuries are an occupational hazard and attending training session	χ^2	0.002	N/A**	N/A**
4.3.53	Belief that the availability of safety devices influences inoculation injuries and attending training session	χ^2	0.001	N/A**	N/A**
†4.3.54	Sustaining a sharps injury within 1 year and belief that staff take fewer precautions when patients are not 'high risk'	χ^2	0.008	N/A**	N/A**
4.3.56	Sustaining splash to mucous membranes within 1 year and belief that are more likely when staff undertake unfamiliar procedures	χ^2	0.034	N/A**	N/A**
††4.3.57	Sustaining a sharps injury within 5 years and belief that staff take fewer precautions when patients are not 'high risk'	χ^2	0.026	N/A**	N/A**
††4.3.58	Sustaining a sharps injury within 5 years and belief that it is acceptable to take fewer precautions when patients are not 'high risk'	χ^2	0.016	N/A**	N/A**
††4.3.59	Sustaining a sharps injury within 5 years and belief that inoculation injuries are an occupational hazard	χ^2	0.003	N/A**	N/A**
4.3.60	Sustaining splash to mucous membranes within 5 years and belief that inoculation injuries are more likely in an emergency procedure	χ^2	0.036	N/A**	N/A**
4.3.61	Sustaining splash to mucous membranes within 5 years and belief that inoculation injuries are more likely when staff undertake unfamiliar procedures	χ^2	0.07	N/A**	N/A**
4.3.62	Sustaining splash to mucous membranes within 5 years and belief that staff take fewer precautions when patients are not 'high risk'	χ^2	0.01	N/A**	N/A**
4.3.63	User of sharp object during an injury and profession	χ^2	0.005	2.42	1.33-4.39
4.3.64	Injured during use of sharp instrument and profession	χ^2	0.038	0.54	0.30-0.97
4.3.65	Injured after instrument had been used and profession	χ^2	<0.001	0.18	0.08-0.38

Table	Relationship tested	Test	P value	OR	95% CI
4.3.68	Injured while suturing and profession	χ^2	<0.001	8.179	4.075-16.42
4.3.69	Injured by sharps object left in an inappropriate place and profession	Fisher's exact	<0.001	0.082	0.018-0.382
4.3.70	Injury sustained while suturing and length of time qualified	Mann-Whitney U	0.038	N/A**	N/A**
4.3.71	Injury sustained while clearing away and length of time qualified	Mann-Whitney U	0.005	N/A**	N/A**
4.3.72	Injury sustained between steps in a procedure and length of time in current speciality	Mann-Whitney U	0.031	N/A**	N/A**
4.3.73	Injury sustained while preparing to re-use an instrument and length of time in current speciality	Mann-Whitney U	0.031	N/A**	N/A**
4.3.74	Injury sustained while suturing and length of time in current speciality	Mann-Whitney U	0.008	N/A**	N/A**
4.3.75	Injured after use of a sharp instrument and attending training session	χ^2	0.043	2.125	1.08-4.18
4.3.76	Injured while disposing of a sharp object and attending training session	Fisher's exact test	0.038	3.137	0.018-0.382
4.3.77	Injured while suturing and attending training session	χ^2	0.007	0.407	0.218-0.763
4.3.78	Sustaining sharps injury within 1 year and avoiding passing sharps by hand	χ^2	0.043	2.113	1.08-4.15
4.3.79	Wearing eye protection/full face visor and profession	χ^2	<0.001	N/A**	N/A**
4.3.80	Using safety devices and profession	χ^2	0.046	N/A**	N/A**
4.3.81	Wearing eye protection/full face visor and surgeon's speciality	Kruskal-Wallis	0.005	N/A**	N/A**
4.3.82	Avoiding passing sharps by hand and surgeon's speciality	Kruskal-Wallis	<0.001	N/A**	N/A**
4.3.83	Using safety devices and attending training session	χ^2	0.004	2.418	1.35-4.33
4.3.90	Familiarity with reporting procedures and profession	χ^2	0.017	0.17	0.04-0.75
4.3.91	Reporting inoculation injuries and profession	χ^2	<0.001	N/A**	N/A**
4.3.93	Reporting inoculation injuries and length of time qualified	Kruskal-Wallis	0.007	N/A**	N/A**

Table	Relationship tested	Test	P value	OR	95% CI
4.3.94	Reporting inoculation injuries and attending training session	χ^2	0.001	N/A**	N/A**
4.3.94	Relationship between failure to report because patient considered low risk and surgeon's speciality	χ^2	0.007	N/A**	N/A**
4.3.95	Relationship between failure to report because injuries were too minor and surgeon's speciality	χ^2	0.001	N/A**	N/A**

† table numbers prefixed by † indicate variables entered into the logistic regression model relating to sharps injuries sustained at one year

†† table numbers prefixed by †† indicate variables entered into the logistic regression model relating to sharps injuries sustained at five years

* In table 4.3.75, those participants who had attended at least one training session were more likely than those who hadn't to sustain an injury while disposing of a sharp object. This relationship is counter-intuitive. However, disposing of sharp objects was not one of the variables entered into the logistic regression model and therefore had no impact on the predictions made by the model.

** N/A indicates that odds ratio and 95% confidence interval were not calculated as tables were not 2 x 2.

4.4 LOGISTIC REGRESSION MODELS

The selected outcome/dependent variables are sustaining a sharps injury at one and five years. All data entered into the models were first cross tabulated to ensure that no cells included 0 and that the varables were significant (sections 4.3.3). Logistic regression was conducted using a backwards likelihood ratio criterion to allow observation of the relative importance of each of the variables as the variable with the least impact on the fit of the model will be removed first and so on (Field, 2009). Automatic removal therefore reduces subjective selection of the variables.

The chosen variables are dichotomous, an injury is either sustained or it is not. In addition to being identified as statistically significant in this study, many of these predictor variables have also been identified as significant in other studies. The predictor variables entered into the models were:

<u>From the literature:</u>

- Profession (Burke and Madan, 1997; Lymer *et al*, 1997; Hettiaratchy *et al*, 1998; Haiduven *et al*, 1999; Benitez *et al*, 1999; Shiao *et al*, 1999; Alvarado-Ramy *et al*, 2003; Cutter and Jordan, 2003; Stein *et al*, 2003; Trim *at al*, 2003; Cutter and Jordan, 2004)
- Length of time since qualification (Ronk and Girard, 1994; Williams *et al*, 1994; Ramsey et al, 1996; Jeffe *et al*, 1998; Akduman *et a*l, 1999; Abu-gad and Al-Turki, 2001; Fisman *et al*, 2007; HPA, 2008)
- Attending training sessions (Ronk and Girard, 1994; Ramsey *et al*, 1996; Akduman *et al*, 1999; Jeffe *et al*, 1998; Kim *et al*, 2001)
- Belief that inoculation injuries are an occupational hazard (Cutter and Jordan, 2003)
- Belief that inoculation injuries are more likely if staff take fewer precautions if patients are not high risk (Mangione *et al*, 1991; Ronk and Girard, 1994; Williams *et al*, 1994; Gershon *et al*, 1995; Burke and Madan, 1997; Kim *et al*, 1999, Benitez *et al*, 1999; Leliopoulou *et al*, 1999, Naing *et al*, 2001; Madan *et al*, 2002; Cutter and Jordan, 2003; Cutter and Jordan, 2004)
- Avoiding passing sharps from hand to hand (Jagger and Balon, 1997; Folin *et al*, 2000)

- Using safety devices (Hartley *et al*, 1996; Mingoli *et al*, 1996; UK Health Departments, 1998; OSHA, 1999)

<u>From the study where probability <0.1:</u>

- Profession
- Length of time since qualification
- Attending training sessions
- Belief that inoculation injuries are an occupational hazard
- Belief that inoculation injuries are more likely during emergency procedures
- Belief that inoculation injuries are more likely during unfamiliar procedures
- Belief that inoculation injuries are more likely if staff take fewer precautions if patients are not high risk
- Belief that it is acceptable to take fewer precautions if patients are not high risk
- Avoiding passing sharps from hand to hand
- Using safety devices

Several models were developed. The outcome variables were sustaining one or more sharps injuries at five and one years (models 1 to 4). In each model, consideration was given to including both the length of time qualified and length of time spent working in chosen speciality. However, a strong positive correlation existed between the two variables (Spearman's rho 0.776, $P<0.001$) suggesting that either would be appropriate to include in the model but both would be inappropriate (Field, 2009). The models relating to sharps injuries sustained at one and five years were tested using both time qualified and length of time in current speciality. The goodness of fit was tested for each variable at step 10. The results are as follows:

Sustaining one or more sharps injuries at one year

Including length of time qualified in the model –

Omnibus Tests of Model Coefficient significance Sig. = 0.015

Hosmer and Lemeshow test Sig. = 0.672.

Including length of time in current speciality in the model –

Omnibus Tests of Model Coefficient significance Sig. = 0.001

Hosmer and Lemeshow test Sig. 0.491.

Sustaining one or more sharps injuries at five years

Including length of time qualified in the model –

Omnibus Tests of Model Coefficient significance Sig. = 0.002

Hosmer and Lemeshow test Sig. 0.515.

Including length of time in current speciality in the model –

Omnibus Tests of Model Coefficient significance Sig. = 0.001

Hosmer and Lemeshow test Sig. 0.425.

In each case, the higher value of significance on applying the Hosmer and Lemeshow test suggests that length of time qualified provides a better fit (Field, 2009). Hence, length of time qualified was included in each model.

Tables 4.4.1 – 4.4.2 describe the variables as they appear in the models. See table 4.3.119 for a full description of the variables.

Table 4.4.1: Categorical variables entered into models 1 and 3

	Frequency	Percentage	Numbers missing
Sharps injury at 5 years			0
Yes	183	58.1	
No	132	41.9	
Sharps injury at 1 year			0
Yes	96	30.5	
No	219	69.5	
Profession			0
Surgeon	180	57.1	
Scrub nurse	135	42.9	
Emergency combined			2
Agree/strongly agree	208	66.5	
Uncertain	27	8.6	
Disagree or strongly disagree	78	24.9	
Pressure combined			2
Agree/strongly agree	241	77.0	
Uncertain	29	9.3	
Disagree or strongly disagree	43	13.7	
Familiar combined			3
Agree/strongly agree	168	53.8	
Uncertain	52	16.7	
Disagree or strongly disagree	92	29.5	
High risk combined			2
Agree/strongly agree	182	58.1	
Uncertain	25	8.0	
Disagree or strongly disagree	106	33.9	
Not high risk combined			2
Agree/strongly agree	34	10.9	
Uncertain	23	7.3	
Disagree or strongly disagree	256	81.8	
Occ haz combined			3
Agree/strongly agree	205	65.7	
Uncertain	27	8.7	
Disagree or strongly disagree	80	25.6	
Availability combined			6
Agree/strongly agree	182	58.9	
Uncertain	64	20.7	
Disagree or strongly disagree	63	20.4	
Attend tr			1
Yes	110	35.0	
No	204	65.0	
Avoid pass not other			15
Yes	259	86.3	
No	41	13.7	

Table 4.4.2: Number of years qualified

Number	Median	Range in years (Minimum-maximum)
313	20.00	42.25 (1.75-44.0)

<u>Model 1 – sustaining one or more sharps injuries at five years</u>

Two hundred and ninety one cases were included in the analysis (92.4%) with 24 missing cases. The variables included in the model are listed in table 4.4.3. The reference categories are underlined and terms in brackets are the descriptives as they are entered into the model. The most significant variables at step 1 were profession and belief that inoculation injuries are an occupational hazard. See appendix 14 for the SPSS print out of the full model.

Table 4.4.3: Variables in model 1 at step 1

Variable		Significance at step 1
Profession	Categorical- surgeon/scrub nurse	0.002
Length of time qualified (qualified)	Interval	0.46
Belief that injures more likely during emergency procedures (emergency combined)	Categorical - strongly agree or agree/uncertain/disagree and strongly disagree	0.99
Belief that injures more likely when working under pressure (pressure combined)	Categorical - strongly agree or agree/uncertain/disagree and strongly disagree	0.63
Belief that injures more likely when performing unfamiliar procedures (unfamiliar combined)	Categorical - strongly agree or agree/uncertain/disagree and strongly disagree	0.82
Belief that staff take fewer precautions when patients are not 'high risk' (high risk combined)	Categorical - strongly agree or agree/uncertain/disagree and strongly disagree	0.04
Belief that it is acceptable to take fewer precautions when patients are not 'high risk' (not high risk combined)	Categorical - strongly agree or agree/uncertain/disagree and strongly disagree	0.05
Belief that inoculation injuries are an occupational hazard (occ haz combined)	Categorical - strongly agree or agree/uncertain/disagree and strongly disagree	0.004
Belief that injures are influenced by availability of safety devices (availability combined)	Categorical - strongly agree or agree/uncertain/disagree and strongly disagree	0.49
Attended training session (attend tr yes no)	Categorical - has attended training/has not attended training	0.06
Avoid passing sharps from hand to hand (avoid pass not other)	Categorical - always/patient suspected as having blood-borne viral infection/never	0.51

Backwards likelihood ratio was used in the first instance, with all 11 variables entered. Using the Omnibus Tests of Model Coefficients and Hosmer and Lemeshow test of significance to estimate goodness of fit at step 10, the expected number of successful predictions suggests that the model fits the data. Omnibus Tests of Model Coefficients χ^2 15.09, P=0.002, Hosmer and Lemeshow χ^2 2.29, P=0.53. The Cox and Snell R Square and Nagelkerke R Square values at step 10 suggest that between 5 and 7.00% of the variability in the dependant variable can be explained by the set of variables entered into the model. The change in -2 log likelihood between steps one and 10 is 14.011 (381.337 - 367.326) indicating a significant difference between the steps (table 4.4.4). However, as -2LL rises, the value of the model falls. The smaller final model explains less of the variance than the model with all variables.

Table 4.4.4: Summary of model 1 (sharps injuries at 5 years)

Step	Model summary			Hosmer and Lemeshow Test		
	-2 log likelihood	Cox and Snell R Square	Nagelkerke R Square	Chi square	df	Sig.
1	367.33	0.10	0.13	10.41	8	0.24
2	367.33	0.10	0.13	6.54	8	0.59
3	367.45	0.10	0.13	6.94	8	0.54
4	367.66	0.09	0.13	10.59	8	0.23
5	368.26	0.09	0.12	10.64	8	0.22
6	369.62	0.09	0.12	6.42	8	0.60
7	370.19	0.09	0.12	7.63	8	0.47
8	373.74	0.08	0.10	8.17	7	0.32
9	377.41	0.06	0.09	9.20	7	0.24
10	381.34	0.05	0.07	2.29	3	0.52

SPSS removed the variables that contributed least to the model. The 95% confidence intervals of odds ratios for the excluded variables all crossed 1. The belief that it was acceptable to take fewer precautions if the patient was not high risk was a strong predictor (P=0.07) as was disagreeing or strongly disagreeing that fewer precautions are taken when the patient is not high risk (P=0.06), table 4.4.5. Once again these were strongly linked to profession, see tables 4.3.56 and 4.3.66.

Table 4.4.5: Variables removed from the equation (model 1)

Step of removal	Variable	B	Standard error	Significance in model, P value	Exponent of B (odds ratio)	95% confidence intervals of odds ratio
1	Attend training (agree/strongly agree)	-0.02	0.30	0.95	0.98	0.54-1.78
2	Availability of safety devices			0.92		
	Availability of safety devices (uncertain)	0.01	0.34	0.98	1.01	0.52-1.96
	Availability of safety devices (disagree/strongly disagree)	-0.13	0.34	0.70	0.88	0.45-1.71
3	Emergency procedures (agree/strongly agree)			0.92		
	Emergency procedures (uncertain)	-0.09	0.52	0.42	0.75	0.33-2.53
	Emergency procedures (disagree/strongly disagree)	0.13	0.38	0.15	1.60	0.54-2.41
4	Working under pressure (agree/strongly agree)			0.74		
	Working under pressure (uncertain)	0.33	0.49	0.50	1.39	0.49-3.79
	Working under pressure (disagree/strongly disagree)	0.20	0.41	0.63	1.22	0.44-2.87

Step of removal	Variable	B	Standard error	Significance in model, P value	Exponent of B (odds ratio)	95% confidence intervals of odds ratio
5	Avoid passing by hand (agree/strongly agree)			0.51		
	Avoid passing by hand (uncertain)	-0.48	0.44	0.28	0.62	0.26-1.47
	Avoid passing by hand (disagree/strongly disagree)	0.24	0.65	0.72	1.27	0.36-4.49
6	Length of time qualified	-0.01	0.01	0.45	0.99	0.96-1.02
7	Fewer precautions when patient is not high risk (agree/strongly agree)			0.19		
	Fewer precautions when patient is not high risk (uncertain)	-0.27	0.51	0.60	0.77	0.28-2.09
	Fewer precautions when patient is not high risk (disagree/strongly disagree)	-0.54	0.29	0.06	0.58	0.33-1.02
8	Unfamiliar procedures (agree/strongly agree)			0.17		
	Unfamiliar procedures (uncertain)	-0.30	0.35	0.39	0.74	0.37-1.47
	Unfamiliar procedures (disagree/strongly disagree)	0.43	0.29	0.15	1.53	0.85-2.75

Step of removal	Variable	B	Standard error	Significance in model, P value	Exponent of B (odds ratio)	95% confidence intervals of odds ratio
9	Acceptable to take fewer precautions when patient is not high risk (agree/strongly agree)			0.18		
	Acceptable to take fewer precautions when patient is not high risk (uncertain)	1.34	0.73	0.07	3.82	0.92-15.81
	Acceptable to take fewer precautions when patient is not high risk (disagree/strongly disagree)	0.37	0.40	0.36	1.44	0.92-15.81

N.B. for the variables in the final model, see table 4.4.7

At step 10, 168 participants were observed as having sustained a sharps injury at five years. Of these 140 (83.3%) were predicted correctly. The final model predicted correctly 62.2% of cases who would or would not sustain inoculation injuries at five years (table 4.4.6).

Table 4.4.6: Model prediction for sharps injuries sustained at 5 years (step 10)

	Predicted		
Observed			
Step 10 Sharps injuries at 5 year	**No**	**Yes**	**Percentage correct**
No	41	82	33.3
Yes	28	140	83.3
Overall percentage			62.2

The final model included two variables (table 4.4.7) and indicates that profession and the belief that inoculation injuries are an occupational hazard are significant predictors of sustaining a sharps injury at five years. In each case the odds ratio is <1. This indicates that the odds of sustaining a sharps injury decrease as the value of the predictor increases, i.e. scrub nurses are at lower risk than surgeons and the risk of injury is lower in those who disagree/strongly disagree that inoculation injuries are an occupational hazard. The final model predicted 62.2% of injuries, an improvement over the empty model (step 0) where the prediction was 57.7%.

Table 4.4.7: Variables in final model 1

Variable	B	Standard error	Significance in model, P value	Exponent of B (odds ratio)	95% confidence intervals of odds ratio
Profession	-0.52	0.26	0.05	0.60	0.367-0.99
Occupational hazard (agree/strongly agree			0.06		
Occupational hazard (uncertain)	0.26	0.45	0.56	0.77	0.32-1.85
Occupational hazard (disagree/strongly disagree)	-0.71	0.30	0.02	0.49	0.28-0.88
Constant	0.76	0.174	0.00	2.13	

Summary statistics for the final model are shown in table 4.4.8.

Table 4.4.8: Summary of final model 1 (injuries sustained at 5 years)

Residual variance and R Square: Cox and Snell	0.05
Residual variance and R Square: Nagelkerke	0.07
Hosmer and Lemeshow test	0.52
% of inoculation injuries at five years predicted	62.2

A further model (model 2) was calculated using the 'enter' method where the outcome variable was sustaining sharps injuries at five years, and the predictor variables were profession, length of time qualified and belief that inoculation injuries are an occupational hazard i.e. the predictor variables from the later steps of models 1 and 3 (model 2). The purpose of this was to confirm the predictive value of the original model.

Model 2 predicted 61.3% of injuries at five years, slightly lower than model 1 (62.2%). Profession (P=0.03) and belief that inoculation injuries are an occupational hazard (P=0.01) contributed significantly to the predictive ability of the model. In each case, the odds ratio was < 1 (0.581 and 0.489 respectively) indicating once again that scrub nurses are at lower risk of sustaining a sharps injury at five years than surgeons and the risk of injury is lower in those who are uncertain or disagree/strongly disagree that inoculation injuries are an occupational hazard. Length of time qualified was not a significant predictor (P=0.67). See table 4.4.9. The enter model reproduced the findings of the backwards entry model.

Table 4.4.9: Variables in final model 2

Variable	B	Standard error	Significance in model, P value	Exponent of B (odds ratio)	95% confidence intervals of odds ratio
Profession	-0.54	0.26	0.03	0.58	0.35-0.96
Qualified	-0.01	0.01	0.67	1.0	0.97-1.02
Occupational hazard (agree/strongly agree			0.05		
Occupational hazard (uncertain)	-0.23	0.42	0.59	0.79	0.35-1.82
Occupational hazard (disagree/strongly disagree)	-0.72	0.29	0.01	0.49	0.28-0.86

Summary statistics for the final model are shown in table 4.4.10.

Table 4.4.10: Summary of final model 2 (injuries sustained at 5 years)

Residual variance and R Square: Cox and Snell	0.05
Residual variance and R Square: Nagelkerke	0.07
Hosmer and Lemeshow test	0.92
% of inoculation injuries at five years predicted	61.3

Regression equation for model 1

A logistic regression equation was calculated for model 1 to quantify the relationship between the sustaining a sharps injury at five years (outcome variable) and profession and considering inoculation injuries to be an occupational hazard (predictor variable). By entering varying values for each predictor variable, the probability of sustaining a sharps injury at either one was calculated. The equation is as follows, see section 3.7:

$$P = \frac{e^{(b_0 + b_1 X_1 + b_2 X_2)}}{1 + e^{(b_0 + b_1 X_1 + b_2 X_2)}}$$

By substituting: 0.755 (constant or intercept) for b_0; -0.0687 for b_1; -0.519 for b_2; 0 or 1 (0 = surgeons, 1 = scrub nurses) for X_1; 0 or 1 (considering that inoculation injuries are an occupational hazard, 0=agree/strongly agree, 1=disagree/strongly disagree) for X_2, the probability of injury can be calculated. The equation predicts that the probability of sustaining a sharps injury at five years is higher for both surgeons and scrub nurses who agree or strongly agree that inoculation injuries are an occupational hazard is higher than for those who disagree/strongly disagree. The predicted risk of injury for surgeons is higher than for scrub nurses in each case. Results are presented in tables 4.4.11 and 4.4.12.

Table 4.4.11: Predictions of sustaining a sharps injury at five years in relation to believing that inoculation injuries are an occupational hazard for surgeons

Predictor variable	Probability of sustaining an injury (%)	Probability of not sustaining an injury (%)
Agree/strongly sagree	68.0	32.0
Disagree/strongly disagree	51.2	48.8

Table 4.4.12: Predictions of sustaining a sharps injury at five years in relation to believing that inoculation injuries are an occupational hazard for scrub nurses

Predictor variable	Probability of sustaining an injury (%)	Probability of not sustaining an injury (%)
Agree/strongly agree	55.9	44.1
Disagree/strongly disagree	38.4	61.6

Model 3 – sustaining one or more sharps injuries at one year

Two hundred and ninety one cases were included in the analysis (92.4%) with 24 missing cases. The variables included in the model are listed in table 4.4.13. The most significant variable at step 1 was profession.

Table 4.4.13: Variables in model 3 at step 1

Variable		Significance at step 1
Profession	Categorical- surgeon/scrub nurse	0.02
Length of time qualified (qualified)	Interval	0.16
Belief that injures more likely during emergency procedures (emergency combined)	Categorical - strongly agree or agree/uncertain/disagree and strongly disagree	0.445
Belief that injures more likely when working under pressure (pressure combined)	Categorical - strongly agree or agree/uncertain/disagree and strongly disagree	0.11
Belief that injures more likely when performing unfamiliar procedures (familiar combined)	Categorical - strongly agree or agree/uncertain/disagree and strongly disagree	0.83
Belief that staff take fewer precautions when patients are not 'high risk' (high risk combined)	Categorical - strongly agree or agree/uncertain/disagree and strongly disagree	0.06
Belief that it is acceptable to take fewer precautions when patients are not 'high risk' (not high risk combined)	Categorical - strongly agree or agree/uncertain/disagree and strongly disagree	0.23
Belief that inoculation injuries are an occupational hazard (occ haz combined)	Categorical - strongly agree or agree/uncertain/disagree and strongly disagree	0.12
Belief that injures are influenced by availability of safety devices (availability combined)	Categorical - strongly agree or agree/uncertain/disagree and strongly disagree	0.62
Attended training session (attend tr yes no)	Categorical - has attended training/has not attended training	0.08
Avoid passing sharps from hand to hand (avoid pass not other)	Categorical - always/patient suspected as having blood-borne viral infection/never	0.11

The goodness of fit of the model is estimated from the Omnibus Test of Model Coefficients and Hosmer and Lemeshow test of significance. Using backwards logistical regression, with all 11 variables entered, at step 10 the expected number of successful predictions suggests that the model fits the data, Omnibus Tests of Model Coefficient, χ^2 15.09, P=0.02, Hosmer and Lemeshow χ^2 5.78, P=0.63. The Cox and Snell R Square and Nagelkerke R Square values at step one suggest that between 3.0% and 4. 00% of the variability in the dependant variable can be explained by the set of variables entered into the model. It is acknowledged that these values are low.

Change in -2 log likelihood between steps 1 and 10 (339.489–324.46=15.029) indicating a significant difference. However, as -2LL rises, the value of the model falls. The smaller final model explains less of the variance than the model with all variables.

In the final model, as at step 1, 208 cases were observed not to have sustained a sharps injury at one year. The final model included two variables (table 4.4.14) and suggested that profession and length of time qualified are significant predictors of sustaining a sharps injury at one year although time qualified is only significant at the 10% level rather than the 5% level. The final model predicted correctly 100% of these. The final model also predicted correctly 71.5% of the cases who would not sustain sharps injuries at one year. The empty model also predicted 71.5% of injuries meaning that the variables in the final model are unable to predict injuries over and above the empty model and this is a major limitation.

Table 4.4.14: Variables in final model 3

Variable	B	Standard error	Significance in model, P value	Exponent of B (odds ratio)	95% confidence intervals of odds ratio
Profession	-0.69	0.28	0.01	0.50	0.29-0.86
Length of time qualified (per year)	0.02	0.02	0.10	0.98	0.95-1.004
Constant	-0.18	0.33	0.58	0.83	

Summary statistics for the final model are shown in table 4.4.15.

Table 4.4.15: Summary of final model 3 (sharps injuries at 1 year)

Residual variance and R Square: Cox and Snell	0.03
Residual variance and R Square: Nagelkerke	0.04
Hosmer and Lemeshow test	0.67
% of inoculation injuries at one year predicted	71.5

To confirm the predictive value of model 3, another enter model was calculated where the outcome variable was sustaining sharps injuries at one year, and the predictor variables were profession, length of time qualified and belief that inoculation injuries are an occupational hazard i.e. the predictor variables from the later steps in models 1 and 3. This model (model 4) predicted 69.7% of injuries at one year, slightly lower than model 3 which predicted 71.5% of injuries. Profession was found to contribute significantly to the predictive ability of the model (P=0.03) while length of time qualified (P=0.37) and belief that inoculation injuries are an occupational hazard (P=0.16) were not significant when compared to the reference groups. As the odds ratio for profession was <1, the model indicated that surgeons are more at risk of injury than scrub nurses. See table 4.4.16. The enter model confirmed the predictive value of profession but did not confirm the value of time qualified as a predictor of sharps injuries at one year.

Table 4.4.16: Variables in final model 4

Variable	B	Standard error	Significance in model, P value	Exponent of B (odds ratio)	95% confidence intervals of odds ratio
Profession	-0.64	0.28	0.03	0.53	0.30-0.92
Qualified	-0.01	0.01	0.37	0.99	0.96-1.02
Occupational hazard (agree/strongly agree			0.36	1.00	
Occupational hazard (uncertain)	-0.25	0.47	0.60	0.78	0.31-1.97
Occupational hazard (disagree/strongly disagree)	-0.48	0.34	0.16	0.62	0.32-1.20

Summary statistics for the final model are shown in table 4.4.17.

Table 4.4.17: Summary of final model 4 (injuries sustained at 1 year)

Residual variance and R Square: Cox and Snell	0.04
Residual variance and R Square: Nagelkerke	0.05
Hosmer and Lemeshow test	0.09
% of inoculation injuries at five years predicted	69.7

To determine whether the models could be improved, both models 1 and 3 were re-run repeatedly using the enter method. On the first re-run, the first two variables removed by SPSS were omitted. Variables were removed one by one until only the variables present in the final models remained. In neither model 1 nor model 3 was the predictive ability indicated by the percentage of injuries at either one or five years improved.

As the influence of profession was strong in each of the models, a model was constructed excluding nurses but due to the low numbers this was approached with caution. On cross-tabulation, no cells contained 0 but none of the variables were significant in relation to sustaining a sharps injury at one year therefore, no model was constructed. At five years, no cells contained 0, but only three variables were significant at the 10% level or below: pressure (P=0.09), not high risk (P=0.034) and avoid pass (P=0.08). These were entered into a final model together with time qualified. The backwards likelihood ratio method was used. In the final model, none of the variables were statistically significant at 5% indicating that none of the variables was a significant predictor of surgeons sustaining a sharps injury at five years.

Testing for multicollinearity

According to Field (2009) regression analysis may be subject to bias from collinearity, or the links between predictor variables. As regression only requires one predictor, close correlation between the predictors leads to an inability to obtain unique estimates of the regression coefficients for the predictors. Consequently, Field recommends testing for this. This was undertaken for the outcome measures and predictors in each of the final models.

For each of the four models, the tolerance level exceeded 0.1, the VIF was less than 10 indicating no serious collinearity problems. Although there are no fixed rules for the value of the eigenvalue or condition index, they were fairly similar within each model which suggests that the collinearity of the models falls within acceptable limits in social science (Field, 2009).

Summary

The regression analysis of surgeons and scrub nurses in participating trusts created two models that correctly predicted 62.2% of injuries at five years (model 1) and 71.5% of sharps injuries at one year (model 3). Model 2 confirmed the predictive value of model 1 (profession and belief that inoculation injuries are an occupational hazard) although a further model (model 4) failed to confirm the predictive value of length of time qualified. Therefore, model 3 must be considered with caution (see section 5.2.7). The models predicted that profession i.e. being a surgeon is a significant predictor for sharps injury at both one and five years.

Section 4.5 discusses the data within the open-ended questions in the questionnaire.

4.5 CONTENT ANALYSIS - QUESTIONNAIRES

A total of 227 comments were received from 118 participants. In all, 37.5% of participants offered comments in the survey, 65/180 (36.1%) of surgeons and 53/135 (39.3%) of scrub nurses. All categories and themes deriving from the questionnaire are presented in appendix 17, table A17.5.1. Comments made in relation to individual categories are also presented in appendix 18, tables A18.1 – A18.10.

Although many of the comments were brief, many others provided a significant insight into the opinions and feelings of the participants. As these are direct quotes from the questionnaires, emphases, abbreviations, grammatical and spelling errors are those of the participants not the researcher.

The largest number of comments in the questionnaires related to adherence to or violation of guidelines. The UK Health Departments (1998) advise that during surgical procedures double gloves and eye protection should be worn routinely and that sharps should be passed via a neutral field, use of sharps should be minimised, no more than one person should have their hands in a body cavity at any one time and consideration should be given to using safety devices to replace current equipment. It could be argued that unless all these procedures are followed for each case, then guidelines have been violated. However, it was apparent from both the quantitative and qualitative analysis that very few participants achieved complete compliance. Seven participants chose to comment on this issue on the questionnaire.

It was recognised by some participants (n=11) that constant adherence to guidelines offers effective protection, 3/11 (27.3%) of these were surgeons and 8/11 (72.7%) nurses:

> "If you're used to safe practice then whatever the circumstances you shouldn't sustain any injuries. If you do it's as I've seen it's purely accidental i.e. a needle sticking through a sharps pad or assisting the surgeon who slips" 3.N.11.
>
> "All patients should be treated as "High Risk". The likelihood of accidents happening are higher if staff become over anxious when "high risk" patients come through theatre" 4.N.53.
>
> "There are no excuses for needle stab injuries during any procedure if guidelines are followed" 3.N.11.
>
> "I treat every patient the same – I assume they all could be HIV or Hep B/C" *(SIC)* 5.N.23.
>
> "I feel that the best way to reduce the incidence of inoculation injuries is to wear gloves at all times whilst performing invasive procedures and preferably double gloving while operating. It is also important to wear adequate eye protection and avoid passing sharp instruments and needles directly to hand during operations" 3.S.25.

All comments related guideline adherence are presented in table A18.1

The number of respondents consistently adhering to guidelines was far outnumbered by those who consistently or periodically fail to do so. Unsurprisingly therefore, this category received the largest number of comments. These responses were categorised as guideline violations and are recorded in table A18.2.

Reasons for guideline violation were divided into themes. One participant suggested a lack of confidence in the efficacy of guidelines:

"I don't see the point of double gloving. Surely one pair is enough!" 5.N.23.

While four others found available safety equipment uncomfortable:

"I have worn visors in the past but they are all uncomfortable" 5.N.23.

It was observed by 2/102 participants (1.9%) that length of service influenced whether guidelines were adopted with those qualified longer being less likely to follow established procedure:

"I started my training 5.5 years ago and qualified in 2003. I find that younger people who qualified recently do take precautions against inoculation injuries. However, the mature scrub nurses don't take as many precautions especially wearing a visor (or any eye protection" 1.N.23.

Some (5/105, 4.8%) participants commented on violations by other healthcare professionals:

"Most sharps injuries occur due to surgeons not handing sharps back properly" 5.N.26.

While a 1/102 (0.95%) was unaware of some of the facilities/equipment designed to improve safety:

"? safety devices" 3.S.31.

More common than consistent adherence to guidelines was the adoption of guidelines under specific circumstances. Two clear reasons have emerged for partial compliance: type of surgery and surgeons' preference, 33/105 participants (31.4%) indicated that the type of surgery determined the precautions followed. Double gloving was the protective measure most often affected by the type of operation and was frequently discussed in relation to orthopaedic surgery (15/10514.3%).

"Double glove in orthopaedics" 1.N.3

"Double glove for joint replacement" 3.N.17.

Eye protection was also frequently adopted for orthopaedic surgery:

"Eye protection for all joint replacements" 3.S.30.

"Certain procedures (eye protection)" 2.S.58.

"Eye protection – hip/knee replacements, vascular cases, other cases where fluid prone to splashing" 6.N.20.

18/105 participants (17.1%) indicated that use of safety devices was decided by surgeons' preference and one said:

> "It is all dependent on the consultant surgeon. If the consultant surgeon practices safety then the junior staff will practice automatically" 6.S.34.
>
> "At surgeon's preference or request (safety device)" 6.N.30.
>
> "Most cases depends on who's the surgeon (avoid passing sharps)" 2.N.18.

Whether or not to avoid the use of sharp instruments or pass instruments from hand to hand was also frequently dictated by surgeons:

> "I will avoid sharp instruments as much as possible" 6.S.34.
>
> "I think the surgeons need training in passing sharps safely as well as the nurses – my incident occurred due to a surgeon not securing a used suture needle to the needle holder" 6.N.13.
>
> "Only one surgeon uses blunt needles on every patient, otherwise never" 2.N.36.

Speciality also dictated whether safety devices were utilised:

> "Ophthalmology" (safety device) 6.N.10.
>
> "Use blunt needles during caesarean sections but not otherwise". 2.S.18.

It was apparent that the use of eye protection is important to many theatre staff, and 25/105 (23.8%) wore eye protection for some or all cases, while 2/105 (1.9%) commented that they were likely to use eye protection routinely:

> "Generally starting to use visor more regularly for non-risk patients" 3.S.12.
>
> "Any case that is likely to involve splattering of fluids e.g. washouts and high risk cases" 2.S.45.

However, some of those who wore eye protection (8/25, 32%) were under the impression that eye protection was unnecessary if spectacles were worn. This misapprehension could put personnel at risk as found by Brearley and Buist (1993) and Bell and Clement (1991) and this was recognised by one (0.95%) participant:

> "I wear normal glasses which offer some protection (I know limited) 5.N.23.

Twenty seven participants elected to comment on reporting of inoculation injuries. These comments are presented in table A18.3.

There were 5/27 (18.5%) participants who fully supported the idea that injuries should always be reported,

> "Sharps injuries should ALWAYS be reported" 4. N.73
>
> "I reported my inoculation injury. I went through the correct channels. If it happened again I'd do the same" 1.N.23.

However, many others (20/27, 74.1%) disagreed. It appears that surgeons are less likely to report injuries than scrub nurses (see table 4.3.89), and that this was an issue of concern to the nurses:

> "Getting doctors to report needlestick injuries is very difficult, they don't like filling in forms, going to staff health. Normally left to nurse in charge to fill in relevant documents and to follow up investigations straight away while everything is fresh in everyone's mind. Also nurse normally has to get patient's permission to take bloods" 5.N.22.

Of those who commented on the reporting procedure, the majority of negative comments (9/27, 33.3%) related to the cumbersome nature of the reporting process:

> "It is probably a cumbersome process of filling appropriate form, chasing patient, obtaining blood from the patients and the whole process disrupts the whole day" 1.S.43.
>
> "I find the reporting of needlestick injury is too cumbersome. Sometimes you can have a minor scratch and you are forced to go through the same procedure" 6.S.22.
>
> "It is the amount of time involved and the interruption to work (which usually cannot be covered) that causes me to ignore the injury" 5.S.17.

Even where injuries have previously been reported, dissatisfaction with the follow up procedure may deter participants from reporting subsequent injuries:

> "I have completed incident form for sharps injury and telephoned occupational health for blood sampling – message left on answer phone but no further contact from occ *(SIC)* health, therefore no blood sample was taken on this occasion" 2.N.26.

> "OH *(SIC)* not always available" 6.N.6.

Others have concerns about the consequences of admitting that an injury has occurred:

> "Expect censorship not support for allowing it to happen"2.S.3.

Table A18.4 lists the comments made in relation to training sessions

Only one (1/24, 4.2%) participant provided a negative comment in relation to training:

> "And it will be of no use" 1.S.17.

However, the majority of participants who commented in response to the open question on the questionnaire (17/24, 70.1%) had a positive attitude towards training regarding the use of appropriate precautions and actions following inoculation injury:

> "Universal precautions and training can only help further to reduce injuries. Working in the orthopaedic theatre we always wear masks and eye protection and double glove routinely" 4.N.42.

> "Inoculation injuries would be reduced by having more reinforced education and by having safe disposal equipment freely available" 1.N.8.

> "I would welcome training/management of these injuries for all staff in the operating department" 1.N.17.

> "Would like to know more about the training session for prevention of inoculation injury and to have it done for the department" 6.S.19.

Worthy of note here is that only one of the positive comments was made by a surgeon, the rest were made by scrub nurses.

Five scrub nurses (5/27, 18.5%) were also able to identify the training needs of others, particularly the surgeons:

> "I think the surgeons need training in passing sharps safely as well as the nurses – my incident occurred due to a surgeon not securing a used suture needle to the needle holder" 6.N.13.

> "I find doctors need more training on the understanding of sharps – most incident forms are completed due to doctors receiving injuries" 1.N.6.

> "I think inoculation injuries training must be done for all the TA's *(SIC)* working inside the theatre and other staff as well like cleaners. They must be orientated before the start of their work especially if they don't have any medical background at all or hospital experience. This kind of training must be done annually to update the staff about latest cases that must be reviewed by the department" 2.N.58.

Table A18.5 displays the comments in relation to availability of equipment.

One respondent (1/14, 7.1%) recognised the value of safety devices in reducing injuries:

> "Retractable blades would be helpful in reducing inoculation injuries" 2.N.54.

However, availability of such equipment was sometimes limited:

> "Always use blunt suture needles. Don't have retractable blades" 2.N.54.

> "If in stock (safety devices)" 6.N.41.

> "There is a problem with our Trust about availability of proper (Kevlar) protective gloves and Stryker exhaust hoods – purely on the grounds of cost" 4.S.37.

Once again, the surgeon's preferences were influential in deciding what safety measures would be available:

> "Blunt needles used in preference by some surgeons. Other safety devices not at present available in our department" 1.S.4.

> "Depends on surgeon's preference. DO NOT STOCK RETRACTABLE BLADES" 1.N.9.

Comments from 8/14 (57.1%) suggested that safety equipment wasn't always readily available. Cost was identified by 1/14 (7.1%) participant as a factor affecting the availability of certain protective equipment:

> "Cheap sticky sharps pads with no weight in them are more likely to cause injuries than the slightly more expensive weighty ones. Not necessarily the very expensive ones just the heavier than basic ones" 2.N.45.

Only 2/14 (14.2%) participants, both of whom were surgeons identified pressure of work as a contributory factor to the occurrence of inoculation injuries see table A18.6.

Seven respondents commented on the influence of pressure of work on inoculation injuries, and all acknowledged that increased pressure increases the risk of injury and that taking more care can reduce the risk:

> "Be calm and take your time, operate without making too much mess!" 4.S.52.

Organisational issues that increase pressure of work have also been identified as a factor that will contribute to injuries:

> "Issues such as staffing levels, workloads, team dynamics, skill mix all contribute to increased risk of injuries" 4.N.88.
>
> "Minimum staffing levels e.g. out of hours work, can mean policy – i.e. de-scrubbing would be difficult to achieve" 4.N.88.

Table A18.7 lists the comments made in response to the statement in the questionnaire that inoculation injuries are an occupational hazard.

While 6/12 (50%) participants identified that inoculation injuries are an avoidable occupational hazard:

> " 'Sharps injuries are an occupational hazard that can be avoided" 1.N. 2.
>
> "A preventable occupational hazard" 4.S.4.

One surgeon made the point that while inoculation injuries may be an occupational hazard, they should not be tolerated:

> "An 'occupational hazard' does not mean they are acceptable in any form" 4.S.40.

One suggested that all surgeons will sustain an injury whether or not they report it:

> "Needlestick injuries are an occupational hazard for a surgeon. This does happen to every surgeon/assistant whether they report it or not" 4.S.12

Another felt that inoculation injuries should not be considered as a occupational hazard:

> "Most of inoculation injuries occur in OT *(SIC)* while suturing. They are not reported as the process is too cumbersome. It should never be considered an occupational hazard" 3.S.32.

Several participants (4/12, 33.3%), all of whom were surgeons felt that such injuries were unavoidable:

> "In surgical field, one can only minimise but cannot completely avoid sharp injury. It is a professional hazard" 6.S.22.
>
> "Injuries are inevitable when performing complex surgical procedures deep within the pelvis" 2.S.7.

Three (25%) participants felt that compensation or support should be available for health care professionals sustaining an inoculation injury, while one nurse would always report inoculation injuries because failure to do so would invalidate a critical illness insurance policy, see table A18.8.

Ten participants commented on the study. Whereas two comments praised the questionnaire, 4/10 (40%) passed negative comments on its quality:

> "Good questionnaire" 2.S.77
>
> "You have asked for very few facts – mostly opinions, and the subsequent report will be of little value therefore" 2.S.11.

Two comments were made regarding the difficulty of remembering all injuries sustained.

Comments relating to the study are listed in table A18.9. Six miscellaneous comments were received. These are listed in table A18.20

Data from the semi-structured interviews with selected surgeons and scrub nurses are discussed in section 4.6.

4.6 SEMI-STRUCTURED INTERVIEWS - CONTENT AND THEMATIC ANALYSIS

The interviews were largely concerned with objectives four and five of the study i.e. to explore healthcare professionals' views of their personal risks and adoption of guidelines/protocols on standard/universal precautions and inoculation injury reporting. A total of 16 interviews were conducted between June 9th and September 15th 2008 by which point data saturation had occurred and no further requests for interviews were sent (response rate 16/110, 14.5%). The participants comprised eight surgeons, six scrub nurses and two operating theatre managers both of whom were also scrub nurses. The interview schedule used for the managers' interviews can be found in appendix 22. Five out of six participating trusts were represented in the interviews, surgeons from four trusts were interviewed, nurses from two and managers from two. The specialities of the surgeons who participated are: obstetrics and gynaecology (n=3), general surgery (n=2), ear, nose and throat (n=1), urology (n=1) and orthopaedics (n=1). All interviews were recorded and transcribed. Table 4.6.1 contains a list of participants.

Table 4.6.1: Participants

Code	Profession	Speciality (surgeons)	Length of time qualified	Date and duration of interview	Location of interview	Comments
2.S.7	Consultant surgeon	Urology		09.06.08 35 minutes	Office within ENT directorate	Secretary asked to hold all calls. Quiet environment, no interruptions.
2.S.4	Consultant surgeon	General specialising in vascular surgery	34 years	30.06.08 30 minutes	Office within the consultant's ward.	Interview interrupted by 10 minute mobile phone call. Office next to public toilet, very noisy.
6.S.51	Consultant surgeon	Obstetrics and gynaecology		02.07.08 50 minutes	Office within the labour ward.	No interruptions
4.N.19	Consultant surgeon	Obstetrics and gynaecology		03.07.08 30 minutes	Consulting room in the early pregnancy clinic situated at the end of a ward.	Lunches being served on the ward, very noisy. Interviewee did not speak English as a first language, strong accent. Phrasing sometimes difficult to understand
6.S.49	Consultant surgeon	Obstetrics and gynaecology	23 years	23.07.08 45 minutes	Office on obstetrics ward.	Very quiet, no interruptions
2.S.22	Consultant surgeon	General		15.08.08 45 minutes	Office within Academic Department of Surgery.	No interruptions
4.N.1	Nurse	N/A	12 years	18.08.08 25 minutes	Office within the operating theatre.	Nurse was called away before the interview was completed.

4.N.2	Nurse	N/A	8 years	18.08.08 30 minutes	Office within the operating theatre.	No interruptions.
4.N.3	Nurse	N/A	20 years	18.08.08 30 minutes	Office within the operating theatre.	No interruptions.
4.M.1	Nurse/ Manager	N/A	34 years	18.08.08 40 minutes	Office within the operating theatre.	No interruptions.
4.N.4	Nurse	N/A	2 years	18.08.08 45 minutes	Consulting room within the day surgical unit.	Slight noise from waiting room but this did not disturb interview.
4.N.5	Nurse	N/A	8 years	18.08.08 35 minutes	Consulting room within the day surgical unit.	Slight noise from waiting room but this did not disturb interview
2.S.35	Consultant surgeon	Orthopaedics		28.08.08 55 minutes	Consulting room in private hospital.	No interruptions
3.M.1	Nurse/ Manager	N/A	21 years	09.09.08 70 minutes	Training room in operating theatre.	No interruptions
1.S.15	Consultant surgeon	Ear, nose and throat	25 years	15.09.08 55 minutes	Staff room in ENT out patients department.	2 interruptions by nurses making beverages.
2.N.29	Nurse	N/A	24 years	17.09.08 50 minutes	Nurse's home.	3 dogs present, some disruption caused

Content analysis was undertaken on the interviews. Many of the themes identified in the qualitative element of the questionnaire also emerged during the interviews. However, two new categories emerged namely that of teamwork and sustaining an injury, and within existing categories, several new themes were discussed. Appendix 17 lists all categories and themes emerging from both the questionnaire and interviews. Those themes suffixed by (I) emerged only during the interviews.

Completion of interviews

Interviews were considered complete when answers were repeated during successive interviews. The frequency and distribution of events were enumerated to check the frequency and distribution of responses in relation to each category thereby providing an overall impression of the data (Silverman, 2001). In general, there was a high degree of consistency in the responses from all respondents. However, in relation to two categories i.e. reporting and training, differences were evident between surgeons and nurses. Table 4.6.2 illustrates the degree of repetition.

Table 4.6.2: Themes and coverage

Category	Surgeons n=8	Nurses n=6	Managers n=2	Comments
Guideline adherence	No surgeons adhered to universal/standard precautions for every patient. All would change the level of protection for high risk patients. No surgeons claimed to follow universal/standard precautions. However, passing instruments via a neutral field is standard practice.	1/6 (16.7%) wore visor, double gloves, passed instruments through a neutral field for all patients. The remainder would change the level of protection for high risk patients. 2/6 (33.3%) stated that universal precautions were necessary. Passing instruments via a neutral field is standard practice although 1 nurse felt that some surgeons would pass hand to hand out of choice.	Neither manager adhered to universal/standard precautions for every patient. However, both emphasised the importance of everyone following universal precautions.	Distribution of responses reflects the questionnaire.
Guideline violation	3/8 (37.5%) of surgeons wore eye protection for every case, only 1/8 (12.5%) double gloved routinely (orthopaedic surgeon), but all would double glove and wear eye protection for high risk cases. 5/8 (62.5%) of surgeons use blunt needles.	Only 1/6 (16.7%) nurses double gloved for every case regardless of speciality, a further 3/6 (50%) would double glove for orthopaedics and all would double glove for high risk cases. 3/6 (50%) of nurses wear eye protection for all cases, all would wear it for high risk cases.	Neither double gloves for all cases but would for high risk cases. Both would wear eye protection for all cases.	Distribution of responses reflects the questionnaire.

Reporting	Only two surgeons (25%) would report all inoculation injuries. Each surgeon who failed to report (6/6, 100%) commented that the reporting mechanism was overly time consuming.	All nurses would report inoculation injuries.	Both managers emphasised the need for consistent reporting.	Distribution of responses reflects the questionnaire. Surgeons acknowledged that nurses report more consistently and nurses recognised that surgeons were unlikely to report injuries.
Training	No surgeon had attended a training session on the prevention and management of inoculation injuries. 4/8 (50%) felt they could be beneficial.	3/5 nurses (60%) had attended a training session. All felt they would be beneficial*	Both have arranged training sessions, uncertain of number of surgeons who attend.	Distribution of responses reflects the questionnaire.
Availability of equipment	Despite being involved in trials, 4/8 (50%) surgeons felt that they had been asked to use poor quality gloves at some time. Quality was felt to be affected by price.	Despite being involved in trials, 4/5 (80%) nurses had been dissatisfied with the quality of gloves at some time. Quality was felt to be affected by price*	Both managers stressed that users were actively involved in product selection. Cost is important, however, quality has equal priority.	Not considered in questionnaire.
Pressure of work	3/8 (37.5%) felt that increased pressure could result in more injuries. 1/8 (12.5%) felt that emergencies were safer because adrenaline level and awareness are higher.4/8 (50%) did not discuss pressure of work.	1/6 (16.7%) felt pressure of work had no impact on injuries, 1/6 (16.7%) felt that injuries were less likely during an emergency. because staff were more cautious, 1/6 (16.7%) felt the risk of accident was related to the expertise of the surgeon. The remaining 3/3	Neither discussed the impact of pressure of work on injuries.	Distribution of responses reflects the questionnaire.

		(50%) did not discuss pressure of work.		
Occupational hazard	6/8 (75%) surgeons felt that inoculation injuries are an occupational hazard.	No nurses expressed the view that inoculation injuries are an occupational hazard.	Neither manager expressed the view that inoculation injuries are an occupational hazard.	Distribution of responses reflects the questionnaire.
Compensation or support	Only one surgeon (12.5%) considered that it was reasonable to expect compensation if an occupational infection was acquired.	No nurses identified compensation as an issue.	Neither manager identified compensation as an issue.	Low number of respondents concerned with compensation reflects findings of survey.
Teamwork	Teamwork was considered important by all surgeons. Level of teamwork considered good.	Teamwork was considered important by all nurses. Level of teamwork considered good.	Teamwork was considered important by both managers. Level of teamwork considered good.	Not considered in questionnaire.
Cause of injury	Suture needles were the main cause of inoculation injury with all surgeons (8/8, 100%) having sustained injuries in this way. 1/8 (12.5%) reported a blood splash to the eyes and 1/8 (12.5%) had sustained a cut from a scalpel.	2/6 (33.3%) nurses had been injured by used scalpels, 2 (33.3%) by suture needles and 2 (33.3%) had not sustained an inoculation injury while working in the operating theatre. 1/6 (16.75%) of nurses had sustained a blood splash to the eyes	1/2 (50%) managers had sustained a splash of blood to the eyes and a needlestick injury. The other knew that she had sustained a sharps injury but could not recall the instrument.	Cause of sharps injuries not considered in questionnaire.

* Interview with one nurse discontinued early as she had to return to work, therefore training and availability of equipment not discussed

Themes emerging

The findings are discussed under headings representing the categories that emerged during the interviews and are illustrated by extracts from the interviews. Extracts from the interviews can be found in appendix 19. Two complete interviews, one coded and one un-coded are included as appendices 21 and 22.

The themes for discussion are:

- Guideline adherence
- Guideline violation
- Reporting injuries
- Injuries are an occupational hazard
- Attending training sessions
- Availability of equipment
- Pressure of work
- Teamwork
- Sustaining an injury

Guideline adherence

It was apparent from the interviews that although one interviewee (4.N.5) complied unconditionally with all available precautions, this was the exception. Interestingly, many professed to follow universal/standard precautions consistently but in fact did not apply them at all times (table A19.1). This was evident in conflicting responses from many of the participants. For example 4.N.1 stressed the need for consistent application of universal precautions:

> "Would different people decide to do different things perhaps or is it fairly standardised?" Interviewer.
>
> "There are universal precautions really, isn't it from the moment the patient comes in. Um, and you try to be so discreet that they don't even notice anyway" 4.N.1.

Yet admitted that in her own practice, she was inconsistent in their use:

> "You mentioned that you wear visors. Do you wear a visor for every case?" Interviewer.
>
> "No, I don't. No, only when there's a risk of splashing" 4.N.1.

This was a recurring theme, with HCPs acknowledging that the risk status of patients cannot be assumed - the cornerstone of standard/universal precautions, yet making judgements on whether to take precautions based on an assessment of risk status:

> "I mean if someone comes in and you know they're a drug addict off the street, that's different but I think the big risk with HIV is the posh people you know who are doing things they shouldn't" 2.S.22.
>
> "Well everybody's high risk really if you think about it aren't they?" 6.S.51.
>
> "….. we had an HIV caesarean to do and oh gosh, we had Kevlar gloves and double gloves , you name it…" 6.S.51.

Guideline violation

As standard/universal precautions rely on adopting the same precautions for all patients whenever exposure to blood or body fluids is anticipated, it was assumed if guidelines were not adhered to in all situations and for all patients that guideline violation had occurred. Therefore, if participants were selective about which precautions to adopt e.g. wearing of visors but failure to double glove they were considered to have violated guidelines. Only one respondent (4.N.5) adopted all precautions for all patients, the remainder would be selective in their approach to protective measures (table A19.2).

There was considerable variation in the type of protective measures participants would readily adopt. The use of a neutral field for passing sharps was practiced by all and was often initiated by nurses according to 4/8 surgeons (50%) and 3/6 nurses (50%), although, one scrub nurse felt that some surgeons do so only under pressure:

> "I always use a kidney dish but some consultants will try to hand them straight back to you but if you say you'd rather use a kidney dish and pass it over to them, they will use that" 2.N.29.

Almost all the surgeons interviewed (6/8, 75%) stated that they would be happy for nurses to make suggestions regarding improvements to safety and to adopt these changes.

Other precautions were not followed universally. Reasons for guideline violation were varied, but most commonly, violation occurred due to self-selected circumstances which represented choices made by the individuals based on presumption of risk. Commonly, the assumption that the patient is known or suspected to be at high risk of blood-borne viral infection motivates participants to adopt what they consider to be appropriate precautions. For example, eye protection is worn for every case by 3/8 (37.5%) surgeons and 3/6 (50%) nurses. All would wear eye protection for high risk cases or where there is a high risk of splashing:

> "If we're doing an amputation using a saw I use a visor then because we use an electric saw and that of course goes everywhere but I don't use them at other times" 2.S.4.

One nurse said, that:

> "For power tools I would use them" 4.N.3.

Despite being aware that caution is required:

> "I think in this day and age, in the present climate with all these different diseases going around you're very careful. You've got families and you protect yourself and you protect others" 4.N.3.

Interestingly, two surgeons (2/8, 25%) had worked in South Africa where they acknowledged the incidence of HIV is higher than in the UK, and consequently the risk to healthcare workers was higher. Both said that they took extra precautions when working there:

> "Well, in South Africa I used to double glove all the time" 2.S.22.

Wearing spectacles was cited as a reason for not needing extra eye protection by a nurse and a surgeon during the interviews. However, wearing glasses highlighted to one surgeon the extent to which blood could splash into the eyes:

> "I wear contact lenses and when I used to have to come in on call at night for problem deliveries I wouldn't bother with them and I'd have my glasses on and afterwards there'd be blood all over them so I know that's all going into my eyes now" 6.S.49.

Double gloving is practised less commonly, with only 1/8 (12.5%) surgeons and 1/6 (17.4%) nurses double gloving for every case. The surgeon worked exclusively in orthopaedics where double gloving is adopted for both infection control reasons and because of the cement used during the procedures. Nurses working in a variety of specialities would double glove for orthopaedic surgery but only wear one pair of gloves for other surgery:

> "We are supposed to wear double gloves for orthopaedics because of the joints and things but it's only one pair for everything else unless we know it's an infected case and then you double glove" 4.N.3.

According to two participants, failure to double glove routinely was because of lack of faith in the ability of two layers of glove material to reduce the risk of injury:

> "It's not very good protection against needlestick injury" 2.S.35.

More commonly, the effect on dexterity of two pairs of gloves was cited:

> "...you can't make fine movements accurately" 6.S.49.

All participants acknowledged that tactile sensation is altered by double gloving, although those who used double gloves regularly stated that the change in sensation was easily accommodated and did not affect performance:

> "They feel different, so I suppose they must *(affect dexterity)* but I'm used to it now" 2.N.29.

> "Double gloving was strange at first but you get used to it and you learn to re-feel the instruments so I find it strange now if I haven't got double gloves on" 4.N.5.

However, all participants would double glove for high risk patients:

> "For a patient with known risks, then I tend to double glove" 1.S.51.

> "I try to be that much more careful if they're HIV which is pretty uncommon in this part of the world or hepatitis B or C positive. I try to wear double gloves in those instances. Um, but there aren't many at the moment in this part of the world, thank God" 2.S.4.

One nurse and two surgeons agreed that if dexterity was compromised during double gloving for those who do it infrequently this could potentially increase the risk of sharps injury:

> "I've tried wearing two pairs of gloves in the past, in my training and I've found it very unwieldy. The sensation's very, very different and I perceive, although I haven't tried this out, I'd have a greater chance of sticking a needle in myself with two pairs of gloves than one pair of gloves" 2.S.7.

Typically, those who wore double gloves used two single pairs of gloves and only one surgeon (12.5%) and one nurse (16.7%) routinely wore indicator gloves to highlight whether the outer glove had been torn. Two nurses (33.3%) and one surgeon (12.5%) were aware of these but stated that they were not in common use within their departments. There was no consistency on glove sizing i.e. whether a smaller or larger pair is worn on the inside.

Among surgeons, the most common injuries were caused by suture needles. To reduce the incidence of these injuries, five out eight surgeons (62.5%) were happy to use blunt needles for suturing where appropriate rather than sharp needles. Two of those who didn't use blunt needles cited the nature of their speciality as the reason i.e. vascular surgery where finer needles are required and orthopaedics where:

> They're no good for skin and they're no good for facscia. They're no good for tendons and that's what orthopaedic surgery is all about" 2.S.35.

However, one surgeon (12.5%) had little confidence in the ability of blunt needles to prevent injury:

> "...because they don't go through so cleanly they veer to one side or another if the tissue is a bit tough...I tend to bump myself with a blunt needle far more often than a sharp needle" 2.S.22.

Nevertheless, among those who routinely used blunt needles, attitudes towards them were positive:

> "You have to press pretty hard to stick them in your fingers" 6.S.51.

However, it was recognised that blunt needles are not suitable for all types of tissue and must be used appropriately:

> "Veins that bleed there *(within the pelvis)* are very flimsy and if you start putting blunt needles through them they probably start tearing" 2.S.7.

Although most guideline violation is due to self selected circumstances, some guidelines are violated because of peer pressure:

> "...when it comes that some are wearing them *(goggles)* but some are not I think 'do I really need to wear it?" 4.N.2.

Compliance would be improved in the event of operating on a high risk patient:

> "If you knew the patient was HIV or hepatitis C that might change how you'd behave" 2.S.22.

All surgeons and 4/5* nurses (66.7%) would adopt extra protection when operating on a known HIV or hepatitis positive patient. In addition, these interviewees admitted that those patients falling into the stereotypical high risk groups e.g. homosexual men and intravenous drug users:

> "If you have a situation where you're dealing with a patient who was say a drug addict then you know you've got to be doubly careful because they don't tell you they're positive" 2.S.4.

Currently in the UK, obstetric patients are tested for bloodborne viruses during the ante-natal period. Consequently, the three obstetricians/gynaecologists interviewed felt confident that they would know if a high risk pregnant woman was being operated on and several surgeons (4/8, 50%) would like routine testing of all elective patients to be carried out:

> "Well in my view, I think the system has a duty of care to the carers and the recipients have a responsibility to their carers to make known hazards and permit themselves to be tested....The point is if you're a practicing homosexual for instance and in a sort of drug culture lifestyle you're a high risk individual" 2.S.35.

Two surgeons (25%) felt that this would raise no objection from patients:

> "I don't think they'd mind really. As I said before, I don't think the stigma of HIV is as bad as it used to be and it would be in their interest to know so they could get treatment which is very good nowadays" 6.S.49.

However, one surgeon felt that:

> "If you tested every patient, the patients would require every doctor to be tested on a regular basis. If you test every doctor on a regular basis and they become positive they lose their job....If I had my job under threat, I'd want some kind of compensation" 2.S.4.

Other surgeons were prepared to be tested themselves should patients request it and 3/8 (37.5%) felt that routine testing of surgeons for HIV would be reasonable:

> "I wouldn't mind if we had to be tested as well. I suppose it's a good thing that we know as well" 6.S.49.

**one nurse did not complete the interview and therefore her views on this subject were not discussed*

Reporting inoculation injuries

There were fundamental differences between the two professions in relation to reporting of inoculation injuries. All nurses who had sustained an injury (5/6, 83.3%) reported them; the only nurse interviewed who had never sustained an injury, would report one were it to occur. Only 2/8 surgeons (25%) would report all injuries however (table A19.3).

Two reasons for not reporting injuries were commonly given, firstly the fact that surgeons considered most of their injuries to be superficial and not an infection risk (6/8, 75%):

> "They're tiny scratches" 2.S.4.

Secondly, the cumbersome nature of the reporting process with 6/8 surgeons (75%) citing this as a reason:

> "You have to fill in a great big form, you then have to go and mobilise a junior member of staff to go and counsel the patient about having their blood taken and then you have to go over to Occupational Health and have your bloods taken" 6.S.51.

Closely linked to this viewpoint was the lack of time available to follow this lengthy procedure expressed by four of the six (66.7%) surgeons who failed to report injuries:

> "I'm sure it's a long and cumbersome process and I just haven't got time to engage with all the busybodies that get involved" 2.S.22.

Introducing a scheme whereby someone took responsibility for reporting on behalf of the surgeon was suggested as a way of improving reporting by 2/8 surgeons (25%):

> "I think that if they employed two or three specialist nurses to sort this out, they'd counsel the patient, they'd bleed the patients, bleed the doctor in the environment so they didn't have to go tramping off you know" 6.S.51.

> "You describe what happens and then someone else ticks all the boxes to put the incident into categories and then we need to make sure there is feedback to people" 6.S.49.

Although both theatre managers described the mechanism by which health care professionals are kept up to date on incident reports:

> "I feed that data back to senior staff in meetings, senior sister's meetings....we'd discuss it and what I would expect to happen is for the co-ordinator to take it to the unit meeting" 4.M.1,

lack of feedback on incidents was a common perception among surgeons (4/8, 50%) and was cited as a reason for not reporting injuries:

> "If you report a critical incident there's virtually never any feedback and there's no comprehensive analysis of critical incident reports" 2.S.35.

Freedom to leave the operating table during a procedure may also affect reporting, with nurses apparently more able to do this than surgeons:

> "I descrubbed and called for a replacement to take the rest of the case" 2.N.29.

Nurse 4.N.4 was also able to do this. However, a surgeon said:

> "If you've got a torrential haemorrhage and you stop it with a stitch and you stick a needle through your finger, well I guess the priority should be yourself but it's 100% with the patient. I can't decide suddenly to stop, let the patient bleed to death and fill out a protocol" 2.S.7.

A further reason for failure to report by surgeons was a perception that the risk of bloodborne viral infection is low. This may be related to the severity of injury, the low prevalence of bloodborne viral infection in Wales or the demographic profile of the patient:

> "Well, if I had a bad injury I'd report it then. I cut my leg with a scalpel once when I dropped it, but it hadn't been used. But if it had been used, I would probably have reported that and I suppose if the patient was high risk I'd report that as well but it hasn't happened yet" 6.S.49.

> "Oh, I think there is a particular risk. I mean there's a risk with anything. There's a risk to walking across the road and there's a risk of winning the lottery which is why I do the lottery but I think the chances of getting a bloodborne infection from an unsuspected patient is extraordinarily small. Probably smaller

> than being hit by lightning, crossing the road or sadly, winning the lottery" 2.S.7.

> "If you've got a little old lady she will be much less risky than someone who's 24 basically, or a drug addict or anybody who falls into that higher risk category" 6.S.51.

Conversely, nurses were more likely to perceive the risk of infection as high. Concerns about the risk of infection encouraged nurses to report and undergo the appropriate tests, despite the fact that awaiting the results could be stressful:

> "It was a terrifying experience. The whole thing of was he positive, was the patient probably HIV or MRSA or CJD, am I likely to get it and probably, is it the window period and am I going to get it later on? I had a blood check and I said 'I've had a needlestick injury and I'd be very keen to know if I'm positive or negative, you know" 4.N.2.

However, 2/8 (25%) of surgeons acknowledged that some patients not included in the traditional high risk groups could also have a bloodborne viral infection:

> "We don't know which posh middle aged businessman is using prostitutes" 2.S.22.

No nurse reported making such judgements when considering whether to report an injury. However, an injury involving a high risk patient would make 3/6 (50%) of the surgeons who wouldn't normally report injuries take the appropriate action:

> "If there was a patient I knew had hepatitis B or HIV and the other bloodborne viruses, yeah, I would" 2.S.7.

One nurse felt that surgeons may know more about their patient's history than the nurses and that this knowledge may influence reporting and use of protective clothing:

> "Maybe the surgeons are fully aware of the patient's background and they know for sure 'I'm alright, I'm safe' " 4.N.1.

However, she would not take the surgeon's word for this and should she sustain an injury herself, she would report it.

One surgeon cited a blame culture and lack of support for reluctance to report:

> "They'll throw you to the media or the patient or the lawyers or whatever and they'll find some little breach in your procedure" 2.S.22.

Despite a reluctance to report injuries spontaneously, 2/8 (25%) of surgeons would report if pressurised by a colleague such as a theatre sister:

> "I did report a blood splash recently because everyone saw it happen and if I didn't report it I would have been nagged by sister" 6.S.49.

All participants recognised the differences between professions in relation to reporting injuries and there was a consensus of opinion among all interviewees that nurses follow protocols and guidelines better than doctors:

> "It surprises me sometimes when I see some surgeons take it *(inoculation injury)* with a pinch of salt and don't even acknowledge it" 4.N.4.

> "Nurses follow rules and guidelines to the letter of the law and many surgeons don't because there's not a lot to be gained from doing it to be honest" 2.S.4.

> "Well, I think it's personality, training and hierarchy. It's all of those things. Um, most hospital doctors…in hospital, many of the junior doctors are aspiring to be consultants. Not all of them, but many of them and by and large share the same kind of ethos, attitude which is the job is there to be done, let's do it. And it's the job that matters not the protocol. So if the protocol says this and the way to do the job well is that, they'll go and do that and b****r the protocol. Whereas nurses will say there's a protocol, that's the way we've got to do it, it can't be done any other way" 2.S.35.

> "…there's a thing called the clinical forum where protocols and policies get discussed. The clinical forum meets every couple of months and um, before the meeting a variety of policies and protocols and policies are circulated for comment and further discussed in the meetings and then adopted or not. The majority run to 20, 30 and 40 pages. God only knows who authors them. Most of them are written in appalling English. They have structures which are designed for verbosity. They all follow the same thing, the executive summary blah, blah, blah, blah, bullet points until they come out of your ears. Yeah? And they are all comprehensive, terribly comprehensive. You can see that they have ticked all the boxes, you know, equality, ethnicity and all that sort of b******s and completely missing the point in that what you need is a policy that is clear, concise and deliverable" 2.S.35.

One reason for this might be that the relevant managers are perceived as more likely to penalise nurses than surgeons for breaches in protocol and this itself could affect compliance with both protective measures and reporting:

"...they *(nurses)* follow rules and regulations better than surgeons and also their managers don't let them deviate. They come down very hard if nurses act outside their normal routine so they obey the rules" 6.S.49.

"...nurses tend to be governed by rules written down on paper and guidelines and they follow the letter of the law because the nursing hierarchy is particularly ruthless against nurses who deviate from it...The medical hierarchy isn't particularly interested in it" 2.S.4.

This was acknowledged by two nurses who defended the approach by saying:

"I think we have very high standards" 4.N.5.

"It's a good thing that we've got that hierarchy here or we wouldn't report" 4.N.4.

One of the managers felt that this was related to the amount of time spent within the operating department by each profession:

"...because the theatre staff is in the theatre every day as opposed to the medical staff who are not, they are exposed to a more sustained emphasis on the rules and regulations" 3.M.1.

However, in her experience, surgeons are becoming increasingly likely to report:

"Surgeons, some tend to shrug them off but I notice now that it tends to be a 50/50 split between surgeons and nursing staff whereas before it was mostly nursing staff" 3.M.1.

Injuries are an occupational hazard

A category closely linked to that of reporting injuries is the belief that such injuries are common during surgery and as such are an 'occupational hazard', a view held by 6/8 (75%) of the surgeons, but none of the nurses although one nurse did recognise this trait in surgeons (table A19.4).

"I've never seen a surgeon be particularly worried about putting a needle through their finger. I guess it's a culture of surgery. Its part ... it's an occupational hazard if you like" 2.S.7.

These injuries were viewed as unavoidable by 3/8 surgeons (37.5%):

"There's nothing you can do about it and accidents happen but it's the nature of the job" 2.S.4.

One explanation for the difference in opinion on inoculation injuries being an occupational hazard between professions may be the suggestion that there are personality differences between surgeons and nurses including arrogance and a tendency to take risk among surgeons, an opinion expressed by 5/8 (67.5%) surgeons and 5/6 (83.3%) nurses:

> "I think there is some innate arrogance in anybody who wants to become a surgeon. That's just the type of people we are, I think we all think we're invincible" 2.S.7.
>
> "You need to be a risk taker to cut someone open and remove an organ. Nurses don't need to take these risks" 6.S.51.
>
> "Nurses don't need to think for themselves as much as doctors and don't need to risk assess. They have a routine, they know what they must do and they do it, but doctors need to react to different circumstances and risk assess" 6.S.49.

This tendency to take risks originates both from differences in under-graduate and post-graduate training (5/8 surgeons, 62.5% and 1/6 nurses, 16.7%) and in personality traits within individuals attracted to each profession (4/8 surgeons, 50% and 4/6 nurses, 66.7%).

> "I think there are a lot of nurses who still want to give it their all. I think at the moment nursing is attracting more of that than medicine. It wasn't the case 20 years ago" 2.S.22.
>
> "I think it's the mentality that surgeons have and they don't have somebody...they don't need somebody telling them what to do" 4.N.2.
>
> "It's partly during the training period. To be a surgeon, you are expected to work long hours and not show any weakness because you are a team leader" 6.S.51.

However, 4/6 nurses (66.7%) felt that personality differences were becoming less apparent. This was not identified by surgeons.

> "I think it is because years ago if you were a doctor you came generally from a wealthy family who could afford for you to go to Oxford, Cambridge or whatever. Whereas now the opportunities are open to everyone, you know, from a council estate to whatever" 4.N.5.

Attending training sessions

In the same way as profession affected the likelihood of reporting inoculation injuries and considering such injuries to be an occupational hazard, the likelihood of attending training sessions also depended on profession with scrub nurses (3/5, 60%) being more likely to attend sessions than surgeons (0/8, 0%). All the nurses felt that training on this subject would be beneficial whether they had attended sessions or not, while only 4/8 surgeons (50%) believed this to be the case. See table A19.5.

The tendency among surgeons to shun training sessions may be due to a degree of arrogance according to one manager:

> "They just wouldn't be interested in being told something they probably already know but don't do" 4.M.1.

This may be perpetuated by level of seniority:

> "...once they've actually reached the peak of their profession, they feel that they shouldn't attend unless they are presenting" 3.M.1.

This would seem to be endorsed by at least one surgeon (see the extract from the interview with 2.S.35 in table A19.5.

More fundamentally however, may be lack of awareness of training sessions with 6/8 surgeons (75%) claiming to be unaware that they are held. Two surgeons (25%) agreed that training sessions would be useful for junior medical staff and a further two (25%) were prepared to attend training sessions if they were practical demonstrations of good technique rather than lectures.

Availability of equipment

Although all participants agreed that some safety equipment, for example blunt needles, was readily accessible for those wishing to use them, there was some concern expressed by all surgeons and scrub nurses that other equipment was not e.g. high quality surgical gowns (see table A19.6).

Some safety equipment was available in some departments but not all interviewees were aware of its existence. Within one trust, one scrub nurse and a manager said that single use scalpels with retractable blades were available in the theatre, yet the remaining four nurses and the surgeon from the same trust were unaware of their existence. No participants from other trusts were aware if their department stocked these.

However, the quality of surgeons' gloves drew most comments with 50% (4/8) of surgeons and 80% of nurses (4/5) stating that they had been asked to use inferior quality gloves at some time.

> "We have had issues with gloves because they keep changing the suppliers so they keep asking us to try something which we may not like" 1.S.15.

The reason for poor quality equipment was cited as cost by all participants.

> "I think they bought them *(gowns)* because they were disposable and cheap" 2.S.22.
>
> "...whenever they change certain...like from one product to another, they want to go to other companies...they always go for a cheaper price rather than for higher quality" 2.S.19.

According to one interviewee, nurses are not allowed to use the same quality products as surgeons because of the cost:

> "We have been told lots of times not to use the surgeons' gloves even though they are lovely to use" 4.N.4.

Five surgeons (62.5%) and 2/6 nurses (33.3%) felt that their trust put cost before safety and that cheaper products might compromise safety:

> "The thing I'm also somewhat irritated about though is that we have the cheaper gloves, we weren't able to have the Biogel ones anymore, we have these thinner, cheaper ones and they leak. It's not uncommon to finish an operation and find there's blood underneath your glove and you haven't stuck yourself" 6.S.51.

Both managers agreed that cost was an important consideration:

> "...when you're paying with taxpayers money, you are obliged to look for something cheaper" 4.M.1.

However, they denied that quality was a secondary consideration:

> "...at the end of the day we are all here to offer the best possible service to the patient and inferior gloves, a glove that

> doesn't do its job is more costly to the theatre department, no matter how cheap it is" 3.M.1.

Furthermore, they emphasised that personnel were given the opportunity to participate in trials of new equipment and that their opinion was considered when new products were purchased and were generally keen to participate:

> "I've never seen a group of people so keen to offer an opinion" 3.M.1.

All the interviewees agreed that they had participated in trials.

Pressure of work

Only four surgeons and three nurses offered an opinion on whether pressure of work influenced the incidence of inoculation injuries and opinion was divided; 3/4 surgeons (75%) and 1/3 nurses (33.3%) felt that emergency or high pressure situations increased the risk of injury

> "I can't remember ever stabbing myself in an elective case, it's always unpredictable emergencies and no matter how many training sessions you go to, you'll always have unpredictable emergencies in the middle of the night" 2.S.22.

However, 1/4 surgeons (25%) and 2/3 nurses (66.6%) felt that emergencies had no impact on safety or were actually safer than uneventful ones because:

> "Your adrenalin levels are higher, your awareness is higher. It's when you are cruising that you are most at risk" 2.S.35.

Teamwork

Teamwork was considered important by all surgeons and 4/6 nurses (66.7%). This was in relation to the smooth running of the department, ease of communication and improving safety during emergency situations:

> "You can't do anything without teamwork....In theatre there are dedicated gynae [SIC] theatre nurses and if they're with you it's great because it runs really smoothly" 6.S.51.

Within specialities, teams of nurses and surgeons commonly worked together during routine procedures and a high level of mutual respect was evident on behalf of those participants who discussed teamwork:

> "You have to be able to work with people and get on with them. Everyone needs to know that they can express an

> opinion without being afraid of being shot down in flames" 6.S.49.

Working with scrub nurses from other teams was thought to cause stress among the workforce, interfere with the progress of the operation, and increase the risk of adverse incident:

> "However, if there's a staffing shortage you know, you'll sometimes get ENT or urology and they'll say I'm not qualified to do that and please don't shout at me..... I wouldn't shout anyway, it's pointless, but um, you know, you don't have the same kind of ... it doesn't kind of follow in the same way, because you're kind of trying to explain to them what specific instrument you want because they're not quite sure what its name is and this sort of thing...... and also if you're running into trouble, it isn't quite the same as a sister who knows what you want, who can predict what you want. It's quite amazing how they know this sort of thing and you're in a quite low risk situation if you've got nurses who are well versed with that type of procedure but it's not always possible and we're not always doing diabolically horrible operations" 6.S.51.

The informality of the relationship between surgeons and scrub nurses was valued by one nurse:

> "Well it has surprised me how you can sit down in the coffee room and have a chat with the consultants you know. It's not like where I worked as a student where there's a line between you and you don't talk to the doctors. It is more sort of you know teamwork here" 4.N.4.

Sustaining an injury

All the surgeons, both managers and 4/6 nurses interviewed (66.7%) had sustained at least one inoculation injury. Among surgeons, the most common instruments causing injury were suture needles with all surgeons having sustained such an injury (table A19.9). One surgeon (12.5%) had been cut with a used scalpel and 1/8 (12.5%) had received a splash of blood to the eyes. Of the nurses, 2/6 (33.3%) had been cut with a used scalpel, 2/6 (33.3%) had been stabbed with a suture needle and 1/8 (16.7%) had sustained a splash of blood to the eyes. One manager had been stabbed with a dirty needle and splashed blood into eyes and the other had sustained an injury but could not remember the offending instrument.

With the exception of one surgeon who had been accidentally stabbed by a junior member of staff, surgeons' injuries were self inflicted. In contrast, 4/6 (66.7%) of nurses were injured as a direct or indirect consequence of the actions of others, usually surgeons:

> "I was circulating, and these were the days of the cloth drapes and a surgeon left a straight needle on the drape and it had been missed by the scrub nurse. I went to take the drapes off once the dressing was on and in it went" 4.N.1.
>
> "The first one, a surgeon handed me a scalpel and the blade caught my finger and the second one, the surgeon was putting a scalpel back in a kidney dish and he missed and caught my finger as well" 2.N.29.

The vast majority of these injuries were superficial with only one surgeon (12.5%) and 1 nurse (16.7%) having sustained a more severe injury:

> "Mine are when I catch myself while suturing in operations. Just with the tip of the needles sometimes when you're putting the suture round" 2.S.4.
>
> "I could see that I'd made a mess of myself and I had my blood trickling into the patient and that wouldn't have been acceptable" 6.S.51.

Three surgeons (37.5%) and 3/6 nurses (50%) said that they had some concerns about the risk of acquiring a bloodborne viral infection following an inoculation injury, but only 3/8 surgeons (37.5%) expressed concern that there might have been a risk of bloodborne infection to the patient.

> "Once you get an injury to your fingers your glove tends to get broken so the sterile environment gets broken and you might have a cut on your hand. But in this situation it is very serious because there is a contamination of the patient's body fluids with yours and both of us can get into a state of common contamination and I can pick something up from the patient or the patient can pick something up from me" 1.S.15.

Summary

This section considered the data from the semi-structured interviews with surgeons and scrub nurses. Agreement was achieved in relation to the majority of categories and themes within each profession and between professions, for example, in relation to guideline adherence and guideline violation. Only one interviewee, a scrub nurse routinely complied with all available precautions for every patient and hence complied fully with universal/standard precautions. However, in relation to some categories, most notably reporting injuries and attending training sessions, there were profound differences in the opinions of surgeons when compared to those of the scrub nurses with nurses being more likely to comply with current guidelines.

The next section of the chapter links the themes across the three data sets.

4.7 Combining the data sets

This section considers the findings from all three data sets: telephone interviews of ICNs, questionnaire survey of surgeons and scrub nurses and the semi-structured interviews of selected surgeons, scrub nurses and theatre managers to examine similarities and differences between the data sets.

Not all the data themes were available from each data set, for example the telephone survey of ICNs only related to the provision, content and attendance at training sessions on the prevention and management of inoculation injuries, the availability of inoculation injury policies and limited data on the number of injuries reported during one calendar year.

The data are considered in relation to the themes identified during the interviews.

4.7.1 Guideline adherence

Adoption of universal or standard precautions should be independent of any knowledge or suspicion of blood-borne viral infection and hence should be adopted for all patients in any situation where contact with blood or body fluids is anticipated (Garner *et al*, 1996; UK, Health Departments 1998; Siegel *et al*, 2007). Invariably during surgery such contact would be expected and a range of precautions have been devised to minimise the risk of infection including eye protection, double gloves, passing sharps through a neutral field and using safety devices where available. Of these, only the first three variables are under the control of all theatre personnel. Use of safety devices was influenced by many issues such as lack of availability, surgeons' choice (rather than nurses' choice) and unsuitability for the task. Therefore, it was excluded from this analysis. Cross tabulating each of these three variables relating to protection i.e. double gloving, wearing eye protection and avoiding passing sharps by hand, it was determined that only 10.3% of respondents to the questionnaire survey (31/302) adopted all precautions for every patient (table 4.3.12). Data from the interviews and responses to the open question on the questionnaire concurred. Although eleven respondents identified in response to the open question in the questionnaire survey that compliance with standard/universal precautions was best practice:

> "I think we should take the necessary precautions for all patients, not just the known high risk" 1.N. 3,

violations routinely occurred. Only 1/16 interviewees (6.25%), a scrub nurse, would adopt the complete range of precautions for all cases.

All ICNs reported that they advocated standard/universal precautions in their inoculation injury policies and during training sessions.

4.7.2 Guideline violation

Guideline violation was assumed unless all precautions were adopted at all times for every case and both the survey and interviews identified that compliance with precautions was variable. Data from the questionnaire survey suggested that only 22.9% of respondents (72/310) would double glove for every case, 44.8% (141/315) would wear eye protection, 82.2% (259/315) would pass sharps through a neutral field and 20.3% (64/315) would use safety devices (histogram 4.3.7). More common was the addition of extra precautions in the event of a perceived 'high risk' case and although only 34/315 respondents (10.8%) agreed or strongly agreed that it was acceptable to do so (table 4.3.21), 58.2% (182/315) admitted that they took fewer precautions for patients not known or suspected to be at high risk of having a blood-borne viral infection (table 4.3.20).

Interview data supported these findings. Both the interview and survey data revealed that operating theatre personnel have a variety of reasons for not complying including discomfort, loss of dexterity, poor performance, wearing spectacles and risk assessment, illustrated by these quotes:

> "Well, I wear glasses so that tends to protect my eyes 2.S.35.

> "They (visors) steam up". 2.S.22.

> "Because they *(blunt needles)* don't go through tissue so cleanly and you can't predict where the tip is going to come out" 2.S.22.

Professional differences were identified that suggested that scrub nurses were more likely to adopt precautions for all patients than surgeons. For example, 62.7% of nurses (84/134) would wear eye protection for every case compared to 34.5% of surgeons (57/165) (table 4.3.79, χ^2 22.384, P < 0.001, df=1, odds ratio (OR) 0.31, 95% confidence interval (CI) 0.20-0.51) and more likely to use safety devices, 31/96 nurses (32.3%) compared to 23/162 surgeons (20.4%) (table 4.3.80, χ^2 3.976, P = 0.046, df=1, odds ratio (OR) 0.54, 95% confidence interval (CI) 0.30-0.95).

4.7.3 Reporting inoculation injuries

According to the ICN interviews, each participating trust (n=6) had a policy on the prevention and management of inoculation injuries. These were available as both hard copy and via the trust intranet. All policies advocated the timely reporting and appropriate first aid treatment of all injuries. The content of the policies was also disseminated during training sessions. The influence of attending training sessions on reporting injuries is discussed in section 4.7.5. Despite the availability of the policies, 42/282 respondents (14.9%) felt that failure to report injuries was very likely or quite likely to be influenced by not knowing the appropriate action to take in the event of an injury and 37/282 (13.1%) felt that not knowing where to find the relevant policy was very likely or quite likely to influence reporting (tables 4.3.24 and 4.3.25).

Five ICNs were able to provide information on the number of inoculation injures reported in their trusts between January 1st and December 31st 2004 (29-275), see section 4.2. Only one ICN (employed at trust 6) was able to provide data on the number of inoculation injuries reported by surgeons (n=3) and scrub nurses (n=3) during this period.

Both the questionnaire survey and interview data suggested that inoculation injuries were reported inconsistently. Of the 220 respondents who had sustained an inoculation injury, only 112/220 (54.9%) reported all of them using the mechanism approved by their employing trust (histogram 4.3.11). Nurses were far more likely to report injuries than surgeons with 63/71 of nurses (88.7%) compared to 49/133 of surgeons (36.8%) reporting all injuries (χ^2 =51.317, P<0.001, df=3, table 4.3.91). Among those interviewed, all nurses and only 2/8 surgeons (25%) would report injuries.

During the interviews, two reasons for not reporting injuries were commonly cited by surgeons. Firstly, was the fact that most injuries were superficial and hence too minor to report (6/8, 75%, table 4.4.5). Although the relationship between profession and not reporting because injuries were too minor could not be tested for significance due to small numbers (table A16.86), six out of eight surgeons (75%) commented on this on their questionnaires:

> "Providing they are minor, gloved and from non-hollow needles" 2.S.25.

No nurses expressed this opinion during the interviews.

Secondly the cumbersome nature of the reporting mechanism deterred 6/6 surgeons who had never reported an injury from doing so (100%, table 4.6.5). However, in the survey, only 96 respondents (30.2%) gave this as a reason. When examining whether this was more likely among surgeons than scrub nurses, no statistical significance could be demonstrated (table A16.83). Once again, comments were made on the questionnaires in relation to this:

> "The main problem is, it is incredibly time consuming and cumbersome to report and get yourself and the patient bled" 4.S.51.

> "It is the amount of time involved and the interruption to work (which usually cannot be covered) that usually causes me to ignore the injury" 5.S.17.

Despite the fact that statistical significance could not be demonstrated in relation to failure to report injuries due to the fact that patients were perceived to be low risk, the interviews revealed that several surgeons held this opinion and that 3/6 (50%) of those surgeons who wouldn't normally report injuries would do so if the patient was high risk:

> "If there was a patient I knew had hepatitis B or HIV and the other bloodborne viruses, yeah, I would" 2.S.7.

Nurses were felt to be better at following the rules than surgeons and this was acknowledged by all the interviewees:

> "Nurses follow rules and guidelines to the letter of the law and many surgeons don't because there's not a lot to be gained from doing it to be honest" 2.S.4.

Four respondents to the open question on the questionnaire also acknowledged this:

> "Getting doctors to report needlestick injuries is very difficult, they don't like filling in forms, going to staff health. Normally left to nurse in charge to fill in relevant documents and to follow up investigations straight away while everything is fresh in everyone's mind. Also nurse normally has to get patient's permission to take bloods" 5.N.22.

Those who attend training sessions were more likely to report injuries than those who did not; 83.3% of respondents (50/60) who had attended a training session reported >50% of their injuries (table 4.3.96, χ^2 =19.89, P=0.001, df=4).

4.7.4 Injuries are an occupational hazard

Closely related to poor compliance with reporting is the idea that inoculation injuries are an occupational hazard with 33/71 (46.5%) of respondents who reported none or fewer than 50% of their injuries but unlikely or very unlikely to influence those who reported all or >50% (58/73, 79.4%), (χ^2 =23.992, P<0.001, df=3), table 4.3.89.

However, the relationship between profession and reporting is affected by the belief that inoculation injuries are an occupational hazard could not be tested for statistical significance because of the low number of nurses responding (n=6) (table A16.87).

Sustaining injuries was also affected by the belief that they are an occupational hazard. Those who believed inoculation injuries to be an occupational hazard were more likely to be injured at both one year (Linear by linear association =5.448, P<0.002, df=2) and five years (χ^2 =11.95, P<0.003, df=2) than those who didn't (tables 4.3.55, 4.3.59 and model 1).

Thirteen respondents offered comments on this subject in response to the open question on the questionnaire. Nurses were more likely to believe that the risks were avoidable: three nurses compared to one surgeon. Four surgeons felt that this risk was unavoidable and one expressed the view that while attempts should be made to avoid injury, if it occurred, it should be ignored:

> "Needlestick injuries are an occupational hazard for a surgeon. This does happen to every surgeon/assistant whether they report it or not. One should take all the precautions possible but it happens, it should not be mentioned/told" 4.S.12

More surgeons than nurses believed that such injuries are an occupational hazard for those working in an operating theatre (χ^2 =43.644, P<0.001, df=2), table 4.3.44. Of those surgeons interviewed, 6/8 (75%) believed inoculation injuries to be an occupational hazard although none of nurses interviewed shared this opinion.

Several interviewees (5/8 surgeons, 67.5% and 5/6 nurses, 83.3%) expressed the view that there were personality differences between the professions in that surgeons were possibly arrogant and more disposed to take risks than the nurses:

> "I think there is some innate arrogance in anybody who wants to become a surgeon. That's just the type of people we are, I think we all think we're invincible" 2.S.7.

Furthermore, differences in under-graduate and post-graduate training were felt to contribute to the tendency to take risks:

> "It's partly during the training period. To be a surgeon, you are expected to work long hours and not show any weakness because you are a team leader" 1.S.51.

4.7.5 Training

According to the questionnaire data, most respondents (204/314, 65%) had never attended a training session on the prevention and management of inoculation injuries. However, the likelihood of sustaining a sharps injury was reduced in those who had attended such a session at both one (table 4.3.38, χ^2 = 4.358, P = 0.037, df=1, odds ratio (OR) 1.82, 95% confidence interval (CI) 1.07-3.09) and five years (table 4.3.39, χ^2 = 4.265, P = 0.039, df=1, odds ratio (OR) 1.68, 95% confidence interval (CI) 1.05-2.69) and a splash to the mucous membranes within five years (table 4.3.40, χ^2 = 5.711, P = 0.017, df=1, odds ratio (OR) 2.22, 95% confidence interval (CI) 1.19-4.17). Reporting inoculation injuries was also influenced by attending training sessions with 83.3% of respondents (50/60) who had attended a training session reporting <50% of their injuries (table 4.3.96, χ^2 =19.89, P=0.001, df=4). Significantly more scrub nurses (83/135, 61.5%) attended training sessions than surgeons (27/179, 15.1%) (table 4.3.37, χ^2 = 70.768, P <0.001, df=1, odds ratio (OR) 0.111, 95% confidence interval (CI) 0.061-0.19).

Reluctance among surgeons to attend training sessions was also evident in the interviews. None of the surgeons interviewed had attended a training session compared to 3/5 nurses (60%).

> "Well, I know that pointed things are sharp and they hurt and they shouldn't stick into me but I don't know .... unless they are going to teach me different ways of practising in which case they should come into the theatre and tell me that anyway without me having to go off on a separate half day um... bonding session" 2.S.7.

During the telephone interviews, the ICNs stated that sessions on the prevention and management of inoculation injures were held in all the participating trusts (n=6). This training was mandatory in 4/6 trusts and held between one and eight times per year. Training sessions commonly comprised standard precautions, sharps policies, action to take in the event of an inoculation injury and the role of the Occupational Health and Accident and Emergency departments when injuries are reported.

The findings of the ICNs' telephone interview corroborated the data from both the questionnaire survey and interviews in relation to attendance at training sessions. Only three trusts recorded the designation of the staff in attendance at these sessions, and no surgeons were recorded.

4.7.6 Availability of equipment

Only 20.3% of respondents (64/315) would use safety devices for all patients according to the survey. Nurses (31/96, 32.3%) are more likely to use them than surgeons (23/162, 20.4%) (table 4.3.80, χ^2 3.976, P = 0.046, df=1, odds ratio (OR) 0.54, 95% confidence interval (CI) 0.30-0.95). However, several nurses in the open question on the questionnaire (17/135, 12.6%) suggested that the choice of whether to use safety devices rested with the surgeons:

> "Engineered safety device depends on surgeon and operation" 6.N.20.

The interviews clarified the reasons for inconsistent use of some safety devices. Blunt needles for example could not be used during certain operations e.g. orthopaedic surgery. Some equipment was not available within the department e.g. scalpels with retractable blades.

Comments given in response to the open question on the questionnaire and during the interview revealed that the respondents felt that quality was sometimes compromised by cost saving exercises within the trusts. Of the interviewees, five surgeons (62.5%) and 2/6 nurses (33.3%) felt this to be the case and had particular concerns about the quality of gloves provided. In response to the questionnaire, other equipment was mentioned by a surgeon (Kevlar protective gloves and Stryker exhaust hoods) and a nurse (sticky pads for disposal of sharps):

> "Cheap sticky pads with no weight in them are more likely to cause injuries than the slightly more expensive weighty ones" 2.N.45 (questionnaire).

4.7.7 Pressure of work

Data from the questionnaire survey suggested that 208/315 (66.3%) of respondents agreed or strongly agreed that injuries were more likely during emergency procedures and 241/315 (77%) agreed or strongly agreed that injuries were more likely when working under pressure (tables 4.3.16 and 4.3.17). Several of those who provided comments on the questionnaire confirmed this:

> "Most of the injuries I have sustained are during emergency procedures...It's partly pressure and partly carelessness when proper procedures (taught to all surgeons) are not followed properly. I would say it is an attitude problem rather than complacency especially when a surgeon is off guard following a difficult and prolonged procedure where one has to concentrate a lot!" 5.S.8.

The difference between professions in relation to working under pressure was not statistically significant (table A16.15). Only 4/8 surgeons (50%) and 3/6 scrub nurses (50%) offered an opinion on this subject during the interviews and opinion was divided between those who believed that working under pressure or during emergency conditions increased the likelihood of sustaining an inoculation injury (3/4 surgeons, 75% and 1/3 nurses, 33.3%) and the remainder who did not. However, interview data did suggest that surgeons were more likely to believe that pressure adversely influenced the incidence of injuries.

4.7.8 Teamwork

The importance of teamwork was not directly addressed in the closed questions in the survey and no respondents raised the issue in the comments fields of any of the questions. However, all surgeons and 4/6 nurses (66.7%) who were interviewed felt this to be extremely important in the operating theatre in relation to safety, ease of communication and the smooth running of the department.

4.7.9 Sustaining an injury

The number of injuries recorded by the ICNs of each trust is discussed in section 4.7.3. Only data from one trust was available from the telephone interviews concerning the number of sharps injuries compared to blood splash injuries. Trust 3 recorded 47 sharps injuries and 6 blood splash injures between January 1st and December 31st 2004. No data were collected by the ICN on how many of these may have been sustained by surgeons and scrub nurses.

The questionnaire identified that 219/315 (69.5%) of respondents had sustained at least one inoculation injury within the last five years (tables 4.3.14-4.3.16). Most common were sharps injuries with 96/315 (30.5%) reporting at least one sharps injury within one year and 193/315 (61.3%) reporting such injuries within five years. Blood splashes to broken skin were reported least often 6/315 (1.9%) and 18/315 (5.7%) within one and five years respectively.

Injuries were more common among surgeons than nurses as follows:

- Sharps injury within one year 65/180 surgeons (36.1%) compared to 29/135 nurses (21.5%) (table 4.3.32, $\chi^2 = 7.20$, $P = 0.007$, df=1, odds ratio (OR) 0.48, 95% confidence interval (CI) 0.29-0.81).
- Splash to mucous membranes within one year 30/180 surgeons (16.7%) compared to 7/135 nurses (5.2%) (table 4.3.33, $\chi^2 = 8.73$, $P = 0.003$, df=1, odds ratio (OR) 0.27, 95% confidence interval (CI) 0.12-0.64).

- Sharps injury within five years 119/180 surgeons (66.1%) compared to 64/135 nurses (47.4%) (table 4.3.34, χ^2 9.68, P = 0.002, df=1, odds ratio (OR) 0.47, 95% confidence interval (CI) 0.3-0.75).
- Splash to mucous membranes within one year 51/180 surgeons (28.3%) compared to 16/135 nurses (11.9%) (table 4.3.35, χ^2 = 11.55, P = 0.001, df=1, odds ratio (OR) 0.34, 95% confidence interval (CI) 0.18-0.63).

The interviews also suggested that surgeons experience more inoculation injuries than scrub nurses. All surgeons, 4/6 nurses (66.7%) and both managers had sustained an injury.

Both the questionnaire and interviews confirmed that surgeons were frequently the user of the sharp object that caused their injury. This occurred most commonly during suturing, with all those who were interviewed experiencing at least one injury from a suture needle and 87.1% of those who reported in the survey being injured during suturing (88/101) being surgeons (table 4.3.68, 87.1%, χ^2 38.353, P < 0.001, df=1, OR 8.18, 95% CI 4.08 – 16.42).

Nurses were more likely to be injured while disposing of sharps (table 4.3.66, 11/15, 73.3% χ^2 9.36, P = 0.002, df=1, OR 0.16, 95% CI 0.05 – 0.53) and when instruments were passed from hand to hand (table 4.3.67, 25/37, 67.6% χ^2 20.37, P < 0.001, df=1, OR 0.18, 95% CI 0.08 – 0.38). Those scrub nurses who were interviewed confirmed that injuries were often caused by the actions of another (4/6, 66.7%) with passing instruments a common cause of injury for them.

Logistic regression modelling suggested that the belief that inoculation injuries are an occupational hazard is a significant predictor for sustaining a sharps injury at five years (tables 4.4.6, 4.4.7, 4.4.8).

4.8 CONCLUSIONS TO CHAPTER FOUR

Chapter four presented the findings of the three data sets. The questionnaire survey and interviews of surgeons and scrub nurses investigated a number of issues surrounding the sustaining and reporting of inoculation injuries while the telephone interview with the ICNs only investigated the availability, attendance and content of the training sessions on the prevention and management of inoculation injuries. Section 4.7 suggested a high degree of correlation between the data sets on issues that overlapped. Furthermore, the interviews provided a richness of data that could not be captured in a survey.

Throughout the data collection exercise, it has become apparent that profession most strongly influenced the extent and cause of inoculation injury with surgeons being more likely to sustain both sharps injuries and splashes of blood or body fluid to the mucous membranes than nurses, but despite this surgeons were less likely to report the injuries and obtain appropriate first aid to minimise the risk of acquiring a blood-borne viral infection. The logistic regression models confirmed that profession was a significant predictor for sustaining a sharps injury at both one and five years, believing injuries to be an occupational hazard was significant for injuries at five years. Profession and believing injuries to be an occupational hazard were both raised during the interviews and found to impact on sustaining and reporting injuries.

Chapter five will discuss the study and the findings in relation to the methods used and the existing literature.

CHAPTER FIVE

DISCUSSION: WORK IN CONTEXT

5.1 Introduction

This chapter will comprise a discussion of the study and the findings in relation to the methods used and the existing literature. The choice of methods will be discussed in relation to the aims and objectives of the study and the benefits and limitations of the chosen methods will be debated.

The results will be discussed in relation to the key findings of the study. Comparisons will be drawn with the findings of previous studies on the uptake of standard/universal precautions and reporting of inoculation injuries. Comments from respondents will be incorporated into the discussion to illustrate the opinions held and explain behaviours adopted.

Explanations for the findings will be discussed and strategies for improving compliance with standard/universal precautions and inoculation injury reporting will be suggested.

Overall, the study demonstrated that compliance with standard/universal precautions in the operating theatre is low despite their introduction over two decades ago and that levels of reporting of inoculation injuries is poor (sections 1.3.6 and 4.3). A total of 219/315 (69.5%) respondents had sustained at least one inoculation injury within the last five years. Most of these were sharps injuries with 193/315 (61.3%) reporting such injuries within five years (table 4.3.13). However, reporting was poor, with only 112/204 (54.9%) of respondents reporting all injuries and 35/204 (17.2%) admitting that they never report injuries and a further 34/204 (16.7%) reporting less than 50% of their injuries (histogram 4.3.11). Only 10.3% (231/302) of respondents to the questionnaire survey adopted a range of precautions comprising double gloving, eye protection and avoiding the passage of sharps by hand for every patient (table 4.3.12).

The study that is the focus of this thesis will be referred to during the discussion as 'this study'.

5.2 LIMITATIONS AND STRENGTHS

It is essential that the most appropriate method of data collection is chosen for the subject under consideration (Polit and Beck, 2008). Therefore, careful thought must be given to both the research question and the available methods before commencing the study. When considering the most appropriate data collection methods, the benefits of each type of data should be considered and these have been discussed in section 3.3. However, the limitations of each should also be considered.

5.2.1 Limitations in quantitative data

Quantitative data are derived from the premise that human behaviour can be correctly observed, identified, reported and measured. However, some researchers suggest that the social world does not lend itself to objective forms of measurement and neither can one examine relationships when removed from their everyday situations (Leininger, 1985; Patton, 1997; Hammersley and Atkinson, 1983). A positivist approach to research is incapable of incorporating interpretations, values or feelings, which do not easily lend themselves to quantification (Bryman, 2008). Quantitative research may be considered 'reductionist' in that it only meets the researcher's definitions rather than those of the participants under study (Polit and Beck, 2004).

According to Silverman (2001), reported data may not correspond to how individuals behave in naturally occurring situations. Therefore, "researchers who generalize from a sample survey to a larger population ignore the possible disparity between the discourse of actors about some topical issue and the way they respond to questions in a formal setting" (Fielding and Fielding, 1986, p 21). Memories may be inaccurate after a long period of time has elapsed (Bryman, 2008). In addition, respondents may answer in a way that will make them look good or avoid making them look bad and therefore will answer questions in a way that they see as socially desirable (Fowler, 1995). Respondents may also distort answers because the accurate answer does not portray them as they would want to be viewed (Fowler, 1995). Fowler (1995, p30) suggests three strategies to reduce such response distortion. They are:

1. "assure confidentiality of responses and communicate effectively that protection is in place;
2. communicate as clearly as possible the priority of response accuracy;
3. reduce the role of an interviewer in the data collection process."

Fowler's strategies were adopted in this study. All respondents were assured of confidentiality and anonymity was guaranteed during the publication of the findings. This was reinforced for those who participated in the interviews. While there is no certainty that fear of confidentiality being breached may not have affected the quality of the responses, the fact that so many admitted not complying with appropriate precautions or reporting protocols suggests that this was not a major limitation in this study.

The need for honesty in answering all questions was stressed in the information letter requesting participation in the survey and where relevant the interview. This was reinforced verbally at the start of each interview. Yet again, while the desire to give the answer the participant thinks the researcher may want to hear may be strong in some, the nature of the responses suggests that this was not a major limitation.

Respondents were contacted by letter and completed a postal questionnaire thus limiting the contact between the researcher and participant. For the face to face interviews, interviewer bias was a potential problem as the social desirability response may have been increased. However, the positive value of the rich data that was achieved during the interviews outweighed concerns of interviewer bias.

See also section 5.2.3.

5.2.2 <u>Limitations in qualitative data</u>

Naturalistic or qualitative research investigates not only the phenomena but their relation to their naturally occurring context (Patton, 1997). However, some authors regard qualitative research as unscientific, lacking rigour, biased, soft or even trivialised due to the involvement of the researcher, particularly if inexperienced, and incapable of generalisation (Patton, 1997; Polit and Beck, 2004; Burns and Grove, 1997). Qualitative researchers have been accused of generating work which is biased, unscientific, exploratory, or personal opinion (Denzin and Lincoln, 1994) or subjective implying "opinion rather than fact, intuition rather than logic and impression rather than rigour" (Patton, 1997, p280).

While they can never be accused of generating superficial data, in depth qualitative studies rely on human beings, who are often fallible, as the instrument for data collection, also potentially giving rise to claims of lacking external reliability (Patton, 1997; Polit and Beck, 2004). In contrast, the survey's capacity to generate quantifiable data from large numbers of people in order to test theories or hypotheses has the appeal of emulating the scientific tradition of the natural sciences (Bryman, 1988).

Due to constraints of time and resources, qualitative research rarely covers more than a small sample of a population, and is therefore less amenable to generalisation (Polit and Beck, 2008). In this study, as in others, the limitation of time and resources restricted the number of participants who could be interviewed to 16. Data analysis of even large amounts of quantitative data is relatively straightforward whereas qualitative studies yield data that, while valuable, may be difficult and painstaking to analyse (Patton, 1997). This study was no exception. Data from the 16 interviews took considerable time, not only to analyse but also to collect as the interviews were conducted with participants from a wide geographical area across Wales. However, the interviews provided considerable insight into why participants behaved as they did and not only corroborated the questionnaire findings but enhanced them.

5.2.3 Overcoming problems with reported data

In this study, every effort was made to ensure that Fowler's (1995) three strategies to avoid response distortion were followed (section 5.2.1). Unfortunately, anonymity could not be assured as, firstly, contact of non-responders was necessary, and secondly, those being interviewed were obviously identified to the researcher. Although the researcher knew the names of the participants, these were not divulged to anyone else including the academic supervisor, confidentiality was assured, and this was confirmed in the covering letter. The letter also asked for accurate, honest responses, and as most of the data collected were via postal questionnaires, undue influence by the researcher was reduced.

While it is recognised that memories of general events may become hazy with time, it is likely that the memory of a significant event such as an inoculation injury will remain clear. Nevertheless, recollections of even significant events may fade over time (Bryman, 2008). Therefore, the questions concerning inoculation injuries were confined to those occurring five or fewer years prior to the study.

5.2.4 Limitations of combining paradigms

Triangulation as a method of increasing validity and checking credibility is not without its critics. Guba and Lincoln (1989) dispute the theory that "there exist unchanging phenomena so that triangulation can logically be a check" (p240) and feel that triangulation should be a way of checking data of a factual nature only, for example the ICNs' data. There is no guarantee that any inherent bias in the study e.g. recall bias is not contaminating both qualitative and quantitative procedures. Hammersley and Atkinson (1983) point out that even when results agree it may be that all inferences are invalid rather than valid. In addition, according to Fielding and Fielding (1986) an 'objective' truth may not be possible when methods applying different theoretical perspectives are applied. They recommend that methods and data are chosen which will yield data appropriate to the perspective of the study or researcher.

It is uncommon for books on research methods to discuss qualitative and quantitative techniques in the same chapter. A traditional view of the epistemological debate is that qualitative and quantitative research paradigms reflect antagonistic views about how the social sciences ought to be conducted (Bryman, 1988). Nevertheless, by using both qualitative and quantitative methods, it is possible to address issues within a research topic from both perspectives, recognising that using a range of methods from within the two paradigms can complement the strengths and weaknesses of each approach (Patton, 1997; Polit and Beck, 2008). However, adopting a multi-method approach to solve practical problems leaves the researcher outside either dominant epistemological and ontological tradition (Adamson, 2005; Bryman, 2008).

Large amounts of data may be collected by triangulation and therefore, only treated superficially (Cowman, 1983). Furthermore, it is possible that different methods could produce different results, resulting in dissonance in the data (Zeibland and Wright, 1997; Jordan *et al*, 2003), either because errors have been made when applying one or both data collection methods or both methods are correct but revision of the initial theoretical assumptions are necessary (Erzberger and Kelle, 2003). For example, Jordan *et al* (2003) undertook a study into the effects of introducing a nutritional screening tool into a medical ward in an acute district general hospital. The screening tool was introduced onto one ward (intervention ward) but not onto a comparator ward. On the intervention ward it was identified that 12/46 patients (26.1%) were weighed prior to the introduction of the screening tool and 46/64 patients (71.9%) were weighed afterwards. In comparison, 8/27 (29.6%) patients on the comparator ward had their weight recorded prior to the intervention compared to 3/38 (7.9%) after. However, interviews with ward sisters suggested that all patients' weights were recorded following the introduction of the screening tool. In this study, all the nurses (6/6) emphasised the need for standard/universal precautions during the interviews, yet only one of the interviewed scrub nurses adopted all available precautions for all patients regardless of infection status (see section 4.6).

Unfortunately, any inconsistencies in the results from a combined approach may be difficult to interpret (Adamson, 2005) and it is possible that the findings from diverse data sources may be contradictory (Ziebland and Wright, 1997; Campbell *et al*, 2003; Jordan *et al*, 2003). Campbell *et al* (2003) for example, found a less than 50% concordance between quantitative and qualitative data collected from the same subject group. These disparities could depend on whether the components being converged are truly complementary or whether there are differences in the sampling frame (Denzin, 1970). Campbell *et al* (2003) suggest that differences occurred because of differences in the environment and data collector i.e. the quantitative data were obtained in the presence of the doctor, while the interviews were conducted in the patients' own homes by an interviewer who was not a healthcare professional. In this study, two of the data sets were congruent thereby strengthening the findings. Both the questionnaire survey and semi structured interviews provided data that showed a high level of agreement and the interview data provided insight into the answers given in the survey. However, there was some dissonance in the data between the telephone interviews with ICNs and survey data relating to training sessions. All ICNs provide training sessions on the prevention and management of inoculation injuries, yet according to the survey, only 38.1% of respondents were aware that these sessions were held suggesting perhaps a problem with publicity rather than provision.

The potential for disparities raises the question about what to do with inconsistent results. However, in this study there was a high level of concordance between data sets. The telephone interview data were used to corroborate survey data relating to the number of surgeons and scrub nurses who had attended training sessions. These criticisms notwithstanding, data and method triangulation were adopted for this study to reduce bias and improve validity.

5.2.5 Limitations and strengths of mixed methods research design

The retrospective design of the study necessitates reliance on the ability of the participants to recall accurately events of up to five years prior to the study. It is possible that memories of these events may not be accurate (Bryman, 2008) and consequently the quality of data may have been adversely affected. There is no method available for directly corroborating some data provided by participants. However, data from the ICNs offered some corroboration on attendance at educational sessions. In addition, the study asked for factual reports rather than conjecture. Nevertheless, changes in attitudes in the intervening years since experiencing an inoculation injury may have affected the respondents' ability to recall incidents accurately.

To overcome the bias associated with inaccurate memories, a prospective study would be necessary. A cohort study that followed a group of surgeons and scrub nurses regularly over time and monitored their compliance with standard/universal precautions, frequency of inoculation injuries and compliance with reporting procedures would allow the collection of data unaffected by recall bias.

The cohort would need to be representative of the population being studied if "inferences of causation are to be made" (Martin, 2005, p137). This would be difficult as a 'typical' surgeon or scrub nurse would be impossible to find, as they will vary according to age, speciality and experience. Selection bias would be a significant risk, and a large sample would be required to achieve representativeness. Furthermore, the cohort would require lengthy follow up to "measure event risks or rates" (Martin, 2005, p141). Where the events are rare or take considerable time to develop e.g. inoculation injuries, sero-conversion with HIV, HBV or HCV, cohort studies are slow and expensive (Grimes and Schulz, 2001) and this would be prohibitive within the resources allowed for a PhD. A prospective study was therefore rejected. However, a prospective study will be considered for funded post-doctoral work.

5.2.6 Limitations of methods employed

The strengths of the chosen data collection methods have been discussed in sectiona 3.3.1 and 3.3.2. However, in determining the methods to be utilised for any research study, consideration must also be given to the weaknesses. This section considers the limitations of the methods chosen.

This study utilized a mixed methods design incorporating a postal questionnaire survey of surgeons and scrub nurses, face to face semi-structured interviews with selected respondents and a telephone interview of senior ICNs in participating trusts.

Several researchers including Williams *et al* (1994); Nelsing *et al* (1997); Kim *et al* (1999); Chan *et al* (2002); Trim *et al* (2003); Cutter and Jordan (2003, 2004) have utilized surveys to elicit information on sustaining inoculation injuries, uptake of standard/universal precautions and inoculation injury reporting.

Exemplar

Burke and Madan (1997) combined descriptive and analytical research when exploring reasons for non-reporting and knowledge of risks related to contamination incidents among doctors and midwives. Questions eliciting numerical information on factors relating to frequency of contamination incidents were asked, followed by free text responses explaining reasons underlying certain actions such as failure to report accidents.

Other work in this field has been purely descriptive. For example, Ronk and Girard (1994) carried out a descriptive study among nurses working in operating departments; obtaining numerical data to describe how they perceived risk and selected precautions.

Limitations of questionnaire surveys

In this study, the initial data were collected via the questionnaire survey. All surgeons and scrub nurses were initially contacted and asked to participate in the survey (n=315) and only a minority (n=16) were interviewed to add richness to the data. One ICN per participating trust participated in the telephone interviews (n=6). Consequently, limitations to each of these methods may threaten the reliability and validity of the study. Although there was some dissonance in the data between the telephone interviews and the survey in relation to the provision of training sessions, the data sets were congruent in all other aspects thereby strengthening the findings.

<u>Response rate</u>

One major drawback of a questionnaire survey is the risk of a low response rate compared to face to face interviews when a response rate of between 80% and 90% can be achieved (Polit and Beck, 2004; Bryman, 2008). Some authors consider that the success of any quantitative survey depends on its response rate as it is generally considered that a high response rate reduces the extent of non-respondent bias and the risk that the respondents are not a representative sample (Asch *et al*, 1997; Barriball and While, 1999). Bias is a particular problem if it can be proven or even suspected that those who didn't respond differed from those who did (Murray, 1999; Bryman, 2008). In addition, a low response rate can compromise the external validity of the data set (Barriball and While, 1999; Passmore *et al*, 2002). Mangione (1995) considers a response rate of below 50% unacceptable, 50-60% barely acceptable, 60-70% acceptable, 70-85% very good and over 85% to be excellent. Passmore *et al* (2002) suggest that a response rate of 70% is adequate to assume generalisability. However, Burns and Grove (1997) have reported a response rate as low as 25-30% for postal questionnaires. A zero response rate is theoretically possible, for example, in those with a serious mental illness.

Although the study had a sample size of 315 respondents and achieved a response rate of 51.47% which compared favourably with reported response rates for postal questionnaires, for example, 25–30% (Burns and Grove, 1993), these numbers may limit the generalisability of the findings. The impact of response rate on the findings is considered in section 5.2.6. However, the practical adequacy of the findings indicates that they are likely to be transferrable to similar workplaces (Mitchell, 1983; Sayer, 1992; Jordan *et al*, 1999). Nevertheless, every attempt was made to maximise the response rate (see section 3.3.1).

The response rates for surveys reviewed in chapter 2 were variable i.e. 48%-82.6% (Wong *et al*, 1991; Bauer and Kenney, 1993; Knight and Bodsworth, 1998; Wong *et al*, 1998; Chan *et al*, 2002; Shiao *et al*, 2002; Cutter and Jordan 2003,2004). Of these only Chan *et al* (2002); Shiao *et al* (2002); Cutter and Jordan (2003/2004) achieved a response rate of over 70% considered by Passmore *et al* (2002) as necessary to assume generalisability.

The response rate in this study falls into the category of barely acceptable as described by Mangione (1995). However, not all authors agree that a high response rate is essential. For example, Knickman (1998) doubts whether a 70% response rate is really necessary and Boynton (2004) argues that fewer good quality questionnaires are better than a higher number of incomplete or inaccurate questionnaires. Schoenman *et al* (2003) maintain that a slightly higher response rate for example the low – mid 60% range compared to the high 50's had little impact on the quality of the data obtained in their work on the quality of data collected in the Community Tracking Study's Physician Survey. Furthermore, they found that "....data resulting from a very low response rate (approximately 33%) were not significantly different from data obtained from all respondents" (p40). Berry and Kanthouse (1987) felt that a high response rate did not necessarily eliminate bias and that "some methods of boosting response rates will appeal more to some types of respondents than others" (p112). However, a poor response rate is unlikely to be accepted by a peer review journal (Barriball and While, 1999; Schoenman *et al,* 2003), which is an important consideration when attempting to disseminate the results of a research study.

Even when response rates are high, for example the 1991 census for England and Wales where the response rate was almost 98%, there may be under-representation of some groups (Majeed *et al*, 1995, see section 3.5). However, the census received no data for 2.2% of the population. Although this non-response rate would be considered extremely small by the previous authors, the Office of Population, Censuses and Surveys considered this figure significant as the under enumeration was not random leading to under-representation of approximately 9% of men aged 20-29 years nationally, and almost 20% in inner London (Majeed *et al*, 1995). Consequently, there is no way of knowing whether the demographics of the whole population differ from the demographics of the respondents in any study. There is also no way of ascertaining whether the behaviour of those who respond differs from those who do not (Murray, 1999; Bryman, 2008).

Studies have been conducted to explore whether non response rate is related to non response bias. A variety of factors were found to influence response rate including age; gender, income, state of health, busy lifestyle; interest in the subject; likelihood that considering the topic will be beneficial to the individual; questionnaire being sent to the wrong address; and whether the survey data are collected by telephone interview or postal questionnaire (Hill *et al,* 1997; Keeter *et al*, 2000; Kotaniemi *et al*, 2002; Dallosso *et al*, 2003; Groves *et al*, 2006). However, the impact of response rate on the quality of the findings is open to question. Hill *et al* (1997) found significant differences between responders and non responders in a lifestyle survey and suggested that lifestyle surveys that do not consider non response should be viewed with caution. In contrast, according to Kotaniemi *et al* (2002), while socioeconomic factors and smoking habits differed between those who responded to an epidemiological questionnaire on respiratory health and those who responded to a non-response study to explore reasons for not participating in the original study, the results of the study were not affected by non response bias. Similarly, Dallosso *et al* (2003) found that although there were differences in the health, gender and race of responders compared to non-responders in a postal survey on urinary symptoms, there was no evidence of non response bias. Following a meta-analysis of studies Groves (2006) concluded that there was little support for the suggestion that a high risk of bias was associated with low response surveys.

Although the majority of the work exploring whether there are differences between those who respond to questionnaire surveys compared to those who don't has been conducted with patients or households (Hill *et al* 1997; Keeter *et al*, 2000; Kotaniemi *et al*, 2002; Dallosso *et al*, 2003; Groves *et al*, 2006), there is no evidence to suppose that the same principles don't apply to surveys conducted with healthcare professionals. Nevertheless, there may be factors requiring consideration that do not apply to the general public or patients. For example in 1999, Barriball and While found a statistically significant difference in the level of continuing professional education between responders and non-responders to a postal survey. One third of non-responders had not attended continuing education sessions in the 3 years preceding the study (n=13) compared to the respondents where 16.1% (n=71) had attended continuing education sessions during the same period (χ^2 6.73' p<0.01). However, there was no statistically significant difference in qualified status (χ^2 2.8' p>0.09), level of registration (χ^2 0.42, p>0.52), employment status (χ^2 22.37, p>0.12) or hours worked (χ^2 0.00, p=1). It was unclear whether these findings resulted in bias. Consequently, it is difficult to extrapolate from this whether any differences between responders and non-responders in this study may have influenced the findings.

Despite not having access to demographic information on the non responders, a degree of approximation can be assumed between responders and non-responders in this study in so much as they will all be well-educated healthcare professionals, employed as surgeons or scrub nurses in NHS acute hospital operating theatres. However, not only may respondents differ from non-respondents in age, nationality, speciality and level of experience, it will be impossible to determine whether there are variations in terms of continuing professional education and training on the subject of universal/standard precautions and reporting procedures. This could affect external validity, as continuing education on these subjects is a key construct under examination. However, some assessment of the number of surgeons and scrub nurses who have attended education and training sessions on the prevention and management of inoculation injuries was obtained from the ICN telephone survey. It was identified that attendance at these sessions was poor, with a total of only 103 scrub nurses and no surgeons recorded as attending such sessions at three of the participating trusts during 2004 (no data was available for the other three trusts, see section 4.1). The impact of the difference between the numbers of non responders and responders who had attended training was therefore not considered significant. Furthermore, the range of specialities and variation in length of time since qualification and in current speciality was broad with no reason to suppose that the distribution would be different among non-responders (histograms 4.3.1, 4.3.4 and chart 4.3.1).

It has been demonstrated that fewer doctors respond to surveys than non-doctors (Asch *et al*, 1997). Cartwright (1978) also identified that doctors were less inclined to participate in surveys than were nurses and that response rates among this group were falling, an observation also made by McAvoy and Kaner (1996). In a review of 219 published papers on response rates, Asch *et al* (1997) found that physicians had a response rate of 9.5% lower than non-physicians ($p<0.001$).

Comparisons between responses given by different professional groups will not be valid if any group is under-represented. Selection bias will occur where there is an absence of comparability between the groups being studied (Grimes and Schulz, 2001). This study required the views of surgeons as well as scrub nurses. Under-representation by surgeons could adversely affect external validity as the difference between professions and compliance with guidelines was a fundamental part of the study. It was accepted with reluctance that fewer responses were possible from the surgeons. This consideration notwithstanding, every effort was made to maximise the response rate. However, once data were collected, it was apparent that the response rate was slightly higher among surgeons than scrub nurses: 135/287 nurses responded, a response rate of 47%; 180/325 surgeons responded, response rate 55%. Within the sample, 180/315 respondents were surgeons (57%) and 135/315 were nurses (43%). The difference between professions was statistically significant. However, the result was borderline (χ^2 3.923, p=0.048, 95% CI 0.52-0.98), section 4.3.

Non contact

It has to be accepted that it is impossible to obtain data from an entire population and that some attempt must be made by researchers to select a representative sample (Barriball and While, 1999). In this study, five trusts were excluded from the study and it is conceded that this might have introduced bias. However, to include them may also have created bias as the trusts were fundamentally different those trusts approached to participate (see sections 1.4.4 and 3.4). Ten trusts were asked to participate, but in four of them, permission to conduct the study was refused. This may have introduced bias and threatened external validity (see section 3.8.2). Within each of the participating trusts, non contact with individual participants was known to have occurred in only two cases where a secretary returned the questionnaire because a surgeon had retired and another case where a departmental secretary could not locate the addressee after he had left his position. There was no way of identifying whether all the intended recipients of the questionnaires were contacted. It is possible that there may have been more non-contacts than these two which could have introduced bias.

Item non response

Item non response occurs when participants agree to participate but fail to answer one or more questions. According to Barriball and While (1999) researchers must accept that there are some subjects that participants may be reluctant to discuss. The American Association of Public Opinion Research (2004) define questionnaires in which >80% of the questions have been answered as complete. In this study, 92.7% (292/315) of respondents answered in excess of 80% of questions. Part one of the questionnaire was considered complete in 312/315 cases (99.4%), no cases were incomplete, and part two considered complete in 182/219 cases (83.1%), twenty cases were incomplete (20/219, 9.1%) as <50% of questions were answered (American Association of Public Opinion Research (2004). Eight of these respondents (8/20, 40%) failed to answer any questions in part two and were therefore excluded from the analysis of part two to remove bias. At what point item non-response creates bias is not clear from the literature.

Incomplete responses

Data collected by questionnaires even when open-ended questions are used may be superficial as respondents may be reluctant to compose lengthy answers (Denscombe, 2003; Polit and Beck, 2008). Polit and Beck (2008) believe that respondents sometimes resent being required to compose and write in-depth answers. Similarly, respondents can leave out answers or answer "I don't know" to questions on a questionnaire but are less likely to do so during an interview. Respondents may choose not to answer some questions creating the problem of missing data. Where data is missing from a scale e.g. questions 5, 7, and 15 the researcher has the option of excluding the respondent from the analysis or substituting a value for the missing item (Bowling, 2009). Commonly, this substituted value is the average value of the completed items, and this can be inputted by statistical packages such as SPSS, however, the effect of this on the validity of the results has not been fully evaluated (Bowling, 2009) and was not utilised in this study as it is not an attitude scale. Again at what point missing responses make questionnaires unusable is unclear.

Data from respondents returning questionnaires on second and third mail shots

Schoenman *et al* (2003) increased their response rate from 33% to 62% by sending two reminders after the first wave of questionnaires was returned. In this study, the response rate increased from 27.28% following the first mail shot to 42.64% following the second mail shot to 51.47% by the third mail shot.

While follow-up letters have been shown to effectively improve response rates (Polit and Beck, 2008; Bowling, 2009), follow up by telephone has been found to be more effective (Charles *et al*, 2000). However, telephone contact was rejected on grounds of cost and time and non responders were contacted by letter.

It has been suggested that differences exist between the characteristics of those who reply late e.g. age compared to those who respond to an initial mail shot (Schoenman *et al*, 2003), which may adversely affect external validity. The demographic characteristics of the respondents to each mail shot in this study are summarized in tables A16.2-A16.5. There were no statistically significant differences between professions responding to each mail shot when tested using the χ^2 test. The relationship between length of time qualified, length of time in current speciality, surgeons' speciality and mail shot were tested using the Kruskal-Wallis test. In each case, no statistically significant relationship was demonstrated. Therefore, demographic characteristics are unlikely to have influenced the findings in this study.

Questionnaires may be completed reluctantly by those responding to the first, second and third mail shot (Stang and Jöckel, 2004; Olsen, 2006). In particular, questionnaires returned following re-contact may have been completed "rapidly, perhaps grudgingly and with little thought" (Mulhall *et al*, 1997, p 242) which calls into question the quality of data collected. According to Keeter *et al* (2000) item non-response may be slightly higher in reluctant respondents further casting doubt on the quality of data collected following re-contact all of which led Stang and Jöckel (2004) to suggest that studies with low response rates may be less biased than those in which response rates has been increased following re-contact of participants. Nevertheless, these concerns had to be balanced against the requirement for generalisability and reduction of non-response bias and an attempt was made to determine whether the quality of data provided by those who responded late was poorer than those who replied promptly.

The questionnaire number for the respondents replying to the first, second and third mail shots were compared to the questionnaire numbers in table 4.3.1 to identify whether the 'late' respondents were more likely to submit incomplete questionnaires than those who replied promptly as this might indicate a level of reluctance to complete the questionnaire thoroughly among the late responders resulting in inaccurate data. Of the partially complete or incomplete questionnaires 11/23 (47.8%) were returned by those replying to the first mail shot, 8/23 (34.8%) to the second mail shot and 4/23 (17.4%) to the third indicating that Keeter *et al's* (2000) concerns that late responses may have a higher item non-response rate than others were not founded in this study.

While it is hoped that all respondents will provide optimal answers to each question in the survey, this may be unrealistic. Respondents may complete the questionnaire using satisfactory rather than the most accurate answers, a process described by Krosnick (1999) as satisficing. Satisficing is most likely to occur "(a) the greater the task difficulty, (b) the lower the respondent's ability, and (c) the lower the respondent's motivation to optimize" (Krosnick, 1999, p548). There is no method of testing whether this has occurred in this study.

Presence of the researcher

Postal questionnaires are completed in the absence of the researcher and the absence of the researcher may have negative effects. Non-verbal cues such as body language or signs of emotion that can help with interpretation of the answers are missed and an interviewer is not present to probe or clarify the meaning of questions (Bryman, 2008). Hence, questionnaire data could be considered less reliable than data collected during face to face interviews (Bowling, 2009). It is possible that individuals could pass the questionnaire on to someone else for completion, which will give inaccurate data (Guiffre, 1997; Bryman, 2008; Polit and Beck; 2008 Bowling, 2009). Copying cannot be excluded and respondents may collaborate when completing the questionnaire, both of which will affect the quality of the data. Furthermore, the answers given may not be accurate or honest (Denscombe, 2003). However, these factors are out of the researcher's control.

Question order

Whereas during a face to face interview, the order of questions is dictated by the interviewer, when completing a questionnaire, respondents could potentially answer the questions in any order, and this can affect the type of response (Bryman, 2008; Bowling, 2009). Not only can some questions be accidentally omitted, but the change in order may have an impact on replies (Bryman, 2008). Questions 5 and 12 in this study both relate to precautions used to reduce the risk of inoculation injury. Question 5 asks for compliance with precautions in relation to knowledge or suspicion of the blood-borne virus status of the patient, whereas, question 12 asks for compliance during a specific inoculation injury. It is known from previous work that not all healthcare professionals adopt a full range of precautions for every patient (Cutter and Jordan 2003; 2004). Behaviours may have differed in the case of the inoculation injury, because it is possible that the patient may have been known or suspected to have a blood-borne viral infection and consequently, protective clothing may have been worn when it may otherwise not have been. Answering question 12 before question 5 may prompt the respondent to offer the same response to question 5 and this may therefore not be an accurate reflection of his/her routine behaviour.

Literacy and language

Although literacy could be a potential problem in some surveys, it was not a problem in this study. However, misunderstandings could have occurred if the questions were not clear. Extensive piloting of the questionnaire using cognitive techniques before commencing the study should have identified any ambiguous or incomprehensible questions and allowed the questions to be re-worded in a more suitable format before the study was carried out. For example, during a pre-test interview one scrub nurse felt that in question 5 an extra category 'Other' and a space for comments should be included to allow participants to contribute where the original three choices did not apply. Another nurse reported that in question 14, one of the headings on the five point scale 'had no effect' did not allow her to fully express her opinion. This was changed to 'had no effect/influence'.

The study was conducted in English, and this might have contributed to those who prefer to respond in a different language not responding as English may not be the first language of all respondents. However, it was assumed that those working in either the medical or nursing profession in Wales would have sufficient grasp of the English language to fully comprehend the questionnaire. Translation into languages other than Welsh was not practical because of cost, obtaining access to translators and the large number of languages that may have been required. Furthermore, not only would making enquires concerning participants' first language provide logistical difficulties, it may be interpreted as intrusive and could have alienated potential respondents.

However, the study was conducted in Wales and it is reasonable for respondents to wish to use the national language. Therefore, a Welsh language version of the questionnaire could have been provided on request although nobody requested this. However, some Welsh speakers may have been deterred from participating due to the inconvenience of having to request an alternative questionnaire.

All interviews were conducted in English out of necessity as the researcher spoke no other language.

<u>Social desirability response</u>

In this study, the questionnaire approach may have been limited by the social desirability response; response set biases, the acquiescence response bias and/or extreme responses. Some questionnaires could lose their anonymity e.g. by handwriting. It is possible that respondents were aware of this possibility; this may have induced a social desirability response thereby threatening internal validity (Jordan, 2000). See section 3.8.2.

Limitations of face to face interviews

<u>Cost</u>

Face to face interviews are costly in terms of money and time (Polit and Beck, 2004). Together with the geographical spread of participants in this study, this precluded the use of interviews as a single data collection method on a large sample of theatre staff.

Since data obtained during face to face interviews will be derived from many open ended questions, data processing will also be costly (Oppenheim, 1992).

Anonymity and confidentiality

Anonymity cannot be assured during interviews. Although confidentiality was assured, concerns over loss of anonymity could have affected the candour with which participants answered, particularly as the responses were potentially sensitive e.g. prejudices, lack of compliance with established policies/guidelines (Guiffre, 1997; Polit and Beck, 2004) hence social desirability bias could be introduced (Bryman, 2008). Fear of reprisals for failing to follow prescribed protocols and procedures could lead to some staff being reluctant to be completely honest when answering the questions. Consequently, there may be a discrepancy between actual and reported behaviour (Jordan, 2000; Bryman, 2008). Similarly, some questions may appear threatening and fail to elicit an honest response (Bryman, 2008). This is possible during all stages of data collection. However, as questionnaires are usually completed in the absence of the researcher, this is less likely to be a concern during the survey than during face to face interviews.

Bias

The presence of an interviewer may introduce bias (Polit and Beck, 2004). Some might be inhibited by the presence of a tape recorder, and this might affect the degree of candour expressed by the interviewees (Denscombe, 2003) for example, when describing breaks with policy, careless or negligent behaviour.

Perceived threat of criticism

If researchers do not aim to work with clinicians in reviewing practice, they could be regarded as instruments of audit. If clinicians feel threatened, those who perceive themselves to be vulnerable to adverse criticism will not supply data (Jordan, 2000). Outlining the purpose of the survey in the explanatory letter hopefully reduced the effect of this, as does ensuring confidentiality. Nevertheless, this may not have been sufficient to allay fears of some respondents, especially where numbers of potential respondents were low. However, these data were needed to include all risk groups in planned education sessions.

Telephone interview

Many of the limitations associated with face to face interviews also apply to telephone interviews. In addition, during telephone interviews it is possible that the interviewee may not be the person intended. However, in this study, the ICNs in Wales were known to the researcher. Hence, she was secure in the knowledge that the interviewees were the intended participants. Nevertheless, telephone interviews were used for corroboration of other findings only.

5.2.7 Limitations and strengths of analysis and model

The choice of statistical analyses was dictated by the number of respondents and distribution of the data. While bivariate analysis was able to determine the statistical significance of many of the relationships tested, many other relationships were either not testable or did not achieve statistical significance because of low numbers in some categories (appendix 16). In particular, the influence of surgeons' speciality could not be tested without combining specialities e.g. oral/maxillofacial with ENT due to the inequality in numbers in some cells of each speciality (chart 4.3.1) and this was considered illogical on clinical grounds and was therefore not done.

The logistic regression modeling was undertaken to account for confounders but was affected by low numbers. It was intended to model factors relating to both the subjects under consideration i.e. sustaining and reporting inoculation injury. However, factors influencing poor reporting could not be modeled as the number of respondents who had sustained an inoculation injury but never reported it was low (35/204, 17.9%).

Despite many statistically significant relationships being identified through bivariate analysis in relation to sustaining one or more sharps injuries at one and five years (see table 4.3.97) model 3 was unable to predict more than 63% of sharps injuries for five years. The percentage of participants who would or would not sustain a sharps injury was correctly predicted at 62.2%. However, in the model contructed for one year, the final prediction was no better than the empty model.

A further limitation of both models is the relationship between profession and many of the other variables. Surgeons were more likely to agree or strongly agree that inoculation injuries were related to emergency procedures, working under pressure, performing unfamiliar procedures, personnel take fewer precautions when patients are not high risk and that it is acceptable to take fewer precautions when patients are not high risk. Furthermore, they were also more likely than nurses to believe that inoculation injuries are an occupational hazard. Consequently, the independent contribution of these variables cannot be accurately assessed from the models incorporating both professions. Given the findings of the bivariate analyses, a model was constructed including only the surgeons at five years. In the final model, none of the variables were statistically significant indicating that none of the variables was a significant predictor of surgeons sustaining a sharps injury at five years.

In logistic regression models, the coefficient R is a measure of how well the model fits the data and is measured on a scale of -1 to +1. According to Field (2009), a positive value of R indicates that the likelihood of an event occurring increases as the predictor variable increases. However, the smaller the value, the lower the contribution of the variables to the event in question i.e. sharps injury at one and five years. In model 3, the Nagelkerke R^2 value was 0.04. Therefore, although profession and length of time qualified contributed to sharps injury at one year, the R^2 value was low at 4% suggesting that the contribution was limited. In model 1, the Nagelkerke R^2 value was 0.07, which although low, implied that the contribution of profession and the belief that injuries were an occupational hazard to sharps injuries at five years was slightly higher at 7% than the variables considered in model 1. Nevertheless, the contribution may still be low.

To confirm the predictive value of these two models, further models were calculated only including the three variables found to be significant predictors in models 1 and 3. In this case, the Nagelkerke R^2 value was 0.07 at five years and 0.05 at one year (tables 4.4.8 and 4.4.17) indicating that the predictive value of models 1 and 3 were accurate but that the contribution of the variables was still low.

Other types of inoculation injuries, i.e. sustaining a splash of blood to mucous membranes at one and five years and splash of blood to broken skin at one and five years could not be modelled because of low numbers reporting such an injury (tables 4.3.14 and 4.3.15).

5.2.8 Methodological and theoretical limitations

In addition to the limitations already discussed, there are other factors that may have impacted on the study. They are:

Sample

For reasons discussed in section 3.4, personnel from only six acute NHS trusts were included in the study, the remaining four trusts having excluded themselves from the study for reasons beyond the researcher's control. However, one of the major threats to external validity in any study is the response rate (section 3.8.2) and although there is debate in the literature concerning what constitutes an acceptable response rate (Knockman, 1998; Schoenman *et al*, 2003; Boynton, 2004) the response rate of 51.47% achieved in this study may not be enough to satisfy some authors e.g. Mangione (1995). Similarly, sample size may influence external validity (Barriball and While, 1999; Passmore *et al*, 2002) and again a sample size of 315 may not satisfy some critics in terms of generalisability. However, the sample size was largely out of the researcher's control. In an experiment, where the difference between two groups is to be tested (i.e. bivariate tests with an implication that randomisation has taken place), power calculations may be useful to calculate the required sample in each group and extra respondents may be included to reach the required sample size if appropriate. However, when undertaking a survey, one cannot know the proportions of each group that will appear in the final sample: this will depend on the response rate for each group (surgeons and nurses) and cannot be predicted. In a study such as this where a whole population is considered, sample size calculation is less helpful, as the sample cannot be changed. The whole population of the UK or Wales was not used. Therefore, the number needed to estimate the prevalence of a key variable was calculated (section 3.4). Possible non-response bias in the sample used for the calculation would limit the transferability of the prevalence used for the calculation.

Although every attempt was made to maximise the response rate within the six NHS trusts included in the study (section 3.3.1), the response rate and sample size would have been increased had one or both of the university trusts been included. However, this was rejected for reasons discussed in section 3.4.

On reflection, although the pilot site would have been unsuitable for inclusion in the study, the personnel providing acute services in the second university trust could have been included in the study, and the data analysed alongside those from the other trusts. Should they have proved to differ significantly from those obtained in the remaining trusts; these data could have been presented separately otherwise included in the final report to enhance the findings and boost the sample size and potentially the response rate. Tertiary services could have been excluded to maintain anonymity in the final thesis.

In trusts 3 and 4, the researcher was unable to contact the participants directly. In trust 3, surgeons and nurses and in trust 4, nurses were contacted via a third party. To achieve this, those responsible for distributing the questionnaires were sent a list of codes together with packs containing the questionnaire, relevant information and a pre-paid envelope addressed to the researcher. The third party in each trust allocated the codes to the individual surgeons and/or nurses. This could have raised concerns about breaches of confidentiality and deterred some from participating. However, those distributing the questionnaires had no access to the completed forms. Therefore, to maximise the sample size, it was decided to include these trusts in the sample.

Another potential concern about the sample relates to the interviewees. The stated intention was to interview those who demonstrated extremes of behaviour. Unfortunately, only 16/110 of those invited to participate in the interviews agreed to do so. Accordingly, not all of those interviewed were the individuals who described the most extreme behaviour during the questionnaire survey. To have contacted more potential interviewees to increase the volume of qualitative data would have resulted in fewer interviewees of the planned 'quality'.

Data collection

Data were collected via a questionnaire survey and semi-structured interviews. As such the findings represented only self reported data which may have been influenced by the social desirability response, the respondents' perceived need to portray themselves in a positive light (Jordan, 2000) and faulty memories (Bryman, 2008). A minority may even have wished to be contentious and demonstrate an extreme disregard for policies and procedures that did not accurately reflect their practices.

Contradictions were evident in that some respondents e.g. 4.N.1 claimed to always use standard/universal precautions but on further questioning only used precautions selectively rather than universally based on judgements they made regarding the perceived bloodborne viral status of patients.

Direct observation of practices in theatre could have given an insight into actual rather than reported behaviour in relation to compliance with standard/universal precautions and assisted with the interpretation of reported data, the observer or Hawthorne effect notwithstanding (Roethlesberger and Dickson, 1939; Morse and Field, 1996; Sharkey and Larson, 2005) and has been employed in research within the operating theatre (Coe and Gould, 2008). Differences in compliance between surgeons and nurses could have been witnessed first-hand, social desirability response and interviewer bias reduced.

Direct observation may also be a method by which causes of error can be monitored (Leape, 1997) and near misses that never reach the formal reporting stage can be observed allowing a more comprehensive picture of the organisational and individual factors affecting behaviour within the operating theatre than can be achieved by self reporting alone. Failure to include direct observation in the data collection phase of this study means this opportunity was lost. However, the comparatively small number of operations that could have realistically been observed would have been unlikely to have revealed any significant insight into the cause and reporting of inoculation injuries beyond that provided by the survey and interviews. Direct observation was reluctantly not pursued as a potential data collection method as discussed in section 3.3.3.

The insider researcher

It is common within qualitative research, particularly ethnography to adopt an insider approach to data collection whereby the researcher investigates a phenomenon directly concerned with his/her own area of expertise (Robson, 2002). This has the advantage that the researcher has an intimate knowledge of the clinical setting, knows which questions would be appropriate and the politics of the institution, has a degree of credibility with the research participants and may find negotiating access easier than those not known to the participants (Robson, 2002). As such the insider researcher can often obtain candid data based on rapport and trust gained through his/her position and may be able to detect nuances that an outsider may not (Barton, 2008; Polit and Beck, 2008). However, there may be problems associated with maintaining objectivity (Robson, 2002; Polit and Beck, 2008). Indeed Hutchinson and Wilson (1994) argue that objectivity cannot be achieved during qualitative research because the process is influenced by the researcher's experiences. As such, a degree of reflexivity is required on behalf of the researcher to ensure that his/her role in influencing and interpreting findings and outcome is acknowledged (Manias and Street, 2001).

In this study, the researcher could have been considered an insider in that she is a registered nurse with an understanding of the operating theatre, its routine and internal politics. Interviewees were keen to engage with the researcher during the interviews and the tone of the interviews was often that of a conversation between those 'in the know', for example when discussing the quality of safety equipment, those responsible for purchasing were called 'they' with the assumption that the researcher would know who 'they' were without explanation:

> "We have had issues with gloves because **they** keep changing the suppliers so **they** keep asking us to try something which we may not like" 1.S.15.
>
> "I think **they** bought them *(gowns)* because **they** were disposable and cheap" 2.S.22.

Therefore, in terms of building a rapport and maintaining the flow of interviews, adoption of the role of insider was beneficial as it was in the generation of codes for the qualitative data analysis but had the disadvantage that participants may have felt that opening up to the researcher about their apparent difficulties would lead to an improvement in their situation which was outside her remit and ability. A similar situation was found by Richards and Emslie (2000) in which the interviewer who was also a general practitioner (Richards) was sometimes asked medical questions by the interviewees. Furthermore, there is the danger that this level of shared understanding may have meant that the research perspective, intuition and sensitivity was lost and that adequate clarification was not sought when appropriate. Chew-Graham and colleagues (2002) and Bonner and Tolhurst (2002) agree that this is a problem for insider researchers in that this level of understanding prevents adequate interrogation of respondents. Things may have been left unsaid because the assumption was made that an insider would already have certain knowledge and information.

In some respects, the researcher could also have been considered an outsider by the participants in that she was an ICN during the early stages of the study (rather than a theatre nurse or surgeon within the hospitals studied) and then took up a position as a lecturer outside the NHS. This also has benefits and limitations. While this outside perspective may have led to increased objectivity, it is possible that the nurses could have perceived the researcher's past and present occupations to imply a degree of seniority and expertise that may have influenced the quality of the replies leading to an increased defensiveness and a risk of social desirability in their responses (Richard and Emslie, 2002). Those who feel they are being judged may be cautious in their responses (Chew-Graham *et al*, 2002; Arber, 2006). For example, this may have led to their desire to over-emphasise their adoption of standard/universal precautions and in a study that relied totally on self-reporting, this may have been a considerable limitation. However, the degree to which bad practice was reported suggests that this may not have been too significant.

Outsider researchers may have the advantage of not being able to judge individual participants' professional skills and capabilities which could increase the objectivity with which they view the data (Bonner and Tolhurst, 2002). Not having the professional expertise with which to judge whether the technical aspects of the surgeons' and nurses' roles are performed well allowed the researcher to focus completely on compliance with infection control procedures.

<u>Study design</u>

The study was based on infection control theory and the use of that theory in practice. It used previous research relating to sustaining and reporting inoculation injuries and adoption of standard/universal precautions to formulate the questionnaire (chapter 2). The findings of the questionnaire were then utilised to design the interview schedule. The purpose of this was to determine the extent of compliance with standard/universal precautions and reporting among the sample as well as exploring factors that influenced behaviour. In particular, the success of current strategies for improving compliance such as provision of guidelines, policies, education and training by the employing trusts was explored. For example, training and education are frequently suggested in the literature as being the most appropriate methods by which compliance can be ensured although others have demonstrated that these strategies are largely ineffective at ensuring compliance with standard/universal precautions and reporting suggest that the true value of education in improving compliance is uncertain. (sections 2.8.2 and 2.8.3). Only by establishing that current mechanisms for achieving compliance are unsuccessful can there be any justification for adopting alternative strategies which are largely untested in relation to infection control (Pittet, 2004) and this was attempted in this study through taking this approach.

Although some work has been done in the field of social and behavioural science in relation to infection control (section 5.8.1), authors agree that the sociological/psychological factors contributing to compliance need to be explored in future work surrounding compliance with infection control guidelines (Pittet, 2004; Pittet, 2005; Pratt *et al*, 2007). This study identified that education in its current form was largely ineffective at improving compliance among the sample providing justification for exploring alternative strategies within the discussion. The discussion relating to social or behavioural theory (sections 5.7 and 5.8) developed as a consequence of analysing and interpreting the data, attempting to explain the findings and seek more effective ways of improving compliance. However, not basing the study on such theory was a limitation in that the findings did not fully explain why surgeons and scrub nurses behaved as they did in relation to the objectives of the study.

An alternative approach would have been to base the study on current social and behavioural theory in order to explore factors influencing compliance and this may have strengthened the findings and consequently the recommendations for future practice, research and education in that these may have been based on a deeper understanding of what made the relevant HCPs behave as they did over and above the factors that were investigated. However, any location of the study in a theoretical model would have been at the cost of an inductive analysis, and any given model might have risked confining the interpretation to a single perspective.

5.2.9 Summary

It is recognised that there are limitations in the data collection methods, study design and data analysis that may threaten validity, in particular, sub-optimal response rate and bias. Recognising that limitations exist is an essential requirement of the research process. Addressing these limitations, where possible, is an important step towards minimising threats to external validity e.g. non-response bias and social external validity e.g. the representativeness of the sample. However, while every effort was made to reduce the limitations as discussed, some potential solutions e.g. change in data collection methods, were rejected as the need to reduce limitations had to be balanced against the practicalities of conducting a large scale study over an extensive geographical area.

5.3 ETHICAL CONSIDERATIONS

While the need for all research projects to follow sound ethical principles cannot be questioned (see section 3.11), the ethical approval procedure was complex and time consuming. Application for research ethics approval at the time of the commencement of this study was via COREC (Central Office for Research Ethics Committees). The application involved the completion of a three part 57 page form requiring information on the study and researcher, with, according to Wald (2004), only one question on ethics on the entire form. In addition, permission was required from the research and development committees of the participating trusts. Each trust had their own application forms, several of which extended to over 15 pages. Each trust required the same information as COREC. The COREC form suggested that permission should be sought and gained from the participating trusts before submitting the COREC application. However, in this study, two of the trusts requested ethical approval before granting permission, meaning that in this respect the COREC application was incomplete. However, this was overlooked by COREC. The length of time that elapsed between applications to the Research Development Committees to gaining approval was four months (April to August 2004). Following completion and electronic submission of the COREC form, the application was scheduled to be considered at a meeting of a Research Ethics Committee in August 2004.

A week following the meeting of the Committee, a letter was received stating that ethical approval had been refused based on concerns expressed by the statistician on the Committee that the planned statistical analysis was not sufficiently defined. This presented two options, that the application be amended to satisfy the statistician or an appeal lodged against the decision. It was decided between the researcher and her academic supervisor to appeal the decision as the reason that the original application may have appeared vague regarding the exact nature of the statistical tests to be applied was that as there was no way of predicting the number of responses and whether the data would be normally distributed, it was not possible to state categorically which tests would be used. The appeal was heard in November, 2004 by a different committee and the original decision overturned. Minnis (2004) also reports inconsistencies in opinion between various ethics committees.

The complexity and time consuming nature of applications to COREC has been criticised by other authors (Greenhalgh, 2004; Jamrozik, 2004; Wald, 2004; Bentley and Enderby, 2005). According to Bentley and Enderby (2005), the bureaucracy surrounding the process discouraged applications to local research ethics committees. The process has now been revised and simplified and application via the new Integrated Research Application System (IRAS) will begin from April 1st 2009 (National Patient Safety Agency (NPSA), 2009a).

As discussed in section 3.11, information was provided in writing for all survey participants. No consent form was required as completion of the questionnaire implied consent. On the introductory letter (appendix 4), contact details were given to allow the participants to discuss any concerns regarding the study with the researcher. Only one participant did so. One surgeon was unclear about the purpose of the study and whether he could be identified by his employing trust. Following reassurance that the trust would not be able to identify any individual from the information returned to them, he completed the questionnaire.

Consent forms were required for the interviewees (appendix 6). In addition to written information (appendix 5), verbal reassurance that ethical principles would be followed throughout the interview process and during the writing up and dissemination of the findings was also given prior to the interview. No potential interviewee contacted the researcher prior to the study expressing any concerns.

The principles of research governance were followed and the study was conducted in such a manner as to achieve high scientific and ethical standards as defined by the Medical Research Council (1997) and Welsh Assembly Government (2001). However, there is no guarantee that some potential participants may not have had ethical concerns that they chose not to discuss with the researcher but may have prevented them from taking part.

5.4 UPTAKE OF STANDARD/UNIVERSAL PRECAUTIONS

The UK Health Departments (1998) recommend that all blood and body fluids are treated as potentially infectious, and appropriate protective measures be taken whenever exposure to such fluids is anticipated, a concept known as standard or universal precautions (CDC, 1987, Siegel *et al*, 2007) see sections 1.3.2 and 2.3.1.

Compliance with standard/universal precautions

Some studies have suggested that compliance with precautions is high, for example Knight and Bodsworth (1998) found that 73% of respondents used universal precautions at all times and Raghavendran *et al* (2006) demonstrated a 64% compliance rate, although the majority of studies agree that uptake of standard/universal precautions is generally low (Henry *et al*, 1994; Williams *et al*, 1994; Nelsing *et al*, 1997; Akduman *et al*, 1999; Kim *et al*, 1999; Chan *et al*, 2002; Osborne, 2003; Cutter and Jordan, 2004). However, disparities in data collection methods, and the limited number of studies that define the precautions to be taken means that the true level of compliance with universal or standard precautions is difficult to assess. For example, this study examined how many personnel adopted double gloves, face protection avoided routine passage of sharps by hand during all exposure prone procedures and found compliance with these precautions collectively to be poor with 10.3% of respondents (31/302) observing all the precautions for every patient (table 4.3.12). Similarly, Cutter and Jordan (2004) directly questioned respondents about use of double gloves, masks, eye protection, waterproof gowns and passing sharps by hand and found compliance among only 1.5% of surgeons, scrub nurses and midwives. This study did not include use of waterproof gowns in the range of precautions examined as these are now standard issue across Wales. Although an improvement in the level of compliance since the 2004 study is noted, it is still low.

Studies that show higher compliance with standard/universal precautions e.g. Raghavendran *et al* (2006) simply asked staff whether they followed universal precautions rather then identify individual components. However, interpretation of what constitutes universal or standard precautions varies. This study revealed that although 2/6 nurses interviewed (33.3%) claimed to recognise the importance of standard/universal precautions and adopt them all the time, compliance was variable. For example one nurse said:

> "There are universal precautions really from the moment the patient comes in" 4.N.1,

while admitting at another point in the interview that she would take extra precautions for drug users. Only one of the scrub nurses interviewed adopted all the precautions for all patients. None of the surgeons interviewed claimed to follow the precautions for every case. Eleven of the 18 participants (61.1%) who discussed guideline adherence in response to the open question on the questionnaire claimed to adopt precautions for every case, 3/11 (27.3%) of these were surgeons and 8/11 (72.7%) nurses.

This may be due to a lack of understanding of the actual meaning of standard/universal precautions, concern about censure for not reporting compliance or simply due to the social desirability response among research subjects which means that studies such as that conducted by Raghavendran *et al* (2006) are likely to provide information that is somewhat less than trustworthy.

Selective compliance

While compliance with standard/universal precautions as a whole is difficult to determine, compliance with individual precautions is more straightforward. Double gloving was the precaution least likely to be adopted in this study. Only 22.9% of respondents (72/310) would double glove for all patients (histogram 4.3.7). This has been identified in other studies with double gloving only being adopted by 15.6% - 81.8% of respondents (Akduman *et al,* 1999; Kim *et al*, 1999; Osborne, 2003; Cutter and Jordan, 2004; Brasel *et al*, 2007). Similarly, compliance with eye protection was found to be poor both in this study (141/310, 44.8%) and others: 9% - 76.5% (Akduman *et al*, 1999; Chan *et al* 2002; Osborne, 2003; Cutter and Jordan, 2004; Gańczak and Szych, 2007; Holzmann *et al*, 2008). Trauma and orthopaedic surgeons were more likely that other specialities to wear both double gloves and eye protection (tables 4.3. 81 and 4.3.82). This has been noted elsewhere (Au *et al*, 2008) and not only reflects the additional hazard of sharp spicules of bone associated with orhopaedic surgery, but according to one of the surgeons and one scrub nurse interviewed due to contact with bone cement.

One area however, where respondents in Wales demonstrate a higher level of compliance than has been shown elsewhere is in the avoidance of passing sharps directly from hand to hand. This study demonstrated that 259/307 respondents (82.2%) would pass sharp instruments via a neutral field for all cases compared to 8-69.2% identified in other studies (Stringer *et al*, 2002; Cutter and Jordan, 2004; Phillips *et al*, 2007).

If standard/universal precautions are to be fully effective, choice of protection must be based on the type of exposure to blood and body fluids anticipated, not on patient characteristics. For example, if splashing to the face is possible, mucous membranes should be protected, if skin is broken, a waterproof dressing should be applied before contact with body fluids occurs. For exposure prone procedures, including surgery, the range of protective measures described by the UK Health Departments (1998) should be employed as contact with blood and body fluid is likely to be extensive. Evidently, this does not occur routinely amongst these respondents.

Risk perception

The lack of understanding of the true nature of standard/universal precautions is supported by the fact that all interviewees except one scrub nurse would increase the precautions taken for known or suspected 'high risk' patients suggesting that risk perception is a strong motivator. Other studies also found that judgements are made on the basis of suspicion of infection. Henry *et al* (1994) found that 59% of respondents would change their behaviour if the patient had a suspected infection, while Williams *et al* (1994) found that 57% would do so.

The questionnaire survey revealed an improved uptake of double gloving and eye protection when the perceived risk increased (histogram 4.3.7). This is emphasized by the fact that the two surgeons who had worked in South Africa where the incidence of HIV is greater than in the UK, perceived the risk of infection to be high there and therefore a high degree of protection was adopted at all times. Where the risk of infection is constantly high, adoption of standard/universal precautions is consistently good as fear of infection promotes compliance (Gerberding *et al*, 1990; Gerberding, 1991; Goldmann, 2002). Conversely, where the risk is perceived to be low, compliance is often poor (Willy *et al*, 1990; Gerberding 1991; Gershon *et al*, 1995; Patterson *et al*, 1998; Kim *et al*, 1999; Leliopoulou *et al*, 1999; Naing *et al*, 2001; Hills and Wilkes, 2003; Cutter and Jordan, 2004) and this was apparent in this study. From the interviews it appears that surgeons in particular perceive the risk of injury and subsequent infection to be low leading to poor compliance:

> "The gynae [SIC] patients are low risk. They're usually elderly…" 6.S.49.
>
> "…if you are operating on a 50 or 60 year old they would have a low risk…" 4.S.19.

Individual factors influencing risk perception were not explored in this study but have been considered elsewhere (Osborne, 2003; Lymer *et al*, 2004). However, other factors that may have been influential in determining behaviour were considered.

The basis for suspicion of infection was not fully investigated in this study but has been explored elsewhere (Cutter and Jordan, 2004). It could have been based on the notion of certain groups of society being at "high risk" of infection, such as gay men, haemophiliacs and intravenous drug users and this was confirmed by the interviewees i.e. 8/8 (100%) of surgeons and 4/5 (66.7%) of nurses who said that they would change their behaviour if caring for a patient falling into one of the stereotypical high risk groups. Presumably, those not perceived as being at high risk of having a blood-borne infection were not perceived to be a threat to these respondents:

> "...if you've got a little old lady she will be much less risky than someone who's 24 basically, or a drug addict or anybody who falls into that higher risk category" 6.S.51.

Cutter and Jordan (2004) also found that decisions regarding protective clothing are made on the basis of such opinions and found that 63.3% of respondents (119/188) admitted to making judgements related to lifestyle, sexuality or nationality when choosing protective clothing. Other authors have reported similar findings. Mangione *et al* (1991) found that 26% of respondents did not believe their exposure constituted a risk, as did Haiduven *et al* (1999).

Profession

Profession influenced the precautions taken in both the questionnaire survey and interviews. This study found nurses to be more likely to comply with all the precautions considered than surgeons. From the interviews, nurses were more likely to wear double gloves for every case, 1/8 surgeons (12.5%) compared to 1/6 nurses (16.7%). However, statistical analysis of the survey data did not reveal any significant difference in relation to double gloving and profession (table A16.65). Protective eyewear was also worn for every case by more nurses than surgeons, 3/8 surgeons (37.5%) and 3/6 nurses (50%). This was found to be statistically significant during analysis of the survey data where only 34.5% of surgeons (57/165) compare to 62.7% of nurses (84/134) would wear eye protection for all patients (table 4.3.79). Although few studies examined this phenomenon in relation to operating theatre staff, those that did also found that doctors are less compliant than nurses (Stein *et al*, 2003; Trim *et al*, 2003; Cutter and Jordan, 2004; McDonald *et al* 2005; Raghavendran *et al*, 2006). McDonald *et al* (2005) suggest that the reason for poor compliance among doctors is the 'cavalier' attitude they have towards guidelines. This study supports this viewpoint:

> "I think there is some innate arrogance in anybody who wants to become a surgeon. That's just the type of people we are, I think we all think we're invincible" 2.S.7.

Safety devices

The uptake of safety devices is low. Only 20.4% of surgeons (23/162) and 32.3% of scrub nurses (31/96) table (4.3.80) use a safety device for all cases according to the survey. It is interesting here that despite there being a statistically significant difference between the professions with nurses using safety devices more frequently than surgeons, 17 nurses in the open question of the questionnaire claimed that their use was dictated by surgeons. In the context of devices used specifically for the surgery such as blunt needles, this will undoubtedly be the case. In relation to other devices such as disarming devices and sticky pads for containing used sharps, nurses will have more control over whether they are to be used. However, only two nurses interviewed and four nurses in response to the open question specifically mentioned their use. These are not new devices and have been in common use for many years. Two explanations are possible here. Firstly, nurses did not consider these products to be safety devices and secondly they have become so familiar with the products that their use is automatic. Either way, these results must be viewed with caution. None of the studies reviewed considered professional differences in relation to the use of safety devices.

Most of the literature surrounding the use of safety devices relates to availability and often the subject is discussed together with the availability of protective clothing. The general consensus is that lack of availability of appropriate equipment contributes to poor compliance (Henry *et al*, 1992; Nelsing *et al,* 1997; Naing *et al,* 2001; Cutter and Jordan, 2004; Askarian *et al*, 2006; Gańczak and Szych, 2007). The interviews specifically addressed the availability of equipment and while some safety equipment for example, blunt needles were readily available, other equipment was not. Only one nurse and one manager stated that scalpels with retractable blades were available in the department, the remaining four nurses and the surgeon from the same trust were unaware of their existence. Perhaps in some cases, lack of availability is not the issue, rather lack of awareness of the availability.

Efficacy of protective clothing

The sub-standard quality of some elements of protective clothing was a frequent cause for concern among the interviewees, particularly in relation to gloves. Both the managers interviewed disputed the fact that poor quality gloves were imposed on surgeons and nurses emphasising the fact that frequent trials are conducted within operating departments during which all potential users are given the opportunity to participate. This was not discussed in the studies reviewed.

It is apparent from the data that rather than adopt a collection of measures to reduce the risk of exposure to blood and body fluids, as recommended by the UK Health Departments (1998), healthcare professionals in this study are selective about which precautions to take suggesting that another factor contributing to the adoption of precautions is the assessment of the relative importance of each individual precaution or faith in the efficacy of some measures compared to others.

Concerns have been expressed in the literature that double gloves reduce tactile sensation and compromise dexterity (Wilson *et al*, 1996; Naing *et al*, 2001; Thomas *et al*, 2001; Stein *et al*, 2003; Cutter and Jordan, 2004; Tansley *et al*, 2004). This is confirmed by the results of this study in which all surgeons and scrub nurses interviewed made reference to the fact that double gloves 'felt different'. Only two of the interviewees, a surgeon and a scrub nurse double gloved for all operations and while acknowledging that tactile sensation varied between one pair of gloves and two, said that this difference was overcome with practice and didn't adversely affect dexterity or accuracy of movement. Patterson *et al* (1998) supports this and reported that decreased tactile sensation was significantly higher in those who used double gloves only occasionally. It is possible that the 206/310 respondents (65.7%) who only double glove for patients with known or suspected bloodborne viral infection are unwittingly increasing their risk of injury by doing this, as unfamiliarity could make the user more 'awkward' (Cutter and Jordan 2004; Tansley *et al*, 2004). This was recognised by one nurse and two surgeons during the interviews.

Lack of faith in the ability of double gloves to prevent sharps injuries was suggested as a possible reason for non-compliance by 3/8 surgeons (37.5%) interviewed. One of these was an orthopaedic surgeon who double gloved for every case:

> "It's not very good protection against needlesticks" 2.S.35.

This was also reported by Nelsing *et al* (1997). This is despite evidence that suggests that not only does double gloving reduce the volume of inoculum through the gloves compared to one pair (Lefebvre *et al*, 2008) but even when the outer glove is punctured the inner glove frequently remains in tact (Matta *et al* 1988; Thomas *et al*, 2001; Malhotra *et al*, 2004; Brasel *et al*, 2007).

It has been demonstrated that 44-86% of face shields are visibly contaminated with blood post-operatively (Bell and Clement 1991; Marasco and Woods, 1998; Collins *et al*, 2000; Singh *et al*, 2006; Endo *et al*, 2007; Holtzman *et al*, 2008), with the implication that in the absence of the face shields, blood would splash into the eyes, noses and mouths of the scrub team. Consequently, eye protection is recommended for exposure prone procedures but compliance is poor with only 141/310 respondents (44.8%) wearing eye protection for every case. One of the reasons given for failure to wear eye protection was that the surgeon or scrub nurse wore glasses. Eleven comments were made on the questionnaire by those who chose spectacles as an alternative to visors or goggles. However, it has been shown that blood splashes can contaminate the inside of spectacles and hence the eyes (Brearley and Buist, 1989; Bell and Clement, 1991; Marasco and Woods, 1998; Endo *et al*, 2007). Therefore, rejecting protective eyewear in favour of spectacles could result in mucocutaneous exposure to blood or body fluid.

Eye protection has been criticised for fogging up and impairing vision (Tansley *et al*, 2004). However, only one nurse and a surgeon mentioned any discomfort in relation to eye protection in response to the open question on the questionnaire and one surgeon during the interviews:

> "I have worn visors in the past but they are uncomfortable" 5.N.23.

Length of time qualified

The influence of length of time since qualifying on the uptake of standard/universal precautions was explored to determine whether the timing of undergraduate or pre-registration education was relevant to compliance. Some research has suggested that those HCPs who underwent training after the introduction of universal precautions in 1987 would have been fully educated in their use during this training (Ronk and Girard, 1994; Williams *et al*, 1994; Ramsey *et al*, 1996; Jeffe *et al*, 1998; Akduman *et al,* 1999; Osborne, 2003; Raghavendron *et al*, 2006; Singh *et al*, 2006; Chan *et al*, 2008). In theory these individuals should be more likely to comply than those trained pre 1987 as those not trained in their use may find it difficult to change their established behaviour (Grol, 1997; Akduman *et al*, 1999). However, other studies have failed to demonstrate any statistically significant link between experience and compliance (Cutter and Jordan, 2004; Sencan *et al*, 2004). This study also failed to demonstrate any statistically significant link between length of time qualified and compliance with double gloving, eye protection, using safety devices or avoiding passing sharps by hand and length of time in current speciality and the same variables (tables A16.67 and A16.68).

Training

All the trusts who participated in the study provided training sessions on the prevention and management of inoculation injuries yet attendance was variable with 64.8% of respondents (204/314) never having attended such a session. Nurses were more likely to attend training sessions than surgeons: 61.5% of nurses (83/135) compared to 15.1% of surgeons (27/179) (table 4.3.36) although, during the interviews two surgeons said that they would be interested in attending the sessions providing they were held at a convenient time and place and addressed issues pertinent to them and their practice. None of the studies reviewed specifically addressed inter-professional differences in attending training sessions although studies do acknowledge that training sessions must be tailored to individual needs and profession to encourage attendance (Seto, 1995; Farrington, 2007).

This study identified that those healthcare professionals who had attended training sessions were less likely to sustain a sharps injury at one and five years and splashes to the mucous membranes within the last five years (tables 4.3.37 to 4.3.39). Training also influenced the belief that fewer precautions are needed when patients are low risk and the belief that injuries are an occupational hazard (tables 4.3.43 and 4.3.44). However, training did not influence double gloving; wearing eye protection and avoidance of passing sharps directly from hand to hand (tables A16.71-A16.73). Therefore, the success of training sessions is variable. Moreover, as few surgeons attended training sessions (15.1%, 27/179) (table 4.3.36), it is questionable whether the attendance at training sessions is beneficial in this professional group. Various degrees of success have been achieved through education in other studies. Huang *et al* (2002) found that knowledge and compliance improved following introduction of education. It would be tempting to speculate that one of the reasons why nurses' compliance with standard/universal precautions is higher than that of the surgeons in this study is due to the fact that more nurses than surgeons attended training sessions.

However, this association was not tested and could not be tested in a survey. A prospective cohort study is recommended to explore this further.

Some studies have found that improving knowledge does not necessarily improve compliance (Knight and Bodsworth, 1998; van Gemert-Pijnen *et al*, 2005). However, other studies (Talan and Baraff, 1990; Freeman and Chambers, 1992; Turner, 1993; Ronk and Girard, 1994; Naing *et al*, 2001; Cutter and Jordan, 2004; Cooper, 2006; Askarian *et al*, 2006; Farrington, 2007) have identified that while theoretical knowledge concerning standard/universal precautions may be good, practical application is variable. Willy (1990) found that education was of little benefit unless perceptions of risk were altered. Factors affecting these perceptions need to be identified before they can be changed, including racial and social influences (Henry *et al*, 1994), attitude, communication, respect and fairness (Kretzer and Larson, 1998). Thus, simply presenting the facts is not sufficient. The factors reducing the success of education must be recognised and addressed to ensure that the aims of educational sessions are met. However, assessment of the personal, cultural and health beliefs of each HCW before commencing education and training is impractical in a busy workplace and might be perceived as being intrusive.

Table 5.1 summarises the level of agreement between this study and other studies.

Table 5.1: Level of agreement with findings concerning uptake of standard/universal precautions

Finding	Studies supporting	Studies in contrast	Comments
Compliance with standard/universal precautions was poor		Knight and Bodsworth, 1998; Raghavendran *et al*, 2006	Studies examining compliance with standard/universal precautions as a whole were limited
	Henry *et al*, 1994; Williams *et al*, 1994; Nelsing *et al*, 1997.		
Compliance with double gloving was poor	Akduman *et al*, 1999; Kim *et al,* 1999; Osborne, 2006; Cutter and Jordan, 2004; Brasel *et al*, 2007; Au *et al*, 2008.		There was consensus among all studies that compliance with double gloving was poor
Compliance with protective eye wear was poor	Akduman *et al*, 1999; Kim *et al,* 1999; Chan *et al*, 2002; Osborne, 2006; Cutter and Jordan, 2004; Gańczak and Szych, 2007; Holzman *et al*, 2008; Au *et al*, 2008.		There was consensus among all studies that compliance with eye protection was poor
Compliance with passing sharps via a neutral field was high		Stringer *et al,* 2002; Cutter and Jordan, 2004; Phillips *et al,* 2007.	This area of operating theatre practice has not been extensively researched
Precautions adopted increase if healthcare workers perceive	Henry *et al*, 1994; Williams *et al* 1994.		All studies that concerned risk perception identified that

patients to be high risk	Gerberding *et al,* 1990; Gerberding *et al,* 1991; Goldman, 2002.		this is a significant determinant in the level of precautions adopted.
Where healthcare workers perceive the risk of infection to be low, fewer precautions are adopted	Willy *et al,* 1990; Gerberding *et al,* 1991; Gershon, 1995; Patterson *et al,* 1998; Kim *et al,* 1999; Leliopoulou *et al,* 1999; Naing *et al,* 2001; Hills and Wilkes, 2003. Cutter and Jordan, 2004.		As above
Where exposure was not felt to constitute a risk of infection, uptake of precautions was low	Mangione *et al,* 1991; Haiduven *et al,* 1999; Cutter and Jordan, 2004		As above
Profession strongly influenced the precautions taken	Stein *et al,* 2003; Trim *et al,* 2003; Cutter and Jordan, 2004; McDonald *et al,* 2005; Raghavendran *et al,* 2006.		Doctors are less likely to follow standard/universal precautions than nurses
Lack of availability of safety device restricted their use	Henry *et al,* 1992; Nelsing *et al,* 1997; Naing *et al,* 2001; Cutter and Jordan, 2004; Askarian *et al,* 2006; Gańczak and Szych 2007.		The extent of availability in this study varied according to the device. Some were readily accessible e.g. blunt needles, others for example safety scalpels were not.
Protective clothing interfered with working practices	Wilson *et al,* 1996; Naing *et al,* 2001; Thomas *et al,* 2001.	Tansley *et al,* 2004.	Double gloving in particular was felt to compromise dexterity and the majority of

	Stein *et al,* 2002; Cutter and Jordan, 2004; Tansley *et al,* 2004.		studies identified this. Tansley et al (2004) also identified that eye protection 'fogged up'. This study did not support this finding.
Length of time qualified did not influence compliance with standard/universal precautions	Cutter and Jordan, 2004; Sencan *et al,* 2004.	Ronk and Girard, 1994; Williams *et al,* 1994; Ramsey *et al,* 1996; Jeffe *et al,* 1998; Akduman *et al,* 1999; Osborne, 2006; Raghavendran *et al,* 2006; Singh *et al,* 2006; Chan *et al,* 2008.	Most studies suggest that the longer healthcare professionals have been qualified, the less likely they are to comply with standard precautions. This study did not find any statistically significant relationship between length of experience and compliance
Compliance with standard/universal precautions improves following training		Huang *et al,* 2002.	This study did not identify that training positively influenced compliance. However, this might have been influenced by the low attendance at training sessions. Other studies have failed to identify a positive relationship between improving knowledge and improving compliance.

5.5 FACTORS CONTRIBUTING TO PERCUTANEOUS AND MUCOCUTANEOUS EXPOSURE TO BLOOD AND BODY FLUIDS AMONG HEALTH CARE PROFESSIONALS PERFORMING EXPOSURE PRONE PROCEDURES IN THE OPERATING THEATRE

Frequency and rate of injury

The exact number of percutaneous and mucocutaneous injuries sustained by operating theatre personnel is difficult to determine. This study asked for respondents to recall the number of injuries over a one and five year period and as such may have been subject to recall bias, as evident by the number of respondents who could only give approximate numbers. This was most apparent in those who had sustained multiple injuries. Those who had sustained a small number of injuries were more likely to state exact numbers suggesting that an injury was a significant event for them whereas those who had sustained several may no longer have considered them to be so. No attempt was made to determine rates of injury as the researcher had no access to denominator data.

Comparison with other national and international data was difficult firstly, because the methods for determining injury rates were not consistent across studies/surveillance projects and secondly as very few studies examined surgeons and scrub nurses within the same study. However, patterns of injury can be compared. This study demonstrated that the majority of reported injuries were percutaneous exposures with 30.5% (96/315) and 61.3% (193/315) of respondents having sustained such an injury within the last one and five years respectively (table 4.3.13) compared to 40/315 (12.7%) and 74/315 (23.3%) of respondents who had sustained a splash to the mucous membranes within the last one and five years (table 4.3.14). This is confirmed by the work of others (CDC, 2001; CNSSN, 2001; Petrisillo et al., 2001; EPINet, 2004b; HPA, 2008). The incidence of reported splashes to the mucous membranes may be under estimated as other studies have demonstrated that theatre personnel are often unaware of splashes to the eyes (Marasco and Woods,, 1998; Collins *et al,* 2000) and there is no reason to suppose that the respondents in this study would be any different. Splashes of blood to broken skin have not been widely considered in other studies and formed only a small proportion of the injuries reported in this study with only 18/315 (5.7%) reporting such an exposure within the last five years (table 4.3.15).

According to the HPA (2008d), the number of significant exposures to blood-borne viruses is higher in operating theatres than other clinical areas; theatre incidents accounted for 17% (62/360) of all exposures reported by 194 centres in England, Wales and Northern Ireland in 2007. Other studies have also identified the operating theatre as an area where there is a high risk of inoculation injury (Bakaeen *et al*, 2006; Fisman *et al*, 2007). However, as this study only considered the operating theatre, no inferences can be made to other clinical areas.

This study investigated differences between professions and identified that surgeons sustained more injuries than scrub nurses. Significantly more surgeons than nurses sustained a sharps injury at one and five years (36.1%, 65/180 surgeons, 21.5%, 29/135 nurses at one year and 66.1%, 119/180 surgeons and 47.4%, 64/135 nurses at five years), see tables 4.3.32 and 3.3.34. Similarly, sustaining a splash of blood to the mucous membranes within five years was also influenced by profession with 51/180 surgeons (28.3%) compared to 16/135 nurses (11.9%). However, this study examined frequency of injuries within the operating department only. Other studies that have also examined frequency of injuries have found that injuries are more common among nurses compared to other professions (Ippolito *et al*, 1994; Lymer *et al*, 1997; Ling *et al*, 2000; Puro *et al*, 2001; Shiao *et al*, 2002; Alvarado-Ramy *et al*, 2003; Gillen *et al*, 2003; EPINet, 2004a, EPINet 2004b; Sencan *et al*, 2004; Mehta *et al*, 2005) perhaps reflecting the higher number of nurses than doctors employed within healthcare (Ippolito *et al*, 1994; Lymer *et al*, 1997, Trim and Elliott, 2003). However, studies that examine rates of exposure demonstrate a higher rate of injury among doctors than nurses (Benitez *et al*, 1999; CNSSN, 2001; Ng *et al*, 2002).

None of the studies that report a higher frequency of injuries among nurses were specific to the operating department which may also contribute to the lack of consistency between this study and others. Studies conducted exclusively among operating theatre personnel have also demonstrated a higher frequency of injuries among surgeons (Quebbeman *et al*, 1990; Ling *et al*, 2000). According to Tokars *et al* (1992) surgeons also sustain the highest rate of injury within the operating theatre and more recently the HPA (2008d) bi-annual report on significant exposures to blood-borne viruses also identified that in the operating theatre doctors experienced the highest rate of exposure (80%, 37/46). Conversely, Cutter and Jordan (2004) and

Bakaeen *et al* (2006) failed to demonstrate any statistically significant differences between the professions in relation to the number of injuries sustained.

Cause of injury

The operating theatre is a unique environment in which the number of medical staff may equal or exceed the number of nursing staff involved in each exposure prone procedure whereas in other clinical areas the number of nurses usually exceeds the number of doctors. This may explain the higher incidence of injuries to surgeons compared to scrub nurses both in terms of frequency and as a proportion of all injuries within the department. Another explanation may be that during surgery, the surgeons are primarily the users of the sharp object. According to the HPA (2008d), most exposures to bloodborne viruses occurred after use of a sharp instrument. Between 2000 and 2007, 20% (76/377) of exposures occurred after the procedure was completed i.e. once the sharp instrument was contaminated (HPA, 2008d). The majority of participants in this study were injured during the use of the sharp item (133/217, 61.3%) again implying that the instrument was contaminated. Surgeons were most likely to be injured during the use of a sharp instrument (97/136, 72.9% compared to 36/71, 27.1% scrub nurses).

In addition, 79/217 (25.1%) of respondents were injured between steps in a procedure and 48/218 (15.2%) were injured after use but before disposal, once again suggesting that contaminated sharps were the source of these injuries (histogram 4.3.9). Other studies agree that injuries commonly occur during use, after use or after use but before disposal (English, 1992; Greene *et al*, 1998; Ling *et al*, 2000; Puro *et al*, 2001; Phipps *et al*, 2002; Gillen *et al*, 2003; Ippolito *et al*, 2003; Trim and Elliott, 2003; Cutter and Jordan, 2004; Rapparini *et al*, 2007). These findings suggest that safer sharps handling needs to become a priority among operating theatre personnel. Furthermore, the HPA stated that safety devices might have prevented some of these injuries (HPA, 2008d).

Some authors support the use of safety devices to reduce the number of injuries including retractable scalpels (Jagger *et el*, 1998; Tarantola *et al*, 2006; Watt *et al*, 2008) and blunt suture needles (Wright *et al*, 1993; Hartley *et al*, 1996; Mingoli *et al*, 1996; Rice *et al*, 1996; Tarantola *et al*, 2006). This study did not find any statistically significant relationship between the use of safety devices and sustaining an inoculation injury. This may be due in part to the inconsistent use of safety devices among participants in the study. Only 7/205 (3.2%) respondents admitted to using a safety device during their most recent accident (histogram 4.3.10). However, participants in the survey also believed that the availability of safety devices influenced inoculation injuries suggesting some agreement with the other studies. One hundred and nine out of 177 surgeons (61.6%) and 73/132 (55.3%) scrub nurses strongly agreed/agreed that this was the case (table 4.3.45).

Suturing was the activity in which the majority of staff were engaged at the time of their injury with 101/217 (46.6%) injuries being sustained in this way (histogram 4.3.9). Other studies support this finding (Tokars *et al*, 1992; Smith *et al*, 2006b). This was more common among surgeons, 88/136 (87.1%) surgeons compared to 13/71 (18.3% nurses), see table 4.3.68. This is reinforced by the interview data. All the surgeons interviewed had been injured while suturing but only 2/6 (33.3%) nurses.

The use of blunt needles has been found to significantly reduce the rate of suturing related injuries (Wright *et al*, 1993; Hartley *et al*, 1996; Mingoli *et al*, 1996; Rice *et al*, 1996; Tarantola *et al,* 2006). Although participants in the survey were not questioned directly on the use of blunt needles, only 5/8 (62.5%) of surgeons interviewed used blunt needles routinely for a variety of reasons including lack of suitability for certain operative procedures and lack of confidence in their ability to protect from sharps injuries. One surgeon said:

> "They're no good for skin and they're no good for fascia"
> 2.S.35.

However, Hartley *et al* (1996) successfully utilized blunt needles for fascia closure in abdominal surgery. While respecting the difference between specialities, there may be scope for extending the use of these needles. The interview data implied that there was no problem in accessing blunt needles. More importantly, all interviewed theatre personnel were aware of their presence within the department.

None of the interviewees commonly used retractable scalpels. None of the interviewees with the exception of one scrub nurse and one theatre manager, both of whom were employed in the same NHS trust, were aware of the existence of retractable scalpels within the departments. As only two theatre managers were interviewed, it is impossible to know whether these devices are available throughout Wales or simply within the trust that employed both the scrub nurse and manager. Nevertheless, even within this trust there was a lack of awareness of these devices as five other members of staff employed there were interviewed and none of them knew of the existence of retractable scalpels. Lack of availability of equipment has been highlighted in other studies as a factor contributing to inoculation injury although there should be no reason why this should occur in a wealthy country such as the UK (Chelenyane and Endacott, 2006; Phillips *et al*, 2007), see section 5.4.

Two of the nurses who were interviewed (33.3%) and 1/8 surgeons (12.5%) had been stabbed by a used scalpel. These injuries could have been avoided by using scalpels in which the blade can be retracted after use (Jagger *et el*, 1998; Tarantola *et al*, 2006; Watt *et al*, 2008). Despite these injuries being less common, the potential for infection may be greater than following an injury with a suture needle because the severity of the injury is likely to be greater (Jagger *et al*, 1998). A worrying allegation made by 4/6 (66.7%) interviewed nurses was that their injuries were the result of the actions of another, usually the surgeon:

> "The first one, a surgeon handed me a scalpel and the blade caught my finger and the second one, the surgeon was putting a scalpel back in a kidney dish and he missed and caught my finger as well" 2.N.29.

This has not been fully explored by other authors in relation to nurses. However, it is well documented that careless disposal of sharps has contributed to injury in ancillary staff (English 1992; Gillen *et al*, 2003; HPA, 2005) and is a subject that could be researched further.

Length of time qualified

Several studies have examined the influence of age and length of experience on the likelihood of sustaining an inoculation injury and concluded that inexperience was a significant contributory factor (Ronk and Girard, 1994; Williams *et al*, 1994; Ramsey et al, 1996; Jeffe *et al*, 1998; Akduman *et a*l, 1999; Abu-gad and Al-Turki, 2001; Fisman *et al*, 2007). The HPA bi-annual report suggests that among the medical profession there are indications that the majority of injures were reported by senior house officers (271/790) while senior registrars and consultants reported 231/790 (29%) and 166/790 (21%) respectively (HPA, 2008d). The HPA are unclear as to whether this represents a higher incidence of injuries among the more junior grades or simply a higher rate of reporting. Other studies have also demonstrated that seniority reduces the risk of injury (Brasel *et al*, 2006; Gańczak and Szych, 2007; Makary *et al*, 2007). These findings tentatively imply that the influence of pre-registration programmes delivered pre-1987 may be waning and that increased expertise that often comes with experience positively influences the likelihood of injury.

In this study, statistical analysis of the relationship between sustaining injuries and length of time since qualification/length of time in current speciality failed to demonstrate any statistical significance. Although a logistic regression model did suggest that profession and length of time qualified are predictors of sustaining a sharps injury at one year (model 3), the model prediction was no better than the empty model and therefore must be treated with caution. Consequently, it may be unwise to attempt to draw any inferences from this finding.

Relationship between use of precautions and injury

Although this study did not attempt to explicitly demonstrate a link between use of standard/universal precautions and inoculation injuries, other studies have done so and report that exposures to blood and body fluids would have been reduced by use of appropriate precautions. For example, the physical barrier provided by eye protection can prevent mucocutaneous exposure to blood and body fluid (Bell and Clement, 1991; Wong *et al*, 1991; Lymer *et al,* 1997; Knight and Bodsworth, 1998; Wong *et al,* 1998; Lee *et al*, 1999; Endo *et al*, 2007); face masks are an effective method by which splashes to the mouth and nose can be avoided (UK Health Departments, 1998; Clark *et al*, 2002; Pratt *et al*, 2007; Siegel *et al*, 2007); and double gloving can reduce glove perforation and the volume of inoculum that can penetrate a punctured glove (Matta *et al* 1988; Thomas *et al*, 2001; Malhotra *et al*, 2004; Brasel *et al*, 2007; Lefebrevre *et al*, 2008). This study identified that compliance with these measures for all patients regardless of their bloodborne viral status is sub-optimal (see section 5.5). However, 126/179 (70.4%) surgeons and 56/134 (41.8%) nurses would take extra precautions when caring for a patient with a known or suspected bloodborne viral infection (table 4.3.42). This has been recognised in other studies (Ronk and Girard, 1994; Cutter and Jordan, 2004). Changing behaviour in light of known or suspected infection was also discussed during the interviews where it was identified that where the risk of infection was perceived to be high e.g. when operating on a patient with an infection or those associated with a stereotypical 'high risk' patient such as a homosexual male or intravenous drug user, extra precautions were taken (section 5.5). Once again, this has been identified elsewhere (Willy *et al,* 1990; Gerberding, 1991; Gershon *et al*, 1995; Patterson *et al*, 1998; Kim *et al*, 1999; Leliopoulou *et al*, 1999; Naing *et al*, 2001; Hills and Wilkes, 2003). Paradoxically, only 30/179 (16.8%) surgeons and 4/134 (3%) feel that is acceptable to do so (table 4.3.43). This would suggest that the respondents recognise the limitations in their own behaviour and that safety may be compromised by their actions. This has not been investigated elsewhere. Furthermore, infrequent adoption of some precautions such as double gloving may impact on dexterity and increase the likelihood of injury (section 5.4).

There is some evidence to implicate the passage of sharps as a major cause of injury and 2/6 of the nurses interviewed had been injured by a surgeon handing back a used scalpel. Three nurses also commented that they had sustained injuries in this way in response to the open question on the questionnaire and common sense should suggest that passing sharps through a neutral field would reduce the risk. None of the surgeons reported being injured while passing sharps. These injuries could be reduced by employing a neutral zone while passing sharps instruments (Jagger and Balon, 1997; Folin *et al*, 2000; Stringer *et al*, 2002; EPINet 2004a). This has been recommended as best practice (UK Health Departments, 1998; Folin *et al*, 2000; OSHA, 2001; Stringer *et al*, 2002; Perry and Jagger, 2005; Berguer and Heller, 2004). Studies have demonstrated that few operating theatre personnel (8-69.2%) employ the hands free technique (Cutter and Jordan, 2004; Stringer *et al*, 2006; Phillips *et al*, 2007). This study does not support this conclusion and found that in excess of 80% of respondents pass sharps via a receiver or some other neutral field (section 5.5). Not surprisingly perhaps, using a kidney dish or other receptacle to pass contaminated sharps was frequently initiated by nurses according to 4/8 surgeons (50%) and 3/6 nurses (50%) but sometimes practiced reluctantly by surgeons:

> "I always use a kidney dish but some consultants will try to hand them straight back to you but if you say you'd rather use

a kidney dish and pass it over to them, they will use that"
2.N.29.

According to the HPA (2008d) theatre related injuries were related to the more complex and emergency procedures. Smith *et al* (2006b) concur that working under pressure is a contributory factor. In this study, 208/313 (66.1%) of respondents in the questionnaire survey strongly agreed/agreed that injuries were more likely during an emergency when time is of the essence (table 4.3.16) and on a related subject 241/313 (76.5%) strongly agreed/agreed that injuries were more likely when working under pressure (table 4.3.17). However, the interview data suggested that opinion was divided on this issue. Only 50% (4/8) of surgeons and 50% (3/3) of nurses commented on this. Of these, 3/4 surgeons (75%) and 1/3 nurses (33.3%) felt that working under pressure increased the number of injuries. The remainder felt that pressure had no impact as:

"Your adrenalin levels are higher, your awareness is higher.
It's when you are cruising that you are most at risk" 2.S.35.

It is difficult to draw any conclusion for this apparent dissonance but the impact of stress and stressors on behaviour in relation to inoculation injuries would be an interesting subject for future research.

Surgeons in particular ($\chi 2=43.644$, $P<0.001$) believed inoculation injuries to be an occupational hazard (table 4.3.55). Logistic regression modelling suggested that the belief that inoculation injuries are an occupational hazard is a significant predictor for sustaining a sharps injury at five years (tables 4.4.7-4.4.12).

Table 5.2 displays the level of agreement between this study and previous studies.

Table 5.2: Level of agreement with findings related to factors contributing to percutaneous and mucocutaneous exposure to blood and body fluids

Finding	Studies supporting	Studies in contrast	Comments
The majority of inoculation injuries were sharps injuries	CDC, 2001; CNSSN, 2001; Petrisillo et al, 2001; EPINet, 2004b; HPA, 2008		
Sharps injuries are more common among surgeons than nurses	Benitez *et al*, 1999; CNSSN, 2001; Ng *et al*, 2002	Ippolito *et al*, 1994; Lymer *et al*, 1997; Ling *et al*, 2000; Puro *et al*, 2001; Shiao *et al*, 2002; Alvarado-Ramy *et al*, 2003; Gillen *et al*, 2003; EPINet, 2004a, EPINet 2004b; Sencan *et al*, 2004; Mehta *et al*, 2005	Other studies examining frequency of injuries found that nurses sustain injuries than doctors. Those examining injury rates found a higher incidence among doctors. However, this study found a higher frequency of injuries among medical staff. No attempt was made to calculate rates as no denominator data was available.
Most injuries occurred during use, after use or after use but before disposal	English, 1992; Greene *et al*, 1998; Ling *et al*, 2000; Puro *et al*, 2001; Phipps *et al*, 2002; Gillen *et al*, 2003; Ippolito *et al*, 2003; Trim and Elliott, 2003; Cutter and Jordan, 2004;		

	Rapparini *et al*, 2007		
The use of safety devices did not reduce inoculation injuries		Jagger *et el*, 1998; Tarantola *et al*, 2006; Watt *et al*, 2008 Wright *et al*, 1993; Hartley *et al*, 1996; Mingoli *et al*, 1996; Rice *et al*, 1996; Tarantola *et al*, 2006	No statistically significant relationship between use of safety devices and inoculation injury was found in this study perhaps because the use of safety devices was inconsistent. Where studies have demonstrated a relationship the researchers purposefully sought to identify the effect of safety devices on injury.
Suturing was the activity that causes most inoculation injuries	Hussain *et al*, 1988; Tokars *et al*, 1992; Smith *et al*, 2006b		
Length of time qualified did not influence the likelihood of injury (see comment)		Ronk and Girard, 1994; Williams *et al*, 1994; Ramsey et al, 1996; Jeffe *et al*, 1998; Akduman *et a*l, 1999; Abu-gad and Al-Turki, 2001; Fisman *et al*, 2007 Brasel *et al*, 2006; Gańczak and Szych, 2007; Makary *et al*, 2007	Many studies have shown that inexperience contributes to the likelihood of inoculation injury. However, this study found no statistically significant relationship between length of time qualified and injury. Logistic regression modeling did tentatively predict that those qualified longest were least likely to sustain a sharps injury at five years. However, these results should be treated with caution, see section 4.4.
Inoculation injuries are most likely when working under	Smith *et al* (2006b)		The survey of scrub nurses and surgeons indicated that 66.1% of

pressure			respondents felt that injuries were more likely when working under pressure. However, the interview data suggested that participants were divided on whether this was the case

5.6 REPORTING AND FACTORS INFLUENCING REPORTING OF INOCULATION EXPOSURES

This study found that a substantial number of inoculation injuries go unreported. Among the respondents who had sustained an inoculation injury in the five years preceding the study, 112/204 (54.9%) claimed to report all injuries, 35/204 (17.2%) admitted that they were never reported according to the Trust's reporting procedure. A further 34/204 (16.7%) admitted reporting <50% of their injuries (histogram 4.3.11). This level of reporting is higher than in many other studies for example, Hettiaratchy *et al* (1998) and Knight and Bodsworth (1998) each found that 17% of injuries were reported. Cutter and Jordan (2003) identified that 32.4% (47/145) of surgeons, scrub nurses and midwives reported inoculation injuries while Au *et al* (2008) identified that 33.3% of surgeons reported needlestick injuries to Occupational Health. However, Raghavendran *et al* (2006) found a higher rate of reporting and identified that 65% of HCWs who had sustained a needlestick injury completed an incident form.

Reasons for failure to report were varied: pressure of work (χ^2 =26.063, P<0.001, df=3), reporting mechanism is too cumbersome (χ^2 =50.832, P<0.001, df=3), dissatisfaction with the procedure the last time an injury was reported (χ^2 =18.795, P<0.001, df=3), the patient was low risk (χ^2 =56.533, P<0.001, df=3), the injury was too minor to report (χ^2 =42.242, P<0.001, df=3), and injuries are an occupational hazard (χ^2 =23.992, P<0.001, df=3), see tables 4.3.84 to 4.3.89.

Reporting process

Many of the above factors have been considered by other authors. Pressure of work is closely related to lack of time for reporting and each has been cited as a reason for poor reporting (Haiduven *et al*, 1999; Benitez *et al*, 1999; Shiao *et al*, 1999, Burke and Madan, 1997; Cutter and Jordan, 2003; Au *et al*, 2008). The lack of time is exacerbated by the cumbersome nature of the reporting process and this adversely affected reporting according to those who reported none or <50% of their injuries (49/93, 52.7%). This was emphasised in the interviews with surgeons and scrub nurses:

> "I'm sure it's a long and cumbersome process and I just haven't got time to engage with all the busybodies that get involved" 2.S.22.

Suggestions were made by the interviewees on how to streamline the process with the intimation that should the system be more 'user friendly' reporting would increase. This is supported by other studies (Shiao *et al*, 1999; Debnath, 2000; Holodnick and Barkauskas, 2000; Clough and Collins, 2007; Makary *et al*, 2007). Furthermore, if HCWs were dissatisfied with the procedure when reporting previous inoculation injuries they will be deterred from reporting again. Not only did this study identify this but a previous Welsh study also did so (Cutter and Jordan, 2003). Inappropriate follow up has been described by other authors (Patel *et al*, 2002; Kiertiburanakul *et al*, 2006; van Wijk *et al*, 2006) and it is important that follow up is conducted in a prompt manner and contains the appropriate interventions to minimize the risk of infection and encourage reporting (Gershon *et al*, 2000b; Holodnick and Barkauskas, 2000). Feedback was considered important by several respondents. However, evidence suggests that among 4/8 (50%) surgeons who were interviewed and 2/27 (7.4%) of those who replied to the open question on the questionnaire the perception is that feedback following adverse incidents is poor in Welsh trusts:

> "The main reason for non-reporting - extensive paperwork and never had any feedback when done in past" 3.S.12.

Not only is feedback to the individual concerned important, but feedback to key committees such as the risk management forum, health and safety committee and clinical governance committee within each trust is also important so that the frequency and cause of injuries and subsequent action is reviewed. This type of feedback allows for a clear understanding of the incidents among senior personnel within the organisation and underpins the development of initiatives to reduce exposures and improve reporting (Gershon *et al*, 2000b; Abu-Gard and Al-Turki, 2001; Clough and Collins, 2007). Evidence from the two managers and 3/8 (37.5%) surgeons interviewed suggests that feedback is provided in Welsh trusts despite the converse opinion expressed by others. Whether those interviewees who did not discuss this were aware of the process or not is unknown, but one surgeon did suggest that if these issues were not considered at a high level within the trust, reporting was viewed as pointless. This is supported by Raghavendran *et al* (2006).

Risk perception

Risk perception has been demonstrated as important in relation to the adoption of precautions to minimize the risk of infection (section 5.4). It was also found to influence rates of reporting. Perception that the patient was low risk was likely or very likely to affect reporting in 48/79 (60.7%) of respondents who reported none or fewer than 50% of their injuries. Conversely, those (65/72, 90.2%) who reported all or >50% of their injuries were unlikely or very unlikely to be influenced by this (χ^2 =56.533, P<0.001, df=3), table 4.3.87. The interviews revealed that risk perception may be related to the severity of injury, the low prevalence of bloodborne viral infection in Wales or the demographic profile of the patient, with judgements being made on the risk status of the patient on grounds of sexual orientation and known or suspected intravenous drug use. Cutter and Jordan (2003) also found that these judgements were being used to determine uptake of precautions in deciding whether to report injuries, judgements that should have no place in an environment where standard/universal precautions are promoted.

Studies have shown that perception of risk influences reporting in the same way as it influences uptake of standard/universal precautions (section 5.4). The influence of risk perception on reporting has been identified elsewhere with rates of between 26 and 90.6% where the risk of infection is thought to be low (Mangione *et al*, 1991; Burke and Madan, 1997; Patterson *et al,* 1998; Benitez *et al*, 1999; Cutter and Jordan, 2003; Sohn *et al*, 2004). Unfortunately, studies have shown that healthcare workers often under-estimate the risk of infection following exposure to infected blood (Burke and Madan, 1997; Patterson *et al*, 1998; Duff *et al*, 1999; Raghavendran *et al*, 2006). Furthermore, the information on which they base their judgements on whether patients have a bloodborne infection may be flawed.

The total number of people in England and Wales in 2003 with known HIV or HCV approached 300,000, many of whom may be unaware of their diagnosis (HPA 2008a, HPA 2008b; Welsh Assembly Government, 2009). Not all of these fit into a 'traditional' high risk group (HPA, 2008c), see section 1.3.2, meaning that adopting extra precautions for those assumed to be at high risk of infection while taking fewer for those perceived to be 'low risk' could increase the risk of occupational infection.

Superficial injuries were less likely to be reported than more severe injuries in this study and many were thought too minor to report. Forty four of 83 respondents (53%) who reported none or <50% of injuries were likely or very likely to be influenced by the fact that the injury was minor. However, the extent of injury was not influential in reporting for the 63/73 respondents (86.3%) who reported all or >50% of injuries (χ^2 =42.242, P<0.001, df=3), table 4.3.88. This has not been explored in other studies but may be linked to perception of risk as the interviews revealed that more severe injuries were more likely to be reported.

This was affected by surgeons' specialty with urologists being most likely to feel that perceiving the patient to be 'low risk' would prevent reporting (4/4, 100%, χ^2 15.157, df 4, P=0.004), see table 4.3.94, while general surgeons felt that minor injuries would not be reported (24/24, 100%, χ^2 21.78, df 4, P<0.001), table 4.3 95. However, these results should be interpreted with caution as the number of surgeons within each speciality varied considerably, see chart 4.3.1 and among those who agreed or disagreed that reporting was affected either by the patient being low risk or the severity of the injury, some of the numbers were very low. The influence of surgeons' speciality on reporting was not considered in the studies reviewed.

Injuries are an occupational hazard

One of the most influential factors identified in this study for under-reporting was the belief that inoculation injuries are an occupational hazard. This belief was likely or very likely to influence reporting in 33/71 (46.5%) of respondents who reported none or fewer than 50% of their injuries but unlikely or very unlikely to influence those who reported all or >50% (58/73, 79.4%), (χ^2 =23.992, P<0.001, df=3), table 4.3.89. The interviews confirmed this belief with 6/8 (75%) of surgeons stating that they are simply a consequence of surgery which may be unavoidable (3/8, 37.5% of surgeons).

> "There's nothing you can do about it and accidents happen but
> it's the nature of the job" 2.S.4.

Interestingly, scrub nurses rarely shared this view and none of those interviewed believed this to be the case. Cutter and Jordan (2003) also found that surgeons commonly held this belief and that reporting was adversely affected as a consequence. However, none of the other studies reviewed explored this.

Profession

Although overall, reporting among the respondents in this study was higher than in most previous studies, it was identified that this level of reporting was not distributed equally between surgeons and nurses. It was established in the study that surgeons sustain more inoculation injuries than nurses, perhaps because they are most frequently the user of the sharp objects involved in the accidents (see section 5.5) or perhaps because they are less likely to adopt precautions (section 5.4). It may be reasonable to expect those who sustain more injuries to have a higher reporting rate than those who had fewer injuries. However, this was not the case in this study and this was also found by Trapé-Cardoso and Schenke (2003) though not explored by other authors. Despite sustaining most injuries, surgeons were poorest at reporting ($\chi^2 = 51.317$, $P<0.001$); with only 36.8% of surgeons (49/133) reporting all their injuries compared to 88.7% of nurses (63/71) (see table 4.3.91). This rate of reporting among surgeons was more consistent with the study by Au *et al* (2008) who found that 33.3% of surgeons reported injuries.

There is considerable evidence in the literature confirming the finding that doctors are less likely to report adverse exposures to blood and body fluids than other HCPs. Between 0-85.2% of doctors report inoculation injuries (Burke and Madan, 1997; Lymer *et al*, 1997; Hettiaratchy *et al*, 1998; Patterson *et al*, 1998; Haiduven *et al*, 1999; Benitez *et al*, 1999; Shiao *et al*, 1999; Ng *et al*, 2002; Sohn *et al*, 2002; Alvarado-Ramy *et al*, 2003; Cutter and Jordan, 2003; Tarantola *et al*, 2006; Schmid *et al*, 2007). Even within the medical profession, surgeons are less likely to report injuries than other specialities, 12.6% surgeons reported injuries compared to 28.3% of physicians ($P<0.01$) (Hettiaratchy *et al*, 1998). Within the sample in this study, the influence of surgeons' speciality on reporting was tested and found not to be statistically significant.

Reasons for inter-professional differences are important to identify as they may inform measures to improve reporting but as yet they are unclear and would form the basis of an interesting study. Some of the interviewees expressed some thoughts on why this might be the case and results of personality differences between surgeons and nurses including arrogance and a tendency to take risk among surgeons, an opinion expressed by 5/8 (67.5%) surgeons and 5/6 (83.3%) nurses:

> "I think there is some innate arrogance in anybody who wants to become a surgeon. That's just the type of people we are, I think we all think we're invincible" 2.S.7.

Risk taking behaviour may originate in differences in undergraduate and postgraduate training (5/8 surgeons, 62.5% and 1/6 nurses, 16.7%), personality traits that may attract individuals to each profession (4/8 surgeons, 50% and 4/6 nurses, 66.7%) or differences in social class and background 1/6 (16.7%) nurses.

Guideline compliance

Interestingly, both professions were aware of the tendency for surgeons to report fewer injuries than nurses. All the surgeons and nurses and both managers who participated in the interviews agreed that nurses were more likely to follow protocols, policies or guidelines than surgeons. The interviewees suggested that this was due to nurses being more 'law abiding' and compliant in relation to policies. Although two surgeons (2/8, 25%) felt that possibly surgeons should be more like nurses in this respect, others didn't agree:

> "Nurses follow rules and guidelines to the letter of the law and many surgeons don't because there's not a lot to be gained from doing it to be honest" 2.S.4.

It is possible that this is linked to the same traits that affect risk perception and risk taking behaviour although this was not explored in relation to inoculation injury reporting by the other studies reviewed. It is also possible that this is linked to a fear of reprisals among nurses that is greater than that among surgeons.

Several authors (Mangione *et al*, 1991; Burke and Madan, 1997; Phipps *et al*, 2002; Cutter and Jordan, 2003) have identified that personnel have concerns that admitting to an inoculation injury may lead to reprisals. None of the surgeons interviewed expressed such concerns and did not feel that they were subject to any hierarchical influences from senior staff. However, 3/8 (37.5%) surgeons did feel that nurse managers were more likely to take punitive action against nurses who were seen to be breaking the rules. This was thought to encourage compliance with both standard/universal precautions and reporting. Two of the nurses interviewed felt that this approach on behalf of nursing management was protective:

> "It's a good thing that we've got that hierarchy here or we wouldn't report" 4.N.4.

However, despite not having concerns about sanctions from her superiors, one of the surgeons interviewed felt that there may be an adverse effect on her career because there would be little management support:

> "They'll throw you to the media or the patient or the lawyers or whatever and they'll find some little breach in your procedure" 2.S.22.

Training

Most respondents who had sustained an inoculation injury within the past five years knew the reporting procedure within their own trust (84.5%, 186/220). Although a statistically significant majority of scrub nurses (69/71, 97.2%) compared to surgeons (117/137, 85.4%) were familiar with the mechanism (χ^2 =5.674, P=0.017), table 4.3.90. Therefore, lack of knowledge did not seem to be a significant motivating factor in whether to report. This is supported by other studies where knowledge is also high but reporting low (Burke and Madan, 1997; Cutter and Jordan, 2003; Hills and Wilkes, 2003; Trim *et al*, 2003). This puts into the question the value of training sessions on improving reporting rates.

All six ICNs interviewed revealed that their training sessions included raising awareness of reporting policies. It could be argued that they have successfully achieved this. However, it has been established that attendance at training sessions is poor especially by surgeons; 64.8% of respondents (204/314) never having attended such a session, 61.5% of nurses (83/135) compared to 15.1% of surgeons (27/179) had undertaken some form of training in the prevention and management of inoculation injuries (table 4.3.36). This suggests that personnel gain their information on policy content from other sources. However, the impact of training sessions reaches further than informing HCWs about relevant policies as suggested by the fact that of the respondents who had attended sustained one or more inoculation injury those who had attended training sessions were more likely to report >50% of their injuries (83.4%, 50/60, χ^2 19.890, P = 0.001, df=4) see table 4.3.96. It is possible therefore that training influenced other factors that in turn influenced reporting.

Another explanation could be that those who attended training sessions already had a pro-safety attitude that made them more likely to report and that the influence of training sessions on these individuals was to reinforce the existing safety culture that existed among them.

Length of time qualified

Those who had been qualified the longest were most likely to report inoculation injuries (table 4.3.93) but reasons for this could not be determined in this study. This was only explored in one other study (Au *et al*, 2008) who found that junior surgeons were more likely to report injuries than senior surgeons.

Table 5.3 summarises the level of agreement between this study and previous studies.

Table 5.3: Level of agreement with findings concerning reporting and factors influencing reporting of inoculation exposures

Finding	Studies supporting	Studies in contrast	Comments
Reporting of inoculation injuries is poor	Hettiaratchy *et al* (1998) Knight and Bodsworth (1998) Cutter and Jordan (2003) Au *et al* (2008)	Raghavendran *et al* (2006)	
Pressure of work and lack of time were the most common reasons for failure to report	Haiduven *et al*, 1999; Benitez *et al*, 1999; Shiao *et al*, 1999; Burke and Madan, 1997; Cutter and Jordan, 2003; Au *et al*, 2008		Lack of time and the time consuming nature of the reporting procedure were inter-related.
Time consuming nature of the reporting mechanism deters healthcare professionals from reporting	Shiao *et al*, 1999; Debnath, 2000; Holodnick and Barkauskas, 2000; Clough and Collins, 2007; Makary *et al*, 2007		As above.
Dissatisfaction or inappropriate follow up following previous injuries affected reporting	Patel *et al*, 2002; Cutter and Jordan, 2003; Kiertiburanakul *et al*, 2006; van Wijk *et al*, 2006		
Perception of risk affected reporting	Mangione *et al*, 1991; Burke and Madan, 1997; Patterson *et al*, 1998; Benitez *et al*, 1999; Cutter and Jordan, 2003; Sohn *et al*, 2004		

Injuries were not reported because they were viewed as an occupational hazard	Cutter and Jordan (2003)		This area is under researched
Those sustaining most injuries were less likely to report than those who had fewer injuries	Trapé-Cardoso and Schenke (2003)		This was not explored by other researchers
Surgeons reported fewer of their injuries than nurses	Burke and Madan, 1997; Lymer *et al*, 1997; Hettiaratchy *et al*, 1998; Patterson *et al*, 1998; Haiduven *et al*, 1999; Benitez *et al*, 1999; Shiao *et al*, 1999; Ng *et al*, 2002; Sohn *et al*, 2002; Alvarado-Ramy *et al*, 2003; Cutter and Jordan, 2003; Tarantola *et al*, 2006; Schmid *et al*, 2007		All the studies considered in the literature review agreed that medical staff reported fewer injuries than nurses. Hettiaratchy et al (1998) also found that surgeons were less likely to report than those working in other specialities within medicine.
Failure to report was influenced by fears that reporting an inoculation injury may result in censure or disciplinary action		Mangione *et al*, 1991; Burke and Madan, 1997; Phipps *et al*, 2002; Cutter and Jordan, 2003	Although surgeons were not concerned about disciplinary action, one was concerned that there would be an adverse effect on her career due to lack of management support. 3/8 surgeons also felt that nurses were more likely to be disciplined for injuring themselves.
Reporting was not affected by	Burke and Madan, 1997;		

knowledge of reporting procedure	Cutter and Jordan, 2003; Hills and Wilkes, 2003; Trim *et al*, 2003		
Those who were qualified the longest were most likely to report inoculation injuries		Au *et al* (2008)	Au *et al* (2008) found that junior surgeons were more likely to report injures than senior surgeons.

5.7 THE WIDER CONTEXT

5.7.1 The doctor nurse game

5.7.2 Professional socialisation

5.7.3 Teamwork

5.7.4 The influence of professional dominance

5.7.5 Risk perception

5.7.6 Guideline adherence

The influence of profession dominated the findings in relation to all the variables considered in this study. Both logistic regression models 1 and 3 indicated that profession is a significant predictor in relation to sustaining a sharps injury at one and five years. Bivariate analysis demonstrated that surgeons sustain more inoculation injuries, are less likely to adopt appropriate precautions and report fewer injuries than scrub nurses (see sections 4.3, 5.4 - 5.6). Findings indicate that the way in which surgeons and nurses view the risks associated with their role is quite different and that this risk perception influences how they attempt to minimize the likelihood of exposure or infection. This section considers reasons why these professional differences exist and the role of each profession in the operating theatre.

5.7.1 The 'doctor-nurse' game

The origins of inter-professional differences may be found in a concept known as the 'doctor-nurse game' (Stein, 1967) in which the complex relationship between medical and nursing staff was thought to stem from differences in training. According to Stein, doctors were trained in the knowledge that the fate of the patient rests entirely with them. Consequently, doctors may believe that they are omnipotent and omniscient with an expectation of dominance in the workplace. This may lead to a degree of arrogance. Nurses on the other hand, were trained to demonstrate subservience and to have little autonomy (Stein, 1967). The purpose of the 'game' was for nurses to make recommendations on patient care surreptitiously, influencing medical decisions through subtle means. While both parties understood the rules, nurses had some control over medical decisions and doctors covertly received help and advice from nurses while appearing to make the decisions themselves.

By 1978, Dingwall and McIntosh felt that little had changed despite pressure for greater status and more decision making powers for nurses. However, by 1990, Stein *et al* felt that progress was being made. Developments in nurse education meant that nurses were now university educated, highly trained professionals and were less likely to play the game. Changes in medical and nursing education have made the boundaries less rigid in terms of doctors as "diagnosticians and prescribers of treatment and nurses as obeyers of orders and dispensers of treatment" (Fagin and Garelick, 2004, p278).

There was evidence in this study that nurses indirectly exerted some influence over the actions of surgeons. For example, one surgeon described how she reported an injury because if she had failed to do so, she would be "nagged by sister" 6.S.49.

However, although the surgeons were aware that nurses' compliance with standard/universal precautions and reporting was superior to theirs, they were not influenced by it.

The influence of nurses over doctors' actions was not always covert among participants in this study. Passing sharps through a neutral field was often influenced by nurses although one nurse felt that surgeons would prefer to pass instruments directly from hand to hand. This was done overtly, although the change to passing instruments via a neutral field was achieved with the consent (largely) of both sides with surgeons (3/8, 37.5%) recognising that the nurses were instrumental in instigating this change in practice. Despite the fact that 17 nurses claimed that the use of safety devices was dictated by surgeons in response to the open question of the questionnaire, almost all the surgeons interviewed (6/8, 75%) stated that they would be happy for nurses to make suggestions regarding improvements to safety and to adopt these changes suggesting that although the 'game' was still being played to an degree, a culture of mutual respect is developing with a positive attitude to teamwork being demonstrated by all surgeons and 4/6 (66%) of nurses interviewed.

Public perception of doctors as all-knowing, infallible God-like beings has also altered according to Stein *et al* (1990) and public confidence in doctors has been shaken by events such as the scandal surrounding the retention of children's organs in

Liverpool and excessive deaths following children's' heart surgery in Bristol (Kennedy, 2001; Redfern *et al*, 2001). Therefore, the rules of the game have changed as nurses are no longer necessarily in a subordinate position. However, one surgeon in this study alluded to the fact that nurses in theatre may still be expected to be acquiescent:

> "Nurses don't need to think for themselves as much as doctors and don't need to risk assess. They have a routine, they know what they must do and they do it, but doctors need to react to different circumstances and risk assess" 6.S.49.

Furthermore, in 2000, Snelgrove and Hughes found that medical and nursing staff still held the traditional view of their roles as being dominated by the medical profession, although the boundaries were becoming less distinct. Nancarrow and Borthwick (2005) also claim that doctors still enjoy a position of seniority. This perceived dominance of nurses by doctors may be explained by the way in which personnel are socialised into their respective professions (section 5.7.2).

5.7.2 <u>Professional socialisation</u>

Professional socialisation has been described as "the processes by which individuals come to understand and internalize the attitudes and values inherent in a particular social role and which are distinct from those of society in general" (Lester and Tritter, 2001, p857) and may be a product of their undergraduate and post graduate training and education, social class, status, personality and gender (Dingwall and McIntosh, 1978; Stein *et al*, 1990; du Toit, 1994; Valentine, 1995; Degeling *et al*, 2000; Salvage and Smith, 2000; Vetter, 2000; Lester and Tritter, 2001; Rudland and Mires, 2005; Makary, *et al*, 2006b; Sirota, 2007; Skela Savič and Pagon, 2008; Hur and Kim, 2009) This was recognised some by the participants in this study:

> "Well, I think its personality, training and hierarchy. It's all of those things" 2.S.35.

Training and education

All students entering a healthcare related education programme will have in common the desire to learn and the wish to meet the needs of patients (Headrick *et al*, 1998). However, every student will bring to their chosen programme individual values, motivations and personal qualities which may change during the socialisation process into the values that the profession embraces, and as values change, so does behaviour (du Toit 1994). This process of socialisation is likely to be the result of students' professional training (Bosk, 1979; Lester and Tritter, 2001; Edwards and Marshall, 2003). According to Degeling *et al* (2003) doctors and nurses have distinct profession based sub-cultures that have been derived from their training and common professional experience. Freidson (1970) argued that the doctors are the dominant profession providing health care and that "all the work done by other professions and related to the service of the patient is subject to the order of the physician" (p141). This dominance is justified in terms of expertise and specialisation (Light *et al*, 1985). Within each social group, rules prevail that define the limits of social behaviour of the group members (Becker, 1963). Socialisation of surgeons involves adhering to rules that may not be immediately recognisable to outsiders as being designed to reduce errors. This includes appropriate behaviour that indicates that the doctor is made of the 'right stuff' to become a surgeon and surgical training programmes reflect this (Bosk, 1979). Judgement and technical errors may be ignored during this process but normative errors relating to personal behaviour are afforded more importance (Bosk, 1979). Surgical power is determined by this socialisation process as is the power for doctors to make their own rules and resist rules imposed by those outside their social group which has implications for the implementation of guidelines and protocols (Fox, 1992).

Lester and Tritter (2001) maintain that education and training do not merely inform students on the technical aspects of their role but shape them from a perspective based on a specific identity. However, this re-shaping may not always be for the better. Sinclair (1997) suggests that throughout the course of medical education and training, students move along a continuum from a desire to help people to a desire for the status of a medical student and knowledge. Perspectives may also change with medical students becoming more cynical with time (Lester and Tritter, 2001). First hand clinical experience may take precedence over taught biomedical knowledge (Becker *et al*, 1961) as medicine is characterised by socio-cultural and tacit knowledge which may enable doctors to maintain autonomy and self regulation (Freidson, 1970; Fox, 1992).

Professional socialisation may even be apparent before commencing professional education programmes. Horsburgh *et al* (2006) found that nursing students enter their programmes believing that healthcare is best delivered by teams whereas prospective medical students believe that clinical work is the responsibility of the individual i.e. nursing students are collectivists and medical students are individualists. This has implications for their ability to work effectively in teams once qualified which supports findings that doctors favour what they call the medical ascendancy model of management over a team based model (Kennedy, 2001; Degeling *et al,* 2003).

The perceptions of nurses' characteristics, roles and responsibilities held by doctors and medical students may influence interprofessional relationships (Rudland and Mires, 2005). Laschinger and Weston (1995) found that nursing students were far more aware of the competencies required by medical students than were medical students of the competencies required for nursing students. Wilson (1975) examined doctors' knowledge of the level of competence exhibited by staff nurses on a range of subjects including intravenous fluid rate calculations and collection of specimens. Rarely did she find agreement between actual knowledge and expected knowledge. Within the operating theatre, lack of understanding of the role of colleagues has also been identified (Undre *et al*, 2006; Coe and Gould, 2008). Teamwork and collaboration will not occur until each profession has improved knowledge and understanding of the other (Parsell and Bligh, 1999).

A degree of 'tribalism' also exists within medical and nursing students with medical students interacting with one another and other medical staff more effectively than with nurses while nurses interacted most effectively with other nurses and least effectively with medical students (Nadolski *et al,* 2006), implying that the level of collaboration between medical students and nurses is pre-determined at an early stage in their careers. This has also been noted among qualified HCPs (Deardon, 1985 cited by Beattie 1995; Lester and Tritter, 2001). This 'tribalism' among students may be perpetuated by the enduring 'apprenticeship' nature of medical and nursing training in which medical students are attached to hospital firms or small primary care teams while nurses are attached to wards or community nursing teams. Each group learns about professional practice from seeing others do it, then adopting the behaviour of their role models in addition to lessons learned while in university (Melia, 1987; Lester and Tritter, 2001; Bligh, 2005). For example:

> "It is all dependent on the consultant surgeon. If the consultant surgeon practices safety then the junior staff will practice automatically" 6.S.34.

Furthermore, the desire to fit in with the permanent staff while on clinical placement is strong among students (Melia, 1987) and this may perpetuate 'tribalism'.

One proposed solution to the problem of lack of understanding and improved cooperation is that of shared or interprofessional education at undergraduate level and this approach is favoured by many nurses, medical students and pharmacists particularly in relation to improving team working and collaboration, understanding one another's roles, benefiting patients and improving future working relationships (Weinholtz 1991; Horsburgh, *et al,* 2001; Mitchell *et al*, 2004; Rudland and Mires, 2005; Royal College of Surgeons (RCS), 2007; Royal College of Physicians (RCP), 2008). This is discussed in more detail in section 5.7.3.

The risk with this educational approach however, is that individual professional groups may not feel that they have had sufficient profession specific training (Ponzer *et al*, 2004). Additionally, the size of the teaching groups may adversely affect the learning experience (Mitchell *et al*, 2004). Other difficulties that have been suggested include discrepancies in student numbers from different professional groups, differing assessment requirements, varying programme lengths, planning and resource difficulties (Horsburgh *et al*, 2006).

Social class and status

Social class differences between doctors and nurses may also contribute to professional differences (Makary *et al*, 2006b; Sirota, 2007). Doctors have traditionally been recruited from higher social classes than nurses perhaps leading to an innate feeling of superiority within the medical profession, although the gap in social class is narrowing (Sirota, 2007).

> ..."whereas now the opportunities are open to everyone, you know, from a council estate to whatever" 4.N.5.

Although the status of doctors in society has been shaken by recent scandals in Bristol and Liverpool (Kennedy, 2001; Redfern *et al*, 2001) they are still venerated by many of the public (MORI, 2003). Studies have found that junior medical students perceived that doctors held a higher status in society, considered them to have greater academic ability and to demonstrate more professional competence than nurses (Salvage and Smith, 2000; Lester and Tritter, 2001; Rudland and Mires, 2005) and this is supported by the Office for National Statistics (2000) who have classified doctors higher than nurses according to their skill level and skill competence (positions 2 and 3 respectively on a scale of 1-9 in their Standard Occupational Classification). Status is acquired through the academic requirements and competition for medical school places and is reinforced by the pre-eminence of being a medical student compared to a student studying for another discipline (Lester and Tritter, 2001). Nursing, alongside other traditional female jobs may be perceived as lower in status than male orientated occupations such as medicine, perhaps because they are considered to be a natural extension of women's roles in society (Williams, 1992; Cummings, 1995).

Status is also conferred by the financial rewards received by different professions (Bass, 1977) and with medicine commanding consistently higher salaries than nursing, the lower status of nurses may persist. The salary for qualified nurses between grade 5 and 9 ranges from £20,710 to £95,333 (Royal College of Nursing (RCN), 2009) while a junior doctor is likely to start on a salary of £33,285 and a consultant can earn up to £176,242 (NHS Careers, 2009)

Status is jealously guarded by doctors and may be threatened by developments in nursing that may jeopardize the power of doctors (Allen and Hughes, 2002) and this viewpoint may adversely affect the functioning of teams. Snelgrove and Hughes (2002) found that doctors were most comfortable with teams led by the doctor that did not influence core medical decisions allowing the status of the doctor to remain intact. Although this study related to doctors in a medical setting, analogies can be drawn with surgeons in the operating theatre where nurses could contribute to decision making on issues such as passing sharps through a neutral field but little else. Once again, teamwork training may have some positive impact here but the same caveats apply as are discussed in section 5.7.3.

Personality

A study by Hur and Kim (2009) suggested that doctors exhibit individualism and self-centredness. In a large scale survey of first year medical students, Rudland and Mires (2005) found that medical students believed that while doctors and nurses shared certain characteristics such as being confident, caring, dedicated, non-dithering and good communicators, they perceived doctors as being significantly more arrogant, confident, detached and dedicated than nurses, while nurses were considered more caring than doctors. These characteristics were recognised by some of the participants in this study:

> I think there is some innate arrogance in anybody who wants to become a surgeon. That's just the type of people we are, I think we all think we're invincible" 2.S.7.
>
> "I think there are a lot of nurses who still want to give it their all. I think at the moment nursing is attracting more of that than medicine. It wasn't the case 20 years ago" 2.S.22.

According to Sexton *et al* (2000) senior members of theatre staff may be reluctant to accept advice from more junior members. This was not evident in this study:

> "You have to be able to work with people and get on with them. Everyone needs to know that they can express an opinion without being afraid of being shot down in flames" 6.S.49.

Personality traits tend to be fixed but behaviour can be changed (RCS, 2007). However, if behaviour changes are learned, they may be difficult to sustain long term particularly in times of stress, high workload or fatigue (Salvage and Smith, 2000; Lester and Tritter, 2001; Rudland and Mires, 2005). Should this result in error, it is essential that colleagues remain vigilant to observe behaviour change and a climate whereby team members feel confident to speak up in the event of an error or potential error is essential. However, an environment whereby staff is seen to be in a subordinate position and therefore cannot contribute because of profession, sex or status will not allow this to happen (McDonald *et al*, 2008).

Gender

Gender was not included as a variable in this study due to the possibility of identifying male nurses and female surgeons in minority specialities and so its impact on the findings is unclear. Furthermore, it was not raised by any of the participants, either in the open-ended questions in the questionnaire or during the interviews. However, historically, medical dominance may have been related to male dominance in society (Dingwall and McIntosh, 1978; Stein *et al*, 1990; Makary, *et al*, 2006b; Sirota, 2007) and may influence the ability of nurses to challenge surgeons. Although the number of male nurses and female doctors is increasing, the number of female medical students now often exceeding male students (Vetter, 2000), the traditional image of doctors and nurses remains that of a male doctor and a female nurse. Eventually senior medical/surgical personnel may be predominantly female and it is possible that the effect on the future of the 'doctor-nurse game' may be dramatic although that is by no means certain.

5.7.3 Teamwork

Teamwork is defined in Businessdictionary.com (2009) as "the process of working collaboratively with a group of people, in order to achieve a goal", the goal in the operating theatre presumably being the successful completion of the operation. Arguably, teamwork as described in this study also makes the surgeons' life easier and all the surgeons interviewed valued the contribution of their regular teams of nurses:

> "Sometimes you hardly have to say a word and they've got it ready for you" 6.S.49.

Similarly, scrub nurses also valued this continuity since:

> "You get to know each other quite well and if you've worked with the same surgeons for a long time, you get to know what he wants and it speeds things up" 2.S.29.

Conversely working with unfamiliar teams may cause stress among the workforce, interfere with the progress of the operation, and increase the risk of adverse incidents. This was illustrated by a gynaecologist who said:

> "However, if there's a staffing shortage you know, you'll sometimes get ENT or urology and they'll say I'm not qualified to do that and please don't shout at me..... I wouldn't shout anyway, it's pointless, but um, you know, you don't have the same kind of ... it doesn't kind of follow in the same way, because you're kind of trying to explain to them what specific instrument you want because they're not quite sure what its name is and this sort of thing...... and also if you're running into trouble, it isn't quite the same as a sister who knows what you want, who can predict what you want. It's quite amazing

> how they know this sort of thing and you're in a quite low risk situation if you've got nurses who are well versed with that type of procedure but it's not always possible...." 6.S.51.

Silén-Lipponen *et al* (2005) and Mitchell and Flin (2008) found that nurses also found it difficult working in a strange team and were often frustrated by surgeons who expected nurses to automatically know what equipment they needed.

Both surgeons and scrub nurses also recognised that effective teamwork contributes to safety:

> "Issues such as staffing levels, workloads, team dynamics, skill mix all contribute to increased risk of injuries" 4.N.88.

Although the value of teamwork in increasing compliance with infection control policies and guidelines and consequently reducing the risk of infection has not been studied, the contribution of effective teamwork to safety in the operating theatre and in general has been established (Sasou and Reason, 1999; Linguard *et al*, 2002; Undre *et al*, 2006).

Other studies have found that teamwork is frequently absent in the operating theatres and a culture where nurses experience aggression by surgeons is common (Sexton *et al*, 2000; Coe and Gould, 2008). Undre *et al* (2006) found that while 67% of nurses felt that operating theatre professionals worked as a single team, none of the surgeons and anaesthetists agreed, rather they felt they worked as a collection of individual, highly specialized teams. Nevertheless, they did find that all theatre personnel who participated in their study were satisfied with the quality of teamwork within the department. Admittedly, the concept of teamwork within the operating theatre was not examined closely in this study but there was no implication that the surgeons were unhappy with the team dynamics and no criticisms were leveled at the nurses by the surgeons. However, in response to the open question on the questionnaire and the interviews, it was apparent that nurses were sometimes unhappy that surgeons' actions and the choices they made could compromise safety:

> "I think the surgeons need training in passing sharps safely as well as the nurses – my incident occurred due to a surgeon not securing a used suture needle to the needle holder" 6.N.13.

Interestingly, in a large survey of physicians, nurses and hospital executives, doctors were most likely to score the overall atmosphere of the physician nurse-relationship highly which relates to the findings of this study but rated the significance of the relationship lower than the rest of the participants ($p<0.01$) (Rosenstein 2002). Conversely, Undre *et al* (2006) found that despite not fully understanding their peers' roles within theatre, surgeons, nurses, ODPs and anaesthetists considered the quality of their teamwork to be satisfactory. Coe and Gould (2008) also found a lack of understanding of the roles of team members.

In contrast to the work of Sexton *et al* (2000) and Coe and Gould, (2008) no allegations of aggression were made by the nurses in this study but it is an area that warrants further exploration. However, anecdotal evidence from one of the surgeons interviewed in this study suggests that some nurses may have experienced aggression:

> "...they'll say I'm not qualified to do that and please don't shout at me" 6.S.51.

However, another surgeon from the same trust suggested that there may be aggression exhibited by nursing staff as well:

> "They *(junior medical staff)* wouldn't dare *(not wear a visor)* or the theatre sister would tear a strip off them." 6.S.49.

One nurse interviewed for this study described the informal nature of the teamwork within the operating theatre:

> "Well it has surprised me how you can sit down in the coffee room and have a chat with the consultants you know. It's not like where I worked as a student where there's a line between you and you don't talk to the doctors. It is more sort of... you know teamwork here" 4.N.4.

This was also described by Tanner and Timmons (2000). However, rather than describing the social interaction between surgeons and scrub nurses in a positive way, they felt that the nurses misinterpreted the surgeons' behaviour as indicating changes in the balance of power whereas the authors suggest that surgeons would feel that the relationship between themselves and the nurses still reflects the traditional hierarchical structure. This was illustrated by one of their participants who described how in the theatre she was called by her first name, but when outside the theatre, the surgeon would be unlikely to acknowledge her. The hierarchy was further emphasised when nurses were witnessed walking around surgeons while they simply stood still and deferring to the opinions of the surgeons. According to Businessdictionary.com (2009), in an environment where teamwork prevails, there is cooperation between team members and individual skills are recognised. Constructive feedback occurs even where personal conflict exists between individuals. Makary *et al* (2006b) found that nurses often feel discouraged from speaking up and confronting surgeons about patient care issues suggesting that teamwork within the operating theatre may not exist.

What constitutes teamwork in healthcare is an interesting concept. Teamwork may mean different things to different people and can be based on speciality, profession and locality; may be multidisciplinary or formed around single professions; and may have varying degrees of permanency (Snelgrove and Hughes, 2002). These factors may apply to teams within the operating theatre. For example, there are teams of surgeons from one speciality led by a consultant surgeon; teams of theatre nurses led by a nurse manager; multidisciplinary teams within individual theatres or for specific surgery types, again usually led by a consultant surgeon. This has been noted elsewhere. Kennedy (2001) for example, found that consultants view themselves as team leaders. A survey by Makary *et al* (2006b) identified that doctors and nurses have a different vision of what constitutes team work. Nurses view good teamwork as having their input respected while doctors value nurses who anticipate their needs and follow their instructions.

Sometimes personnel may belong to more than one team at any one time. Nevertheless, there is a common understanding and a shared goal among every member of each of these teams (Undre *et al*, 2006). Movement of nurses between theatres or between surgical teams occurs on a frequent basis meaning that nurses have to be flexible enough to adapt to the different tasks, team structures and team members, perhaps meaning that nurses develop a degree of acquiescence that ensures a smooth transition between teams which may again suggest a level of subservience reinforcing the rules of the 'doctor-nurse game' within the operating theatre. This degree of movement does not happen among the surgeons again reinforcing their dominance.

Research conducted by Morey *et al* (2002) examining teamwork in the emergency department suggested that teamwork can be improved through training and that this can significantly reduce clinical errors (P=0.039). Interprofessional education at both under graduate and post graduate level has been suggested as beneficial in giving different professions a greater understanding of each others' roles and fostering improved teamwork skills (Headrick *et al*, 1998; Horsbrugh *et al*, 2001; Morey *et al*, 2002; Rosenstein, 2002; Undre *et al* 2006; RCS, 2007; RCP, 2008). Teamwork training programmes may be useful in producing efficient, conflict-free teamwork within the operating theatre (Undre *et al*, 2006; RCS, 2007; RCP, 2008). However, this study demonstrated that surgeons are unlikely to perceive training as beneficial in relation to inoculation injuries and therefore their attendance at training sessions is poor (table 4.3.37). Given the fact that the current team structure in theatre was not criticized and was viewed as beneficial by the surgeons in this study, why should they voluntarily participate in any activity that changes the team dynamic and affects the *status quo*?

The contribution of each team member towards safety should be valued, good lines of communication established (Pearce *et al*, 2006). A supportive culture should be fostered within the operating departments to facilitate this. Scrub nurses who may be members of more than one team may need to be particularly flexible in their approach to accommodate the different personalities and surgeons need to recognise that the transition between teams may be difficult:

> "However, if there's a staffing shortage you know, you'll sometimes get ENT or urology and they'll say I'm not qualified to do that and please don't shout at me….." 6.S.51.

The influence of opinion leaders (Seto, 1995; Thompson *et al*, 2000) could be important in achieving strong teamwork that values and promoting safety. These opinion leaders are likely to be found among the surgeons as they are perceived to be team leaders (section 5.7.4) and their power and influence could usefully be harnessed to improve safety (section 2.8.2). Efforts to achieve this however, could be frustrated by surgeons who are reluctant to embrace the philosophy whereby all team members are equal and favour a structure whereby a strict hierarchy exists with surgeons occupying senior positions (Sexton *et al*, 2000) and nurses finding it difficult to challenge their authority from a perceived subordinate position (Makary *et al*, 2006b;

Finn, 2008). Teamwork as it relates to error reduction is also briefly discussed in section

5.7.4 The influence of professional dominance

According to Snelgrove and Hughes (2002), one of the purposes of teamwork is to reduce the influence of medical dominance within healthcare. This may not be understood in the operating theatre. Finn (2008) believes that teamwork reinforces professional inequality rather than reduces it and the assumption of the role of team leader by surgeons was clearly evident within this study. Although all the surgeons interviewed in this study recognised that a consistent team of nurses contributes to the smooth running of operations as they can predict their movements and anticipate the instrument they will require before they are asked, the implication was that the surgeons led the teams:

> "To be a surgeon, you are expected to work long hours and not show any weakness because you are a team leader" 1.S.15.

According to Friedson (1970) doctors exert control over the knowledge base of paramedical occupations. Should this be the case, it may partly explain why surgeons remain in a position of authority over nurses.

The adoption of the position of team leader by the surgeons in theatre is probably borne out of necessity as s/he controls the operation from the first incision to the closure of the wound. As such s/he assumes responsibility for the surgery, and although the role of the nurse as assistant or scrub nurse is vital to the procedure, the nurse cannot take control and assumes a position of subservience despite the symbiotic nature of the professional relationship. According to Finn (2008) efficiency within theatre relies on nurses and operating department practitioners (ODPs) doing as the technical experts i.e. surgeons demand. She argues that surgeons (and anaesthetists) have an interest in maintaining their privileged position and nurses attempting to challenge this from a subordinate position may find it difficult to do so. Unsurprisingly, within such a culture, nurses can only make suggestions on what the surgeon can do to improve safety such as recommending the use of safety devices but their suggestions may be ignored. As such, decisions regarding safety are often not within the gift of the nurse unless they only impact on her/himself e.g. choice of protective clothing or have limited impact on the role of others for example, passing instruments via a neutral field. Tanner and Timmons (2000) also found that the traditional doctor-nurse hierarchy was very much in evidence in the operating theatre.

Interestingly, in a survey of intensive care, theatre and airline staff, consultant surgeons were the profession least likely to favour a flat hierarchy within their teams and preferred an environment in which junior staff do not question the senior staff (55% of surgeons compared to 94% of intensive care and airline cockpit staff) (Sexton *et al*, 2000).

Realistically, can the balance of power ever swing in favour of the scrub nurses in the operating theatre resulting in true equality? The answer to this question may lie in the definition of nursing. Defining nursing is not easy. However, the RCN, (2003) has attempted to do so. They say, "Nursing is the use of clinical judgment in the provision of care to enable people to improve, maintain, or recover health, to cope with health problems, and to achieve the best possible quality of life, whatever their disease or disability, until death" (p3). In addition, the RCN has identified key characteristics that underpin nursing which include a particular mode of intervention concerned with "empowering people, and helping them to achieve, maintain or recover independence" and "involves the identification of nursing needs; therapeutic interventions and personal care; information, education, advice and advocacy; and physical, emotional and spiritual support" (RCN, 2003 p3). It could be argued that it is the uniqueness of this function that creates equality as healthcare professionals who do not perform this function cannot be influential in controlling it.

In the operating theatre however, scrub nurses may not meet this definition and there is a perception among some nurses that that theatre nurses are not 'real' nurses (Timmons and Tanner, 2005). Nursing is more than simply performing a collection of tasks (Clark, 2008). However, according to Taylor and Campbell (2000) the role of the scrub nurse includes correctly scrubbing, instrument preparation, maintaining a sterile environment, assisting the surgeon and performing the instrument and swab count on completion of the operation which suggests that their role is largely task orientated. Mitchell and Flin (2008) argue that their role extends further than this and includes cognitive skills such as anticipation and decision making, and teamwork skills such as communication, while Gillespie *et al* (2009) felt that theatre nurses also addressed patients' psychological, spiritual and cultural needs. However, arguably, as their input into helping the patients regain independence is negligible and provision of physical, emotional and spiritual support is limited to the very short time the patients are conscious within the theatre. The role of the scrub nurse as patient advocate is severely limited by their ability to influence surgeons. Therefore, their role only partially meets the definition of the RCN (2003).

Nurses may now have shed their image of 'handmaiden' to the doctor in favour of that of an expert health professional (Espin and Linguard, 2001) but Timmons and Tanner (2005) argue that this has been exchanged for the role of 'hostess' among theatre nurses where they not only carry out their technical duties but perform a significant amount of emotional labour keeping the surgeons happy. This is also supported by Nestel and Kidd (2006) and Mitchell and Flin (2008) and reinforces the subservient nature of theatre nursing. Furthermore, the role of assistant is now often assumed by specially trained operating department practitioners with no nursing background suggesting that the body of knowledge held by scrub nurses is not unique to nursing. If this is the case, equality may be an unrealistic expectation. However, others would argue that operating department practitioners are merely expert in the technical components and that nurses fulfil a caring and advocacy function in addition to possessing the technical skills (Sigurdsson, 2001; Bull and Fitzgerald, 2006; Gillespie *et al*, 2009).

5.7.5 Risk perception

The number of patients likely to be suffering from a blood-borne viral infection in Wales is likely to be low (section 1.3.8) which has led many of the surgeons to believe the risk of occupational acquisition of infection is minimal resulting in poor compliance with protective and reporting measures (sections 5.4–5.6). This became apparent in this study during the interviews with two surgeons who had worked in South Africa where there is a high incidence of HIV infection among the general population. The surgeons recognised that the risk of infection was high there and therefore adopted considerably more precautions for every case than they currently do while working within the UK. This is supported by previous work (Gerberding *et al*, 1990; Gerberding, 1991; Goldmann, 2002). Where the risk of infection is constantly high, adoption of standard/universal precautions is consistently good as fear of infection promotes compliance. Conversely, where the risk is perceived to be low, compliance is often poor (Willy *et al*, 1990; Gerberding 1991; Gershon *et al*, 1995; Patterson *et al*, 1998; Kim *et al*, 1999; Leliopoulou *et al*, 1999; Naing *et al*, 2001; Hills and Wilkes, 2003; Cutter and Jordan, 2004). This was apparent in this study. Once again, professional differences dominated the findings with surgeons most likely to perceive the risk of infection in Wales to be low leading to poor compliance:

> "The gynae [SIC] patients are low risk. They're usually elderly…" 6.S.49.

> "…if you are operating on a 50 or 60 year old they would have a low risk…" 4.S.19.

Nurses were more likely to be concerned that infection would result from an inoculation injury:

> "It was a terrifying experience. The whole thing of was he positive, was the patient probably HIV or MRSA or CJD, am I likely to get it and probably, is it the window period and am I going to get it later on? I had a blood check and I said 'I've had a needlestick injury and I'd be very keen to know if I'm positive or negative, you know" 4.N.2.

Individual factors influencing risk perception were not explored in this study but have been considered elsewhere (Osborne, 2003; Lymer *et al*, 2004). It was established however, that even when they identified that risks might be present, surgeons are more likely to accept them than nurses, again emphasising professional differences within the sample:

> "We don't know which posh middle aged businessman is using prostitutes" 2.S.22.

> "You need to be a risk taker to cut someone open and remove an organ. Nurses don't need to take these risks" 6.S.51.

This may be related to the opinion that inoculation injuries are an occupational hazard, a view shared by 6/8 (75%) surgeons interviewed in this study, but none of the nurses.

Nevertheless, the risk of infection is unpredictable and cannot be ignored. Healthcare workers have contracted HIV, HBC and HCV from patients (section 1.3.4). This can be reduced by the adoption of standard/universal precautions and following the correct procedure following an inoculation injury (sections 2.3 and 2.7). However, improving compliance with these measures presents a challenge. Traditional improvement measures such as education and training have had limited success in achieving a sustained improvement in practice (Henry *et al*, 1992; Hersey and Martin, 1994; Williams *et al*, 1994; Jagger and Balon, 1995; Roy and Robillard, 1995; Shiao *et al*, 1999; Sohn *et al*, 2004). This is likely to be a particular challenge among the surgeons in this study, many of whom had never attended a training session and had little confidence in their ability to improve compliance and reduce risk (table 4.3.36). According to Willy *et al* (1990) education is of little benefit unless perceptions of risk are altered. Factors affecting perceptions of risk and those influencing compliance need to be identified before they can be changed.

Another consideration here is patients' perception of whether they have been treated fairly should they become aware of different precautions being applied depending on HCPs' judgement of their sexual orientation or lifestyle. Not only could those in these high risk groups perceive that they are being treated less favourably if professionals adopt precautions when operating on them over and above those they adopt for everybody else, but so could those who do not fall into these categories if they perceive that they are being put at extra risk by surgeons and nurses who do not routinely take all the available precautions. Under the Employment Equality (Sexual Orientation) Regulations (2003) and Equalities Act (2006), healthcare professionals who fail to adopt precautions consistently could be assumed to be breaking the law although this has not yet been tested.

5.7.6 Guideline adherence

It was evident in this study that guidelines related to the prevention and management of inoculation injuries were not universally followed. Nurses were consistently more compliant than surgeons (section 5.3). One reason for poor compliance with guidelines, particularly by surgeons is that they may be viewed as affecting healthcare professionals' ability to use professional judgment (Day *et al*, 1998; Manias and Street, 2000; Heritage *et al,* 2002).

Peer or patient pressure may be expected to influence compliance in some circumstances. However, in a theatre environment, patients will not be able to exert pressure where they will frequently be under general anaesthetic. In a team where equality prevails it might be reasonable to expect that best practice will be shared. In some respects, this has happened within the teams included in this study e.g. passing sharps via a neutral field. However in relation to other aspects of safer practice including reporting inoculation injuries and wearing certain protective clothing, nurses perform better than surgeons with little evidence of them being prepared to adopt the same behaviour as nurses. Therefore, it seems that peer pressure has had little impact on surgeons despite surgeons being aware that nurses comply with guidelines more readily than they do themselves (section 4.6) perhaps reflecting the hierarchical nature of their relationship and relative positions within the team. Natsch and van der Meer (2003) have previously identified that patient and peer pressure may have a negative affect on guideline compliance.

Where guidelines are developed externally, such as those issued by bodies such as the UK Health Departments (1998) and introduced with a 'top-down' approach, excluding individual practitioners and current stakeholders from the compilation process, this may reduce personal commitment (Agree Collaboration, 2001; O'Davies & Harrison, 2003). This was illustrated rather colourfully by one of the consultants interviewed during this study. He said:

> "…there's a thing called the clinical forum where protocols and policies get discussed. The clinical forum meets every couple of months and um, before the meeting a variety of policies and protocols and policies are circulated for comment and further discussed in the meetings and then adopted or not. The majority run to 20, 30 and 40 pages. God only knows who authors them. Most of them are written in appalling English. They have structures which are designed for verbosity. They all follow the same thing, the executive summary blah, blah, blah, blah, bullet points until they come out of your ears. Yeah? And they are all comprehensive, terribly comprehensive. You can see that they have ticked all the boxes, you know, equality, ethnicity and all that sort of b******s and completely missing the point in that what you need is a policy that is clear, concise and deliverable" 2.S.35.

Guidelines developed in isolation from practice, may be seen as divorced from the complexities and constraints of clinical reality (Manias & Street, 2000) and may therefore be side-lined or even ignored. They may be viewed as inconvenient and time consuming and ignored as a consequence (Woolf *et al*, 1999).

Guidelines may be perceived as a tool for protecting managers from litigation associated with untoward incidents and reducing insurance premiums, with risk management rather than improved standards being the motivator (Lawton & Parker, 1999). One of the surgeons implied that a blame culture prevails within healthcare and there is little support for those who breach protocols. Consequently, breaches of procedure are not reported:

> "They'll throw you to the media or the patient or the lawyers or whatever and they'll find some little breach in your procedure" 2.S.22.

In this study, surgeons more so than the scrub nurses, failed to adhere to guidelines relating to standard/universal precautions and reporting (sections 5.4 and 5.5) and this was supported by the literature (Burke and Madan, 1997; Lymer *et al*, 1997; Hettiaratchy *et al*, 1998; Patterson *et al*, 1998; Haiduven *et al*, 1999; Benitez *et al*, 1999; Shiao *et al*, 1999; Ng *et al*, 2002; Sohn *et al*, 2002; Alvarado-Ramy *et al*, 2003; Cutter and Jordan, 2003; Stein *et al*, 2003; Trim *et al*, 2003; Cutter and Jordan, 2004; Raghavendran *et al*, 2006; Tarantola *et al*, 2006; Schmid *et al*, 2007). This lack of compliance with guidelines and protocols does not only apply to infection control but has been described in other areas of medicine (Cotton and Sullivan, 1999; Lawton and Parker, 1999; Manias and Street, 2000).

Evidence suggests that doctors place more value on their professional autonomy than guidelines, whereas nurses find policies and protocols useful for decision making and feel that they increase rather than reduce their autonomy (Lawton and Parker, 2000; Manias and Street, 2000; Harrison *et al*, 2002). Not only were doctors likely to view guidelines as unnecessary or even harmful, nurses were keen to embrace written policies and protocols emphasising their role in preventing adverse events (McDonald *et al*, 2005). Differences in role, responsibilities, existing working practice, experience, training, culture and decision making between doctors and nurses could help explain why doctors view guidelines less favourably than nurses (Cotton and Sullivan, 1999; Lawton and Parker, 2000) and may be related once again to the 'doctor-nurse game'. Whereas doctors rely on scientific knowledge and experience from previous medical placements, nurses tend to communicate their knowledge with reference to policies and protocols (Manias and Street, 2000). Again, using a somewhat colourful turn of phrase, one of the surgeons in this study summed up the situation:

> "Well, I think it's personality, training and hierarchy. It's all of those things. Um, most hospital doctors...in hospital, many of the junior doctors are aspiring to be consultants. Not all of them, but many of them and by and large share the same kind of ethos, attitude which is the job is there to be done, let's do it. And it's the job that matters not the protocol. So if the protocol says this and the way to do the job well is that, they'll go and do that and b****r the protocol. Whereas nurses will say there's a protocol, that's the way we've got to do it, it can't be done any other way" 2.S.35.

Doctors expect to be involved in decision-making, and may therefore find the external imposition of protocols incongruous with their professional socialisation (Kendrick, 1995). There was no evidence of surgeons in this study participating in policy or guideline setting and this could contribute in some way to their lack of adherence to standard/universal precautions and reporting procedures.

Nurses are more likely to follow appropriate procedures than surgeons and while there is room for improvement the main focus for improvement needs to be the surgeons. The key to improving compliance may lie in altering their perception of risk (Willy *et al*, 1990; Goldmann, 2002) and changing team dynamics so that the nurses' behaviour exerts a positive influence over the surgeons.

5.8 CHANGING RISK PERCEPTIONS AND ATTITUDES

5.8.1 Behaviour change theory in the operating theatre
5.8.2 The systems approach to error reduction
5.8.3 The person approach to error reduction
5.8.4 Summary

Changing behaviour is undoubtedly complex as it relies on identifying variables affecting behaviour including attitudes, life experiences, beliefs, perceived health threat, self-efficacy, attitude, intention, communication, participation, respect and fairness (Kretzer and Larson 1998; Cooper, 2007; Elliott, 2009a) and incorporating them into interventions that will affect it in a positive way. For many healthcare professionals improving compliance will require significantly changing current behaviour and this can only be achieved by changing attitudes (Wye and McClenahan, 2000). Commonly tried strategies such as education have already been discussed as has their apparent lack of success in improving compliance (sections 2.8.2 and 2.8.3).

Elliott (2009b) argues that a biopsychological approach should be taken towards improving compliance. He describes how taking such an approach to standard precautions increases understanding of the consequences of unsafe practice on the physical, psychological and social well-being of individuals. In the case of personnel sustaining an inoculation injury, this will impact on the well-being of themselves, their patients and even their family and friends. In relation to failure to adopt standard/universal precautions personnel could be considered to be experiencing unrealistic optimism (Ogden, 2007). This theory explains the process whereby people behave in such a way as to put themselves or others at risk because they have a distorted belief of the risks involved by not complying. It may also be described as egocentric behaviour in which their behaviour does not consider others (Ogden, 2007).

Changing behaviour in relation to health has been successfully achieved in several areas including smoking cessation, resolution of eating disorders and alcohol and drug withdrawal. Matarazzo (1984) describes health behaviours as either health impairing or health protective. Health impairing behaviours included adverse behaviour or 'behavioural pathogens' such as smoking while health protective behaviour included positive behaviour or 'behavioural immunogens' such as attending health check ups. Analogous to this in relation to healthcare professionals would be health impairing behaviours such as failure to wear protective eye wear or health protective behaviour such as wearing double gloves. Given the parallels between health behaviour in patients and health behaviour in staff, it is reasonable to suppose that the same strategies for changing health behaviour could be adopted in relation to compliance with standard/universal precautions and reporting injuries and moving personnel away from unrealistic optimism and egocentric behaviour.

Determinants that influence behaviour are susceptible to change. Understanding the motivation behind behaviour is therefore the first step towards initiating change

(Ajzen and Fishbein, 1980; Pittet, 2004). A behavioural sciences approach could be considered to gain an understanding of what motivates personnel to behave as they do in relation to compliance with standard/universal precautions and inoculation injury reporting.

5.8.1 Behaviour change theories and infection control in the operating theatre

Although evidence of the success of this approach in improving infection control practices is limited (O'Boyle *et al*, 2001; Pittet, 2004; Pittet, 2005), some encouraging results have been achieved. A behavioural science approach was taken to reduce the incidence of multi-drug resistant infection in critical care unit (Curry and Cole, 2001) while Jenner *et al* (2002) were able to identify the role of enabling factors and barriers on the intention to perform hand hygiene. Although, this approach has not been used to explore compliance with standard/universal precautions and reporting inoculation injuries in the operating theatre, the intention to adopt one of the components of universal precautions i.e. glove use when in contact with blood and body fluid has been investigated (Godin *et al*, 1998).

Several social cognition and behaviour change models have been proposed to evaluate individual predictors of health behaviour and therefore relate to the aims of this study (Pittet, 2004) and include measures of "the individual's representations of their social world" (Ogden, 2007 p30). These may be used alone or in conjunction with other models. However, not all are good predictors of how HCPs will act to prevent and control infection and have had varying degrees of success identifying motivation to comply with infection prevention and control strategies (Pittet, 2004; Pittet, 2005). However, two have been used successfully either to achieve behaviour change in relation to infection control, the ecological perspective model (Curry and Cole, 2001), or identify factors influencing the intention to comply with an infection control intervention, the theory of planned behaviour (TPB) (Godin, 1998; Jenner *et al*, 2002) and it is possible that they could be utilised to improve compliance with standard/universal precautions and inoculation injury reporting. However, not all studies confirm the benefits of applying these models. O'Boyle *et al* (2001) failed to identify factors influencing the intention to perform hand hygiene as none of the TPB variables predicted compliance.

The ecological perspective model

Ecological perspectives refer to the connection between people and their environment Sallis and Owen (2002). Many current models and theories that can be used to explain HCPs behaviour concern the individual (intrapersonal), interactions between people (interpersonal) and the community (Pittet, 2004; Whitby *et al*, 2007). The ecological perspective model includes two further factors: institutional factors, which include policies and procedures, and public policy including administrative support (McLeroy *et al*, 1988). Following an assessment of these levels of influence on HCPs' behaviour Curry and Cole (2001) successfully intervened by introducing education, policies and programmes at each level to reduce the incidence of Vancomycin resistant *enterococcus* (VRE) in medical and surgical intensive care units at a teaching hospital in Atlanta, Georgia. Other models can be incorporated into the ecological perspective model to enhance specificity and explain the factors included in this model (Sallis and Owen, 2002).

Intrapersonal factors

Intrapersonal factors are individual characteristics that influence behaviour. In this study they would include profession, risk perception and belief that injuries are an occupational hazard (see also sections 5.7.2 and 5.7.5). The Health Belief Model (HBM), first developed by Rosenstock in 1966, seeks to identify factors relating to the success of individual changes and could be used to explain how some of the intrapersonal factors may influence compliance with standard/universal precautions and incident reporting by personalising the risk. According to the model, one's actions depend on perceived health threat (Ogden, 2007) and whether one believes a course of action would be beneficial in reducing the risk (Kanz *et al*, 2002).

Among surgeons in this study, the risk of infection was perceived to be low (section 4.6) and that is likely to have affected compliance with both precautions and reporting. Furthermore, 65.7% (205/315) of them felt that inoculation injuries were an occupational hazard (table 4.3.21). The risk of occupational acquisition of a bloodborne viral infection in Wales may be low (HPA, 2005; 2008d) and as the onset of HIV or hepatitis is likely not to be evident for a considerable time following exposure, it is possible that any infection may not be attributable to any given breakdown in procedure:

> "I try to be that much more careful if they're HIV which is pretty uncommon in this part of the world or hepatitis B or C positive. I try to wear double gloves in those instances. Um, but there aren't many at the moment in this part of the world, thank God" 2.S.4.

Therefore, for surgeons, not only is the risk perceived to be low, the causal link between failing to wear adequate protective clothing and initiating the correct procedure following an inoculation injury may be a theoretical concept only and therefore not positively influence behaviour. Furthermore, surgeons had less faith than nurses in the ability of precautions to reduce the risk of injury:

> "It's *(double gloving)* not very good protection against needlestick injury" 2.S.35.

For nurses, the HBM may be of more use in determining why they act as they do as many exhibited more concern about the risk of bloodborne infection:

> "It was a terrifying experience. The whole thing of was he positive, was the patient probably HIV or MRSA or CJD, am I likely to get it and probably, is it the window period and am I going to get it later on?" 4.N.2,

and demonstrated more faith in the ability of precautions to prevent infection:

> "Universal precautions and training can only help further to reduce injuries. Working in the orthopaedic theatre we always wear masks and eye protection and double glove routinely" 4.N.42.

Intrapersonal factors are also recognised in the Social Cognition Theory (SCT) (Bandura, 1986) which suggests that behaviour is influenced by expectancies, incentives and social cognitions: the expectancy that an inoculation injury will result in a bloodborne viral infection, the incentive that wearing appropriate protective clothing will reduce the risk of injury and infection, the incentive that reporting will result in the appropriate action being taken to prevent sero-conversion and the expectation that the HCP can take appropriate measures to reduce the risk of infection. According to the SCT, behavioural change will be encouraged by a personal sense of control (self efficacy) and a belief in the possible consequences of their actions (outcome expectancies) (Luszczynska and Schwarzer, 2005; Ogden, 2007). Sociostructural factors i.e. impediments and opportunity structures, for example availability of equipment, will also impact on behaviour (Luszczynska and Schwarzer, 2005). Therefore, those who believe that following standard/universal precautions, or the appropriate reporting procedure, will reduce the risk of infection will be more likely to comply. However, any lack of faith in the current measures available to protect HCPs from bloodborne viral infection will influence the intention to follow guidelines, see above.

Interpersonal factors

Interpersonal factors involve groups that provide social identity, support and role definition and include peers, managers and colleagues (Curry and Cole, 2001). In this study they would include the surgical team, nurse managers, and senior medical and nursing personnel. The SCT recognises that people function in the context of their social world and will therefore be vulnerable to influences from others (Ogden, 2007). Consequently, experiential learning is important in clinical practice and HCPs commonly model their own practice on the actions of others through observing peers and superiors (Melia, 1987; Lester and Tritter, 2001; Bligh, 2005). Unfortunately, poor practice as well as good practice may be shared in this way (Lankford *et al*, 2003):

> "...when it comes that some are wearing them *(goggles)* but some are not I think 'do I really need to wear it?" 4.N.2.

Within the operating department there are likely to be individuals who exert a significant amount of social influence over others, i.e. the opinion leaders (Seto, 1995). Engaging the opinion leaders in strategies to improve compliance may be useful. Seto (1995) found that education alone achieved an improvement in infection control standards during catheter care. However, the improvement was significantly better among personnel who had been exposed to education plus the influence of opinion leaders.

Hierarchical influences within each profession may also influence compliance. Nurses in this study were more likely to be influenced by concerns of censure from managers than were the surgeons but whereas this would encourage compliance among nurses; it had no effect on the actions of the surgeons:

> "...nurses tend to be governed by rules written down on paper and guidelines and they follow the letter of the law because the nursing hierarchy is particularly ruthless against nurses who

> deviate from it...The medical hierarchy isn't particularly interested in it" 2.S.4.

Community factors

Community factors are social networks that exist between individuals, groups and organisation and here would include the operating departments and operating teams (Pittet, 2004; Connor and Norman, 2005; Whitby *et al*, 2007). Community level models are frameworks for understanding how these networks function and how communities can collaborate in order to evaluate and solve problems (Curry and Cole, 2001). In this study community factors that influence behaviour would include peer support, team work and feedback following adverse incidents or near misses within the department.

Despite difficulties being identified in the nature of teamwork in the operating theatre, many respondents valued the team structure in which they worked (section 5.7.2).

> "You can't do anything without teamwork....In theatre there are dedicated gynae [SIC] theatre nurses and if they're with you it's great because it runs really smoothly" 6.S.51.

To an extent, varying members of the team responded to each other positively to improve safety e.g. passing of sharps through a neutral field. However, good practice was not always shared with some scrub nurses feeling that they were unable to influence the behaviour of surgeons.

Feedback following incident reporting was often criticised in this study and poor feedback had a negative impact on reporting:

> "If you report a critical incident there's virtually never any feedback and there's no comprehensive analysis of critical incident reports" 2.S.35.

Institutional factors

These include rules, policies and informal structures that promote compliance (Curry and Cole, 2001). National guidelines such as those issued by the CDC (1987), UK Health Departments (1998) and the epic project (Pratt *et al*, 2007) would be included here as well as individual trust policies, education and training provided by the employer to promote compliance. In this study, the influence of these factors varied according to profession with nurses being more prepared to follow guidelines and more likely to attend training and educational sessions than surgeons:

> "There are no excuses for needle stab injuries during any procedure if guidelines are followed" 3.N.11.
>
> "Nurses follow rules and guidelines to the letter of the law and many surgeons don't because there's not a lot to be gained from doing it to be honest" 2.S.4.

Institutional factors would also involve the availability of equipment, which was found to influence compliance in some of the participants:

> "If in stock (safety devices)" 6.N.41.
>
> "There is a problem with our Trust about availability of proper (Kevlar) protective gloves and Stryker exhaust hoods – purely on the grounds of cost" 4.S.37.

<u>Public policy and administrative support</u>

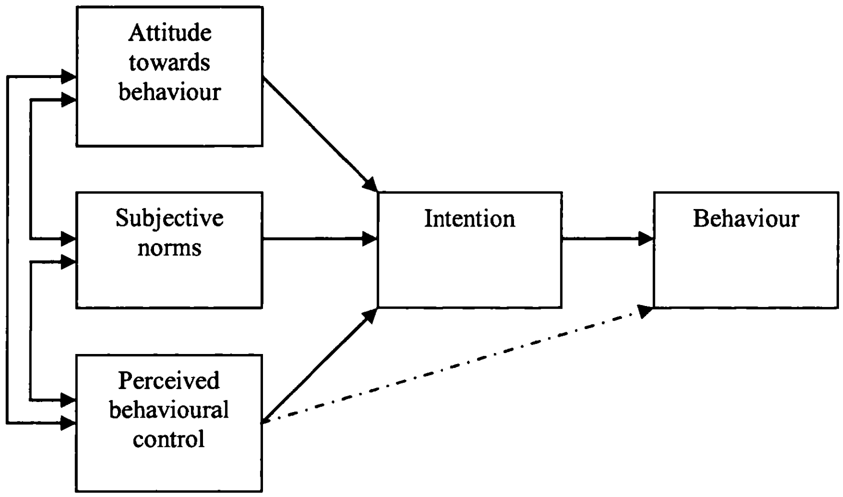
There is a degree of overlap between public policy and institutional factors in relation to this study as it includes local or national policies or guidelines (Curry and Cole, 2001). The importance of feedback following an incident could also be considered under this heading.

It is clear that multilevel approaches are necessary to apply the ecological perspective model successfully. These approaches should be directed towards both the system (section 5.8.2) and the individual (section 5.8.3).

Theory of planned behaviour

The theory of planned behaviour (TBB) (Ajzen, 1985) developed from the theory of reasoned action (TRA) (Ajzen and Fishbein 1980). Both theories are guided by the principle that people think and react in a logical fashion and belief, attitude and intention govern behaviour (Ajzen, 2005). Ajzen (2005) contends that humans usually act in a sensible manner and consider the implications of their actions in relation to available information. According to the TPB, intention is the product of three factors: personal or attitude towards the behaviour, social influence or subjective norm and issues of control i.e. perceived behavioural control. This was represented diagrammatically by Ajzen (2005) as follows:

Figure 1: The theory of planned behaviour (Ajzen, 2005 p118)



The TPB assumes that perceived behavioural control influences intention. Those who believe that they have neither opportunities nor resources to perform a given behaviour are unlikely to hold the intention to do so. Therefore the theory assumes an association between perceived behavioural control and behaviour which is represented by the broken line (Ajzen, 2005).

Godin *et al* (1998) adopted the TPB in order to understand doctors' intention to wear gloves. The model identified that the number of doctors who intended to wear gloves when having contact with blood and body fluids was high (80%). However, the influence of intention was lower than that of a positive attitude to glove use (83%) and a belief that failure to wear gloves would result in infection (38%). The intention to wear gloves was most closely associated with perceived behavioural norms among colleagues (P=0.0001). These findings were thought to be useful in informing education.

Jenner *et al* (2002) successfully utilised an amended form of the TPB to identify psychological constructs predictive of hand hygiene compliance among HCPs in a London teaching hospital. As the TPB does not incorporate obstacles that might hinder compliance, the barriers identified in the HBM (see above) were incorporated into the model. They also incorporated the construct of personal responsibility which was assumed to be a predictor of intention. Ajzen (2005) acknowledges that the incorporation of beliefs in to the TPB enhances the model as people's behavioural intentions result from their beliefs about performing the behaviour.

The modified TPB was successful in predicting the intention for hand hygiene. The researchers found that attitudes, personal responsibility and behaviour were all significantly associated with intention and that barriers were significantly correlated with behavioural control. However, subjective norms and perceived behavioural controls did not influence the intention to wash hands (Jenner *et al*, 2002).

However, O'Boyle *et al* (2001) also attempted to apply the TBM to hand hygiene performance but unlike Jenner *et al* (2002) found that none of the TPB variables predicted compliance with hand hygiene. However, they did find that intensity of activity was a barrier to hand hygiene which confirms the usefulness of incorporating the HBM into the model as did Jenner *et al* (2002).

According to Ajzen (2005) while recognising that intentions often predict behaviour is important, this fact does not provide much information about the reasons for behaviour. Therefore, in relation to this study a model was devised incorporating the components of both the TPB and the HBM similar to that proposed by Ajzen (2005) and Jenner *et a,* (2002) in an attempt to summarise the findings of the study and explain behaviour in relation to compliance with both standard/universal precautions and reporting of inoculation injuries (figure 2) making the model explanatory rather than predictive. The components of the model are described in table 5.4.

Figure 2: Proposed explanatory model (adapted from Ajzen, 2005 p126)

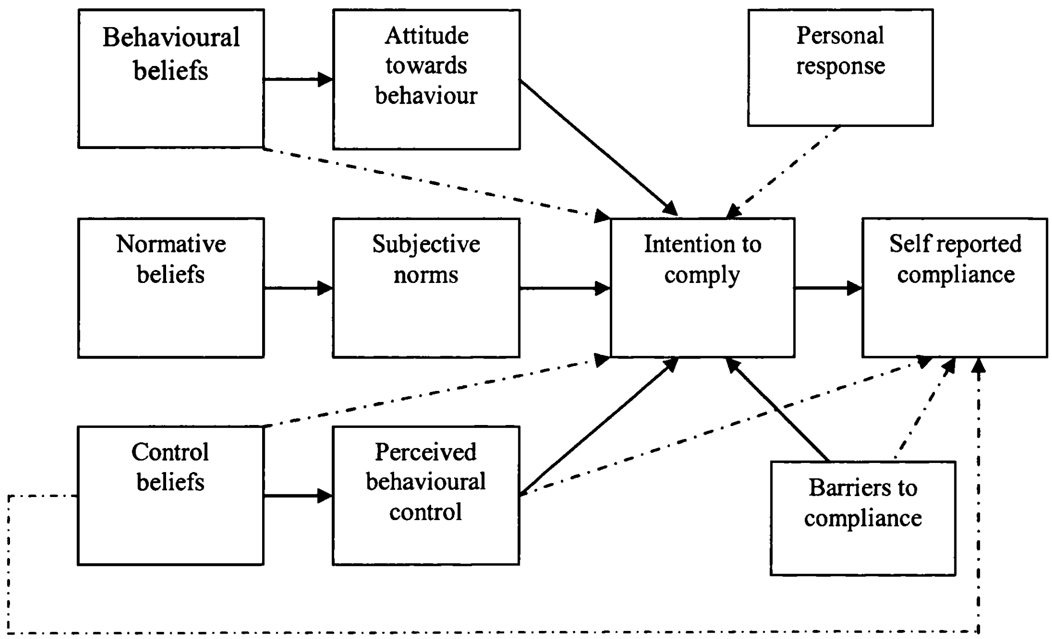


Table 5.4: Components of the adapted TPB model

	Intention to comply with standard/universal precautions	Intention to report inoculation injuries
Behavioural beliefs	Faith in standard/universal precautions to reduce the risk of inoculation injury and subsequent infection	Faith in the reporting procedure and subsequent action to contribute a reduction in the risk of infection and act as an error reduction strategy
Attitude	Feelings regarding standard/universal precautions	Feelings regarding reporting
Normative beliefs	Relates to profession, personality traits, risk perception, belief that inoculation injuries are an occupational hazard. Evaluation of other's expectations – may be related to hierarchy, role modelling and peer pressure	Relates to profession, personality traits, risk perception, belief that inoculation injuries are an occupational hazard. Evaluation of other's expectations – may be related to hierarchy, role modelling and peer pressure
Subjective norms	Social pressure to comply – may be related to professional socialisation, peer pressure, role modelling or hierarchy	Social pressure to comply – may be related to professional socialisation, peer pressure, role modelling or hierarchy
Control beliefs	Beliefs about obstacles and resources including availability of resources, the effect that equipment may have on performance e.g. dexterity	Beliefs about the length of time taken to complete the reporting procedure and follow up injuries according to policy
Perceived behavioural control	Perception of the ease of complying – may be related to availability of equipment, ease of use of equipment, the effect that equipment may have on performance e.g. dexterity	Perception of the ease of complying – may be related to the reporting procedure, satisfaction with follow up by Occupational Health Department
Barriers to compliance	Availability, lack of awareness of safety equipment, effect on personal performance	Length of time taken to report and attend Occupational Health, inability to leave the patient, dissatisfaction with follow up and feedback
Personal response	Risk perception, belief that inoculation injuries are an occupational hazard	Risk perception, belief that inoculation injuries are an occupational hazard

Several of the components were found in the study to be directly associated with either intention to comply or self reported behaviour and these are portrayed by the broken lines. Although this model (figure 2) was not used as a predictive tool as intended by Ajzen (2005) as it incorporates the findings of the study, it is useful in describing the factors that influenced both intention and behaviour among the sample and portrays them in a simple diagrammatic form. This model encompasses both individual and organisational factors and demonstrates the need for interventions to adopt both a systems and persons approach to error reduction (sections 5.8.2 and 5.8.3).

The value of these models does not necessarily lie in their ability to improve compliance *per se*. Rather, the benefit of applying such models lies in their suitability for identifying factors that motivate or inhibit behaviour. Insight into these factors is the first step towards initiating change and once identified, interventions to address both system and individual failings can begin based on a good understanding of the specific changes that need to be addressed (Ajzen and Fishbein, 1980; Pittet, 2004) at both an organisational and individual level, sections 5.8.2 and 5.8.3.

5.8.2 The systems approach to error reduction

Introduction

In relation to this study, inoculation injuries can be considered an error with the potential to cause harm to HCPs and ultimately patients. Traditionally most strategies aimed at reducing such errors by improving compliance with standard/universal precautions have focussed on the individual and apportioned blame for lack of compliance and resulting inoculation injury on the assumption that the errors were somebody's fault; the so-called 'person approach' (Reason, 2000; Dankelman and Grimbergen, 2005).

The person approach implies carelessness, negligence, inattention, poor motivation or incompetence as root causes of errors and consequently, managers may seek to discipline or retrain the 'offenders' which could result in HCPs practicing defensively rather than creatively and hiding rather than reporting mistakes for fear of retribution (DOH, 2000; Keepnews and Heinrich, 2000; Reason, 2000; Keepnews and Mitchell, 2003). This has generated a so-called 'blame and shame' culture within the NHS which may not be conducive to supporting improvements in safety (West, 2006).

Those committing errors are often sent for training to reduce the possibility of further errors (Leape, 1997; Battles, 2006) generating a 'blame and train' culture (Leape, 1997). However, training is unlikely to reduce errors if it does not address all the contributory factors (Battles, 2006) and this was apparent in this study where the logistic regression models failed to demonstrate any association between education and sustaining inoculation injuries (models 1 and 3). Furthermore, many participants in this study often failed to attend training sessions (histogram 4.3.8) and had little confidence in their ability to reduce the incidence of inoculation injuries (section 4.6) despite others, generally nurses valuing the role of education in reducing injuries:

> "Inoculation injuries would be reduced by having more reinforced education and by having safe disposal equipment freely available" (1.N.8).

The failure of the person approach to substantially reduce errors has led to alternative methods of error reduction being developed. One such alternative seeks to find an explanation for errors within the system rather than with individuals based on the assumption that anyone can make a mistake and accepts that while humans are involved in patient care, errors will occur (Leape, 1997; Institute of Medicine 1999; DOH, 2000; Dankelman and Grimbergen, 2005; West, 2006).

According to Reason (2000), there are two factors that contribute to error: active failures which are unsafe acts committed by those in contact with patients or the system and latent conditions which arise from decisions made by designers, builders, policy setters and managers. These latent conditions translate into error provoking conditions which can be considered as the system components. These include organisational structure, fatigue, staff shortages, stress, teamwork and equipment (Keepnews and Heinrich, 2000; Sexton *et al*, 2000; Ottewill, 2003; Dankelman and Grimbergen, 2005; Parker and Lawton, 2006) and have a crucial role in safety and hence the reduction of errors. This was recognised by participants in this study:

> "Issues such as staffing levels, workloads, team dynamics, skill mix all contribute to increased risk of injuries" 4.N.88.

The 'systems approach' seeks to reduce errors by addressing these issues rather than apportioning individual blame and has been used successfully to reduce errors in a range of healthcare situations involving patients including surgery (Cuschieri, 2005; Dankelman and Grimbergen, 2005) and medication prescription and administration (Anderson and Webster, 2001; Dean *et al*, 2002; Bates, 2007). Interestingly, attempts to reduce errors that result in inoculation injuries to HCPs tend to focus on the person approach although there is no reason why the systems approach cannot be applied to personnel safety as well as patient safety.

A major feature of the systems approach is that of taking a non-punitive stance towards those involved in the error (Steiner, 2006) and analysing the system to find the cause of adverse events and building defences into this system to reduce the possibility of future errors (DOH, 2000; Dankelman and Grimbergen, 2005) often using root cause analysis to identify problems within a system as opposed to the individual (Rogers *et al*, 2006; NPSA, 2009c). A root cause analysis toolkit is currently available to investigate other adverse incidents in relation to infection control issues such as bacteraemia and *Clostridium difficile* infection (NPSA, 2006) and there is no reason why it cannot be used to investigate reported inoculation injuries. However, evidence suggests that progress towards a safer systems within the NHS is slow (Hargreaves, 2003; Stryer and Clancy, 2005).

Addressing the systems components

<u>Organisational structure</u>

In Wales there is currently no legal structure by which compliance with infection control guidelines can be monitored and ensured other than the legal duty imposed on employers by the Health and Safety at Work Act (Health and Safety Executive, 1974) and Control of Substances Hazardous to Health (COSHH) Regulations (Health and Safety Executive, 2002b). This is in contrast to England where the Health Act (Office of Public Sector Information, 2006) and Health and Social Care Act (Office of Public Sector Information, 2008) which although do not explicitly refer to the use of standard/universal precautions in the operating theatre, offer some legal support to infection control policies and procedures.

To a large extent, the organisational structure depends on the management hierarchy within each department or profession. This study among others (Degeling *et al*, 2000) demonstrated that nurses are particularly likely to be directly managed and controlled and consequently more likely to be penalised for breach of regulations. The findings of the study suggest that nurses appreciate this approach:

> "It's a good thing that we've got that hierarchy here or we wouldn't report" 4.N.4.

The origin of the nurses' willingness and the surgeons' reluctance to accept such a structure may originate during their professional training (Edwards and Marshall, 2003) or even before admission to the relevant programmes (Horsburgh *et al*, 2006), section 5.7.2, although one of the managers interviewed for this study felt that this was related to the amount of time spent within the operating department by each profession:

> "...because the theatre staff is in the theatre every day as opposed to the medical staff who are not, they are exposed to a more sustained emphasis on the rules and regulations" 3.M.1.

Within the remit of most managers comes the responsibility of undertaking performance reviews. A positive correlation between feedback and compliance has been noted (DeVries *et al*, 1991; McCoy *et al*, 2001; Creedon, 2006; RCS, 2007). Those HCPs not routinely monitored or given positive reinforcement are less compliant than others (Beekmann *et al*, 2001; van Gemert-Pijnen *et al*, 2006) and this may contribute towards why directly managed nurses report better compliance with standard/universal precautions than surgeons. Compliance with precautions should be included in all HCPs' performance reviews.

Fatigue and staff shortages

This study was unable to measure the effects of fatigue on inoculation injury as during the pilot study, participants were unable to recall how long they had been on duty at the time of their accidents and so this question was removed before the actual study. Staff shortages were not considered in this study but are likely to be associated with increased fatigue within the existing workforce. Nevertheless, both are important considerations and need further investigation. Evidence from other studies suggests that fatigue and length of time on duty has a significant impact on error (Fisman *et al*, 2007; Green-McKenzie and Shofer (2007). Adequate staffing levels, regular shift patterns, regular breaks and strict adherence to the European Working Time Directive (Department of Health and Children, 2004) should be ensured to minimise the effects of fatigue.

Stress

Despite the fact that the logistic regression models (models 1 and 3) failed to predict inoculation injuries at either one or five years in relation to stress, the effect of stress on error was measured to an extent in this study in that 66.1% and 78.5% of respondents strongly agreed/agreed that accidents were more likely during an emergency (table 4.3.16) or when working under pressure respectively (table 4.3.17):

> "I can't remember ever stabbing myself in an elective case, it's always unpredictable emergencies and no matter how many training sessions you go to, you'll always have unpredictable emergencies in the middle of the night" 2.S.22.

The belief that inoculation injuries are more likely to occur during emergency procedures was most common among respondents who had suffered at least one splash to the mucous membranes within the past five years (table 4.3.60). Pressure of work was also found to influence reporting among those who reported fewer than 50% of inoculation injuries (table 4.3.84).

While stress itself may not always be the result of organisational failure, the system may contribute to stress where working conditions lead people to make mistakes or fail to prevent them (Institute of Medicine, 1999). Formalisation has been suggested as a way in which safety could be improved. This relies on providing formal guidance to the HCPs to simplify tasks by removing the amount of initiative and individual thought required and reduces the scope for individuals to make their own judgments about what constitutes safe practice (Lawton and Parker, 2000; McDonald *et al*, 2008). This may be particularly useful where stressful circumstances prevail during emergency procedures by allowing attention to be focused on tackling the emergency as opposed to deciding the level of protection required for individual patients (West, 2006). This can be achieved by making protection readily available and accessible and through the production of guidelines such as standard/universal precautions (West, 2006). However, HCPs are divided on the value of guidelines. In this study some, particularly the surgeons, resented the imposition of guidelines on their practice for a variety of reasons while the nurses in general, had a more positive approach towards them (section 5.7.6).

Engaging surgeons and scrub nurses in the development of policies and guidelines may improve compliance by increasing the level of ownership and engagement as currently, some of the interviewees felt a level of detachment from policies whose authorship and purpose was unclear (section 5.7.6). The involvement of those HCPs respected as opinion leaders by their peers may further improve compliance (Seto, 1995; Thompson *et al*, 2000).

Teamwork and safety

The issue of teamwork in the operating theatre was raised during the interviews and it was apparent that teamwork existed and was valued to an extent by both surgeons and scrub nurses. However, inequities within the team did not always foster a culture where safety was valued by all and good practice shared (section 5.7.3). West (2006) recognises that there is a tendency within healthcare for individuals to form relationships with those who are similar to themselves in terms of education, race and gender with doctors forming networks akin to cliques that exclude other professional groups. McPherson *et al* (2001) describe this as the homophily principle while Lester and Tritter (2001) describe 'tribalism' in medicine whereby doctors turn to each other for support rather than those outside the profession. The same principle may also apply to other professions. As long ago as 1985, Dearden (cited by Beattie, 1995) said that there was far too much tribalism within the NHS. If perceived inequalities between team members prevent communication, safety mechanisms will break down (West, 2006). In a recent study by Griffen *et al* (2008), failure to communicate was the largest single cause of error in the operating theatre, accounting for 22% of all complications. This has important ramifications for the concept of teamwork within the NHS and should be addressed to ensure that all disciplines have input into safety (section 5.7.3).

Equipment

Equipment, including suture needles and scalpels, was implicated in many of the accidents reported in the study and attempts to minimise such accidents through use of safety equipment such as blunt needles and retractable scalpels have met with varying degrees of success and not all personnel were aware of the available equipment (section 4.6). In relation to passing sharps safely, operating theatre personnel in Wales commonly passed sharps through a neutral field. However, some scrub nurses were injured by surgeons handing instruments directly from hand to hand (sections 4.5 and 4.6):

> "The first one, a surgeon handed me a scalpel and the blade caught my finger and the second one, the surgeon was putting a

> scalpel back in a kidney dish and he missed and caught my finger as well" 2.N.29.

The extended use of safety devices and safe passage of sharps should be encouraged as standard practice within each operating theatre.

Surgeons and scrub nurses should be involved in the selection process for new safety equipment and this occurs within operating departments in Wales

> "I've never seen a group of people so keen to offer an opinion" 3.M.1.

However, there was concern expressed by some interviewees that their opinions were not always considered:

> "We have had issues with gloves because they keep changing the suppliers so they keep asking us to try something which we may not like" 1.S.15.

Systems approach failure

Under-reporting

A major criticism of the person approach is that fear of retribution leads to those involved failing to report for fear of censure. Proponents of the systems approach feel that seeking to find problems contributing to errors within the system will encourage reporting through providing the incentive of correcting the system errors hence improving safety (DOH, 2000; Keepnews and Heinrich, 2000; Dankelman and Grimbergen, 2005). The success of the systems model relies on reporting near misses as well as errors since hiding errors makes it impossible to learn from them (Anderson and Webster, 2001; Dean, 2002; Mannion, 2009). In order to create a safety culture, data on errors should be collected and analysed and lessons learned from the causes (Dankelman and Grimbergen, 2005). Reporting an error should not be seen as assuming blame (Anderson and Webster, 2001). Once reported and investigated, the findings should be used promptly and visibly to maintain enthusiasm for reporting (Anderson and Webster, 2001). Those involved should be reassured that reporting can bring about positive results as those who feel that reporting serves no purpose will not comply (Raghavendran *et al*, 2006). Reports should be reviewed to find common themes and risk behaviours to enable a clear understanding of the incidents and support the development of reduction strategies (Gershon *et al*, 2000b; Abu-Gard and

Al-Turki, 2001; Clough and Collins, 2007). Unfortunately, in this study, as in others, error (i.e. inoculation injury) reporting was found to be poor at between 17% and 68% (section 1.3.6). Many of the participants in this study perceived that feedback following incidents was poor or non existent. In addition, the mechanism for reporting was viewed as cumbersome and of no benefit (tables 4.3.26, 4.3.27, section 4.6). Consequently, little benefit was seen to be gained from reporting:

> "It is the amount of time involved and the interruption to work (which usually cannot be covered) that usually causes me to ignore the injury" 5.S.17.

Suggestions have been made in the literature (section 2.8.3) about how the system could be addressed to improve reporting and these options should be explored in Welsh operating theatres.

Inadequate investigation of incidents may discourage reporting and in this study surgeons were often unimpressed by the way in which inoculation injuries were managed (table 4.3.86, section 4.6). Unsatisfactory follow up of reported injuries has also been recognised by other authors (Patel *et al*, 2002; Kiertiburanakul *et al*, 2006; van Wijk *et al*, 2006). Therefore, relevant authorities such as the Occupational Health Department and operating theatre managers should assume responsibility for improving the reporting procedures, follow up and feedback to encourage compliance and reporting. Follow up must be appropriate, swift and conducted with consideration (Gershon *et al*, 2000b) to encourage reporting of future accidents.

Anonymous reporting may increase error reporting rates in those who fear some form of blame and censure following an accident (Keepnews and Mitchell, 2003). However, the purpose of inoculation injury reporting is more than to record the incident and determine its cause. Inoculation injuries require relevant first aid, appropriate follow up of both patient and HCP and prophylaxis against HBV and HIV if the risk of infection is to be reduced. Anonymous reporting would not support the correct action following an injury. Nevertheless, anonymous reporting may be useful when near misses or errors occur that have the potential to cause injury.

Surgeons may fail to report errors if they feel that there is limited potential for learning from mistakes either their own or those of others, view lapses in practice inevitable and adverse events as an occupational hazard (McDonald *et al*, 2008) and this was apparent among the surgeons in this study (section 5.7.5) and anonymous reporting is unlikely to affect this. Although not directly a failure within the systems approach, under-reporting may cause the model to break down.

Reported errors only provide partial evidence on the nature and causes of error. The systems approach supports other methods of improving the volume and quantity of data including direct observation, chart review and focus groups (Leape, 1997; Taxis and Barber, 2003) and while not all will be suitable for monitoring inoculation injuries and their contributory factors, direct observation and focus groups could usefully be employed to gather data on behaviour and incidents. Near misses could also be captured in this way through observation and discussion which would reveal flaws in the system that compromise safety. Those identifying such flaws must feel safe in the knowledge that they can report significant issues without fear of retribution from colleagues or managers and a climate should be provided where all personnel feel comfortable in discussing adverse incidents (Brady *et al*, 2008; Mannion, 2009).

Rule and protocol violations

The systems approach focuses on the prevention and investigation of errors. However, not all adverse events are the result of errors and some may be the result of direct violations of rules and protocols (NPSA, 2009c). There is a difference between error and violation in that errors are unintentional whereas violations represent actions that are at least partially intentional (Claridge *et al*, 2006; Parker and Lawton, 2006).

Violations may arise from the attitudes and values of individual HCPs but are encouraged by organisational failures such as poor management, shoddy equipment or inadequate policies (Lawton and Parker, 2006; NPSA, 2009). Violations of standard/universal precautions and reporting policies may reflect risk taking behaviour, a trait demonstrated by many of the surgeons interviewed (section 5.7.5). According to Griffen *et al* (2008) errors are frequently the result of failing to apply knowledge rather than lack of knowledge and this is supported by the fact that knowledge of guidelines and policies was high among the participants in this study (histogram 4.3.7, table 4.3.23), yet compliance was poor. Violations are unlikely therefore, to be influenced by education and reminders to comply, but may rely on persuading the individual that compliance is beneficial (Claridge *et al*, 2006). An organisation that has a recognised safety culture will reduce violations (Gershon *et al*, 2000b; Holodnick and Barkauskas, 2000).

Each registered HCP is accountable for his/her own actions (Institute of Medicine 1999; DOH NHS Appointments Commission, 2004; Munro, 2004; General Medical Council, 2006; NMC, 2008). It is acknowledged that there are sometimes conscious acts that can adversely affect an outcome where personnel deviate from well defined processes and that the person centred approach reinforces accountability (Weiman and Weiman, 2004; Cuschieri, 2005). There is no way that a totally 'no blame' culture can prevail within the NHS (RCS, 2007). Complete adoption of the systems approach could be perceived as absolving individuals of any personal responsibility for their own actions and omissions. Consequently, in addition to exploring aspects of the organisation that may allow violations such as attitudes, morale and safety culture (Reason *et al*, 1998), the reasons behind decisions to wantonly disregard guidelines should be explored and addressed (section 5.8.3).

5.8.3 The person approach to error reduction

All successful models for altering behaviour rely on the subject believing change is necessary, yet most mandatory training programmes are not delivered in such a way as to challenge attitudes and beliefs (Wye and McClenahan, 2000; Cooper, 2007). There is little evidence therefore, that mandatory infection control training achieves behaviour change and improvements in practice (Cooper, 2007). Consequently, other strategies must be adopted.

Health psychologists have developed several models for improving health behaviour, and one of these, the transtheoretical model of behavioural change (Prochaska and DiClemente, 1982) now more commonly called the stages of change model (Ogden, 2007), could usefully be employed to improve compliance with standard/universal precautions and reporting and has also been considered in relation to improving standards of hand hygiene (Cole, 2006) and other infection control practices (Kretzer and Larson, 1998). Models such as the HBM, TPB or SCT (Rosenstock, 1966; Bandura, 1986; Ajzen, 2005) can be used to identify the factors influencing behaviour before attempting the change.

The stages of change model has been used successfully to change health behaviour in relation to smoking, alcohol use, weight loss, exercise and drug use and has also been applied to HIV prevention (Prochaska *et al*, 1994a and 1994b). The model is based on a combination of biological, sociological and psychological factors and comprises five stages: pre-contemplation; contemplation; preparation; action and maintenance.

The model involves consideration of the benefits and costs associated with the change and the belief that the positive benefits of change can be more influential than the satisfaction derived from the behaviour requiring change (Pitts 1991; Ogden, 2007). The success of the model depends on individuals believing they can change and viewing change in the context of what matters to them. It is possible that previous attempts at improving compliance may have failed because practitioners have been coerced into changing their behaviour before they are ready (Cole, 2006). That being the case, this model may be successful in those individuals.

The five stages can be applied to improving compliance with standard/universal precautions or reporting procedures as follows:

- Pre-contemplation – surgeons are happy with current level of precautions and do not intend to change their behaviour. This might include denial that a problem exists. This was apparent in this study where surgeons perceived the risk of bloodborne infection to be low or that the protective measures are ineffective e.g. double gloving.
- Contemplation – surgeons consider change perhaps as a result of sustaining an inoculation injury. At this stage they are aware a problem exists and begin to consider change but are not yet ready to do so. An example of this in this study might be the surgeon (1.S.15) who planned to double glove more often after being alerted to the fact that wearing double gloves only for high risk patients may increase his risk of injury because being unused to the change in dexterity that double gloving causes may result in clumsiness.
- Preparation – surgeons review current protection options or injury reporting procedures within the department with the intention of changing behaviour in the future. Small behaviour changes may be evident such as increasing the

level of protection for high risk patients but no major consistent change is yet apparent.

- Action – increased compliance with precautions or reporting.
- Maintenance – increased compliance sustained. However, this is the most difficult stage and individuals in this stage may relapse to former unsafe behaviour. Support from managers and fellow team members is required to maintain compliance.

The model provides a framework for understanding the process of how individuals change behaviour. Not only does it recognise the importance of self efficacy but also the significance of others and the environment. If it is to be successful in improving compliance with standard/universal precautions and reporting, those working through the change must be aware of the influence of colleagues. It may be more difficult for junior members of staff to affect the change than their more senior colleagues as the desire or pressure to follow the lead of one's superiors is strong (Lankford *et al*, 2003). Opinion leaders within the department may be useful in influencing other theatre personnel (Seto *et al*, 1991; Cooper, 2004) and the ICNs or others involved in planning and delivery of infection control education programmes would be well advised to identify key individuals and engage their assistance. Utilising opinion leaders from within the ranks of the surgeons may be more successful than from within the Infection Control Team as those viewed as 'outsiders' are likely to have less influence over change (Cooper, 2004).

A concept described as social marketing that appeals to healthcare workers' self interest may be useful in improving compliance and encouraging personnel to work through the stages in the model of behaviour change (Mah *et al*, 2006) as messages are often more successful when discussed in relation to gains rather than losses. This technique has been used successfully to improve hand hygiene (Naikoba and Hayward, 2001; NPSA, 2009b) and may be employed by Infection Control Teams to promote the benefits of complying with standard/universal precautions and reporting procedures.

Management support is required to ensure that the required safety equipment is in plentiful supply and that polices and procedures are in place to support the change. A supportive environment and a positive safety culture must be present within the department and the strong hierarchy within the operating department must be used constructively to assert a positive influence over those going through the change process. Positive reinforcement must be used when practice is changed to reinforce and sustain the improvement (Cooper, 2007). Managers, opinion leaders and fellow team members should participate in this. To an extent, its success will be determined by the level to which surgeons are influenced by team members and depends on the dynamics within individual operating teams.

5.8.4 Summary

There is an obligation on NHS managers to promote a suitable safety culture within the operating department to enhance safety. Areas where change is needed should be addressed including improving feedback, streamlining inoculation injury reporting procedures and fostering an environment where all personnel know the procedures and their roles and responsibilities in relation to these procedures. This obligation extends to all personnel within the department. The findings of this study suggest that in some personnel, this commitment is absent particularly in relation to attitudes towards following guidelines, reporting injuries and team dynamics.

Although a systems management approach has been used successfully to reduce and identify the cause of errors, it is not a complete substitute for individual accountability and sound performance and a deeper understanding of the factors that influence behaviour is needed (Griffen *et al*, 2008), section 5.8.1, not least because although some elements of the systems approach can be achieved with minimal change or compromise on behalf of surgeons and scrub nurses e.g. provision of safety equipment, improved follow up and feedback after inoculation injury and provision of adequate numbers of staff, many of the components rely on personnel wanting to change and believing change is possible for example, adapting to changes in the team dynamics and participating in policy and guideline development and a multifaceted approach to change is clearly required. The adoption of a model such as the stages of change model appears to be a useful way of improving safety one can only speculate on its likelihood of success as its effectiveness has not been tested in relation to compliance with standard/universal precautions and reporting.

5.9 CONCLUSIONS TO CHAPTER FIVE

Although compliance with some aspects of standard/universal precautions and reporting has improved since similar studies have been undertaken (Cutter and Jordan, 2003, 2004) and has been reported as higher than in some of the studies included in the literature review in relation to certain aspects such as reporting and passing sharps via a neutral zone (Hettiaratchy *et al* 1998; Knight and Bodsworth, 1998; Stringer *et al*, 2002; Cutter and Jordan, 2004; Phillips *et al*, 2007, Au *et al* 2008) overall, the findings demonstrated lack of compliance with standard/universal precautions and inoculation injury reporting. Comparing the findings with those of other studies indicates there is broad agreement between these findings and those of other authors, although the degree of non-compliance varies.

The role of profession dominated the findings in relation to all the variables considered in this study. Surgeons suffered most inoculation injuries, were less likely than scrub nurses to adopt precautionary measures and were more reluctant than the nurses to report inoculation injuries. Hence, it is clear that these professional differences must be addressed in any intervention planned to improve compliance.

The comments of respondents in response to the open question on the questionnaire and the interview data were particularly useful in emphasising why various protective measures were or were not adopted, and why not all exposures to blood and body fluids were reported. These will be considered when planning interventions aimed at improving compliance.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 The study

6.2 Summary of findings

6.3 Improving compliance

6.4 Implications for clinical practice

6.5 Implications for the Infection Control Team

6.6 Implications for the trusts

6.7 Further research

6.8 New knowledge

6.9 Conclusion

6.1 THE STUDY

A mixed methods study was undertaken to establish the factors affecting sustaining and reporting percutaneous and mucocutaneous exposure to blood and body fluids among personnel performing exposure prone procedures in the operating theatre. Data were collected via an exploratory, cross-sectional survey and a series of qualitative interviews with surgeons and scrub nurses from six participating NHS trusts in Wales. All surgeons and scrub nurses were invited to participate, 180 and 135 respectively did so.

A postal questionnaire survey of surgeons and scrub nurses was undertaken, response rate 51.47% (n=315). A purposive sample of 16 respondents participated in a series of semi-structured interviews. In addition, the Senior Infection Control Nurse from each trust participated in a telephone interview to provide data on the current provision, content and attendance at training sessions on the prevention and management of inoculation injuries, the provision of policies and the number of injuries reported during one calendar year.

Bivariate analyses were employed to explore relationships between key variables. Logistic regression modelling was used to identify factors affecting the likelihood of sharps injuries.

The value of a mixed methods study was:

- Large numbers of participants from a large geographical area could be approached in the postal questionnaire survey. A response rate of 51.47% (n=315) increased the generalisability of the findings;
- The interviews provided depth and richness that could not be captured in a survey which significantly added to the quality of the data;
- The high level of concordance between the findings of the survey and interview data increased confidence regarding both validity and credibility;
- The telephone survey of ICNs corroborated the findings in relation to attendance at training sessions and confirmed the differences in attendance between surgeons and scrub nurses.

6.2 SUMMARY OF FINDINGS

It was established that compliance with standard/universal precautions and policies on reporting inoculation injuries was poor among participants in this study (sections 4.3, 5.4 and 5.6). Inoculation injures were common, with a total of 219/315 (69.5%) of respondents having sustained at least one inoculation injury within the last five years. Most common were sharps injuries with 193/315 (61.3%) reporting such injuries within five years (table 4.3.13); 23.5% (74/315) had sustained a splash of body fluid to the mucous membranes within the previous five years (table 4.3.14). Blood splashes to broken skin were reported least often, 18/315 (5.7%) within the past five years (table 4.3.15). One hundred and thirty-three (133/217, 61.3%) injuries occurred during the use of a sharp item with the most common cause of injury being suturing (101/217, 46.6%). However, not all injuries were reported, with only 112/204 (54.9%) respondents reporting all injuries, 35/204 (17.2%) admitting that they never report injuries and a further 34/204 (16.7%) reporting less than 50% of their injuries (histogram 4.3.11).

Only 10.3% (31/302) of respondents to the questionnaire survey adopted a full range of precautions comprising double gloving, eye protection and avoiding the passage of sharps by hand for every patient (table 4.3.12). More likely than compliance with all three elements was compliance with individual precautions. The most common protective measure adopted was the use of eye protection (86/216, 39.8%) while the least common was use of safety devices (7/205, 3.2%), see histogram 4.3.10.

The influence of profession dominated the findings in relation to each variable considered. Logistic regression modelling indicated that profession is a significant predictor in relation to sustaining a sharps injury. Bivariate analysis demonstrated that surgeons sustain more inoculation injuries, are less likely to adopt appropriate precautions and report fewer injuries than scrub nurses (section 4.3). Surgeons and nurses in this study view the risks associated with their role differently (section 4.5). This has also been noted elsewhere (Burke and Madan, 1997; Lymer *et al*, 1997; Hettiaratchy *et al*, 1998; Patterson *et al*, 1998; Haiduven *et al*, 1999; Benitez *et al*, 1999; Shiao *et al*, 1999; Ng *et al*, 2002; Sohn *et al*, 2002; Alvarado-Ramy *et al*, 2003; Cutter and Jordan, 2003; Stein *et al*, 2003; Trim *et al*, 2003; Cutter and Jordan, 2004; Raghavendran *et al*, 2006; Tarantola *et al*, 2006; Schmid *et al*, 2007), see sections 5.5 to 5.7.

Various strategies have been proposed to improve compliance (section 2.8) and many authors have recorded improved compliance following training and education sessions (Burke and Madan, 1997; Heapy *et al*, 1998; Haiduven *et al*, 1999; Shiao *et al*, 1999; Holodnick and Barkauskas, 2000; Ling *et al*, 2000; Kim *et al*, 2001; Shiao *et al*, 2001; Trim *et al*, 2001; Huang *et al*, 2002; Creedon, 2006) although others have had less success for a variety of reasons (Henry *et al*, 1992; Hersey and Martin, 1994; Williams *et al*, 1994; Jagger and Balon, 1995; Roy and Robillard, 1995; Gould and Chamberlain, 1997; Shiao *et al*, 1999; Sohn *et al*, 2004), see sections 2.8.2 and 2.8.3. Furthermore, according to Willy *et al* (1990) and Goldmann (2002) education alone will not improve compliance. Perception of risk must also be altered and reasons why staff is reluctant to change must be identified in order to change attitudes (Willy *et al*, 1990; Seto, 1995). This study has demonstrated that surgeons were reluctant to attend training and education sessions on the prevention and management of inoculation injuries (section 5.4). Therefore, training as it is currently delivered within Welsh trusts is unlikely to achieve an improvement in compliance.

Several studies have demonstrated that healthcare professionals who have been qualified longest are the least likely to comply with precautions and correct reporting procedures (Ronk and Girard, 1994; Williams *et al*, 1994; Ramsey *et al*, 1996; Jeffe *et al*, 1998; Akduman *et al,* 1999; Osborne, 2003; Raghavendron *et al*, 2006; Singh *et al*, 2006; Chan *et al*, 2008) suggesting that pre-registration or undergraduate education has a positive impact on compliance. These findings were not supported in this study and no statistical significance could be demonstrated in relation to time qualified and compliance with standard/universal precautions (table A16.67). Those qualified the longest were most likely to report inoculation injuries (table 4.3.94). Whatever the influence of pre-registration and undergraduate education on compliance it has been recognised that a poor example set by more senior personnel may have a detrimental effect on compliance with hand hygiene among more junior staff (Lankford *et al*, 2007) and there is no reason to suppose that this may not also occur in relation to compliance with standard/universal precautions and reporting. This suggests that although pre-registration and undergraduate syllabuses should continue to teach the importance of standard/universal precautions, the greatest need for change is among qualified staff.

The time-consuming nature of the reporting mechanisms and dissatisfaction with the follow up procedures were cited by respondents in this study as reasons for not reporting injuries (tables 4.3.85 and 4.3.86, section 4.6) and this was also found in other studies (Patel *et al*, 2002; Cutter and Jordan, 2003; van Wijk *et al*, 2006; Kiertiburanakul *et al*, 2006; Au *et al*, 2008) and this needs to be addressed by streamlining the procedure and identifying more convenient methods of ensuring the correct first aid and follow up takes place (Mangione *et al*, 1991; Ramsey and Glenn, 1997; Shiao *et al*, 1999; Debnath, 2000; Holodnick and Barkauskas , 2000; Clough and Collins, 2007; Makary *et al*, 2007; Patel *et al*, 2007).

6.3 IMPROVING COMPLIANCE

It is clear from this discussion that a sensible approach to improving compliance should be multifaceted and:

- While not ignoring the needs of nurses, primarily focus on surgeons;
- Adopt a strategy that involves changing risk perception and attitudes to the adoption of precautions and reporting procedures;
- Consider changing the dynamics of teamwork within operating theatres;

- Streamline reporting procedures;
- Foster a climate that values and promotes safety.

Changing behaviour is complex for a variety of reasons (see section 5.8) and these reasons must be considered when planning strategies aimed at improving compliance. For many healthcare professionals improving compliance will require changing current behaviour. Varying levels of success have been achieved through education and training (sections 2.8.2 and 2.8.3) in its current form. Therefore, other strategies must be adopted.

Health behaviour has been successfully modified in several areas including smoking cessation, resolution of eating disorders and alcohol and drug withdrawal. Health psychologists have developed several models for explaining and improving health behaviour. Two models that have been used to explain behaviour in relation to infection control are the ecological perspective model and theory of planned behaviour and could be adapted to explain the constructs examined in this study. Understanding what motivates HCPs to act as they do may inform strategies to modify behaviour and improve compliance at both an organisational and individual level.

Although education and training as is currently delivered by the ICNs in Wales has had limited success in improving compliance it is repeatedly held up as the preferred method of addressing compliance issues (sections 2.8.2 and 2.8.3). A more creative approach to education may be possible based on behaviour change models. These could have more success. For example, following an assessment of why HCPs fail to comply, consideration should be given to incorporating a behaviour change model such as the transtheoretical (stages of change) model of behavioural change (Prochaska and DiClemente, 1982), into current education provision sections 5.8.3 and 6.3.

Faults in the organisational structure or system should be assessed and attempts made to foster a climate that values safety and promotes good practice and that while not absolving practitioners of the need to accept accountability, does not seek to apportion individual blame where systems errors may compromise safety. Teamwork should encouraged and support given to all personnel to work effectively within a team structure that values the contribution of all its members and support mechanisms should be in place to facilitate this (section 5.7.3). Influential HCPs (opinion leaders) should be encouraged to participate in strategies aimed at improving compliance.

6.4 IMPLICATIONS FOR CLINICAL PRACTICE

The findings demonstrated that compliance with standard/universal precautions and inoculation injury reporting is unsatisfactory and must be improved to safeguard both patients and HCWs and this has been discussed in detail (chapter 5). To continue with current practice is to perpetuate the risks. In particular, surgeons must be prepared to re-evaluate their practice. To address this, all HCPs, should receive regular updates on the risks associated with contact with blood and body fluids and information on preventing and reducing exposure, as part of their continuing professional development. Furthermore, education and training sessions should be reviewed to make them relevant and more effective at identifying the need for change and strategies for change itself. HCPs must be aware of what influences their behaviour and they must be prepared to alter their behaviour where necessary (see sections 5.8.3 and 6.3).

HCPs practice in increasingly litigious times, therefore, aside from the health risks to themselves and their patients, unsafe practice could result in disciplinary action or even legal action.

6.5 IMPLICATIONS FOR THE INFECTION CONTROL TEAM

Some reasons for failure to comply with standard/universal precautions have been identified in this study most significantly, the role of profession. These can now form the basis of a strategy that can be accurately directed at the appropriate personnel with the aim of heightening awareness of the risks of non-compliance and improving safety. It is evident from the findings that previous education and training has been unsuccessful in ensuring that appropriate safety measures are observed for all patients, particularly by surgeons. Having identified this, efforts must now be made to provide education that not only presents the facts in relation to risk of infection and how to reduce it, but addresses perceptions of risk and the reasons for non-compliance (sections 5.8.1, 5.8.3, 6.3). Kretzer and Larson (1998) suggest that "active involvement of organizational leaders" (p252) during theoretically based interventions can improve infection control practices. Therefore, enlisting co-operation from among the ranks of the surgeons and scrub nurses to participate in education and lead by example might be a useful technique in improving compliance and reporting, particularly if senior members of staff is prepared to participate to ensure that long term behaviour change occurs.

The extent of under-reporting and non-compliance must be brought to the attention of the Executive Directors of the Trustsso that adequate resources to improve safety can be provided. In conjunction with the Health and Safety and Risk Management Departments, the Infection Control Team should evaluate the current mechanism for reporting exposures to blood and body fluids to make it more acceptable to surgeons in particular but also to scrub nurses.

The relevant practitioners should continue to participate in product trials of safety devices and protective clothing with a view to replacing those currently in use where superior products are identified. This would ensure that any new products introduced into the operating departments are acceptable to practitioners thereby encouraging their use. Introduction of new equipment must be backed up with education and support to ensure acceptance by practitioners, and the Infection Control Team can arrange or participate in this.

Regular review of infection control policies and procedures is necessary to ensure that they reflect current thinking and remain research based. Inclusion of influential surgeons and scrub nurses, opinion leaders as described by Seto (1995) in the development process may contribute to improved compliance.

Regular audits of knowledge of policies and utilisation of protective clothing will allow changes in levels of compliance and the effectiveness of the above strategies to be monitored. Review of untoward incident reports will ensure that trends of occupational exposures to blood and body fluids are recorded. Any change in the type and frequency of inoculation injuries can then be considered in relation to any change in compliance with standard/universal precautions. Feedback to all affected personnel would be welcomed by the participants in this study.

6.6 IMPLICATIONS FOR THE TRUSTS

Current rates of inoculation injury reporting do not accurately reflect the number of exposures to body fluids that occur. It is possible, therefore, that the Executive Directors of the trusts are unaware of the extent of such exposures and the investment, in terms of education and finance, required to improve safety.

The role of the trusts in providing safe systems of work, and the need to improve rates of reporting and provide safety equipment that is both accessible and acceptable to surgeons and scrub nurses has now been identified and must be addressed. This can be achieved by:

- Provision of adequate resources to replace 'unsafe' equipment and protective clothing where safer alternatives exist.
- Where safer alternatives to current equipment are available, clinical preference trials should be conducted by surgeons and nurses to gauge the level acceptance prior to purchase. This is particularly important when more than one manufacturer produces a piece of equipment. Opinions should be invited from the potential users on which products are most acceptable.
- Provision of protected teaching time for all relevant personnel to attend education sessions.
- Accreditation of infection control teaching sessions so that personnel can accrue points towards their continuing professional education in order to encourage attendance. However, the structure of the sessions should be modified to make them relevant and more effective at improving compliance (sections 6.3 and 5.8.3).
- Giving consideration to strengthening trust policies to make the use of appropriate precautions such as double gloving or eye protection mandatory backed up by appropriate disciplinary action for failure to comply.
- A commitment on behalf of managers to enforce policies.
- Regular audit to monitor levels of compliance with standard/universal precautions. Audit could be utilised to monitor the acceptability of change. For

example, should double gloving be made compulsory, audits could be used to identify whether the number of reported sharps injuries declined or increased, loss of dexterity persisted or personnel became acclimatised to the change in tactile sensation that has been reported.

- Simplification of the inoculation injury reporting procedure to encourage reporting of all percutaneous and mucocutaneous exposures to blood and body fluids. Reporting an injury should not attract blame so as to encourage HCPs to report. Reports of injuries and near misses should be analysed to identify the causes of accidents.
- Providing comprehensive feedback following inoculation injuries firstly to the person sustaining the injury but equally importantly, to all relevant personnel so that lessons can be learnt from each incident. Feedback should include details on the number and type of incidents occurring within the department, activities underway at the time of injury, factors contributing to the injury, action taken following the injury and measures that could reduce the risk of future similar injuries.
- Engendering a climate within the operating theatre that values safety and supports personnel in efforts to improve current standards and adopts as far as is possible a no blame culture to encourage reporting so that lessons can be learned from errors and near misses.
- Including infection control as a standing item on the agendas of all relevant Trust wide committees for example Risk Management, Clinical Governance and Clinical Forum and other professional meetings to keep it prominent in the minds of all senior staff.
- Engaging the cooperation of opinion leaders within each speciality to share and encourage good practice.

Although many of the above suggestions have financial implications, current practices compromise safety for patients and staff. It is vital that the trusts demonstrate to employees that they place great emphasis on safe practice, and that any action or omission that compromises safety will not be tolerated.

6.7 FURTHER RESEARCH

This study should be followed by post-doctoral research projects to further explore issues identified in this study:

- A prospective cohort study to investigate the relationship between sustaining an inoculation injury and pressure of work and the number, type and victims of injuries caused by other members of staff. This could be achieved by an on-going review of incident report forms and a postal survey of personnel sustaining injuries;
- A study exploring the reasons why risk perception varies between surgeons and nurses. The investigation team would be multidisciplinary and would rely on expertise from psychologists, educationalists, surgeons, nurses and researchers with expertise in survey research. Data collection would involve the use of attitude and personality scales, review of undergraduate/pre-registration curricula for medical and nursing students and face to face interviews with surgeons and scrub nurses.
- A before and after quasi experimental study to explore whether compliance with standard/universal precautions is influenced by attendance at training sessions. Data collection would involve administration of a short questionnaire on the education and training history of healthcare professionals, before and after attendance at a training session on standard/universal precautions in the operating theatre. The primary outcome variable would be compliance with available precautions. This could be followed by a series of direct observations of their practice over a fixed period of time to determine their level of compliance and the extent to which their compliance is maintained over time;
- An experimental study to explore the impact of a coordinator employed to streamline the process of inoculation injury reporting and follow up. Following a pilot study an RCT could be undertaken to determine whether a member of the team within a theatre assuming responsibility for reporting all injuries and arranging the appropriate follow up and treatment on behalf of his/her colleagues would be successful in improving compliance with reporting. The primary outcome variable would be reporting. Coordinators would be appointed within selected operating teams to assume responsibility for completing incident report forms, taking blood from the injured staff

member to establish current immunity and bloodborne virus status, counselling the patient prior to blood tests for bloodborne viral infection, taking the blood from the patient, follow up and feedback of results to affected individuals. In the teams where the coordinators were not present one individual would assume responsibility for monitoring the number of injuries sustained and the number of injuries reported for comparison purposes. Data collection would be via interviews with stakeholders and comparison of reporting rates among operating teams adopting the coordinator and those that don't.

- A study incorporating a behavioural theory such as the TPB or ecological perspective model to identify why HCPs act as they do in relation to adopting precautions or reporting inoculation injuries.

6.8 NEW KNOWLEDGE

New knowledge from this study useful for injury prevention and management is as follows:

1. Interprofessional differences in compliance with standard/universal precautions and reporting are more profound than previously reported. While this has been suggested by other authors, the extent of this influence on all aspects of behaviour in relation to safety and reporting has been firmly established in this study including use of protective clothing, safety devices, attendance at training sessions and reporting. None of the other studies reviewed has established the influence of profession on as wide a range of activities as has this one. The study has demonstrated that the priority for interventions aimed at improving compliance must be placed with surgeons.
2. The impact of the assumption that inoculation injuries are an occupational hazard on sustaining and reporting inoculation injuries has not been fully explored in other studies. Both bivariate analyses and the logistic regression model identified that this belief was significantly associated with sustaining an inoculation injury. It also influenced the likelihood of reporting. Again, professional differences were apparent in that this belief was far more common among surgeons than scrub nurses. This belief was closely associated with risk perception. Surgeons were more likely than nurses to believe that the risk of infection following inoculation injury was low. They were also more

likely to believe that injuries are an occupational hazard and therefore not worth reporting. Consequently, this study has established that risk perception and the belief that injuries are an occupational hazard influence behaviour.

3. There is some evidence of teamwork in the operating theatres in Wales but the teamwork is often directed towards keeping the surgeon happy and the theatre running smoothly rather than encouraging a frank exchange of views and equality. Although studies have identified that teamwork contributes to safety (Sasou and Reason, 1999; Linguard *et al*, 2002; Undre *et al*, 2006), the theatre teams in Wales are based on a strict hierarchy dominated by surgeons whose compliance with standard precautions and reporting is poor. Nurses therefore have a limited overall influence over safety. Health behaviour in relation to teamwork must be altered so that equality becomes the norm and all team members can contribute to operating department safety.
4. Although attendance at training sessions positively affected inoculation injury rates and the number of injuries reported, existing infection control education did not positively influence compliance with standard/universal precautions in theatre. This was particularly obvious among surgeons where only 15.1% (27/179) had ever attended a training session. The apparent association between attendance and injury, seen in bivariate analysis, disappeared when confounding variables were accounted for in a regression table. Therefore current mandatory training and education requires an urgent review to encourage attendance and identify strategies that will positively influence health behaviour, particularly among surgeons.
5. While most of those who had sustained an inoculation injury were the users of the sharp object, interviews revealed that nurses were occasionally injured as a result of some action by surgeons. This has not been discussed elsewhere and reinforces the need for training in the prevention and management of inoculation injuries to be focussed on surgeons.
6. Other studies have identified that doctors comply with guidelines less readily than nurses (Cotton and Sullivan, 1999; Lawton and Parker, 1999; Manias and Street, 2000) and reasons for this phenomenon have been suggested. This study supports these findings but offers additional reasons for why this might be the case i.e. that the perceived rigid hierarchy and punative attitude to breaches of protocol that exist within the nursing profession encourage

compliance and that risk perception and risk taking behaviour among the surgeons means that guidelines are often shunned.

7. This study has reinforced existing knowledge on the causes of inoculation injuries among operating theatre personnel and has confirmed the findings of other authors who have established that compliance with current guidelines in relation to standard precautions and reporting measures is poor. However, one area where the findings of this study differ from others is in relation to passing sharps via a neutral field. This activity was common among theatre personnel in Wales (82.2% compared to 8-69.2% elsewhere).
8. The incidence of reporting injuries increased with length of time qualified. No explanation was apparent for this and it has not been identified in other studies. It is difficult to make any inferences from this other than increased reporting presumably associated with correct follow up among those qualified the longest may in the long term, encourage more junior staff to follow their example thereby reducing their risk of infection.

6.9 CONCLUSION

This study has demonstrated that despite over twenty years of working with first universal precautions and more recently standard precautions, these guidelines are still not being followed in a clinical area in which personnel are repeatedly engaged in exposure prone procedures and are consequently at a higher risk of being exposed to bloodborne viral infection than other clinicians.

Inoculation injuries are common and many of these may have been prevented by closer adherence to standard/universal precautions. Surgeons are less likely to adhere to standard/universal precautions than nurses. Failure to report injuries and follow the prescribed post exposure procedure means that not only are personnel increasing their risk of infection but also it is difficult to accurately assess the number and cause of injuries within the operating theatre. Furthermore, patients are being put at risk of infection should an infected healthcare professional sustain a sharps injury during an exposure prone procedure. Despite being more likely than nurses to sustain an inoculation injury, surgeons are less likely to follow the correct reporting procedure. Risk perception influenced the precautions taken with increased compliance with protective clothing and reporting where the risk of infection was thought to be high e.g. if the patient was an intravenous drug user or homosexual male (section 4.6). Although the incidence of bloodborne viruses in Wales is low one cannot presume that it is non existent. Adoption of precautions for known high risk patients can lead to a false sense of security plus an increased risk of injury because of unfamiliarity with the equipment.

Infection control teams clearly recognise the value of standard/universal precautions in reducing the risk of inoculation injury, demonstrated by the fact that all ICNs in Wales provide in-service training and education on the prevention and management of inoculation injuries (section 4.2). This study identified that these sessions are ineffective at ensuring that compliance with standard/universal precautions is high (tables A16.71-A16.73). Attendance at the sessions is poor, particularly by surgeons, not least because many consider the sessions to be worthless (section 4.6 and table 4.6.7). Behaviour change must therefore involve changing risk perception (Willy *et al*, 1990). The field of health psychology may offer suitable models to achieve change (Prochaska and DiClemente, 1982), see section 5.8. This will involve Infection Control Teams embracing these concepts and incorporating them into their teaching. It also requires surgeons to be motivated to change their behaviour which may be difficult to achieve.

Healthcare professionals will always be required to care for patients who are either not aware of their own bloodborne viral status or not prepared to reveal it to healthcare personnel. Unless standard/universal precautious are followed for all patients regardless of what we know or suspect about their viral status, sexuality or lifestyle the risk of infection will always be present. Constant adherence to precautions will also remove the threat of complaints and even litigation (Employment Equality (Sexual Orientation) Regulations, 2003; Equalities Act, 2006).

While the author of this thesis was a practising ICN, a theatre sister was scratched by a skin hook that penetrated her glove and pierced her skin. The correct procedure was followed, an incident form completed, the sister was bled and the patient counseled and bled. The patient was found to be hepatitis B surface antigen positive on testing indicating infectivity. She had no idea that she had ever been exposed to the infection and had no traditional risk factors. The theatre sister was fully up to date with her hepatitis B vaccinations and was a good responder so no further action was required. When talking about this in the coffee room in theatre, the surgeon revealed that she had been scratched by a suture needle during the same operation. Unfortunately, as she had been either pregnant or breast feeding for several years she was not up to date with her vaccinations and required hepatitis B immunoglobulin. Fortunately, she did not acquire hepatitis B but may not have been so lucky had the theatre sister not been injured as well. Had she acquired hepatitis B as a result of this injury, future patients may have been exposed to the risk of infection in the event of future sharps injuries in the same way as the two patients, one of whom subsequently died, who contracted hepatitis B infection following surgery performed by a hepatitis B positive surgeon (Laurenson *et al*, 2007). "When a surgeon suffers a needlestick injury, not only is he exposed to the risk of disease but so are his future patients" (Hettiaratchy, 1998, p440). Failure to follow appropriate precautions is not only foolhardy but negligent.

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APPENDICES

Appendix 1

Factors influencing sustaining and reporting percutaneous and mucocutaneous exposure to blood and body fluids in the operating theatre

1. Are you a: Surgeon? ☐ Scrub Nurse? ☐

2. How long have you been qualified as a doctor/nurse? __________ years ________ months

3. How long have you worked in your present speciality? __________ years ________ months

4. Surgeons, please state your speciality (nurses please proceed to question 5).

____

5. For each precaution, please tick the box that most accurately describes what influences the measures you take to protect yourself against exposure to blood and body fluids during surgery.

	All patients	**Patients suspected or known to have a blood borne infection, e.g. HIV, hepatitis B or C**	**Never**	**Other - please describe below**
Double glove	☐	☐	☐	☐
Wear eye protection or full face visor	☐	☐	☐	☐
Avoid passing sharp objects from hand to hand	☐	☐	☐	☐
Use an engineered safety device e.g. retractable blade, blunt suture needle	☐	☐	☐	☐

Other, please describe ____

____

Sustaining inoculation injuries

6. Inoculation injury is a term that includes needlestick injury or injuries from other sharp instruments and splashes of blood to mucous membranes or broken skin. How many such injuries have you sustained?

a. during the last year	
Needlestick/sharps injuries	
Blood splashes to broken skin	
Blood splashes to mucous membranes	

b. during the last 5 years	
Needlestick/sharps injuries	
Blood splashes to broken skin	
Blood splashes to mucous membranes	

7. What are your views on the following statements?

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
Inoculation injuries are more likely to occur during emergency procedures, where time is of the essence.	☐	☐	☐	☐	☐
Inoculation injuries are more likely to occur when staff are working under pressure.	☐	☐	☐	☐	☐
Inoculation injuries are more likely to occur when staff undertake procedures with which they are not familiar.	☐	☐	☐	☐	☐
Staff take fewer precautions when patients are not viewed as "high risk"	☐	☐	☐	☐	☐
It is acceptable to take fewer precautions when patients are not "high risk"	☐	☐	☐	☐	☐
Inoculation injuries are an 'occupational hazard' for staff working in operating theatres.	☐	☐	☐	☐	☐
The availability (or otherwise) of safety devices/ equipment influences the occurrence of inoculation injuries.	☐	☐	☐	☐	☐

Training

8. Does your Trust provide training on the prevention and management of inoculation injuries?

Yes ☐ No ☐ Don't know ☐

9. If yes, when did you last attend such a training session?

Within the last year	
Within the last 2 years	
Within the last 5 years	
I can't remember	
I have never attended such a training session	

If you have never sustained an inoculation injury, please turn to question 16. Otherwise, please continue.

10. On **the most recent** occasion that you sustained an injury, were you the user of the sharp object?

Yes ☐ No ☐

11. During **your most recent** injury, how many of the following applied? Please tick as many boxes as necessary.

The accident occurred during the use of a sharp instrument	
The accident occurred between steps in a procedure	
The accident occurred after use, but before disposal of the instrument	
The accident occurred while preparing the instrument for re-use	
The accident occurred during disposal of an instrument	
The accident occurred while passing an instrument	
The accident occurred while cutting tissue	
The accident occurred while suturing	
The accident occurred while clearing away after a procedure	
A sharp object was left in an inappropriate place	
A sharp object was protruding from the top of a sharps container	

12. During your **most recent** injury, were you doing any of the following?

Double gloving

Wearing eye protection/full face visor

Passing instruments directly from hand to hand

Using an engineered safety device e.g. retractable blade, blunt suture needle

Reporting inoculation injuries

13. Are you familiar with the procedure for reporting inoculation injuries in your Trust?

Yes ☐ No ☐

14. If you sustained an inoculation injury, did you report it/them in accordance with your Trust's procedure for reporting inoculation injuries?

I reported all my inoculation injuries	
I reported more than 50% of my inoculation injuries	
I reported less than 50% of my injuries	
I didn't report any of my inoculation injuries	

15. How likely were the following to have influenced your decision on whether to report inoculation injuries. Please tick as many boxes as apply.

	Very likely	Quite likely	Had no effect/ influence	Quite unlikely	Very unlikely
Did not know what action to take	☐	☐	☐	☐	☐
Did not know where to find relevant policy	☐	☐	☐	☐	☐
Pressure of work	☐	☐	☐	☐	☐
Reporting mechanism too cumbersome	☐	☐	☐	☐	☐
Dissatisfied with follow up procedure during the last time I reported an injury	☐	☐	☐	☐	☐
Patient was not "high risk"	☐	☐	☐	☐	☐
The injury was too minor to report	☐	☐	☐	☐	☐
Inoculation injuries are an occupational hazard	☐	☐	☐	☐	☐
Managers within my trust discourage reporting	☐	☐	☐	☐	☐

Other, please describe:

____

____

16. If you have any comments on this questionnaire, or would like to offer any suggestions on how the number of inoculation injuries may be reduced and/or their reporting improved, I should be very grateful.

____

____

____

____

____

____

____

Thank you for taking the time to complete this questionnaire.

ID code	

Appendix 2

Factors influencing sustaining and reporting percutaneous and mucocutaneous exposure to blood and body fluids in the operating theatre

Interview schedule

Biographical details

Could you tell me a little about yourself and your career to date?

Is this a subject that you feel strongly about?

Why did you participate?

Frequency of injuries/reporting

How frequently do you sustain inoculation injuries when operating?

Please describe the inoculation injuries that you can remember.

Please describe the action you usually take following such an injury.

What has influences the action you have taken following inoculation injuries?

Do you have any explanation for the differences between doctors and nurses in relation to guideline adherence and attendance at training sessions?

Interpretation of risk

If you have reported some but not all your inoculation injuries, what factors influenced your decision to report?

Do you consider yourself to be at risk from bloodborne viral infection resulting from such injuries?

Personal protection

What measures do you take routinely to reduce exposure to blood and body fluids when operating?

Why do you take these precautions?

Do you consider these measures to be effective?

Do you consider any other protective measures to be successful in reducing the risk of infection?

If so, why do you not take these measures?

Would these measures change if your patient was known or suspected to have a bloodborne viral infection? If yes, please describe how.

Are there any other measures you would take if your trust provided the appropriate equipment or facilities?

Education and training

Do you feel that your Trust provide adequate education on the prevention and management of inoculation injuries?

Have you ever attended one of these sessions either in your present position or in previous positions?

If yes, did you find it beneficial? Please give reasons for your answer.

If no, what are your reasons for not attending these sessions?

Way forward

What do you think can be done to protect healthcare workers from the risk of inoculation injuries and exposure to blood-borne viral infections?

What would you like to be done within your Trust?

Appendix 3

Infection Control Nurses – Telephone interview

1. Does your trust have a policy for the prevention and management of inoculation injuries?

   Yes ☐ No ☐

2. If yes, does this policy advise the use of standard/universal precautions for all exposures to blood and body fluids?

   Yes ☐ No ☐

3. Does the policy include advice on the appropriate reporting procedure following percutaneous and mucocutaneous exposure top blood and body fluids?

   Yes ☐ No ☐

4. How is the policy disseminated? (e.g. hard copy, trust intranet)

   ____

5. Does your department receive reports of all percutaneous and mucocutaneous exposures to blood and body fluids that occur in your trust?

   Yes ☐ No ☐

6. How many written/electronic reports of percutaneous and mucocutaneous exposures to blood and body fluids did your department receive for the period January 1st – December 31st 2004?

   ____

7. How many of these reports were received from:

   Surgeons ☐ Scrub nurses ☐

8. Please describe briefly how you follow up percutaneous and mucocutaneous exposures to blood and body fluids

   ____
   ____
   ____
   ____
   ____

9. Do you provide training for healthcare personnel on the prevention and management of inoculation injuries?

   Yes ☐ No ☐

10. How often are these sessions held? ______________________________

11. Are the training sessions mandatory?

Yes ☐ No ☐

12. Please describe briefly the content of your training sessions:

____
____
____
____
____

13. During the period January 1st – December 31st 2004, how many healthcare personnel attended these sessions? ______________________________

14. How many of these were:

Surgeons ☐ Scrub nurses ☐

[redacted]

Appendix 4

Dear

Factors influencing sustaining and reporting inoculation injuries by healthcare professionals performing exposure prone procedures in the operating theatre.

I am currently a lecturer in the School of Heath Science, University of Wales Swansea. However, until recently, I was employed as a Clinical Nurse Specialist, Infection Control at Swansea NHS Trust.

I am conducting the above study as part of a PhD. The study has been funded by a fees only bursary from the School of Health Science. Within each participating NHS Trust in Wales, I shall be conducting a survey among professionals who routinely undertake exposure prone procedures.

The study aims to determine:

- The factors contributing to percutaneous and mucocutaneous exposure to blood and body fluids among health care professionals performing exposure prone procedures in operating theatres within Wales.
- The factors influencing reporting of such exposures.

Using the results of this study, it is hoped that recommendations can be made to reduce the incidence of inoculation injury and subsequent risk occupational acquisition of bloodborne infections during occupational exposure to blood and body fluids.

I should be very grateful if you would participate in the study by completing the enclosed questionnaire and returning it to me in the provided envelop (no stamp necessary). Pilot studies indicate that this should take no longer than 10-15 minutes. Please be completely honest in your responses.

The project has been reviewed and approved by the Multi Centre Research Ethics Committee for Wales (MREC) and the Research and Development Committee of your Trust (approval letters enclosed).

Confidentiality is assured at all times. Complete anonymity is guaranteed both in the completed dissertation and in any resulting publications. On completion of the study, all records and questionnaires will be destroyed.

Please contact me if you would like further information:

Tel. (work): 01792 295790 (Monday – Friday: 08.30 – 16.30) Mobile: [redacted]
E-mail: j.cutter@swan.ac.uk

Your help and co-operation is very much appreciated.

Yours sincerely,

Mrs. Jayne Cutter,
Lecturer, Infection Control.

Participant Information Sheet

Re: Factors influencing sustaining and reporting inoculation injuries by healthcare professionals performing exposure prone procedures in the operating theatre.

You recently completed a questionnaire circulated as part of my PhD research. You are being invited to take part in the second part of the study. Before you decide it is important for you to understand why the research is being conducted and what it will involve. Please take time to read the following information carefully. Talk to others about the study if you wish.

- Part 1 tells you the purpose of this study and what will happen to you if you take part.
- Part 2 gives you more detailed information about the conduct of the study.

Please ask if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Part 1

What is the purpose of the study?
This study aims to investigate, within selected NHS Trusts in Wales:

- The factors contributing to percutaneous and mucocutaneous exposure to blood and body fluids among health care professionals performing exposure prone procedures in the operating theatre.
- The factors influencing reporting of such exposures.

It is hoped that the study should provide information that can be used to improve education and safety equipment provision for operating theatre personnel.

Why have I been chosen?
You have been chosen because I think your experiences and opinions will help improve understanding of the issues outlined above. Approximately 14 other interviews are being conducted with surgeons and scrub nurses working across Wales.

Do I have to take part?
No, it is up to you to decide whether or not to take part. If you do, you will be given this information sheet to keep and be asked to sign a consent form. You are still free to withdraw at any time and without giving a reason. If you withdraw from participation in the study all of the data supplied by you will be destroyed.

What will happen to me if I take part?
You will be asked to participate in a 'one to one' interview to explore your views and experiences on the subject. With the full consent of participants, the interviews will be audio recorded and transcribed. Also with full consent some verbatim quotations from the interviews will be included in the PhD thesis and future publications, along with the results from the questionnaire survey. Any quotations used will be anonymised to maintain the anonymity of participants.

If you decide to participate, the interview will be conducted at a venue of your choice on your Trust premises or your own home.

The interviews will last approximately 45 minutes.

What do I have to do?
If you decide to participate you will be asked to agree a suitable time and location for the interview.

What are the disadvantages and risks of taking part?
Participation in this study will not involve any physical risks. All the information you provide will be treated as confidential.

What are the possible benefits of taking part?
It is intended that the findings of the study will identify continuing professional development needs in relation to prevention and management of inoculation injuries for operating theatre personnel.

What if there is a problem?
Any complaint about the way in which you have been dealt with during the study will be addressed. The detailed information on this is given in Part 2 of this information sheet.

Will my taking part in the study be kept confidential?
Your participation in the project will be kept strictly confidential.

Contact Details
Further information about the study is available from the researcher, Mrs Jayne Cutter School of Health Science, Swansea University, Singleton Park, Swansea. SA2 8PP. Tel. 01792 295790. e-mail: j.cutter@swansea.ac.uk

This completes Part 1 of the Information Sheet.
If the information in Part 1 has interested you and you are considering participation, please continue to read the additional information in Part 2 before making any decision.

Part 2

What if there is a problem?
If you have a concern about any aspect of this study, you should speak with Jayne Cutter who will answer any questions.

If you remain unhappy and wish to complain formally you can do this through the School of Health Science. In the first instance, the academic supervisor, Dr Sue Jordan, telephone number 01792 518541, email s.e.jordan@swan.ac.uk should be contacted. If you are not satisfied, your complaint will then be dealt with by a member of the School's senior management team. Details are available from the School.

Harm
This research project has indemnity cover for negligent harm.

Will my taking part in this study be kept confidential?
Your participation in the research will be kept strictly confidential.

Audio recordings and transcripts from the interview will be securely stored in the School of Health Science. Individual names will be removed from the transcripts. Participants' names will not be used to label recorded material. Each interview will be given a code number. A list of code numbers and corresponding participants' names will be stored securely in the School of Health Science in a separate location to the recorded material. Only I will have access to these. Contact details will be destroyed on completion of the study.

The information you provide in the interview will be analysed, and the results from the overall study will be reported in academic papers, conferences presentations and workshops for NHS personnel. No individuals will be identified, and any verbatim quotations from the interviews which are used will be anonymised.

After the end of the study all data (including transcripts and recorded material) will be stored securely for 10 years, before being destroyed.

Who is organising and funding the research?
This is a PhD study and is funded by Swansea University.

Who has reviewed the study?
This study has been reviewed by the Multi Centre Research Ethics Committee for Wales (MREC) and the Research and Development Committee of your Trust. Should you wish to receive further copies of the approval letters, please do not hesitate to contact me.

Thank you for taking the time to read this information sheet.

Fctors affecting sustaining and reporting inoculation injuries by healthcare professionals undertaking exposure prone procedures

CONSENT FORM

In signing this document, I am giving consent for my interview with Jayne Cutter to be recorded. I understand that I shall be taking part in a research study that will focus on factors affecting sustaining and reporting inoculation injuries by healthcare professionals undertaking exposure prone procedures.

I understand that I am free to withdraw from the study at any time.

I understand that the researcher may need to contact me in the future for further information.

I have been informed that Jayne Cutter is the person to contact if I have any questions about the study or my right as a participant.

Date:________________ Participant's signature: ________________________
Print name: ________________________________

Interviewer's signature: ________________________

Contact details:

Mrs Jayne Cutter
Lecturer, Infection Control
Swansea University
Singleton Park
Swansea
SA2 8PP

Telephone: Work - 01792 295790
Home - [redacted]
Mobile - [redacted]

E-mail: j.cutter@swan.ac.uk

1 copy to be retained by the participant and 1 by the researcher.

Multi-Centre Research Ethics Committee for Wales

MREC for WALES

Pwyllgor Ymchwil Ethegau Aml-Ganolfan yng Nghymru

Chairman/Cardeirydd: Professor John Saunders

Administrator/Gweinyddes: Mariane Parsons

Temple of Peace and Health, Cathays Park, Cardiff CF10 3NW
Teml Heddwch ac Iechyd, Parc Cathays, Caerdydd CF10 3NW

WHTN 0 1809 Telephone enquiries to: 029 2040 2455 Fax No. 029 2040 2504

MREC website: http://www.corec.org.uk
e-mail: mariane.parsons @ bsccardiff.wales.nhs.uk

Mrs Jayne Cutter
Clinical Nurse Specialist, Infection Control
Swansea NHS Trust
Singleton Hospital
Sketty
Swansea
SA2 8QA

12th November 2004

Dear Mrs Cutter

MREC reference number 04/MRE09/45 PLEASE QUOTE THIS IN ALL CORRESPONDENCE
Study title - Factors influencing sustaining and reporting percutaneous and mucocutaneous exposure to blood and body fluids in the operating theatre

The MREC for Wales reviewed the above application at the meeting held on 11th November 2004.

The members of the Committee present gave a favourable ethical opinion to the above research on the basis described in the application form, protocol and supporting documentation.

Conditions of approval

The favourable opinion is given provided that you comply with the conditions set out in the attached document. You are advised to study the conditions carefully.

The documents reviewed and approved at the meeting were:

- Cover letter dated 23rd August 2004
- Application form version 3.0 dated 20th August 2004
- Curriculum Vitae
- Supervisor's curriculum vitae
- Protocol of study, version 1
- Sponsor's letter
- Letter of indemnity dated 15th July 2004
- Questionnaire, version 1 (Appendix 1)
- Interview schedule, version 1 (Appendix 2)
- Telephone interview, version 1 (Appendix 3)
- Invitation letter, version 1 (Appendix 4)
- Consent Form (interview), version 1 (Appendix 5)

You should obtain final management approval from your host organisation before commencing this research.

You should arrange for all relevant host organisations to be notified that the research will be taking place, and provide a copy of the REC application, the protocol and this letter.

All researchers and research collaborators who will be participating in the research must obtain management approval from the relevant host organisation before commencing any research procedures. Where a substantive contract is not held with the host organisation, it may be necessary for an honorary contract to be issued before approval for the research can be given.

Membership of the Committee

The members of the Ethics Committee who were present at the meeting are listed on the attached sheet.

We shall notify the research sponsor that the study has a favourable ethical opinion.

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

REC reference number: 04/MRE09/45	**Please quote this number on all correspondence**

Yours sincerely

Professor John Saunders
Chairman
MREC for Wales

MREC FOR WALES : Attendance List for the MREC for Wales' meeting on 11th November 2004

Professor John Saunders	Chairman	Professional (Hospital Consultant)
Dr. Gordon Taylor	Vice Chairman	Professional (Statistician)
Dr Gail Boniface		PAM member (Occupational Therapist)
Mr Paul Brown		PAM member (Radiographer)
Dr. Maurice Buchalter		Professional (Hospital Consultant)
Mrs. Ceri Channon		Lay member
Mrs. Philippa Herbert		Lay member
Dr. Meriel Jenney		Professional (Paediatrician)
Dr. Dai John		Pharmacist
Mr. David Rabjohns		Lay member
Dr. V. Bapuji Rao		Professional (Psychiatrist)
Dr. Pete Wall		Lay member
Mr. Stewart Williams		Lay member

Summary of findings of research studies included in the literature review (chapter 2)

Author	Data analysis (as reported)	Summary of method and findings
Abu-Gad H, Al-Turki KA (2001)	Descriptive statistics, χ^2 test and *t*-test	Retrospective analysis of needlestick injuries (n=282) reported over 2 years in 11 hospitals in Saudi Arabia. Findings: 50% of injuries occurred in the first 3 years of employment. The highest percentage of injuries (46.8%) was related to use of syringes and needles. Patients' wards were the major location of injury (48.5%) followed by ICUs and dialysis units (17.7%), theatres (15.6%) and accident and emergency departments (13.8%)
Adams A, Elliott TSJ (2006)	χ^2 test	Four year prospective study in the UK to evaluate the effect of introducing a range of safety hypodermic needle devices on the number of reported needlestick injuries In a UK hospital. Findings: Following an enhanced sharps awareness campaign in 2002 the number of injures fell from 16.6/100,000 devices used in 2001 to 13.9/100,000 devices used in 2002. In 2003 when only standard training was provided the rate increased to 20/100,000 devices used. Following the subsequent introduction of three safety devices alongside training, the number of reported injuries decreased to 6/100,000 devices used in 2004 (P=0.045).
Akduman D., Kim L.E., Parks R.L., L'Ecuyer P.B., Mutha S., Jeffe D.B., Evanoff B.A., Fraser V.J (1999)	χ^2 test, Fisher's exact test and *t*-test	Prospective cohort study. Observation of US operating room personnel (n = 597) from gynaecology, orthopaedics, cardiothoracic and general surgery during 76 operations. Findings: Compliance with universal precautions was poor, 28% for double glove use, announcing passage of sharps (9%), no eye protection (24%). Double gloving and eye protection varied by speciality (P<0.001) and job description (P<0.001) in each case.
Alvarado-Ramy F, Beltrami EM, Short LJ, Shivastava PU, Henry K, Mendelson M, Gerberding JL, Delclos GL, Campbell S,	Not specified	Questionnaire surveys to identify baseline rates of percutaneous injury during the use of conventional devices and the efficacy of engineered sharps injury prevention devices in six US hospitals. Findings: 1630 percutaneous injuries were recorded during the study period. 1540/1630 (94%) were considered preventable by the

Solomon R, Fahrer R, Culver DH, Bell D, Cardo DM, Chamberland ME (2003)		employees. Of the 861 injuries involving hollow bore needles, the researcher felt that 673 (78%) could have been prevented by engineered sharps injury prevention devices or safer work practice. Reporting rates varied: phlebotomists reported 91%, nurses 68%, medical students 35%, residents 31%. Bluntable phlebotomy needles and phlebotomy needle with recapping sheath achieved a reduction in injury rate (76% and 66% respectively, P=0.003).
Askarian M, McLaws M-L, Meylan M (2006)	Kruskal-Wallis test, Spearman correlation coefficient.	Cross sectional study of surgeons, surgical residents, physicians and medical residents to measure levels of knowledge, attitudes and practices related to standard precautions in Iran. Questionnaire survey (n=155). Response rate 62%. Findings: Knowledge of standard precautions was fair - median score 6 to 7 (maximum score 9). Median attitude scores were high at between 35 and 36 (maximum score 45), median practice attitudes were low, 2 to 3 (maximum score 9). A moderate relationship between knowledge and attitudes was found in surgical and medical residents (*r*=397, P=0.03 and *r*=554, P=0.006). Significant but poor relationship was found between attitude and practice in surgical residents (*r*=0.399, P=0.029). No significant correlation was found between knowledge and practice.
Au E, Gossage JA, Bailey SR (2008)	Fisher's exact test	Questionnaire survey of surgeons in one UK hospital (n=42). Response rate 60.9%. Findings: 840 needlestick injuries occurred over 2 years, of which 126 caused bleeding. Senior surgeons who spent more hours operating per week had a higher rate of injury compared with junior surgeons (29.1 vs 6.59 injuries per surgeon over 2 years) Only 19/840 injuries (2.26%) were reported. Junior surgeons were more likely to report than senior surgeons (P<0.001). Main reasons for failure to report: lack of time and excessive paperwork. 73% of surgeons did not routinely double glove because of loss of hand sensation.
Bakaeen F, Awad S, Albo D, Bellows CF, Huh J, Kistner C, Izard D, Triebel J, Div M, Khan M, Berger DH (2006)	Fisher's exact test.	Retrospective review of 98 exposure injuries among US healthcare workers. Findings: 17/98 (17%) were inflicted by hollow bore needles. 74/98 (76%) were sustained in the operating theatre. Sharps injuries accounted for 69 (93%) of OR injuries and were inflicted by suture needles (n=37, 50%), hollow bore needles (n=7, 9%), sharp instruments (n=25, 34%), mucocutaneous contamination (n=5, 7%). Surgeons were most commonly injures (n=43, 44%) followed by nurses (n=28, 29%), students (n=17, 17%) and others (n=10, 10%).
Beekmann SE, Vaughn TE,	Wilcoxon rank sum	Survey of Infection Control Practitioners from 129 hospitals and 5 long term care

McCoy KD, Fergusson KJ, Torner JC, Woolson RF, Doebbeling BN (2001)	test, Fisher's exact test, χ^2 test.	facilities in Iowa 129 and 106 hospitals in Virginia (n=153) to determine hospital practices and policies relating to bloodborne pathogens and current rates of occupational exposure. Response arte 64%. <u>Findings</u>: Every facility required standard precautions training for all nursing staff, fewer than half required training for physicians. Mean training rate for nurses, housekeeping staff and nursing assistants 95% (range 2%-100%) but only 27% (range 0-100%) for physicians. Compliance with standard precautions was monitored annually by 80% of facilities. The overall incidence of percutaneous injuries was 5.3 per 100 HCWs, physician were excluded from this analysis as few were considered employees and fewer reported injuries to the appropriate authority.
Benítez Rodriguez E, Moruno AJR, Dona JAC, Pujolar AE, Fernandez FJL (1999)	χ^2 test, logistic regression	Questionnaire Surrey of HCWs employed in medicine, infectious disease, general surgery, emergency and haemodialysis departments in a teaching hospital in Cádiz (n=232) to determine rates of reporting . Response rate 92.8%. <u>Findings</u>: A total of 14% (32/232) had sustained at least one inoculation injury between July 1994 and July 1995, overall rate of 11.7 accidents per 100,000 hours worked. Doctors had the highest accident rate (22.2 per 100,000 hours worked), this was 2.5 times the rate of auxiliaries and laboratory technicians (95% CI 1.16-5.45) and 2.7 times that of nurses (95% CI 1.25-5.67). Doctors failed to report 89% of incidents and nurses 54%. Those working in general surgery were 14.1 times more likely to under report than those in non surgery areas (95% CI 1.03-194.81). Duration of service (OR 6.6, 95% CI 0.21-23.06) and not perceiving the accident to be a risk to health (OR 5.9, 95% CI 0.80-42.93) were associated with under reporting.
Brasel KJ, Mol C, Kolker A, Weigelt JA (2007)	Friedman and Mood median tests.	Retrospective review of needlestick injury reports by surgical residents in Wisconsin, USA between 2001 and 2006 (n=118). Questionnaire survey, response rate 80% (n=94). <u>Findings</u>: Routine double gloving reported by 15.6% (n=5) of respondents, 6 (18.8%) never double gloved and 21 (65.6%) would double glove if the patient was high risk. Reasons for not double gloving: concerns about dexterity, being made to feel it was an inconvenience, not being allowed to. Rate of needlestick injures per resident year was 0.49. The mean rate of exposure decreased per years experience from 7.03 per 1000 cases in years 1 – 3 to 2.09/1000 cases in years 4 - 5 (P<0.001).
Brearley S, Buist L (1989)	None	Observation of number of blood splashes on glasses following surgery in a UK hospital (n=257 observations). <u>Findings</u>: At least one splash of blood was found after 64 operations (25%). The number of splashes ranged from 1-40. More than 10 splashes were present on 8 occasions. A mean of 1.3 splashes per operation.

		Surgeons were aware of contamination in only 3 cases.
Bricout F, Moraillon A, Sonntag P, Hoerner P, Blackwelder W, Plotkin S (2003)	Wilcoxon rank-sum test or for 3 or more gloves, Kruskal-Wallis test.	French RCT to determine efficacy of anti viral layer in gloves. Findings: The reduction in BVDV viral count was reduced by >10 fold in the virucidal gloves. In vitro testing with FIV, a reduction from 62.5 to 15.5 was estimated. 7/15 (47%) cats became infected with FIV with the virucidal glove compared to 100% with the control gloves. Reduction in median count of HSV in vitro ranged from 6 fold to 14 fold. Percentage of surviving mice uninfected mice significantly increased with virucidal gloves (P<0.001). Efficacy of virucidal gloves in preventing death for 13 days in mice was 64% (95% CI 49-74%).
Burke S, Madan I (1997)	None	Retrospective study of 384 doctors and 293 midwives in two UK NHS trusts. Response rate = 80% and 77% respectively. Findings: 9% of doctors and 46% of midwives reported contamination injuries. 77% (283/384) of doctors, 69% (176/293) of midwives under-estimated the risk of contracting HBV from a needlestick injury. 52% (191/384) of doctors and 36% (92/293) of midwives underestimated the risk of HIV.
Caillot J-L, Côte C, Abidi H, Fabry J (1999)	Mann-Whitney-U test, ANOVA, χ^2 test	RCT undertaken in France to evaluate the value of double gloving. Findings: 164 alarms recorded during 80 surgical procedures, 31 glove perforations, 32 mixed glove porosity and perforation and 76 wet gowns. At least one alarm was generated during 78% of deep procedures compared to 24% of superficial procedures. Deep procedures generated 137 alarms compared to 27 during superficial procedures (P<0.001). Double gloving reduced the number of alarms in all circumstances (P<0.001). The number of alarms due to wet gowns suggests that efficient reinforced gowns would improve the patient-surgeon barrier. Double gloving is a simple and effective means of risk reduction.
Cardo D, Culver DH, Ciesielski CA, Srivastava PU, Marcus R, Abitebuol D, Heptonstall J, Ippolito G, Lot F, McKibbren PS, Bell DM (1997)	Logistic regression	Italian case control study of HCWs with occupational exposure to HIV positive blood. The case patients (n=33) were those who seroconverted and the controls (n=665) were those who did not. Findings: Significant risk factors for seroconversion were deep injury (OR 15, 95% CI 6.0-41); injury with a device that was visibly contaminated with blood (OR 6.2, 95%CI 2.2-21), procedure where needle had entered the source patient's vein or artery (OR 4.3, 95% CI1.7-12), exposure to a patient who had died of AIDS two months afterward (OR 5.6, 95% CI 2.0-16). The case patients were significantly less likely to have taken zidovudine after the exposure (OR 0.19, 95% CI 0.06-0.52).

Castella A, Vallino A, Argentero PA, Zotti CM (2003)	None	Review of report forms following needlestick injuries (n=439), scalpel injuries (114), suture needlestick injuries (n=221) in Italy to examine the preventability of percutaneous injuries either through correct behaviour of use of needles with safety features. 74% of needlestick injuries could have been prevented by adoption of correct behaviour and 26% were unpreventable. 79% of injuries caused by incorrect behaviour and 24% of accidents could have been prevented by safety needles. 26.2% of suture needle injuries and 14% of scalpel injuries were caused by incorrect behaviour.
Chan R, Alexander M, Chan E, Chan V, Ho B, Lai C, Lam P, Shit F, Yiu I (2002)	Pearson correlation coefficients, Kruskal-Wallis and Mann Whitney U tests	Cross sectional survey of nurses in an acute hospital in Hong Kong (n=306). Response rate 70%. Findings: Nurses' knowledge of universal precautions was inadequate. Knowledge was good in relation to use of precautions when disposing of sharps (99.3%), handling vaginal secretions (96.1%), clearing up blood spills (89.5%), use of masks and goggles (85.9%) and application of precautions for all patients regardless of bloodborne virus status (75.5%-84.6%), but many were under the misapprehension that universal precautions were necessary for handling tears (55.2%), sweat (48%), saliva (76.5%), urine/faeces (87.6%). Compliance of 83% for handling blood, body fluids, deep body fluids and mucous membranes or non intact skin. Compliance with eye protection was low (25.4%). Only 44.9% would wear aprons/gowns appropriately
Chan MF, Ho A, Day C (2008)	χ^2 test, Fisher's exact test, Mann-Whitney U test. Spearman's correlation.	Cluster analysis investigating knowledge, attitudes and practices of operating staff in Hong Kong towards standard precautions. Questionnaire survey of nurses and non medical support staff (n=113). Response rate cluster 1 (50.4%) (n=57), cluster 2 49.6% (n=56). Findings: Cluster 1 respondents had a higher educational attainment level and worked at more senior level than cluster 2 respondents. Cluster 1 reported better knowledge, more positive attitudes and practices than cluster 2. Significant differences towards standard precautions were found except in relation to attitudes to PPE (P=0.095) and wearing gowns and eye protection (P=0.759). Attitudes of cluster 2 staff were highly significant but weakly correlated with practices (r_s=0.39, P<0.05).
Chelenyane M, Endacott R (2006)	None	Descriptive exploratory study investigating reported practices and perceptions of emergency nurses (n=22) related to infection control in the context of the HIV/AIDS epidemic in Botswana. Response rate 55%. Findings: Level of knowledge regarding universal precautions was high. 72.3% (n=16) reported and or documented exposure to risks. 68% (n=15) provide care to HIV positive patients almost daily. 72.3% (n=17) strongly agreed and 22.7% (n=5) agreed that they complied with universal

		precautions.
Clarke SP, Sloane DM, Aiken LH (2002a)	Logistic regression	Analysis of retrospective data from 732 and prospective data from 96(nurses on needlestick injuries and near misses over different one month periods in 1990 and 1991 in Baltimore, USA. Findings: In the retrospective survey 34/789 (4.3%) of nurses reported a needlestick injury in the previous month. In the prospective survey, 53/962 (5.5%) reported a needlestick injury containing blood and 228 (23.7%) reported an incident involving a near miss. Nurses from poorly staffed units (retrospective, OR 3.03 95% CI 1.22-7.51) and low nurse manager leadership (retrospective, OR 2.8495% CI 1.14-7.08) were twice as likely as nurses on well staffed and well organised units to report risk factors and near misses
Collins D, Rice P, Nicholson P, Barry K (2000)	None	Prospective study, 46 orthopaedic operations undertaken in Ireland. Findings: 86% of mask-visors contaminated during surgery. 85% of surgeons were unaware of the contamination. Surgeons using power tools should routinely wear upper face protection
Cotton and Sullivan (1999)	*t*-test	Questionnaire survey of UK general practitioners (n=309), practice nurses (n=74), hospital consultants (n=178), senior hospital nurses (n=30) to investigate HCWs perceptions of guidelines. Response rate 74% (437/591). Findings: Hospital doctors were more likely than GPs to not implement guidelines for a variety of reasons ($P<0.005$ in each case). Practice nurses considered that guidelines improved practice while hospital nurses were not convinced about the benefits to patient care ($P<0.05$). Hospital doctors were more likely than hospital nurses to consider that guidelines restricted clinical freedom ($P<0.008$) although they were more likely to agree that they improved clinical practice ($P<0.008$)
Creedon SA (2006)	χ^2 test, Mann Whitney U test	Quasi-experimental research study to observe HCWs compliance with hand hygiene guidelines in an Irish intensive care unit. Convenience sample of nurses, doctors, physiotherapists and care assistants (n=73 observational participants, n=62 questionnaires, n=314 observations). Findings: Significant improvement in compliance with handwashing guidelines following multifaceted hand hygiene programme (pre-test 51%, post test 83%, $P<0.001$). Significant changes found in relation to HCWs' attitudes, beliefs and knowledge ($P<0.05$).
Cullen BL, Genasi F, Symington I, Bagg J, McCreaddie M, Taylor A, Henry M, Hutchinson SJ, Goldberg DJ (2006)	Multifactorial analyses	Prospective survey in the UK to estimate proportion of needlestick injuries sustained by NHS staff in Scotland that could have been prevented by the use of safety devices. Questionnaire administered to all acute and primary care NHS Trust, Ambulance Service and Blood Transfusion Service. Expert panel assessed data on 64% of

		injuries (952/1497) reported by HCWs. Findings: 56% of all injuries and 80% of venepuncture/injection administration injuries would probably have been prevented through safety device usage; 52% of all injuries and 56% of venepuncture/injection administration injuries would probably/definitely have been prevented through guideline adherence and 72% of all injuries and 88% of venepuncture/injection administration injuries would definitely been prevented buy either intervention. Venepuncture/injection administration injuries would be more likely to be prevented through safety device usage (adjusted 95% CI 3.11-8.31 and adjusted OR 0.31, 95% CI 0.12-0.78 respectively)
Cutter J, Jordan S (2003)	χ^2 test, Fisher's exact test	Cross sectional survey of nurses, midwives and surgeons in one Welsh NHS trust (n=200). Response rate 72.5%. Findings: Significantly more surgeons than nurses and midwives had sustained inoculation injuries in the 10 years prior to the study 79/90 (87.8%) compared to 66/106 (62.3%) (P<0.001). However, surgeons were less likely to report their injuries (39/74) (52.7%) compared with 59/65 (90.8%) (P<0.001). Only 18/90 (20% surgeons and 8/108 (7.4%) nurses and midwives were not familiar with universal precautions. All nurses and midwives and 69/88 (78.4%) surgeons knew the reporting procedure. Reasons for not reporting included considering injuries to be an occupational hazard (20/32, 62.5% surgeons but no nurses or midwives, P=0.03), patient not considered to be high risk (29/32, 90.6% surgeons OR 9.7, 95% CI 0.98-95.67, P=0.08).
Cutter J, Jordan S (2004)	χ^2 test and *t*-test	Cross sectional survey of nurses, midwives and surgeons in one Welsh NHS trust (n=200). Response rate 72.5%. Findings: Only 1.5% of respondents adopted universal precautions for exposure prone procedures. On average only half the recommended theatre specific precautions were adopted (mean 3.725/7, SD=1.385). Most respondents (63.3%) admitted making judgements related to lifestyle, nationality or sexual orientation when making decisions about protective clothing. 74% (145/196) respondents reported sustaining an inoculation injury in the previous 10 years however, 32.4% (47/145) did not report their injury.
Dodds RDA, Guy PJ, Peacock AM, Duffy SR, Barker SGE, Thomas MH (1988)	McNemar's test of association	Quasi-experimental study undertaken in the UK to investigate the bacterial contamination on surgeons' hands before and after surgery and the effect of glove perforation on the bacterial counts. Findings: 582 gloves were tested and 74 perforations were found (12.7%). One or more perforations were present in 34.5% of operations. In 85% of cases the perforation was the result of a needle prick not glove tear and in 50% the operator was unaware of the perforation. Glove perforation did

		not increase the bacterial contamination of the surgeons' gloves or hands.
Duff SE, Wong CKM, May RE (1999)	None	Telephone survey of occupational health departments (n=11) and on-duty general surgical and orthopaedic registrar grade surgeons (n=26) in the South West region. Findings: All occupational health departments were aware of Department of Health guidelines on PEP. All had either implemented a local policy or had nearly completed implementation of a policy related to the guidelines. All offered triple therapy 24 hours a day for HCWs occupationally exposed to HIV. Only 8 surgeons were aware of the DOH guidelines; 10 were aware that local guidelines existed but only 2 of these were familiar with the local policy. Only 10 hours knew the time within which PEP must be administered. No surgeon knew the correct estimated seroconversion rate after a needlestick injury from an HIV infected patient.
Endo S, Kanemitsu K, Ishii H, Narita M, Nemoto T, Yaginuma G, Mikami Y, Unno M, Hen R, Tabayashi K, Matsushima T, Kunishima H, Kaku M (2007)	Not specified.	Prospective study to detect blood splatter on face masks of Japanese surgeons and scrub nurses. 600 face masks in 200 procedures. Findings: Blood splatter was found among lead surgeons, first assistants and nurses in the ratio of 85.5%, 68.5% and 46% ($P<0.01$). A statistically significant difference was found between splatter during cardiovascular surgery (75.3%) compared to orthopaedic surgery (60%) and cardiovascular and gastrointestinal surgery cases (60%) ($P<0.01$).
Fisman DN, Harris AD, Rubin M, Sorock GS, Mittleman MA (2007)	χ^2 test, unpaired t test, Wilcoxon rank-sum test	Case cross over study of healthcare workers reporting to employee healthcare clinics for evaluation of sharps injuries (n=350). Findings: 109/350 (31%) subjects were medical trainees. Trainees worked more hours per week ($P<0.001$) and slept less the night before an injury ($P<0.001$) than other HCWs. Fatigue increased injury risk in the whole study population (IRR 1.4, 95% CI 1.03-1.90) but this effect was limited to medical trainees (IRR 2.94, 95% CI 1.71-5.07) and was absent for other HCWs (IPP 0.97, 95% CI 0.66-1.42) ($P<0.001$)
Gańczak M, Szych Z (2007)	χ^2 test, Mann-Whitney *U* test, Kruskal-Wallis test	Questionnaire survey of Polish nurses (n=601) to identify level of compliance with PPE. Findings: Compliance with glove use was 83% but only 9% for protective eyewear. Only 5% of respondents routinely used gloves, masks, gowns and protective eyewear when in contact with potentially infective material. Nurses who had a high to moderate fear of contracting HIV were more likely than nurses with no fear to comply (($P<0.005$ and 0.004 respectively). Training in infection control and experience in caring for HIV positive patients significantly improved compliance ($P<0.001$).
Gańczak M, Milona M Szych Z (2006)	χ^2 test, Mann-Whitney *U* test	Analytic cross sectional survey of 601 nurses from 18 hospitals in Poland. Response rate not specified. Findings: 45.9% of respondents had a puncture wound in the past

		year. The number of injuries was significantly less in those who had undertaken HIV/AIDS training compared to those who hadn't (56.7% vs 41.7%. 95% CI 5.8%-24.1%, P=0.002). 74.4% of respondents did not report injuries. The most common reason for underreporting was the assumption that patients were not infected (38.1%). Reporting was not influenced by HIV/AIDS training.
Gerberding JL, Littell C, Tarkington A, Brown A, Schecter WP (1990)	χ^2 test, Fisher's exact test, logistic regression	Observational study of 1307 consecutive surgical procedures in the US to record exposures to blood and body fluids, determine the factors predictive of these exposures and identify interventions to reduce exposures. Validation study to observe 50 additional procedures to determine the accuracy of data collection. 960 gloves used by surgical personnel were examined for perforations. Findings: Accidental exposure to blood occurred during 84 procedures (6.4%, 95%CI 5.1-7.8%). Parenteral exposure was the most common, occurring in 1.7% of procedures. Risk of exposure was highest when the procedure exceeded 3 hours (OR 1.63, 95% CI 1.27-2.11) and resulted in excess of 300mls blood loss (OR 1.6, 95% CI 1.24-2.06), during intra-abdominal gynaecological procedures (OR 1.82, 95% CI 1.18-2.8) .
Gershon RRM, Vlahov D, Felknor SA, Vesley D, Johnson PC, Delcos GL, Murphy LR (1995)	χ^2 test, multiple logistic regression.	Questionnaire survey of US hospital based physicians, nurses, technicians and phlebotomists (n=1726) to identify compliance with universal precautions. Response rate 57%. Findings: Compliance varied: glove use 95%, disposal of sharps 95%, protective outer clothing 62%, eye protection 63%. Compliance was influenced by: perceived organisational commitment to safety; perceived conflict of interest between workers' need to protect themselves and care for patients; risk taking personality; perception of risk; knowledge regarding routes of transmission and training in universal precautions. Females workers had higher overall compliance that males (P<0.05), geographical location affected compliance (P<0.01).
Gershon RRM, Pearse L, Grimes M, Flanagan PA, Vlahov D (1999)	Not specified	Pre and post interventional study to determine the effect of a multi focussed interventional programme on sharps injuries in the US. Sharps injury data collected over 9 years, before and after implementation of sharps prevention interventions including anti needlestick intravenous catheter ad new sharps disposal system. Findings: incidence rate of sharps injuries fell from 82 injuries per 1000 WTE employees pre-intervention to 24 injuries per 1000 WTE employees (P<0.001). The injury rate for intravenous lines fell by 93%, hollow bore needlesticks by 75% and non-hollow bore needlesticks by 25%.
Gershon RRM, Flanagan PA, Karkashian C, Grimes M,	Not specifed	Questionnaire survey of US HCWs (n=65) to assess HCWs experience of a post exposure bloodborne pathogen management programme. Response rate 43%.

Wilburn S, Frerotte J, Guidera J, Pugliese G (2000a)		Findings: The majority of reported injuries were needlesticks (35/65, 56%) followed by cuts (14/65, 22%), blood splashes to eyes and mouth (13/65, 21%) and to open wounds (6/65, 10%). Most HCWs (n not specified) were satisfied with the follow up they received but many perceived a lack of social support during the follow up period. Long term stress following the incidents was common. Many would have liked department managers to be more personally involved when their staff members have an inoculation injury.
Gershon RRM, Karkashian CD, Grosch JW, Murphy LR, Escamilla-Cejudo A, Flanagan PA, Bernacki E, Kasting C, Martin L (2000b)	Descriptive statistics, Croncbach's α, logistic regression	Questionnaire survey of hospital based HCWs (n=789) to determine hospitals' commitment to bloodborne pathogen risk management programmes. Response rate 60%. Findings: Senior management commitment for safety programmes (OR2.3, 95% CI 1.5-3.4), absence of workplace barriers to safe working practices (OR 1.5, 95% CI 1.0-2.3), cleanliness and tidiness of the work site (OR 3.3, 95% CI 2.2-4.9) were significantly related to compliance. Senior management support (OR 0.56, 95% CI 3.8-0.81) and frequent feedback were significantly related to workplace exposure incidents (OR 0.42, 95% CI 0.21-0.82).
Gillen M, McNary J, Lewis J, Davis M, Boyd A, Schuller M, Curran C, Young CA, Cone J (2003)	Student's *t*-test, χ^2 test, Mann-Whitney *U* test	Sharps injury surveillance project of 2532 healthcare facilities in California to determine whether a low cost sharps registry could be establishes to evaluate the circumstances surrounding sharps injuries. Findings: Nurses sustained the most injuries (n=658). Hospital injuries occurred during taking blood, injections or assisting with a procedure such as suturing (approximately 20% each).
Gould D, Chamberlain A (1997)	Analysis of covariance	Quasi experimental study on qualified nurses in 4 wards of a UK hospital to assess the feasibility of using a ward based teaching package to enhance nurses' compliance with infection control precautions. Two wards were randomly selected to act as experimental wards where nurses received an educational intervention and 2 control wards closely matched to experimental wards in terms of workload and patient profile. 51 nurses initially recruited but data only collected from 31 nurses at 3 month follow up. Findings: Teaching sessions were well evaluated and the workplace was considered a suitable environment for delivery. Heavy and unpredictable workload prevented the teaching programme being delivered as planned. Half the sessions were cancelled at short notice. There was no difference in performance between the experimental and control groups at 3 months e.g. hand decontamination: experimental group - 13.94% of the time after clinical contact and 13.13% by the controls at the first observation and 12.75% and 14.86% at the second observation respectively. Mean duration of hand decontamination 5.02 and 5.33 seconds by the

		experimental group and control group respectively at the first observation and 4.8 and 4.72 seconds at the second observation.
Green SE, Gomptertz RHK (1992)	χ^2 test	Electronic testing of surgeons' gloves pre and post operatively (n=220) for rates of glove perforation in an anastomosis training workshop and general elective surgery procedures in the UK. <u>Findings</u>: During 61% of operations, at least one member of the team perforated a glove. Only 15 (29%) realised that a glove was perforated. Glove perforation was less common among trainees during the training workshop that during surgery (17% vs 46%, P<0.005) probably because perforation commonly occurs during wound closure. Among surgeons, consultants had a lower perforation rate than trainees (26% vs 46%, P<0.005)
Green-McKenzie J, Gershon RRM, Karkashian C (2001)	Descriptive statistics, odds ration, regression, Cronbach's α	Cross sectional survey to determine the relationship between the availability of PPE and safety devices on infection control practices in a prison healthcare system. Questionnaire sent to full time HCWs in Correctional Healthcare Facilities in Maryland (n=225). Response rate 64%. <u>Findings</u>: Individual PPE were significantly more likely to be used if readily available e.g. eye protection (OR 5.5 95% CI 2.8-10.8), mask (OR 2.9, 95% CI 1.2-7.3), waterproof gown (OR 4.5, 95% CI 2.1-9.7). Respondents did not perceive a strong organisational commitment to safety.
Haiduven D.J., Simpkins S.M., Phillips E.S., Stevens D.A. (1999)	None	Survey of practitioners including physicians, nurses, dentists, nurses aides and operating department technicians in the USA (n = 549). Response rate undetermined as some personnel may have completed more than one questionnaire. <u>Findings</u>: 80% of physicians and 45% of nurses did not report injuries. Reasons included no perception of risk (26%), too busy (9%), dissatisfaction with follow-up (8%).
Halpern SD, Asch DA, Shaked A, Stock P, Blumberg EA (2006)	χ^2 test, 2-sample t tests, Wilcoxon-rank sum test. Multivarable logistic regression.	Questionnaire survey of American transplant surgeons (n=347). Response rate 56.1%. <u>Findings</u>: 70/311 (22.5%) surgeons received fewer than the recommended 3 doses of hepatitis B vaccine. The following were associated with inadequate vaccination: length of clinical practice (OR 1.5 per 10 year increment in duration of practice 95% CI 1.2-2.2), increased fear of infection (OR 1.2 for each unit increase in fear out of 10 95% CI 1.1-1.4), lack of recent testing for HBV infection (OR 2.0, 95% CI 1.1-3.8). Surgeons under estimated the risk of percutaneous infection and becoming infected with HBV.
Hartley JE, Ahmed S, Milkins R, Naylor G, Monson JRT, Le PWR (1996)	Fisher's exact test.	RCT conducted in the US, 85 operations. <u>Findings</u>: 14/39 pairs of gloves worn when using cutting needles were perforated and 3/46 worn during blunt needle closure (P<0.001). Injuries were mainly to the non-dominant hand. Surgeons were aware of 8/14 sharp needle perforations and 1/3 blunt needle perforations. Blunt needles

		significantly reduced the risk of needlestick injury ($P<0.001$). Surgeons unanimously agreed that surgical technique was not compromised by using blunt needles.
Henry K, Campbell S, Collier P, Williams CO (1994)	Logistic regression, χ^2 test	Direct observation of 1822 procedures in 2 emergency departments in the USA followed by a survey of 102 personnel. Response rate 52%. <u>Findings</u>: Self reported rates of compliance were lower than observed rates except for goggle use. Blood contamination of ungloved hands occurred during 37/759 (4.9%) interactions (95% CI 3.3-6.4%). Blood contamination of gloved hands occurred in 77/804 (9.6%) interactions (95% CI 7.6-11.6%). This difference was significant ($P<0.001$). Compliance with universal precautions was poor because of: lack of time (68%), low risk (59%), protective clothing interferes with dexterity (57%), forget (44%), learned skills without universal precautions (33%), lack of availability of equipment (33%), don't know when to use precautions (10%). Needle recapping was observed on 224/651 occasions (34.4%) (95% CI 30.8-38.0%). Mask use was dependent on age, as age increased, mask use decreased (R^2=0.007). Glove use increased as bleeding increased (R^2=0.05), glove use also increased for male patients (R^2 0.06). Goggle use was higher as age decreased (R^2 =0.25)
Hettiaratchy S., Hassall 0., Watson C., Wallis D., Williams D. (1998)	χ^2 test	Study 1 - Descriptive survey among 300 junior doctors in 2 UK hospitals. Response rate 56%. Study 2 – Descriptive survey among 70 doctors at a third hospital. Response rate 83%. <u>Findings</u>: Results from both surveys were combined. Only 17.5% of needlestick injuries reported. Surgeons were less likely to report injuries than physicians (12.6% vs 28.3%, $P<0.01$) despite having a slightly higher rate of injury (mean number of injuries a year for surgeons 0.88/year vs 0.35/year for physicians, $P<0.01$) Gloves were not used for most routine procedures.
Holtzman R, Liang M, Nadiminti H, McCArthy J, Gharia M, Jones J, Neel V, Schanbacher CF (2008)	χ^2 test and Fisher's Exact Test and logistic regression	Inspection of gowns and visors for blood droplets. 349 surgeons (response rate almost 50%) and 500 operations conducted in the USA. Findings: blood splashes to 20.2 – 56.4% of gowns (P=0.0014) and 21.5-57.4% of face shields (P=0.0028). 76.5% of surgeons always wore eye protection but of these 33.3% classed prescription glasses as protective. 55% noticed the contamination after surgery. 91.6% believed HIV and hepatitis C could be transmitted via conjunctival splashes and 45% would be influenced in their choice of precautions by the patients' status.
Huang J, Jiang D, Wang X, Lui Y, Fennie K, Burgess J, Williams A (2002)	Not specified	Quasi experimental study to evaluate the effect of an education training programme on universal precautions for hospital nurses in China. Randomly selected sample (n=50) received training, 100 nurses sent a questionnaire prior to and 4 months following training. Response rate to survey 49/50 (98%) in each group. <u>Findings</u>:

		Knowledge (P<0.01), self reported practice (P<0.01) and behaviours related to universal precautions (P<0.01) and the prevalence of HBV immunisation improved among those who had received training (P<0.01). No significant difference was found in the frequency of glove use. Under-reporting of inoculation injuries was common.
Hunt J, Murphy C (2004)	Descriptive statistics including visual and numerical summaries.	Data on reported occupational exposures to blood and body substances (OE) were collected from the 12 months before (n=21) and 24 months following an educational programme (n=40). The study was conducted in Australia. Findings: In the operating theatre in 1999 six types of device were implicated in OEs and 3 in 2000 and 2001. The decrease in number of implicated devices may reflect in increased awareness of causes of OE, increased use of personal protective equipment or the impact of interventions such as the elimination of passing sharps by hand.
Ippolito G, De Carli G, Puro V, Petrosillo N, Arici C, Bertucci R, Bianciardi L, Bonazzi L, Cestrone A, Daglio M, Desperati M, Francesconi M, Migliori M, Monti A, Perna MC, Pietroban F, Jagger J (1994)	Cornfield's appropximation, χ^2 test.	Longitudinal survey in 12 Italian acute care public hospitals to document the device specific injury rates and time trends for different hollow bore needles and to compare rates with those in the USA. Findings: Total of 2524 injuries reported. Disposable syringes and needles accounted for 59.3% of injuries, followed by winged steel needles (33.1%), intravenous catheter stylets (5.4%) and vacuum tube phlebotomy needles (2.2). Intravenous catheter stylets had the highest injury rate (1.5 per 100,000 devices used). Nurses accounted fro 69.8% of injuries, housekeepers 13% and doctors 10%
Ippolito G, Puro V, De Carli G and the Italian Study Group on Occupational Risk of HIV Infection (1993)	Poisson distribution	Five year multicentre study of 29 acute hospitals in Italy to investigate the circumstances surrounding inoculation injury and precautious used. Data on the HIV status of the patient was collected. HCWs were followed up for HIV at 1, 3, 6 and 12 months. Findings: 1592 HIV exposures were reported in 1534 HCWs. Most exposures occurred in nurses (67%) followed by physicians and surgeons (17.5%). Needlesticks were the most common injury (58.4%) followed by non intact skin and mucous membrane contamination (22.7% and 11.2%) and cuts (7.7%). 77.5% of source patients were known or suspected to be infected. Two seroconversions were observed among 1488 HCWs followed up for 6 months. The seroconversion rate was 0.1% after percutaneous exposure and (1/1003, 95% CI 0.006%-0.55%) ad 0.63% after mucous membrane contamination (1/158, 95% CI 0.018%-3.47%).
Jagger J, Bentley M, Tereskerz P (1998)	None	Surveillance study of occupational blood exposures in the operating room at 6 US hospitals over 15 months to identify risk patterns and prevention strategies. Findings: A total of 481 exposures were reported including 386 percutaneous injuries and 95

		mucocutaneous injuries Surgeons had the highest frequency of injuries (55.1%) followed by scrub nurses (19.1%). A significant number of sharps injuries could be prevented by use of safety devices. Use of blunt suture needles could reduce injuries by 30%. Increased use of barrier precautions is indicated to prevent mucocutaneous exposures. HCWs eyes were identified as the most vulnerable area.
Khoo SK, Ibester A (1999)	χ^2 test.	Prospective trial, 326 pairs of gloves from 100 operations carried out in Australia. Findings: At least 1 perforation was present in 37 operations. The difference in rate of perforation between professions was not statistically significant (P=0.7). In operations of <1 hour duration the rate of perforation was half that in operations > 1hour (P<0.02). In operations classified as easy, the rate of perforation was 20% compared to 43% and 35% respectively when the operations were considered standard or difficult. In very difficult operations, the rate was 69%. These differences were statistically significant (P<0.01).
Kiertiburanakul S, Wannaying B, Tonsuttakul S, Kehachindawat P, Apivanich S, Somsakul S, Malathum K (2006)	None	Review of potential exposures to HIV to assess PEP regimens used and side effects experienced among healthcare workers in Thailand. Findings: Between 1998 and 2003, 820 exposures that carried a risk of HIV transmission in 816 HCWs were registered. Nurses were the largest group affected (27%) followed by medical students (21%) and nurses aides (17%). Sixty four HCWs were prescribed HIV PEP. The regimen was changed in four (6%) because of adverse drug reactions. Overall, 18 (28%) reported some symptoms when on PEP. Symptoms included nausea (33%), vomiting (20%), dizziness (14%), fatigue (12%), diarrhoea (6%), rash (2%), hepatitis (2%), haematuria (2%), Abdominal pain (2%), anorexia (2%) and flu like symptoms (2%). Two HCWs had serious adverse effects.
Kim LE, Jeffe DB, Evanoff BA, Mutha S, Freeman B, Fraser J (2001)	χ^2 test.	Observation of cardiothoracic, general, gynaecologic and orthopaedic surgical personnel in a US operating theatre prior to and 1 and 2 years following implementation of an educational intervention designed to improve compliance with universal precautions. Findings: Use of eye protection (54% to 66% P<0.001), and double gloving (28% to 55% P<0.001) increased following the intervention while incidence of documented blood and body fluid exposures decreased from 17 per 200 observed hours pre-intervention to 24 per 545 hours post intervention (P=0.042).
Knight VM, Bodsworth NJ (1998)	χ^2 test, Student's *t*-test.	Descriptive survey of 400 Australian nurses to determine the degree of understanding and utilisation of universal precautions. Response rate, 48%. Findings: Overall, 146 (76%) of nurses experienced 230 occupational exposures in the previous six months. These were more common in men (P=0.024). Percutaneous exposures were more

		common in nurses who stated they did not wear gloves when handling blood/blood equipment (P=0.036). Mucocutaneous exposures were more common in nurses who stated they did not adhere to universal precautions at all times (P=0.005). 83% did not report all exposure incidents. 73% claimed to use universal precautions at all time. Nurses with a good knowledge of HBV transmission were most likely to follow universal precautions.
Korneiwicz DM, Laughton BE, Cyr BH, Larson E (1990)	Mann-Whitney *U* test, χ^2 test, Fisher's exact test	Examination of 240 pairs of vinyl and 240 pairs of latex examination gloves to determine leakage of virus through the gloves. Suspensions of bacteriophage solution were prepared and added to phosphate buffered saline. Control gloves were punctured in the index finger and one latex glove was torn approximately 1cm at the index finger The solution was added to the gloves to fill the fingers and observed for leaks. Study conducted in the USA. <u>Findings</u>: None of the latex gloves with holes had visible leaks or were positive to viral leakage. Torn latex glove had visible and viral leakage. Two punctured vinyl gloves had both visible and viral leakage. Viral leakage was found in 22.9% (55/240) of vinyl gloves and 7.5% (18/240) of latex gloves (P<0.005). In 14.1% (34/240) of vinyl gloves and 7% (16/240) latex gloves visible leaks were not observed but virus still leaked through.
Krikorian R, Lozach-Perlant A, Ferrier-Rembert A, Hoerner P, Sonntag P, Garin D, Crance J-M (2003)	Student's *t*- test, ANOVA.	Experiment to determine parameters affecting the volume of blood transferred through gloves. 135 experiments. 3 types of gloves – standard powder free latex, G-VIR (see Bricout *et al*, 2003) virucidal gloves and gloves similar to G-VIR without disinfectant. <u>Findings</u>: Transferred blood volume increased with the puncture depth (P<0.001). Volume of blood transferred increased with needle diameter and needle bore (P<0.001). Single glove layer reduced 52% of transferred blood volume (P<0.001), but no further reduction was seen with double gloves (P=0.93). The G-VIR glove caused an 81% reduction in the transmission of infectious virus (P<0.001).
Lamontagne F, Abiteboul D, Lolom I, Pellisier G, Tarantola A, Descamps JM, Bouvet E (2007)	χ^2 test, Fisher exact test, Pearson correlation coefficient	Multicentre prospective survey with 1 year follow up to evaluate safety engineered devices with respect to their effectiveness in preventing needlestick injuries. Questionnaire survey of 1506 nurses across 102 medical units in 32 French hospitals. <u>Findings</u>: A total of 110 needlestick injuries were recorded between April 1999 and March 2000. Data were compared to a similar survey in 1990 before the introduction of safety devices. The use of safety devices was associated with a 74% lower risk (P<0.01). The mean needlestick injury rate for all relevant nursing procedures was estimated to be 4.72 cases per 100000 procedures for a 75% decrease since 1990 (P<0.01)> Decrease varied according to procedure. Between 1990 and 2000

		decreases in the needlestick rates for each procedure were strongly correlated with increases in the frequency of safety device use
Lawton R, Parker D (1999)	ANOVA	Survey of doctors, nurses and midwives (n=315) from 3 English NHS trusts. Response rate 53%. Findings: Healthcare professionals are reluctant to report adverse events to a superior. HCPs are more likely to report to a colleague (P<0.001). Reporting to a senior member of staff is most likely when the incident involved a violation of protocol (P=<0.001).
Lee CH, Carter WA, Chiang WK, Williams CM, Asimos AW, Goldfrank LR (1999)	χ^2 test	Questionnaire survey to investigate the epidemiologic characteristics of potentially infectious occupational exposures to blood among emergency medical residents in the USA (n=2985). Response rate 94.4%). Findings: 56.1% participants reported at least on exposure during their training, frequency of exposure increased with advancing level of training (P<0.001). Of these, 36.6% always followed universal precautions, 54% frequently and 9.4% sometimes, rarely or never. Respondents who always used universal precautions sustained fewer exposures than other groups (P<0.001). Latest exposures most commonly caused by solid needle or sharp object (39.4%), hollow bore needle (30.6%) or by eye splashes (17.2%). Only 46.7% were reported.
Lefebvre DR, Strande LF, Hewitt CW (2008)	General linear model univariate ANOVA. Bonfferoni corrected t-tests for number of glove layers. Assumption of equal variances between groups by Levine's test for equality of variances.	Experiment to quantify the volume of inoculation by suture needles through 0-3 layers of glove material, 160 needlesticks. Location of study not specifed. Findings: Double glove layering was superior to single glove layering at removing contaminant (P<0.01, 95% CI 3.26-30.35). No extra benefit from triple glove layering (P=0.9, 95% CI -10.35-12.16). Tapered needles had 97% of contaminant removed compared to the no glove control (P=0,001, 95% CI 123.12-242.18). Double glove layering reduced inoculation by an additional 71% compared to single glove layering when cutting needles were used (P=0.002, 95% CI 13.49-51.76).
Leliopoulou C., Waterman H., Chakrabarty S (1999)	χ^2 test	Descriptive survey among nurses in one UK hospital (n = 133) to examine nurses' perceptions of the risk of contracting infection following exposure to blood or body fluids. Response rate, 46%. Findings: nurses often under-estimate the risk of inoculation injuries. Those working in high risk clinical areas were more likely to believe that there was a high risk of infection compared to nurses working in low risk

		areas (23% compared to 0%). Those who viewed the risk of infection as real were most likely to follow universal precautions.
Ling ML, Wee M, Chan YH (2000)	χ^2 test	Retrospective review of sharps and needlestick injuries among HCWs in a Singapore hospital between 1992 and 1997 (n=347). Findings: 45.7% of injuries occurred among nurses, 25.1% among doctors, 7.5% among health attendants, 5.2% among hospital cleaners and 3.7% among laboratory technicians. Increase in incidents reported by doctors following implementation of educational talks to new medical staff. The number of HCWs with no history of HBV vaccination decreased from 17 in 1996 to 9 in 1997 (P<0.001, OR 1.806, 95% CI 1.443-2.261) after the implementation of a hospital wide vaccination programme.
Lymer U.B., Antonsson Schultz A., Isaksson B. (1997)	χ^2 test	3 part descriptive study conducted in Sweden. Part 1 - a review of 473 occupational injury reports over a 2 year period. Part 2 – questionnaire survey of HCWs who had reported injuries, n = 108, response rate, 90%. Part 3 – questionnaire survey of HCWs, n = 517, response rate 76%. Findings: 245 blood exposure incidents were reported in 1993 and 228 in 1994 with an average of 20 reports per month. Needlestick injuries were the most common inoculation injury. Nurses were most at risk (P<0.01). Adequate precautions were often not taken. 87% of accidents could have been prevented had precautions been followed. Physicians reported injuries via the appropriate channels less frequently than other professional groups (P<0.01).
Lymer U-B, Richt B, Isaksson B (2004)	Content analysis	Grounded theory approach towards identifying factors promoting HCWs' compliance with guidelines in connection with risk. Semi structured interviews of 9 nurses and 6 nursing assistants in Sweden. A multitude of factors other than simply information about safe practices contribute to compliance.
Lynch and White (1993)	Logistic regression	Review of data from surgical cases in nine US hospitals (n=8502) to determine rate of incident reporting. For three of the participating hospitals, incident reports of exposures in the 12 months before the study were also recorded. Findings: 864 cases resulted in one or more blood contacts to 1054 individuals (12.4% person contact rate). Of the contacts, 132 were punctures (2.2% person exposures per case). Incidents were under reported by a factor of approximately 25.
Madan AK, Raafat A, Hunt JP, Rentz D, Wahle MJ, Flint LM (2002)	χ^2 test and Fishers Exact Tests	Questionnaire survey of healthcare practitioners involved in trauma resuscitations in the USA (n=123). Response rate 76%. Findings: 114/123 (93%) of respondents had suffered at least one exposure, usually skin contact, to blood or other body fluids. 105/123 (85%) wore gloves; 58/123 (47%) wore protective eyewear without side protectors; 20/123 (16%) protective eyewear with side protectors; 22/123 (16%)

		gowns, 5/123 (4%) masks. Reasons for non compliance included time (61%) and barriers are too cumbersome (29%). Observed compliance rates were lower than self reported rates (P<0.02).
Maffulli N, Capasso G, Testa V (1991)	χ^2 test	Quasi-experimental study to identify glove perforation in paediatric orthopaedic surgery. Gloves from surgeons performing 100 operations on patient up to 16 years old were tested for holes. 20 unused pairs were tested as controls. Findings: 108 gloves (14%) showed signs of perforation, surgeons knew gloves had been perforated only 8 times. Perforation rate for surgeons and scrub doctors was higher than that of assistants (P=0.039). Perforation was significantly increased in operations lasting >31 minutes (P not stated). The right thumb and index finger were most commonly perforated (P=0.038).
Makary MA, Pronovost PJ, Weiss ES, Millman EA, Chang D, Baker SP, Cornwell EE, Syin D, Freischlag JA (2006)	None	Assessment of suitability of procedures for sharpless surgery, 91 surgical procedures included. Study conducted in the USA. Alternatives were used in place of scalpel incisions (electrocautery) and needle suturing (staples, surgical tape or adhesive) in 358 consecutive operating room procedures falling into 28 different types of procedure. Findings: 25.4% of operations were identified pre-operatively as suitable for sharpless surgery. Of these, 86.8% were successfully completed without sharps. There were no complications attributable to the techniques used.
Makary MA, Al-Attar A, Holzmueller CG, Sexton B, Syin D, Gilson MM, Sulkowski MS, Pronovost PJ (2007)	χ^2 test, Kruskal-Wallis, logistic regression	Survey of surgeons in training at 17 US medical centres (n=699). Response rate 95%. Findings: 99% had sustained a needlestick injury by their final year of training. Of the most recent injuries 51% were not reported, 16% of injuries involving high risk patients were not reported. Lack of time was the most common reason for not reporting. Stepwise multivariate analysis identified 5 factors associated with non-reporting: male sex (P=0.03), patient not high risk (P<0.001), occurrence in operating room (P=0.008), lack of knowledge of injury by another person (P<0.001), total number of injuries in training (P=0.002).
Malhotra M, Sharma JB, Wadhwa L, Arora R (2004)	χ^2 test, Fisher's exact test	Prospective study to assess glove perforation rates in 156 obstetric and gynaecology procedures conducted in India. Inspection of 1120 gloves for signs of perforation. Findings: 32 procedures (20.5%) were carried out using a single pair of gloves despite a double gloving protocol being introduced because surgeons felt uncomfortable double gloving. Overall puncture rate was 13.6% (13.8% single vs 13.2% double, P>0.005). Matching perforations found in 4.6% of cases therefore, protection offered by double gloving was 95.4%. Emergency cases had a higher perforation rate than elective cases (16.6% vs 10.8%, P<0.001). Surgery of more than

		40 minutes duration had a higher perforation rate than those completed in <40 minutes (18.6% vs 7.6%, P<0.001).
Mangione C.M., Gerberding J.L., Cummings S.R. (1991)	χ^2 test	Cross sectional survey of house officers in 3 US hospitals (n=86) to study the frequency of work related exposures to HIV and reporting of injuries among house staff. Response rate, 72%. Findings: During the 12 month prior to the survey, 58 needlestick injuries were recalled by the 86 respondents, 81% (47/58) of these were among year 1 or year 2 trainees (P=0.0004) and all of the 9 injuries contaminated with HIV were among this group (P=0.05). Only 30% of inoculation injuries were reported for the following reasons: lack of time (32%), did not know reporting procedure (26%), did not feel their injury constituted a significant occupational exposure (26%), concerns about confidentiality (17%), fear of discrimination (14%).
Manias and Street (2000)	Textual analysis of the ethnographic accounts	Ethnographic study of six nurses working in a critical care setting in Australia examining the power relations between doctors and nurses, among nurses, and the ways in which nurses used policies and protocols as a means of mediating communication. Findings: Policies and protocols provided nurses with legitimacy of their knowledge while doctors tended to rely on past clinical experience and background to inform their knowledge activities. Nurses believed they required written evidence through policies and protocols to provide valued and collaborative input into patient decisions. Doctors valued their professional authority over policies and protocols while nurses used them to assert power and demonstrate resistance.
Maracaso S, Woods S (1998)	χ^2 test.	Prospective trial, 160 masks of Australian surgeons and assistants. Findings: 44% (71/160) of eye shields tested positive for blood using 6.8% diisopropylbenzene dihydroperoxide impregnated sticks. In only 26 cases (16%) were the splashes visible to the naked eye. The surgeon was aware of only 13 cases (8%). Minor surgery fewer splashes than other surgery (P<0.05). The authors claim that risk of splash increased significantly with duration of operation (65% in operations of 2 hours or more, no probability reported).
Matta H, Thompson AM, Rainey JB (1988)	χ^2 test.	Quasi-experimental study in which surgeons (n=10) and scrub nurses (n=9) wore double gloves during 144 general surgical operations in a UK hospital. Each glove was tested post operatively for punctures. Findings: Punctures were detected in 77/728 (11%) outer gloves tested and occurred most often in surgeons (52/288, 18%) compared to assistants (12/254, 5%, P<0.001) or nurses (13/186, 7%, P<0.005); 15/77 inner gloves worn in these cases were also punctures giving an overall inner glove puncture rate of 2%. No punctures were found in a control group of 20 unused

		gloves. In 37 operations the outer gloves were removed before the end because of discomfort or loss of sensitivity surgeons being more intolerant than assistants ($P<0.02$) or nurses ($P<0.01$)
McDonald R, Waring J, Harrison, Walshe K, Boaden R (2005)	Content analysis	Participant observation and semi-structured interviews of 14 surgeons, 12 anaesthetists and 15 nurses to determine views on rules and guidelines in clinical practice in the UK. Findings: Doctors rejected written rules in favour of what constitutes acceptable behaviour for members of the medical profession. Nurses viewed guidelines as synonymous with professionalism and criticised doctors for failing to comply.
Mehta A, Rodriguez C, Ghag S, Bavi P, Shanai S, Dastur F (2005)	None	Six year on-going surveillance of accidental exposure to blood and body fluids in a tertiary referral centre in Mumbai (n=380). Of those who reported injuries, 45% were nurses, 33% were attendees, 11% were doctors and 11% technicians. On source analysis 23, 25, and 12 were positive for HBV, HIV and HCV respectively. No staff had sero-converted after 6 months. Operating theatre instruments accounted for 126 injuries. Most injuries were the result of intravenous line insertion (n=126), blood collection (n=69), surgical blades (n=36) and recapping needles (n=36).
Mingoli A, Sapienza P, Sgarzini G, Luciani G, De Angelis G, Modino C, Ciccarone F, Feldhaus RJ (1996)	Fisher's exact test, logistic regression	RCT to measure the incidence of glove perforation in emergency abdominal procedures carried out in Italy. 200 patients were randomised to undergo fascia closure with either a sharp or blunt suture needle. Findings: In 25/200 procedures a needlestick injury was recorded, most (19/25, 76%) occurred during suturing. 151 perforations were recorded in 780 pairs of gloves (19%). Surgeons were most frequently contaminated - 14 needlestick injuries and 76 perforations recorded in 69 pairs of gloves ($P<0.00001$). Sharp needles were responsible for a higher needlestick injury rate than blunt needles ($P<0.02$, RR 15) and had a higher glover perforation risk ($P<0.00001$, RR 2.1).
Naing L, Nordin R, Musa R (2001)	χ^2 test	Questionnaire survey of Malaysian nurses (n=150) to assess the prevalence of and factors related to compliance with glove use. Response rate 98.4%. Findings: 91% of respondents knew about universal precautions but only 20/150 (13.5%) reported full compliance. Reasons for not using gloves included gloves being out of sock (46%), not being available at emergency site (44%), reduction of tactile sensation (39%). Knowledge of universal precautions principles was associated with glove use ($P=0.025$) - nurses who knew the principles of universal precautions complied with glove use in six or more procedures (61%) compared to those who did not know universal precautions (42%)

Nelsing S., Nielsen T.L., Nielsen J.O. (1997)	Poisson regression models	Descriptive study of doctors in Denmark (n = 6005). Response rate, 64%. Findings: Compliance with universal precautions was low. 73% with gloves, 32.3% with mask, 26.7% with eye wear. 80 – 98% of injuries would have been preventable if appropriate precautions had been followed. Low perception of risk since no Danish doctor has reported occupational acquisition of HIV.
Ng LN, Lim HL, Chan YH, Bin Bachok D (2002)	None	Retrospective review of incident report records (n=82) from 1997-2000 to identify the type of instruments, personnel and site of injuries involved in sharps injuries in a hospital in Singapore. Findings: Medical staff sustained most injuries (33/82, 40.2%) followed by nurses (22/82, 26.8%). Injection needles caused most injuries (19/82, 23.2%). An average sharps injury rate of 11 injuries per 100 medical staff and 6.9 per 100 nurses.
Osborne S (2003)	Not specified	Descriptive correlation study to investigate relationships between variables and compliance with standard precautions. Questionnaire survey of Australian operating room nurses (n=227). Response rate 45%. Findings: Double gloving compliance was greater in nurses with >2 years experience ($P<0.05$) and less for nurses working in small facilities ($P<0.05$), with few operating rooms ($P<0.05$). Nurses in New South Wales demonstrated highest compliance with double gloving ($P<0.05$). Significant relationship was also present between protective eyewear and state of employment. Compliance was lower in nurses employed in New South Wales than other states ($P<0.05$).
Patel D, Gawthorp M, Snashall D, Madan I (2002)	Fisher's exact test	Review of occupational health and accident and emergency records in a UK hospital to identify completeness of records and the appropriateness of management of body fluid exposures. Findings: A total of 177 body fluid exposures were reported. 109 (61.58%) were initially assessed by the occupational health department. Of those initially assessed in the accident and emergency department, only 21 (30.88%) attended occupational health for follow up. Occupational health department staff were more consistent on assessing and managing exposures and in a higher proportion of cases gave more appropriate advice on PEP
Patterson JMM, Novak CB, Mackinnon SE, Patterson GA (1998)	Student's *t*-test	Questionnaire survey of surgeons from 2 hospitals and 2 surgical societies (n=768) in the USA. Response rate 84%. Findings: Most surgeons (88%) expressed slight or moderate concern about contracting HIV, 81% were vaccinated against HBV. Only 12% always double gloved and 10.8% occasionally double gloved. The most important factor in double gloving was a patient with active HIV or hepatitis infection. Double gloving was less frequent in surgeons with less concern about

		transmission (P<0.001). Most surgeons under-estimated the seroconversion rates of HIV, HBV and HCV. 70% of surgeons never or rarely reported injuries.
Phipps W, Honghong W, Min Y, Burgess J, Pellico L, Watkins CW, Guoping H, Williams A (2002)	Not specified	Questionnaire survey of Chinese nurses (n=441) to establish the risk of medical sharps injuries. Response rate 93%. Findings: 415/441 (94%) of nurses were aware that the most common route of HBV transmission in HCWs is via needlestick injury. 71% of nurses were vaccinated against HBV, of the 127 (29%) not vaccinated 47 had already been infected with HBV. 55% of respondents never wore gloves for taking blood giving an injection (65%), starting an intravenous line (60%), cleaning a blood spill (13%) handling a blood sample (31%). Only 3(5 always washed their hands following contact with a patient. Recapping needles was practiced by 30% of nurses. 82% (361/441) had sustained a needlestick injury in the past year. Separating the needles before disposal compared to not separating the devices increased the risk of injury (RR 1.14, 95%CI 1.01-1.3, P=0.01). Risk also increased for nurses working in operating rooms (RR 1.11, 95%CI 1.02-1.2, P=0.04). Only 29/318 (8%) reported the injury.
Pronovost PJ, Weast B, Holzmueller CG, Rosenstein BJ, Kidwell RP, Haller KB, Feroli ER, Sexton JB, Rubin HR (2003)	χ^2 test	2 questionnaire surveys – Safety Climate Scale (SCS) to a sample of physicians, nurses, pharmacists and ICU staff, Strategies for Leadership (SLS) to clinical and administrative leaders. Findings: Staff perceived that supervisors had a greater commitment to safety than senior leaders. Nurses had higher scores than physicians for perceptions of safety.
Puro V, De Carli G, Petrosillo N, Ipplolito G, the Studio Italiano Rischio Occupazionale de HIV Group (2001)	Not specified	Prospective study - review of reported percutaneous (n=10,998) and mucocutaneous (n=3,361) injures to analyse the rate of occupational exposure to blood and body fluid by job category and work area. Findings: The highest rate of percutaneous exposure per 100 FTE staff was observed among general surgery (11%) nad general surgery (10.6%) nurses. The highest mucocutaneous rates were observed among midwives (5.3%) and dialysis nurses (4.7%). The highest combined HIV exposure rates were among nurses (7.8%) and physicians (1.9%) working in infectious diseases units. The highest rates of high risk percutaneous exposures was among nurses irrespective or work area, but the risk was higher in medical areas than surgical areas (OR 2.1, 95% CI 1.9-2.5, P<0.001).
Raboud C, Zanea A, Mur JA, Blech MF, Dazy D, May T, Guillemin F (2000)	χ^2 test, Kruskal-Wallis test, Spearman's correlation	Cross-sectional survey of French nurses and nursing students (n=964) to describe the behaviour after occupational exposure to blood, to study the reasons for not reporting and explore the links between personality traits and reporting. Response rate 69%. Findings: 947 nurses had been vaccinated against HBV but only 528/947 (56%) had

	coefficient, logistic regression	checked their level of immunity. Only 186/947 (17%) routinely wore gloves for all exposures to blood. There were 505 occupational exposures to blood recorded during the study period – 0.24 per person per year, only 48.5% of these were reported. Two factors were found to influence sustaining at least one occupational exposure: having a permanent position (OR 2.13 95% CI 1.55-2.93) and a higher degree of disinhibition (OR 1.08 95% CI 1.01-1.15). Four factors were found to influence sustaining a larger number of occupational exposures: having a permanent position (OR 2.76 95% CI 2.14-3.56) and a higher degree of disinhibition (OR 1.05 95% CI 1.00-1.10), being more susceptible to boredom (OR 1.10 95% CI 1.04-1.16) and having less nursing experience (OR 0.98 95% CI 0.96-0.99). Three factors were linked to reporting all injuries: younger age (OR 0.95 95% CI 0.92-0.99), having had at least one injury and having lower susceptibility to boredom.
Raghavendran S, Bagry HS, Leith S, Budd JM (2006)	None	Survey of 258 doctors, nurses and ODPs at two London hospitals. Response rate medical staff 90%, non medical staff 61%. Findings: 64% of respondents almost always followed universal precautions, 30% of doctors compared to 80% of nurses. 53% had suffered a needlestick injury and of these 66% had reported it. Only 54% were aware of the use of safety needle devices in their workplace.
Ramsey PW, Glen LL (1996)	*t* test, Pearson's correlation, logistic regression	Two cross sectional surveys of Tennessee nurses in 1991 (n=145), response rate 30% and 1993 (n=143), response rate 24% to investigate whether mandatory universal precautions changed nurses' body fluid exposure and reporting rates, HBV vaccination rates and HIV testing rates. Findings: Self reported needlestick injury rates decreased by 69% and other sharps injuries by 81% between 1991 and 1993. Only 4.1% (57/1385) of all exposure incidents were reported, no significant change between 1991 and 1993. HBV vaccines increased slightly from 61.4% to 82.5% (t=4.1, P=0.001) with an increase in HIV testing from 47.2% to 55.6% but this was not significant (t=1.42, P=0.016).
Rapparini C, Saraceni V, Lauria LM, Barroso PF, Vallozo V, Cruz M, Aquino A, Durovni B (2007)	χ^2 test, Fisher's exact test	Eight year surveillance of occupational exposure to bloodborne pathogens in 537 health units in Rio de Janeiro (n=15,035). Findings: Nearly 90% of exposures were percutaneous. Injuries were caused as follows: recapping needles (14%), performing surgical procedures or handling surgical instruments (14%). Handling trash (13%), disposal of sharps (13%), venepuncture (10%, blood collection (5%). Known source patients were reported in 11,204 exposures. PEP was initiated for 6911/15035 (46%) of exposed HCWs.
Rice JJ, McCabe JP, McManus F	Fisher's exact test.	RCT, 68 hip replacements. Findings: Operations were randomly selected for closure

(1996)		with standard pointed or blunted needles. Double gloves worn in all cases. All gloves tested for perorations following the procedure by filling with water. 7% of surgeons felt cuts on their hands preoperatively. 64 pairs of gloves were used in the control group (standard pointed needles). Punctures found in 16% of outer and 6% of the inner gloves. Blunted needles were used in 36 wound closures and no glove perforation was recorded (P=0.026).
Ronk L L, Girard NJ (1994)	None	Descriptive survey of 126 circulating nurses from 10 hospitals. Response rate not stated. Findings: Up to 86% of nurses felt they were at risk of HIV/HBV infection during surgery; 90% agreed that following universal precautions decreased the risk. 75% of nurses had attended training on universal precautions but 80% would change behaviour if they knew the HIV/HBV status of their patients.
Scouler A, Watt AD, Watson M, Kelly B (2000)	None	Questionnaire survey of 108 UK HCWs to assess awareness of occupational risk to bloodborne viruses. Response rate (44%). Findings: 76/108 (71%) believed their knowledge about bloodborne viruses was sufficient for their area of practice; 32/104 (29%) felt their knowledge was too low. 36/104 (33%) correctly answered that a splash of urine from an HIV positive patient was a low risk of transmission; 73/104 (68%) incorrectly stated that a bite from an infected patient was a high risk of HIV transmision63/104 (59%) correctly identified that a solid suture needle puncture of a surgeons glove during a procedure on an asymptomatic HIV positive patient carried a low risk of infection.
Schmidt K, Schwager C, Drexter (2007)	Descriptive analysis and χ^2 test	Questionnaire survey of hospital employees and medical students in a German university hospital (n=787), review of annual exposures to blood or body fluids (OEB) (n=203) and prospective review on the management of OEB (n=100). 29.5% of students and 22.5% of employees had sustained an OEB. 4.3% of nurses and 3.9% of doctors reported their injury, the mean rate of underreporting was 45%.
Sencan I, Sahin I, Yildirim M, Yesildal N (2004)	χ^2 test.	Questionnaire survey of 278 Turkish HCWs. Response rate 67%. Findings: 152 HCWs (55%) reported at least one exposure to blood and body fluids between October 2001 and October 2002, 77% (117) were sharps injuries and 58 (49.6%) were not wearing gloves at the time of the accident. The operating theatre was the major location of injuries (73%). 145/278 (52%) reported abrasions on the hands. Dermatologists did not find abrasions on the hands of 48 of these, but did find abrasions on the hands of 45 of those who reported none. Only 14% of exposures were reported to the occupational health department.
Shahid M, Leedham-Green M,	None	Observation study of 30 operations in a London teaching hospital, a London district

Breuer J (2005)		general hospital and a South African district hospital. <u>Findings</u>: All lead surgeons wore gloves and waterproof gowns. Double gloving was used in 5 of the 18 operations involving HIV positive patients. On 3 occasions blood entered a torn glove but a wound was not sustained. Each surgeon changed his gloves but did not wash hands. 2 South African surgeons wore protective eyewear. Double gloving was found to compromise dexterity. Adherence to universal precautions was only partly influenced by the risk of infection
Shiao JSC, McLaws ML, Huang KY, Chen W, Guo YL (1999)	χ^2 test and Fisher's exact test.	Questionnaire survey of 8645 full time medical, nursing, technical and support personnel from 16 Taiwanese hospitals to assess reporting rates. Response rate 82.6%. <u>Findings</u>: 87.3% (7550/8645) of respondents had sustained a recent sharps injury. Sharps injuries with a used item were more likely to be reported than those that involved clean item (OR 3.6, 95% CI 3.03-4.26, P<0.001). 81.8% of injuries were not reported. Medical staff had the highest non reporting rate (85.2%, 95% CI 83.2%-87.2%). Attendees at a training programme were more likely to report than those which had not (P<0.001), but reporting was poor in both groups (21.3% and 17.2% respectively). 21.7% failed to report because they felt the risk to be low.
Singh BI, Nurein H, Sinha S, Housden P (2006)	χ^2 test , Mann-Whitney *U* test and Wilcoxon signed ranks.	Prospective analysis of 110 sets of personal face and eye protection used for 29 hip replacements and 26 total knee arthroplasties. Survey of Fellows of the British Orthopaedic Association (n=1026). Response rate 68%. <u>Findings</u>: All eye protection demonstrated macroscopic contamination with an average of 203 blood and fat spots. Blood splashes were highest in total hip arthroplasties compared to total knee arthroplasties (P<0.001) while fat deposits were most common in total knee arthroplasties (P<0.001). 48% of respondents to the survey did not use eye protection routinely. 28% felt that none was needed, 48% felt it compromised their vision. Junior consultants more likely to wear face shields than senior consultants (P<0.001). 107 respondents (13%) reported being aware of eye contamination.
Smith DR, Wei N, Zhang Y-J, Wang R-S (2006a)	Logistic regression	Survey of Chinese physicians (n=361). Response rate 79%. <u>Findings</u>: 64% had sustained a needlestick injury in the past year. Surgical procedures accounted for 27.9% of injuries. A statistically significant correlation was found between needlestick injury and working in the intensive care unit (adjusted OR 5.3, 95% CI 1.7-23.4). Only 15.3% of physicians reported their injuries of which 10% went unreported because the individuals felt themselves not to be unlucky enough to get a disease.
Smith DR, Mihashi M, Adachi Y,	One way analysis	Cross sectional survey of Japanese nurses (n=1162). Response rate 74%. <u>Findings</u>:

Nakashima Y, Ishitake T (2006b)	of variance, χ^2 test, logistic regression.	46% of nurses had sustained a needlestick injury within the previous year. Younger nurses (<25 years old) were 2.18 times more likely to sustain a single needlestick injury (OR 2.18, 95% CI 1.15-4.17) and 2.39 times as likely to have sustained multiple injuries (OR 2.39, 95% CI 1.08-5.34). Working mixed shifts was associated with a 1.67 fold increase is injury (OR 1.67, 95% CI1.01-2.85). Reporting injuries was associated with high level of fatigue after work (1.94, 95% CI 1.03-3.71) and sub-optimal staffing (OR 2.21, 95% CI 1.06-4.89).
Smith DR, Choe M-AE, Jeong JS, Jeon MY, Chae YR, An GJA (2006c)	χ^2 test, logistic regression.	Questionnaire survey of nurses in Korea (n=330). Response rate (97.9%). <u>Findings</u>: 432 needlestick injuries were reported by 263 nurses (79.7%) in the previous year. Syringe needles were the most common device affecting 67.3% of nurses comprising 52% of all injures. Nurses working in departments other than intensive care units and inpatient departments were 5.4 times as likely to sustain an injury than other nurses (OR 5.4, 95% CI 2.0-11.6, P<0.05). Younger nurses (<27 years old) were 4.5 times more likely to sustain a single needlestick injury (OR 4.5, 95% CI 1.7-12.6, P<0.05). Working mixed shifts was associated with a 4.0 fold increase is injury (OR 4.0, 95% CI 2.—10.1, P<0.05).
Smith DR, Smyth W, Leggat PA, Wang R-S (2006d)	χ^2 test, logistic regression	Cross sectional survey of Australian nurses (n=220). Response rate 76.7%. <u>Findings</u>: 39 (17.7%) nurses reported 43 needlestick injuries in the previous 12 months. The most common device causing injuries were normal syringe needle (32.6%), insulin syringe needles (27.9%), intravenous needles (16.3%), blood collection needles (9.3%). Nurses working in maternity/neonatal wards were 0.3 times as likely to sustain a needles as those working in medical or surgical wards (OR 0.3, 95% CI 0.1-0.7). 59% of injuries were reported.
Smith JR, Grant JM (1990)	None	Quasi-experimental study to assess the incidence of glove puncture during caesarean section. Following 200 caesarean sections, the operators gloves were examined for punctures inflating with air and holding under water, 100 new pairs of gloves were examined as a control. The testing method was tested by perforating 40 pairs of gloves and examining for punctures in the same way. <u>Findings</u>: Three gloves (1.5%) of the control pairs were perforated. In the deliberately perforated gloves, the sensitivity and specificity of the testing method was found to be 100%. Of the 200 used pairs of gloves 107 (54%) were punctured. In only 60 cases (56%) was the perforation noticed by the surgeon.
Sohn S, Eagan J, Sepkowitz, Zuccotti G (2004)	Student's t-test, χ^2 test.	Before and after intervention study conducted in the US (n=449). <u>Findings</u>: The injury rate fell from 34.08 per 1000 full time equivalent employees to 14.25 injuries

		per 1000 full time equivalent employees following the introduction of safety devices (P<0.001). Nurses and ancillary staff experienced significant reduction in injury rates following the introduction of the safety devices (74.5%, P<0.001 and 61.5%, P= 0.03 respectively). Considerable reductions in injury rates were achieved across all categories.
Stein AD, Makarawo TP, Ahmed MFR (2003)	χ^2 test, Kolmogorov-Smirnov test	Cross sectional survey of doctors (n=75) and nurses (n=143) in the UK. Response rate not specified. Findings: Knowledge of risk of transmission of BBV was low (44% for HBV, 38.1% for HCV, 54.6% for HIV). 86% of nurses and 41% of doctors said they treated all patients as if they were infected with a BBV. 37% of respondents had suffered a needlestick injury. Doctors were more likely to be injured than nurses (P=0.005). 28% of doctors and 2% of nurses did not report injuries (P=0.004)
Stringer B, Infante-Rivard C, Hanley JA (2002)	Logistic regression.	Observations of 3675 operations. Unstructured interview of theatre personnel (n not specified). Response rate 70%. Findings: The hands free technique was utilised some or all of the time (42%), or none of the time (58%). The incident rate when the technique was used was 4% and when it was not – 10%. In operations of >100mls blood loss, when adjusted for type and duration of surgery, emergency status, noise, time of day this constituted a reduction of 59% (95% CI 23%-72%).
Sutton PM, Greene T, Howell FR (1998)	Student's *t*-test.	RCT comparing double glove perforations with or without a liner, 118 operations, 840 gloves. Study conducted in the UK. Findings: 22 perforations of the inner glove. Of the 56 operations where the glove liner was used 5 perforations of the inner glove occurred (8.9%) whereas 14/62 (22.6%) operations where no liner was used resulted in perforation of the inner glove (P=0.04). No difference in dexterity was noticed and the mean operating time was the same for both groups.
Tarantola A, Golliot F, L'Heriteau, Lebascle K, Ha C, Ferret D, Bignon D, Smail A, Doutrellot-Philippon C, Astagneau P, Bouvet E and the CCLIN Paris-Nord Exposure Surveillance Taskforce (2006)	Student *t* test, χ^2 test and Fischer exact test, stepwise multivariate regression.	Observational multi centre survey. 260 operating staff from 20 French hospitals. Response rate 30.7%. Findings: 16.5% of interviewees had never worn 2 pairs of gloves, 50% double gloved for some phases of the surgical procedure or for high risk patients, 33.1% double gloved in all cases. Needlestick notification rate was 10.4% (95% CI 5.1-18.3%); access to blunt needles was associated with an 11 fold decrease in needlestick injury (OR 0.09, 95%CI 0.015-0.6). Never or sometimes using straight needles for deep tissue with a 1000 fold reduction in risk (OR 0.001, 95% CI 0.001-0.33); availability of single use scalpels with a 9 fold reduction (OR 0.11, 95% CI 0.02-0.75) not knowing if guidelines existed was associated with a 22 fold increase in risk (OR 21.9, 95% CI 2.81-170.51).
Thomas S, Argarwal M, Mehta G	None	RCT to assess the effectiveness of double gloving compared to single gloving in

(2001)		decreasing finger contamination during surgery in India. 66 consecutive surgical procedures studied. Findings: In those who double gloved 32 perforations were observed, 22 (68.8%) in the outer and 10 (31.3%) in the inner glove. Only 4 cases had matching perforations in the outer and inner glove indicating that in 82% of cases the inner glove will protect the hands if the outer glove is punctured. 41 (62.2%) found double gloving comfortable whereas 19 (28.8%) and 6 (9%) felt double gloves to be tight or baggy respectively. 42 surgeons (63.6%) reported satisfactory sensation with double gloves.
Trapé-Cardoso M, Schenke P (2004))	χ^2 test	A 5 year review of percutaneous injuries at an academic health centre in Connecticut, USA (n=870). Findings: The number of percutaneous injures declined among medical/dental students, residents and nurses. Incidence rates fell from 7.9% to 2.6% for students in 2000 to 2001(95% CI 1-4%) and from 9.2% in 1997 to 1998 to 2.7% in 2001 to 2002 for nurses (95% CI 2-4%) following the introduction of safety needles and education.
Valls V, Lozanzo S, Yánez R, Martínez MJ, Pascual F, Lloret J, Ruiz JA (2007)	Test based limits formula	Quasi-experimental trial with before and after intervention evaluation of the effectiveness of safety devices intended to prevent percutaneous injuries. Safety devices introduced into the emergency department and half the hospital in October 2005 accompanied by a 3 hour course on occupationally acquired bloodborne infections and a 2 hour hands on training session on the use of the device. Findings: There was a 93% reduction in the relative risk of injury in the areas where safety devices had been introduced (14 vs 1 percutaneous injury). Rates decreased from 18.3 injuries (95% CI 5.9-43.2 injuries) to 0 injuries per 100,000 patient days in the emergency department (P=0.002) and from 44 injuries (95% CI 20.1-83.6 injuries) to 5.2 injuries (95% CI 0.1-28.8 injuries) per 100,000 patient days in the hospital wards. In the control wards rates remained stable.
van-Gemert-Pijnen J, Hendrix MGR, Van der Palin J, Schellens PJ (2006)	Fisher's exact test	Questionnaire survey of Dutch nurses, physicians, laboratory technicians and cleaners (n=70) to measure the extent to which HCWs were familiar with the risks of exposure to blood and body fluids and specific precautions. Practical test of stratified random selection of respondents (n=42) to identify problems in accessibility, comprehensibility, acceptability and applicability of protocols. Findings: Half the respondents had sustained an inoculation injury. 96% of respondents to the questionnaire knew the protocol for management of inoculation injuries, 70% knew the precautions required and 50% had used the protocol. Medical staff had more injuries than non medical staff ($P<0.05$), respondents who had sustained an injury

		had a higher risk perception (P<0.05), used extra precautions when risk increased risk is expected (P<0.01) and had higher use of gloves (P<0.05) than those who had not. Half the respondents in the practice test were sceptical about the value of precautions in preventing infection, 45% were not familiar with the most recent protocol and 19% did not know where to find it.
Van Wijk PThL, Pelk-Jongen M, Wijkmans C, Voss A, Schneeberger PM (2006)	None specified	Review of injuries reported to a regional counselling service over a 12 month period (n=454). Injuries were assessed for level of risk of transmitting HBV, HCV and HIV. Findings: 36 (7.9%) of injuries were assessed as no risk and 67 (14.8%) as high risk. In total, 36% of injuries with risk of HBV transmission and 40% with risk of HCV or HIV transmission were not dealt with appropriately. Breaches included over reaction 25/396 as well as insufficient response (123/396). Potential inadequate treatment of HIV exposure occurred in 11/63 incidents. In 21/296 low risk exposures, the breaches in protocol resulted from late reporting.
Venier AG, Vincent A, L'Hériteau FL, Floret N, Sénéchal H, Abiteboul D, Reyreaud E, Coignard B, Parneix P (2007)	χ^2 test and Fisher's exact test	Prospective national follow up of blood and body fluid exposures in France. Findings: 13,041 incidents were reported during 2004, 9,396 (72%) were needlestick injuries. Exposures were avoidable in 39.1% (5,091) of cases. 84.4% (10,832) were the result of the HCPs own actions, 8.5% (1112) due to the action of a colleague and 6.9% (886) due to the action of a patient. 11% were causes by suture needles and 6.3% by scalpels. Seroconversion rate for HIV 0.31 (95% CI 0.15-0.48), and for HCV 0.5% (95% CI not presented). Extrapolating the data suggested that 41,276 blood and body fluid exposures occurred in France in 2004 (95% CI 40,896-41,656).
Whitby M, McLaws ML, Slater K (2008)	χ^2 test for trend	Pre and post intervention prospective study. Needlestick injuries for the 5 years (2000-4) prior to the intervention (n=529), and for 2004 (n=103) compared with the 2 following years n=66 and 61 respectively in an Australian hospital. Findings: Needlestick injuries in 2005 and 2006 were significantly lower than in the years preceding the study: 1.93 per 100 full time equivalent employees in 2005 (95%CI 1.48-2.47 per 100 FTE) and 1.5 per 100 FTE in 2006 (95% CI 1.11-1.97) compared to a mean of 3.39 per 100 FTE (95% CI2.7-4.24 per 100 FTE P=0.00004), a reduction of 49% in hollow bore needle injuries. High risk injuries were reduced by 57% by retractable syringe use. Additional cost of safety devices $90,000 per annum.
Wigmore SJ, Rainey JB (1994)	None	Quasi-experiment to determine rate of glove puncture using coloured under glove in a UK hospital. Double gloves incorporating an inner green glove and outer cream glove from 101 operations were examined for evidence of puncture. Puncture of the outer glove releases a green vegetable dye that is visible through the outer glove. 100

		unused inner and outer gloves were also tested. Findings: Puncture of outer gloves was indicated on 38 occasions (29% of operations). Puncture of the inner glove occurred in 3 cases. The inner glove remained intact on 85% of occasions when the outer glove was punctured. No punctures were found in the control gloves.
Wilson SJ, Sellu D, Uy A, Jaffer MA (1996)	χ^2 test, Friedman test of n2 way analysis of variance by rank.	Randomised trial comparing single gloves with a combination of double gloves to determine the subjective effects on comfort, sensitivity, dexterity and glove perforation rates in 32 surgeons. Location of study not specified Findings: Surgeons performed 384 operations. Double gloving impaired comfort, instrument handling, needle loading, knot tying, tissue handling, hand sensitivity compared to single gloves (P<0.002). Glove perforation per total number of operations was significantly reduced by double gloving (P<0.01).
Wright KU, Moran CG, Briggs PJ (1993)	χ^2 test for trend, Mann- Whitney test.	Prospective RCT conducted in the UK, including 68 patients. Findings: Taperpoint (blunt) needle used in 38 operations and cutting needle in 31. All personnel double gloved. At least 1 perforation found in 46/69 operations (67%). 138 outer gloves were worn during wound closure, 62 while using the cutting needle: 31 perforations found in 16 of these gloves; 76 gloves worn while using the taperpoint needle, perforations recorded in 10 gloves (P=0.049). 4 inner gloves (2 from each group) had punctures on the inner glove that corresponded to the holes in the outer gloves. The surgeon noticed punctures in only 7% of cases. The blunt needles were slightly more difficult to use (P<0.001) but the effect on surgical technique was minimal.

Appendix 9

Levels of evidence of studies included in chapter 2

All research studies included in the literature review were categorised according to their level of evidence as described by the US Preventative Services Task Force (1996) cited by Grimes and Schulz (2002 p57), tables A9.1 and A9.2

Table A9.1: Levels of evidence (US Preventative Services Task Force (1996) cited by Grimes and Schulz (2002 p57)

Quality of evidence	
1	Evidence from at least one properly designed randomized controlled trial
11-1	Evidence from well designed controlled trials without randomization
11- 2	Evidence from well-designed cohort or case control studies, preferably from more than one centre of research group
11-3	Evidence from multiple time series with or without the intervention. Important results in uncontrolled experiments (such as the introduction of penicillin treatment in the 1940s) could also be considered as this type of evidence.
111	Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees

Table A9.2: Studies and level of evidence (n=309) - In section 2.2 the number of research papers critiqued is stated as 230. However, some studies have been included in more than one section of the literature review; hence the total number of studies included here exceeds this number.

Section and Topic	Number of studies conforming to the level of evidence as determined by the US Preventative Services Task Force (1996) cited by Grimes and Schulz (2002), see section 2.1, table 2.1		Sample size	Comments
	Level of evidence	Number of studies		
2.3 Protection against exposure to blood and body fluids	1	11	69-476	The efficacy of eye protection, double gloves and blunt suture needles has been demonstrated by several level 1 and 11-1 studies.
	11-1	16	26-582	
	11- 2	1	200	Sample size relates to number of participants, number of devices, number of events including glove punctures and blood splashes
	11-3	0	0	
	111	26	61 - 13041	
2.4 Compliance with standard/universal precautions	1	0	0	Overall agreement that compliance with standard/universal precautions is poor.
	11-1	0	0	Sample size relates to number of participants.
	11- 2	1	597	
	11-3	0	0	
	111	15	61-6005	
2.5 Factors affecting compliance with standard/universal precautions	1	2	32 – 476	Factors affecting compliance withstander/universal precautions include knowledge, length of time since
	11-1	0	0	

	11-2 11-3 111	6 0 48	30 – 306 0 20 - 6005	qualifying, risk perception, interference with working practices, profession and availability of equipment. Sample size relates to number of participants, number of operations or procedures, number of injuries
2.6 Percutaneous and mucocutaneous exposures to blood and body fluids - inoculation injuries	1 11-1 11-2 11-3 111	0 0 4 0 31	0 0 33 –2524 0 72 - 13041	Comparison of injury frequency and rates difficult due to different study methods and inconsistent denominators. Factors affecting injury include profession, device and activity. Sample size relates to number of participants, number of operations, number of injuries, incidents or exposures, number of blood samples
2.7 Reporting of percutaneous and mucocutaneous exposure to blood and body fluids	1 11-1 11-2 11-3 111	0 0 1 0 36	0 0 82 0 42 - 8445	Inoculation injuries are under-reported. Reporting influenced by profession, lack of time, risk perception, familiarity with reporting procedures, dissatisfaction with reporting procedures. Sample size relates to number of participants, number of operations, number of injury reports.
2.8 Improving guideline/protocol adherence	1 11-1 11-2 11-3	0 4 0 1	0 27 – 376 0 388	Improving compliance is complex. Suggested strategies include education, improving the safety climate in the workplace, enforcing legislation and policy, improving feedback. Sample size relates to number of

	111	48	12 - 3094	participants, number of procedures, number of injuries or exposures, number of hours

Appendix 10

Direct line: 01792 295790 email: j.cutter@swan.ac.uk

Dear

Re: Factors influencing sustaining and reporting inoculation injuries by healthcare professionals performing exposure prone procedures in the operating theatre.

In ----- you very kindly completed a questionnaire circulated as part of my PhD research. Data have now been collected and analysed from several NHS Trusts throughout Wales. To complete the study, I would now like to interview selected participants to gain further insight into their views on 'Factors influencing sustaining and reporting inoculation injuries by healthcare professionals performing exposure prone procedures in the operating theatre'.

I have enclosed an information sheet about the research project and the interviews You are welcome to contact me if you have any questions or queries regarding participation in the interview.

If after reading the information sheet you are interested in taking part in the interview, please could you contact me using the telephone number or e-mail address at the top of this letter so that we can arrange a suitable time and location.

If after reading the information sheet you do not wish to take part in an interview you need do nothing although it would be helpful if you could let me know that you do not wish to participate.

Many thanks for your continued support of this research project.

Yours sincerely

Mrs Jayne Cutter
Lecturer (Infection Control)

Appendix 11

Introduction to questionnaire pre-test

Thank you for agreeing to meet me this morning. As you know, I am Jayne Cutter, an Infection Control Nurse in the Trust and I am also a part time PhD student at the School of Health Science. I am studying "Factors affecting sustaining and reporting inoculation injuries by healthcare professionals performing exposure prone procedures in the operating theatre".

I have now conducted 3 pilot studies, but before sending out the finalised questionnaires to participating Trusts in Wales, I would like to confirm that none of the questions are ambiguous, difficult to understand or are of such a sensitive nature as to deter people from participating. To do this, I would like you to confirm that you have read the introductory letter I have given you and sign the consent form. Then I would ask you to complete the questionnaire and make any comments you may have relating to content etc. I would then like to ask you as series of questions related to the questionnaire. Please answer as honestly as possible.

Will you please confirm that you have read the information and signed the consent form?

Appendix 12

Factors affecting sustaining and reporting inoculation injuries by healthcare professionals undertaking exposure prone procedures

QUESTIONNAIRE PRE-TEST

CONSENT FORM

In signing this document, I am giving consent for my interview with Jayne Cutter to be recorded. I understand that I shall be taking part pre-test of a questionnaire to be used in a research study that will focus on factors affecting sustaining and reporting inoculation injuries by healthcare professionals undertaking exposure prone procedures.

I understand that I am free to withdraw from the study at any time.

I understand that the researcher may need to contact me in the future for further information.

I have been informed that Jayne Cutter is the person to contact if I have any questions about the study or my right as a participant.

Date:________________ Participant's signature: ________________________
Print name: ________________________________

Interviewer's signature: ________________________

Contact details:

Mrs Jayne Cutter
Lecturer, Infection Control
Swansea University
Singleton Park
Swansea
SA2 8PP

Telephone: Work - 01792 295790
Home - [redacted]
Mobile - [redacted]

E-mail: j.cutter@swan.ac.uk

1 copy to be retained by the participant and 1 by the researcher.

QUESTION APPRAISAL SYSTEM (QAS-99):
CODING FORM

INSTRUCTIONS. Use one form for EACH question to be reviewed. In reviewing each question:

1) WRITE OR TYPE IN QUESTION NUMBER. ATTACH QUESTION.

Question number or question here:

2) Proceed through the form – Circle or highlight YES or NO for each Problem Type (1a. . .8).
3) Whenever a YES is circled, write detailed notes on this form that describe the problem.

STEP 1 – READING: Determine if it is difficult for the interviewers to read the question uniformly to all respondents.	
1a. WHAT TO READ: Interviewer may have difficulty determining what *parts* of the question should be read.	YES NO
1b. MISSING INFORMATION: Information the interviewer needs to administer the question is *not* contained in the question.	YES NO
1c. HOW TO READ: Question is *not* fully scripted and therefore difficult to read.	YES NO
STEP 2 – INSTRUCTIONS: Look for problems with any introductions, instructions, or explanations from the *respondent's* point of view.	
2a. CONFLICTING OR INACCURATE INSTRUCTIONS, introductions, or explanations.	YES NO
2b. COMPLICATED INSTRUCTIONS, introductions, or explanations.	YES NO

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STEP 3 – CLARITY: Identify problems related to communicating the *intent or meaning* of the question to the respondent.		
3a. WORDING: Question is lengthy, awkward, ungrammatical, or contains complicated syntax.	YES	NO
3b. TECHNICAL TERMS(S) are undefined, unclear, or complex.	YES	NO
3c. VAGUE: There are multiple ways to interpret the question or to decide what is to be included or excluded.	YES	NO
3d. REFERENCE PERIODS are missing, not well specified, or in conflict.	YES	NO

STEP 4 – ASSUMPTIONS: Determine if there are problems with assumptions made or the underlying logic.		
4a. INAPPROPRIATE ASSUMPTIONS are made about the respondent or about his/her living situation.	YES	NO
4b. ASSUMES CONSTANT BEHAVIOR or experience for situations that vary.	YES	NO
4c. DOUBLE-BARRELED: Contains more than one implicit question.	YES	NO

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STEP 5 – KNOWLEDGE/MEMORY: Check whether respondents are likely to *not know* or have trouble *remembering* information.

5a. KNOWLEDGE may not exist: Respondent is unlikely to *know* the answer to a factual question.	YES NO
5b. ATTITUDE may not exist: Respondent is unlikely to have formed the attitude being asked about.	YES NO
5c. RECALL failure: Respondent may not *remember* the information asked for.	YES NO
5d. COMPUTATION problem: The question requires a difficult calculation.	YES NO

STEP 6 – SENSITIVITY/BIAS: Assess questions for sensitive nature or wording, and for bias.

6a. SENSITIVE CONTENT (general): The question asks about a topic that is embarrassing, very private, or that involves illegal behavior.	YES NO
6b. SENSITIVE WORDING (specific): Given that the general topic is sensitive, the wording should be improved to minimise sensitivity.	YES NO
6c. SOCIALLY ACCEPTABLE response is implied by the question.	YES NO

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STEP 7 – RESPONSE CATEGORIES: Assess the adequacy of the range of responses to be recorded.	
7a. OPEN-ENDED QUESTION that is inappropriate or difficult.	YES NO
7b. MISMATCH between question and response categories.	YES NO
7c. TECHNICAL TERMS(S) are undefined, unclear, or complex.	YES NO
7d. VAGUE response categories are subject to multiple interpretations.	YES NO
7e. OVERLAPPING response categories.	YES NO
7f. MISSING eligible responses in response categories.	YES NO
7g. ILLOGICAL ORDER of response categories.	YES NO
STEP 8 – OTHER PROBLEMS: Look for problems not identified in Steps 1 – 7.	
8. Other problems not previously identified.	YES NO

Willis, G. and Lessler, J. (1999), *Questionnaire Appraisal System-1999*, Research Triangle Park, NC: Research Triangle Institute.

Appendix 14

Sample SPSS print out – bivariate analysis

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
profession * sharps injury 1 year yes no	315	100.0%	0	.0%	315	100.0%
profession * splash to skin 1 year yes no	315	100.0%	0	.0%	315	100.0%
profession * splash to mm 1 year yes no	315	100.0%	0	.0%	315	100.0%
profession * sharps injury 5 yeasr yes no	315	100.0%	0	.0%	315	100.0%
profession * splash to skin 5 years yes no	315	100.0%	0	.0%	315	100.0%
profession * splash to mm 5 years yes no	315	100.0%	0	.0%	315	100.0%
profession * emergency combined	313	99.4%	2	.6%	315	100.0%
profession * pressuree combined	313	99.4%	2	.6%	315	100.0%
profession * familiar combined	312	99.0%	3	1.0%	315	100.0%
profession * high risk combined	313	99.4%	2	.6%	315	100.0%
profession * patient not high risk combined	313	99.4%	2	.6%	315	100.0%
profession * occupational hazard combined	312	99.0%	3	1.0%	315	100.0%
profession * availability of safety devices combined	309	98.1%	6	1.9%	315	100.0%

profession * splash to mm 5 years yes no

Crosstab

			splash to mm 5 years yes no		
			no	yes	Total
profession	surgeons	Count	128	52	180
		Expected Count	141.1	38.9	180.0
		% within profession	71.1%	28.9%	100.0%
		% within splash to mm 5 years yes no	51.8%	76.5%	57.1%
		% of Total	40.6%	16.5%	57.1%
	scrub nurses	Count	119	16	135
		Expected Count	105.9	29.1	135.0
		% within profession	88.1%	11.9%	100.0%
		% within splash to mm 5 years yes no	48.2%	23.5%	42.9%
		% of Total	37.8%	5.1%	42.9%
	Total	Count	247	68	315
		Expected Count	247.0	68.0	315.0
		% within profession	78.4%	21.6%	100.0%
		% within splash to mm 5 years yes no	100.0%	100.0%	100.0%
		% of Total	78.4%	21.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	13.228[a]	1	.000		
Continuity Correction[b]	12.241	1	.000		
Likelihood Ratio	13.945	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	13.186	1	.000		
N of Valid Cases	315				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 29.14.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for profession (surgeons / scrub nurses)	.331	.179	.611
For cohort splash to mm 5 years yes no = no	.807	.721	.902
For cohort splash to mm 5 years yes no = yes	2.438	1.458	4.075
N of Valid Cases	315		

profession * splash to skin 5 years yes no

Crosstab

			splash to skin 5 years yes no		
			no	yes	Total
profession	surgeons	Count	170	10	180
		Expected Count	173.1	6.9	180.0
		% within profession	94.4%	5.6%	100.0%
		% within splash to skin 5 years yes no	56.1%	83.3%	57.1%
		% of Total	54.0%	3.2%	57.1%
	scrub nurses	Count	133	2	135
		Expected Count	129.9	5.1	135.0
		% within profession	98.5%	1.5%	100.0%
		% within splash to skin 5 years yes no	43.9%	16.7%	42.9%
		% of Total	42.2%	.6%	42.9%
	Total	Count	303	12	315
		Expected Count	303.0	12.0	315.0
		% within profession	96.2%	3.8%	100.0%
		% within splash to skin 5 years yes no	100.0%	100.0%	100.0%
		% of Total	96.2%	3.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.494[a]	1	.062		
Continuity Correction[b]	2.471	1	.116		
Likelihood Ratio	3.901	1	.048		
Fisher's Exact Test				.077	.054
Linear-by-Linear Association	3.483	1	.062		
N of Valid Cases	315				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.14.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for profession (surgeons / scrub nurses)	.256	.055	1.187
For cohort splash to skin 5 years yes no = no	.959	.920	.999
For cohort splash to skin 5 years yes no = yes	3.750	.835	16.835
N of Valid Cases	315		

profession * sharps injury 5 years yes no

Crosstab

			sharps injury 5 yeasr yes no		
			no	yes	Total
profession	surgeons	Count	61	119	180
		Expected Count	75.4	104.6	180.0
		% within profession	33.9%	66.1%	100.0%
		% within sharps injury 5 yeasr yes no	46.2%	65.0%	57.1%
		% of Total	19.4%	37.8%	57.1%
	scrub nurses	Count	71	64	135
		Expected Count	56.6	78.4	135.0
		% within profession	52.6%	47.4%	100.0%
		% within sharps injury 5 yeasr yes no	53.8%	35.0%	42.9%
		% of Total	22.5%	20.3%	42.9%
	Total	Count	132	183	315
		Expected Count	132.0	183.0	315.0
		% within profession	41.9%	58.1%	100.0%
		% within sharps injury 5 yeasr yes no	100.0%	100.0%	100.0%
		% of Total	41.9%	58.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	11.085[a]	1	.001		
Continuity Correction[b]	10.330	1	.001		
Likelihood Ratio	11.096	1	.001		
Fisher's Exact Test				.001	.001
Linear-by-Linear Association	11.050	1	.001		
N of Valid Cases	315				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 56.57.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for profession (surgeons / scrub nurses)	.462	.292	.730
For cohort sharps injury 5 yeasr yes no = no	.644	.497	.835
For cohort sharps injury 5 yeasr yes no = yes	1.395	1.135	1.714
N of Valid Cases	315		

profession * splash to mm 1 year yes no

Crosstab

			splash to mm 1 year yes no		
			no	yes	Total
profession	surgeons	Count	149	31	180
		Expected Count	158.3	21.7	180.0
		% within profession	82.8%	17.2%	100.0%
		% within splash to mm 1 year yes no	53.8%	81.6%	57.1%
		% of Total	47.3%	9.8%	57.1%
	scrub nurses	Count	128	7	135
		Expected Count	118.7	16.3	135.0
		% within profession	94.8%	5.2%	100.0%
		% within splash to mm 1 year yes no	46.2%	18.4%	42.9%
		% of Total	40.6%	2.2%	42.9%
	Total	Count	277	38	315
		Expected Count	277.0	38.0	315.0
		% within profession	87.9%	12.1%	100.0%
		% within splash to mm 1 year yes no	100.0%	100.0%	100.0%
		% of Total	87.9%	12.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	10.536[a]	1	.001		
Continuity Correction[b]	9.432	1	.002		
Likelihood Ratio	11.516	1	.001		
Fisher's Exact Test				.001	.001
Linear-by-Linear Association	10.503	1	.001		
N of Valid Cases	315				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 16.29.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for profession (surgeons / scrub nurses)	.263	.112	.617
For cohort splash to mm 1 year yes no = no	.873	.808	.943
For cohort splash to mm 1 year yes no = yes	3.321	1.509	7.313
N of Valid Cases	315		

profession * splash to skin 1 year yes no

Crosstab

			splash to skin 1 year yes no		
			no	yes	Total
profession	surgeons	Count	177	3	180
		Expected Count	177.1	2.9	180.0
		% within profession	98.3%	1.7%	100.0%
		% within splash to skin 1 year yes no	57.1%	60.0%	57.1%
		% of Total	56.2%	1.0%	57.1%
	scrub nurses	Count	133	2	135
		Expected Count	132.9	2.1	135.0
		% within profession	98.5%	1.5%	100.0%
		% within splash to skin 1 year yes no	42.9%	40.0%	42.9%
		% of Total	42.2%	.6%	42.9%
	Total	Count	310	5	315
		Expected Count	310.0	5.0	315.0
		% within profession	98.4%	1.6%	100.0%
		% within splash to skin 1 year yes no	100.0%	100.0%	100.0%
		% of Total	98.4%	1.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.017[a]	1	.896		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.017	1	.896		
Fisher's Exact Test				1.000	.633
Linear-by-Linear Association	.017	1	.897		
N of Valid Cases	315				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.14.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for profession (surgeons / scrub nurses)	.887	.146	5.385
For cohort splash to skin 1 year yes no = no	.998	.970	1.027
For cohort splash to skin 1 year yes no = yes	1.125	.191	6.639
N of Valid Cases	315		

profession * sharps injury 1 year yes no

Crosstab

			sharps injury 1 year yes no		
			no	yes	Total
profession	surgeons	Count	113	67	180
		Expected Count	125.1	54.9	180.0
		% within profession	62.8%	37.2%	100.0%
		% within sharps injury 1 year yes no	51.6%	69.8%	57.1%
		% of Total	35.9%	21.3%	57.1%
	scrub nurses	Count	106	29	135
		Expected Count	93.9	41.1	135.0
		% within profession	78.5%	21.5%	100.0%
		% within sharps injury 1 year yes no	48.4%	30.2%	42.9%
		% of Total	33.7%	9.2%	42.9%
	Total	Count	219	96	315
		Expected Count	219.0	96.0	315.0
		% within profession	69.5%	30.5%	100.0%
		% within sharps injury 1 year yes no	100.0%	100.0%	100.0%
		% of Total	69.5%	30.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	9.021[a]	1	.003		
Continuity Correction[b]	8.293	1	.004		
Likelihood Ratio	9.235	1	.002		
Fisher's Exact Test				.003	.002
Linear-by-Linear Association	8.992	1	.003		
N of Valid Cases	315				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 41.14.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for profession (surgeons / scrub nurses)	.461	.277	.768
For cohort sharps injury 1 year yes no = no	.800	.693	.922
For cohort sharps injury 1 year yes no = yes	1.733	1.192	2.519
N of Valid Cases	315		

Appendix 15

Sample SPSS print out – model 1

Logistic Regression

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	291	92.4
	Missing Cases	24	7.6
	Total	315	100.0
	Unselected Cases	0	.0
	Total	315	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
no	0
yes	1

Categorical Variables Codings

		Frequency	Parameter coding	
			(1)	(2)
high risk combined	agree or strongly agree	170	.000	.000
	uncertain	20	1.000	.000
	disagree or strongly disagree	101	.000	1.000
emergency combined	agree or strongly agree	195	.000	.000
	uncertain	22	1.000	.000
	disagree or strongly disagree	74	.000	1.000
availability of safety devices combined	agree or strongly agree	175	.000	.000
	uncertain	57	1.000	.000
	disagree or strongly disagree	59	.000	1.000
occupational hazard combined	agree or strongly agree	191	.000	.000
	uncertain	24	1.000	.000
	disagree or strongly disagree	76	.000	1.000
patient not hogh risk combined	agree or strongly agree	32	.000	.000
	uncertain	19	1.000	.000
	disagree or strongly disagree	240	.000	1.000
pressuree combined	agree or strongly agree	228	.000	.000
	uncertain	24	1.000	.000
	disagree or strongly disagree	39	.000	1.000
familiar combined	agree or strongly agree	156	.000	.000
	uncertain	48	1.000	.000
	disagree or strongly disagree	87	.000	1.000
attend training yes or no	yes	103	.000	
	no	188	1.000	
avoid passing yes no	full compliance	252	.000	
	partial/non compliance	39	1.000	
profession	surgeons	165	.000	
	scrub nurses	126	1.000	

Block 0: Beginning Block

Iteration History[a,b,c]

Iteration		-2 Log likelihood	Coefficients Constant
Step 0	1	396.425	.309
	2	396.425	.312
	3	396.425	.312

a. Constant is included in the model.

b. Initial -2 Log Likelihood: 396.425

c. Estimation terminated at iteration number 3 because parameter estimates changed by less than .001.

Classification Table[a,b]

Observed			Predicted: sharps injury 5 yeasr yes no: no	yes	Percentage Correct
Step 0	sharps injury 5 yeasr yes no	no	0	123	.0
		yes	0	168	100.0
		Overall Percentage			57.7

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.312	.119	6.903	1	.009	1.366

Variables not in the Equation

			Score	df	Sig.
ltep 0	Variables	profession(1)	9.313	1	.002
		emergencycombined	.028	2	.986
		emergencycombined(1)	.018	1	.893
		emergencycombined(2)	.006	1	.940
		pressurecombined	.934	2	.627
		pressurecombined(1)	.856	1	.355
		pressurecombined(2)	.028	1	.866
		familiarcombined	.398	2	.819
		familiarcombined(1)	.299	1	.584
		familiarcombined(2)	.211	1	.646
		highriskcombined	6.696	2	.035
		highriskcombined(1)	.045	1	.832
		highriskcombined(2)	6.605	1	.010
		patientnothoghriskcombined	5.842	2	.054
		patientnothoghriskcombined(1)	5.840	1	.016
		patientnothoghriskcombined(2)	2.023	1	.155
		occhazcombined	11.208	2	.004
		occhazcombined(1)	.136	1	.712
		occhazcombined(2)	10.294	1	.001
		availabilitycombined	1.438	2	.487
		availabilitycombined(1)	.107	1	.744
		availabilitycombined(2)	1.437	1	.231
		avoidpassingyesno(1)	.032	1	.858
		attendyesorno(1)	3.431	1	.064
		qualified	.546	1	.460
		Overall Statistics	27.032	18	.078

Block 1: Method = Backward Stepwise (Likelihood Ratio)

Iteration History[a,b,c,d,e]

Itera-tion		-2 Log likelihood	Coefficients																		
			Con-stant	profes-sion(1)	emer-gency com-bined (1)	emer-gency com-bined (2)	pres-sure com-bined (1)	pres-sure com-bined (2)	familiar com-bined (1)	familiar com-bined (2)	highrisk com-bined (1)	highrisk com-bined (2)	patient not thogh risk combined (1)	patient not thogh risk com-bined(2)	occhaz com-bined (1)	occhaz com-bined (2)	availa-bility com-bined (1)	availa-bility com-bined (2)	avoid passing yes no (1)	attend yes or no(1)	quali fied
Step 1	1	368.529	.576	-.493	-.044	.087	.318	.183	-.274	.436	-.179	-.532	1.134	.418	-.118	-.640	.007	-.097	-.244	.003	-.01
	2	368.074	.619	-.540	-.043	.107	.352	.198	-.308	.486	-.219	-.580	1.432	.456	-.118	-.681	.006	-.103	-.277	.008	-.01
	3	368.072	.620	-.542	-.043	.108	.353	.198	-.309	.487	-.222	-.581	1.464	.457	-.118	-.682	.006	-.103	-.278	.008	-.01
	4	368.072	.620	-.542	-.043	.108	.353	.198	-.309	.487	-.222	-.581	1.465	.457	-.118	-.682	.006	-.103	-.278	.008	-.01
Step 2	1	368.530	.579	-.495	-.044	.087	.318	.183	-.274	.436	-.179	-.533	1.134	.417	-.118	-.640	.007	-.097	-.244		-.01
	2	368.075	.627	-.544	-.043	.107	.352	.198	-.307	.487	-.219	-.580	1.432	.455	-.117	-.680	.007	-.103	-.277		-.01
	3	368.072	.628	-.545	-.043	.107	.353	.199	-.308	.488	-.221	-.582	1.465	.456	-.117	-.681	.007	-.103	-.278		-.01
	4	368.072	.628	-.545	-.043	.107	.353	.199	-.308	.488	-.221	-.582	1.465	.456	-.117	-.681	.007	-.103	-.278		-.01
Step 3	1	368.619	.588	-.491			.330	.239	-.278	.455	-.174	-.537	1.118	.406	-.123	-.633	.005	-.090	-.240		-.01
	2	368.172	.636	-.538			.369	.264	-.312	.508	-.211	-.586	1.413	.441	-.123	-.672	.007	-.093	-.270		-.01
	3	368.169	.637	-.539			.371	.265	-.314	.510	-.213	-.587	1.445	.442	-.123	-.672	.007	-.093	-.271		-.01
	4	368.169	.637	-.539			.371	.265	-.314	.510	-.213	-.587	1.446	.442	-.123	-.672	.007	-.093	-.271		-.01
Step 4	1	368.706	.585	-.502			.328	.239	-.282	.441	-.169	-.540	1.128	.406	-.117	-.639			-.234		-.01
	2	368.257	.634	-.549			.369	.266	-.316	.494	-.207	-.590	1.422	.440	-.117	-.678			-.264		-.01
	3	368.255	.635	-.550			.371	.266	-.318	.495	-.209	-.591	1.454	.441	-.117	-.679			-.265		-.01
	4	368.255	.635	-.550			.371	.266	-.318	.495	-.209	-.591	1.455	.441	-.117	-.679			-.265		-.01
Step 5	1	369.596	.618	-.523					-.268	.503	-.164	-.493	1.149	.383	-.123	-.634			-.222		-.01
	2	369.163	.670	-.572					-.304	.562	-.199	-.537	1.448	.417	-.120	-.670			-.247		-.01
	3	369.161	.671	-.573					-.306	.564	-.201	-.538	1.480	.417	-.120	-.670			-.248		-.01
	4	369.161	.671	-.573					-.306	.564	-.201	-.538	1.481	.417	-.120	-.670			-.248		-.01
Step 6	1	370.038	.563	-.515					-.283	.495	-.181	-.484	1.161	.393	-.122	-.628					-.00
	2	369.618	.609	-.561					-.323	.551	-.215	-.527	1.460	.425	-.120	-.662					-.01
	3	369.616	.610	-.562					-.325	.552	-.217	-.528	1.492	.426	-.120	-.663					-.01
	4	369.616	.610	-.562					-.325	.552	-.217	-.528	1.492	.426	-.120	-.663					-.01
Step 7	1	370.600	.383	-.488					-.312	.475	-.223	-.495	1.176	.410	-.134	-.649					
	2	370.194	.406	-.529					-.355	.524	-.265	-.538	1.480	.445	-.135	-.683					
	3	370.191	.407	-.530					-.357	.525	-.268	-.539	1.512	.446	-.135	-.684					
	4	370.191	.407	-.530					-.357	.525	-.268	-.539	1.513	.446	-.135	-.684					
Step 8	1	374.080	.320	-.587					-.271	.388			1.159	.347	-.095	-.696					
	2	373.742	.329	-.628					-.301	.425			1.453	.373	-.092	-.725					
	3	373.740	.330	-.629					-.302	.426			1.483	.373	-.092	-.725					
	4	373.740	.330	-.629					-.302	.426			1.483	.373	-.092	-.725					
Step 9	1	377.687	.359	-.479									1.035	.344	-.222	-.669					
	2	377.410	.366	-.503									1.311	.365	-.231	-.685					
	3	377.408	.366	-.503									1.339	.365	-.231	-.685					
	4	377.408	.366	-.503									1.339	.365	-.231	-.685					
Step 10	1	381.371	.723	-.494											-.248	-.688					
	2	381.337	.755	-.519											-.260	-.708					
	3	381.337	.755	-.519											-.260	-.708					

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	28.353	18	.057
	Block	28.353	18	.057
	Model	28.353	18	.057
Step 2[a]	Step	.000	1	.979
	Block	28.353	17	.041
	Model	28.353	17	.041
Step 3[a]	Step	-.097	2	.953
	Block	28.256	15	.020
	Model	28.256	16	.029
Step 4[a]	Step	-.086	2	.958
	Block	28.170	13	.009
	Model	28.170	14	.014
Step 5[a]	Step	-.906	2	.636
	Block	27.264	11	.004
	Model	27.264	12	.007
Step 6[a]	Step	-.455	1	.500
	Block	26.809	10	.003
	Model	26.809	10	.003
Step 7[a]	Step	-.576	1	.448
	Block	26.233	9	.002
	Model	26.233	9	.002
Step 8[a]	Step	-3.548	2	.170
	Block	22.685	7	.002
	Model	22.685	7	.002
Step 9[a]	Step	-3.668	2	.160
	Block	19.017	5	.002
	Model	19.017	5	.002
Step 10[a]	Step	-3.929	2	.140
	Block	15.087	3	.002
	Model	15.087	3	.002

a. A negative Chi-squares value indicates that the Chi-squares value has decreased from the previous step.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	368.072[a]	.093	.125
2	368.072[a]	.093	.125
3	368.169[a]	.093	.124
4	368.255[a]	.092	.124
5	369.161[a]	.089	.120
6	369.616[a]	.088	.118
7	370.191[a]	.086	.116
8	373.740[a]	.075	.101
9	377.408[a]	.063	.085
10	381.337[b]	.051	.068

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

b. Estimation terminated at iteration number 3 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	11.199	8	.191
2	11.215	8	.190
3	7.105	8	.525
4	8.795	8	.360
5	5.282	8	.727
6	6.424	8	.600
7	9.184	8	.327
8	8.983	8	.344
9	.502	6	.998
10	.135	3	.987

Contingency Table for Hosmer and Lemeshow Test

		sharps injury 5 years yes no = no		sharps injury 5 years yes no = yes		Total
		Observed	Expected	Observed	Expected	
tep 1	1	22	19.755	7	9.245	29
	2	13	17.030	16	11.970	29
	3	15	15.625	14	13.375	29
	4	17	14.224	12	14.776	29
	5	11	12.958	18	16.042	29
	6	15	11.521	14	17.479	29
	7	11	10.262	18	18.738	29
	8	6	8.807	23	20.193	29
	9	5	7.732	24	21.268	29
	10	8	5.086	22	24.914	30
tep 2	1	22	19.753	7	9.247	29
	2	13	17.036	16	11.964	29
	3	15	15.619	14	13.381	29
	4	17	14.221	12	14.779	29
	5	11	12.969	18	16.031	29
	6	15	11.515	14	17.485	29
	7	11	10.265	18	18.735	29
	8	6	8.802	23	20.198	29
	9	5	7.732	24	21.268	29
	10	8	5.087	22	24.913	30
tep 3	1	21	19.767	8	9.233	29
	2	14	17.033	15	11.967	29
	3	15	15.587	14	13.413	29
	4	14	14.220	15	14.780	29
	5	12	12.995	17	16.005	29
	6	14	11.437	15	17.563	29
	7	14	10.260	15	18.740	29
	8	6	8.535	22	19.465	28
	9	6	7.836	23	21.164	29
	10	7	5.330	24	25.670	31
tep 4	1	21	19.700	8	9.300	29
	2	16	17.003	13	11.997	29

	3	12	15.669	17	13.331	29
	4	17	14.260	12	14.740	29
	5	11	12.939	18	16.061	29
	6	14	11.445	15	17.555	29
	7	13	10.266	16	18.734	29
	8	5	8.561	23	19.439	28
	9	7	7.827	22	21.173	29
	10	7	5.331	24	25.669	31
Step 5	1	20	19.473	9	9.527	29
	2	16	17.033	13	11.967	29
	3	14	15.685	15	13.315	29
	4	15	14.142	14	14.858	29
	5	13	13.249	17	16.751	30
	6	11	11.443	18	17.557	29
	7	15	10.359	14	18.641	29
	8	6	8.839	23	20.161	29
	9	8	7.941	21	21.059	29
	10	5	4.837	24	24.163	29
Step 6	1	21	19.442	8	9.558	29
	2	16	17.026	13	11.974	29
	3	12	15.686	17	13.314	29
	4	14	14.015	15	14.985	29
	5	14	12.721	15	16.279	29
	6	12	11.565	17	17.435	29
	7	14	10.451	15	18.549	29
	8	9	9.165	21	20.835	30
	9	5	8.020	24	20.980	29
	10	6	4.908	23	24.092	29
Step 7	1	14	13.280	5	5.720	19
	2	14	14.812	11	10.188	25
	3	17	17.176	13	12.824	30
	4	11	14.291	17	13.709	28
	5	15	15.497	20	19.503	35
	6	12	10.059	12	13.941	24
	7	15	10.815	13	17.185	28
	8	10	8.330	16	17.670	26
	9	6	11.062	31	25.938	37

	10	9	7.677	30	31.323	39
Step 8	1	21	19.900	9	10.100	30
	2	16	20.673	21	16.327	37
	3	16	14.605	13	14.395	29
	4	15	13.426	13	14.574	28
	5	19	13.897	15	20.103	34
	6	11	10.666	17	17.334	28
	7	2	2.464	5	4.536	7
	8	12	17.226	40	34.774	52
	9	8	7.378	20	20.622	28
	10	3	2.766	15	15.234	18
Step 9	1	33	33.069	21	20.931	54
	2	10	10.363	10	9.637	20
	3	10	9.772	10	10.228	20
	4	24	23.495	29	29.505	53
	5	12	10.648	14	15.352	26
	6	3	3.398	6	5.602	9
	7	28	29.254	62	60.746	90
	8	3	3.000	16	16.000	19
Step 10	1	33	33.257	21	20.743	54
	2	19	18.334	18	18.666	37
	3	25	25.152	32	31.848	57
	4	3	3.409	6	5.591	9
	5	43	42.848	91	91.152	134

Classification Table[a]

			Predicted		
			sharps injury 5 yeasr yes no		
	Observed		no	yes	Percentage Correct
tep 1	sharps injury 5 years yes no	no	56	67	45.5
		yes	40	128	76.2
		Overall Percentage			63.2
tep 2	sharps injury 5 years yes no	no	56	67	45.5

		yes	40	128	76.2
		Overall Percentage			63.2
Step 3	sharps injury 5 years yes no	no	54	69	43.9
		yes	40	128	76.2
		Overall Percentage			62.5
Step 4	sharps injury 5 years yes no	no	53	70	43.1
		yes	41	127	75.6
		Overall Percentage			61.9
Step 5	sharps injury 5 years yes no	no	52	71	42.3
		yes	43	125	74.4
		Overall Percentage			60.8
Step 6	sharps injury 5 years yes no	no	52	71	42.3
		yes	41	127	75.6
		Overall Percentage			61.5
Step 7	sharps injury 5 years yes no	no	53	70	43.1
		yes	41	127	75.6
		Overall Percentage			61.9
Step 8	sharps injury 5 years yes no	no	52	71	42.3
		yes	40	128	76.2
		Overall Percentage			61.9
Step 9	sharps injury 5 years yes no	no	43	80	35.0
		yes	31	137	81.5
		Overall Percentage			61.9
Step 10	sharps injury 5 years yes no	no	41	82	33.3
		yes	28	140	83.3
		Overall Percentage			62.2

a. The cut value is .500

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)

								Lower	Upper
Step 1[a]	profession(1)	-.542	.325	2.777	1	.096	.582	.308	1.100
	emergencycombined			.096	2	.953			
	emergencycombined(1)	-.043	.515	.007	1	.933	.958	.349	2.627
	emergencycombined(2)	.108	.384	.079	1	.779	1.114	.525	2.363
	pressurecombined			.538	2	.764			
	pressurecombined(1)	.353	.518	.464	1	.496	1.423	.515	3.929
	pressurecombined(2)	.198	.468	.179	1	.672	1.219	.487	3.049
	familiarcombined			3.548	2	.170			
	familiarcombined(1)	-.309	.369	.700	1	.403	.734	.356	1.515
	familiarcombined(2)	.487	.336	2.098	1	.147	1.627	.842	3.144
	highriskcombined			3.829	2	.147			
	highriskcombined(1)	-.222	.520	.182	1	.670	.801	.289	2.219
	highriskcombined(2)	-.581	.297	3.828	1	.050	.559	.313	1.001
	patientnothoghriskcombined			3.904	2	.142			
	patientnothoghriskcombined(1)	1.465	.747	3.841	1	.050	4.326	1.000	18.718
	patientnothoghriskcombined(2)	.457	.422	1.173	1	.279	1.580	.691	3.614
	occhazcombined			4.882	2	.087			
	occhazcombined(1)	-.118	.473	.062	1	.803	.889	.352	2.244
	occhazcombined(2)	-.682	.310	4.822	1	.028	.506	.275	.929
	availabilitycombined			.103	2	.950			
	availabilitycombined(1)	.006	.338	.000	1	.985	1.006	.519	1.952
	availabilitycombined(2)	-.103	.338	.093	1	.760	.902	.465	1.750
	avoidpassingyesno(1)	-.278	.374	.552	1	.458	.757	.363	1.577
	attendyesorno(1)	.008	.302	.001	1	.979	1.008	.558	1.821
	qualified	-.012	.014	.729	1	.393	.988	.962	1.015
	Constant	.620	.569	1.189	1	.276	1.859		
Step 2[a]	profession(1)	-.545	.298	3.333	1	.068	.580	.323	1.041
	emergencycombined			.096	2	.953			
	emergencycombined(1)	-.043	.514	.007	1	.933	.957	.349	2.624

	emergencycombined(2)	.107	.384	.078	1	.780	1.113	.525	2.362
	pressurecombined			.538	2	.764			
	pressurecombined(1)	.353	.518	.463	1	.496	1.423	.515	3.927
	pressurecombined(2)	.199	.467	.181	1	.671	1.220	.488	3.047
	familiarcombined			3.558	2	.169			
	familiarcombined(1)	-.308	.369	.700	1	.403	.735	.357	1.513
	familiarcombined(2)	.488	.335	2.124	1	.145	1.628	.845	3.138
	highriskcombined			3.866	2	.145			
	highriskcombined(1)	-.221	.519	.181	1	.670	.802	.290	2.218
	highriskcombined(2)	-.582	.296	3.865	1	.049	.559	.313	.998
	patientnothoghriskcombined			3.905	2	.142			
	patientnothoghriskcombined(1)	1.465	.747	3.845	1	.050	4.328	1.001	18.720
	patientnothoghriskcombined(2)	.456	.421	1.177	1	.278	1.578	.692	3.598
	occhazcombined			4.883	2	.087			
	occhazcombined(1)	-.117	.472	.062	1	.804	.889	.353	2.243
	occhazcombined(2)	-.681	.310	4.822	1	.028	.506	.275	.929
	availabilitycombined			.104	2	.949			
	availabilitycombined(1)	.007	.337	.000	1	.984	1.007	.520	1.949
	availabilitycombined(2)	-.103	.338	.093	1	.760	.902	.465	1.749
	avoidpassingyesno(1)	-.278	.374	.551	1	.458	.758	.364	1.577
	qualified	-.012	.014	.741	1	.389	.988	.962	1.015
	Constant	.628	.487	1.661	1	.197	1.874		
Step 3[a]	profession(1)	-.539	.297	3.288	1	.070	.584	.326	1.045
	pressurecombined			.886	2	.642			
	pressurecombined(1)	.371	.484	.587	1	.444	1.449	.561	3.740
	pressurecombined(2)	.265	.405	.428	1	.513	1.303	.589	2.884
	familiarcombined			4.028	2	.133			
	familiarcombined(1)	-.314	.368	.727	1	.394	.731	.355	1.503
	familiarcombined(2)	.510	.327	2.426	1	.119	1.665	.877	3.161
	highriskcombined			3.962	2	.138			
	highriskcombined(1)	-.213	.518	.170	1	.680	.808	.293	2.229
	highriskcombined(2)	-.587	.295	3.956	1	.047	.556	.312	.991
	patientnothoghriskcombined			3.829	2	.147			
	patientnothoghriskcombined(1)	1.446	.744	3.773	1	.052	4.244	.987	18.250

	patientnothoghriskcombined(2)	.442	.418	1.120	1	.290	1.556	.686	3.526
	occhazcombined			4.796	2	.091			
	occhazcombined(1)	-.123	.470	.069	1	.793	.884	.352	2.222
	occhazcombined(2)	-.672	.309	4.739	1	.029	.511	.279	.935
	availabilitycombined			.086	2	.958			
	availabilitycombined(1)	.007	.337	.000	1	.982	1.007	.520	1.950
	availabilitycombined(2)	-.093	.336	.077	1	.782	.911	.472	1.760
	avoidpassingyesno(1)	-.271	.370	.536	1	.464	.763	.370	1.575
	qualified	-.011	.014	.711	1	.399	.989	.963	1.015
	Constant	.637	.485	1.726	1	.189	1.891		
Step 4a	profession(1)	-.550	.293	3.529	1	.060	.577	.325	1.024
	pressurecombined			.893	2	.640			
	pressurecombined(1)	.371	.484	.587	1	.443	1.449	.561	3.737
	pressurecombined(2)	.266	.405	.433	1	.510	1.305	.591	2.885
	familiarcombined			3.961	2	.138			
	familiarcombined(1)	-.318	.360	.778	1	.378	.728	.359	1.475
	familiarcombined(2)	.495	.321	2.371	1	.124	1.640	.874	3.080
	highriskcombined			4.027	2	.134			
	highriskcombined(1)	-.209	.518	.163	1	.687	.812	.294	2.238
	highriskcombined(2)	-.591	.295	4.019	1	.045	.554	.311	.987
	patientnothoghriskcombined			3.874	2	.144			
	patientnothoghriskcombined(1)	1.455	.744	3.827	1	.050	4.282	.997	18.390
	patientnothoghriskcombined(2)	.441	.416	1.124	1	.289	1.554	.688	3.511
	occhazcombined			4.923	2	.085			
	occhazcombined(1)	-.117	.470	.062	1	.803	.889	.354	2.233
	occhazcombined(2)	-.679	.308	4.853	1	.028	.507	.277	.928
	avoidpassingyesno(1)	-.265	.368	.518	1	.472	.767	.373	1.578
	qualified	-.012	.014	.741	1	.389	.988	.963	1.015
	Constant	.635	.484	1.721	1	.190	1.888		
Step 5a	profession(1)	-.573	.292	3.860	1	.049	.564	.318	.999
	familiarcombined			5.054	2	.080			
	familiarcombined(1)	-.306	.358	.731	1	.392	.736	.365	1.485
	familiarcombined(2)	.564	.310	3.297	1	.069	1.757	.956	3.228
	highriskcombined			3.499	2	.174			

	highriskcombined(1)	-.201	.517	.151	1	.698	.818	.297	2.254
	highriskcombined(2)	-.538	.288	3.495	1	.062	.584	.332	1.026
	patientnothoghriskcombined			4.016	2	.134			
	patientnothoghriskcombined(1)	1.481	.741	3.996	1	.046	4.396	1.029	18.778
	patientnothoghriskcombined(2)	.417	.413	1.020	1	.312	1.518	.675	3.413
	occhazcombined			4.828	2	.089			
	occhazcombined(1)	-.120	.470	.065	1	.798	.887	.353	2.227
	occhazcombined(2)	-.670	.307	4.762	1	.029	.512	.280	.934
	avoidpassingyesno(1)	-.248	.367	.457	1	.499	.780	.380	1.602
	qualified	-.011	.014	.671	1	.413	.989	.963	1.016
	Constant	.671	.482	1.941	1	.164	1.957		
Step 6[a]	profession(1)	-.562	.291	3.733	1	.053	.570	.322	1.008
	familiarcombined			5.058	2	.080			
	familiarcombined(1)	-.325	.356	.830	1	.362	.723	.359	1.453
	familiarcombined(2)	.552	.309	3.186	1	.074	1.737	.947	3.186
	highriskcombined			3.379	2	.185			
	highriskcombined(1)	-.217	.517	.176	1	.675	.805	.292	2.219
	highriskcombined(2)	-.528	.287	3.378	1	.066	.590	.336	1.036
	patientnothoghriskcombined			4.088	2	.130			
	patientnothoghriskcombined(1)	1.492	.740	4.063	1	.044	4.446	1.042	18.967
	patientnothoghriskcombined(2)	.426	.413	1.063	1	.302	1.531	.681	3.439
	occhazcombined			4.730	2	.094			
	occhazcombined(1)	-.120	.469	.065	1	.798	.887	.354	2.225
	occhazcombined(2)	-.663	.307	4.666	1	.031	.515	.282	.940
	qualified	-.010	.013	.575	1	.448	.990	.964	1.016
	Constant	.610	.473	1.663	1	.197	1.840		
Step 7[a]	profession(1)	-.530	.287	3.404	1	.065	.589	.335	1.034
	familiarcombined			4.985	2	.083			
	familiarcombined(1)	-.357	.354	1.016	1	.314	.700	.350	1.401
	familiarcombined(2)	.525	.306	2.942	1	.086	1.691	.928	3.082
	highriskcombined			3.536	2	.171			
	highriskcombined(1)	-.268	.512	.273	1	.601	.765	.281	2.087
	highriskcombined(2)	-.539	.287	3.532	1	.060	.583	.333	1.023
	patientnothoghriskcombined			4.218	2	.121			

	patientnothoghriskcombined(1)	1.513	.740	4.178	1	.041	4.539	1.064	19.361
	patientnothoghriskcombined(2)	.446	.412	1.170	1	.279	1.561	.696	3.500
	occhazcombined			5.060	2	.080			
	occhazcombined(1)	-.135	.469	.083	1	.773	.874	.348	2.191
	occhazcombined(2)	-.684	.306	5.007	1	.025	.505	.277	.919
	Constant	.407	.389	1.096	1	.295	1.502		
Step 8[a]	profession(1)	-.629	.281	5.000	1	.025	.533	.307	.925
	familiarcombined			3.591	2	.166			
	familiarcombined(1)	-.302	.352	.737	1	.391	.739	.371	1.473
	familiarcombined(2)	.426	.298	2.037	1	.154	1.531	.853	2.748
	patientnothoghriskcombined			4.094	2	.129			
	patientnothoghriskcombined(1)	1.483	.733	4.092	1	.043	4.406	1.047	18.536
	patientnothoghriskcombined(2)	.373	.406	.845	1	.358	1.452	.656	3.215
	occhazcombined			5.854	2	.054			
	occhazcombined(1)	-.092	.463	.040	1	.842	.912	.368	2.259
	occhazcombined(2)	-.725	.303	5.721	1	.017	.484	.267	.877
	Constant	.330	.384	.737	1	.391	1.390		
Step 9[a]	profession(1)	-.503	.269	3.491	1	.062	.605	.357	1.025
	patientnothoghriskcombined			3.422	2	.181			
	patientnothoghriskcombined(1)	1.339	.725	3.407	1	.065	3.815	.921	15.813
	patientnothoghriskcombined(2)	.365	.400	.830	1	.362	1.440	.657	3.157
	occhazcombined			5.215	2	.074			
	occhazcombined(1)	-.231	.451	.262	1	.609	.794	.328	1.921
	occhazcombined(2)	-.685	.300	5.211	1	.022	.504	.280	.908
	Constant	.366	.361	1.028	1	.311	1.442		
Step 10[a]	profession(1)	-.519	.261	3.951	1	.047	.595	.357	.993
	occhazcombined			5.737	2	.057			
	occhazcombined(1)	-.260	.448	.338	1	.561	.771	.321	1.853
	occhazcombined(2)	-.708	.296	5.737	1	.017	.493	.276	.879
	Constant	.755	.174	18.771	1	.000	2.127		

a. Variable(s) entered on step 1: profession, emergencycombined, pressurecombined, familiarcombined, highriskcombined, patientnothoghriskcombined, occhazcombined, availabilitycombined, avoidpassingyesno, attendyesorno, qualified.

Model if Term Removed

Variable		Model Log Likelihood	Change in -2 Log Likelihood	df	Sig. of the Change
Step 1	profession	-185.428	2.784	1	.095
	emergencycombined	-184.084	.097	2	.953
	pressurecombined	-184.308	.543	2	.762
	familiarcombined	-185.848	3.624	2	.163
	highriskcombined	-185.962	3.853	2	.146
	patientnothoghriskcombined	-186.244	4.416	2	.110
	occhazcombined	-186.496	4.921	2	.085
	availabilitycombined	-184.087	.103	2	.950
	avoidpassingyesno	-184.310	.549	1	.459
	attendyesorno	-184.036	.001	1	.979
	qualified	-184.401	.730	1	.393
Step 2	profession	-185.709	3.346	1	.067
	emergencycombined	-184.084	.097	2	.953
	pressurecombined	-184.308	.544	2	.762
	familiarcombined	-185.855	3.637	2	.162
	highriskcombined	-185.981	3.891	2	.143
	patientnothoghriskcombined	-186.247	4.421	2	.110
	occhazcombined	-186.497	4.921	2	.085
	availabilitycombined	-184.088	.104	2	.949
	avoidpassingyesno	-184.310	.548	1	.459

	qualified	-184.408	.743	1	.389
Step 3	profession	-185.734	3.300	1	.069
	pressurecombined	-184.534	.899	2	.638
	familiarcombined	-186.152	4.136	2	.126
	highriskcombined	-186.078	3.987	2	.136
	patientnothoghriskcombined	-186.253	4.338	2	.114
	occhazcombined	-186.501	4.832	2	.089
	availabilitycombined	-184.127	.086	2	.958
	avoidpassingyesno	-184.351	.533	1	.465
	qualified	-184.441	.713	1	.399
Step 4	profession	-185.901	3.547	1	.060
	pressurecombined	-184.580	.906	2	.636
	familiarcombined	-186.157	4.060	2	.131
	highriskcombined	-186.153	4.052	2	.132
	patientnothoghriskcombined	-186.330	4.405	2	.111
	occhazcombined	-186.610	4.965	2	.084
	avoidpassingyesno	-184.385	.515	1	.473
	qualified	-184.499	.743	1	.389
Step 5	profession	-186.521	3.881	1	.049
	familiarcombined	-187.194	5.227	2	.073
	highriskcombined	-186.335	3.510	2	.173
	patientnothoghriskcombined	-186.898	4.636	2	.098
	occhazcombined	-187.012	4.864	2	.088
	avoidpassingyesno	-184.808	.455	1	.500
	qualified	-184.916	.672	1	.412
Step 6	profession	-186.684	3.752	1	.053
	familiarcombined	-187.421	5.227	2	.073
	highriskcombined	-186.501	3.387	2	.184
	patientnothoghriskcombined	-187.166	4.716	2	.095
	occhazcombined	-187.189	4.763	2	.092
	qualified	-185.096	.576	1	.448
Step 7	profession	-186.803	3.415	1	.065
	familiarcombined	-187.664	5.137	2	.077
	highriskcombined	-186.870	3.548	2	.170
	patientnothoghriskcombined	-187.522	4.852	2	.088
	occhazcombined	-187.647	5.102	2	.078
Step 8	profession	-189.392	5.044	1	.025

	familiarcombined	-188.704	3.668	2	.160
	patientnothoghriskcombined	-189.267	4.793	2	.091
	occhazcombined	-189.829	5.919	2	.052
Step 9	profession	-190.451	3.493	1	.062
	patientnothoghriskcombined	-190.669	3.929	2	.140
	occhazcombined	-191.330	5.252	2	.072
Step 10	profession	-192.639	3.940	1	.047
	occhazcombined	-193.551	5.764	2	.056

Variables not in the Equation

			Score	df	Sig.
Step 2[a]	Variables	attendyesorno(1)	.001	1	.979
	Overall Statistics		.001	1	.979
Step 3[b]	Variables	emergencycombined	.096	2	.953
		emergencycombined(1)	.018	1	.893
		emergencycombined(2)	.089	1	.765
		attendyesorno(1)	.001	1	.980
	Overall Statistics		.097	3	.992
Step 4[c]	Variables	emergencycombined	.078	2	.962
		emergencycombined(1)	.017	1	.895
		emergencycombined(2)	.071	1	.790
		availabilitycombined	.086	2	.958
		availabilitycombined(1)	.009	1	.923
		availabilitycombined(2)	.085	1	.770
		attendyesorno(1)	.002	1	.967
	Overall Statistics		.183	5	.999
Step 5[d]	Variables	emergencycombined	.416	2	.812
		emergencycombined(1)	.002	1	.966
		emergencycombined(2)	.401	1	.527
		pressurecombined	.897	2	.639
		pressurecombined(1)	.463	1	.496
		pressurecombined(2)	.304	1	.581
		availabilitycombined	.093	2	.954
		availabilitycombined(1)	.024	1	.877
		availabilitycombined(2)	.087	1	.769

		attendyesorno(1)	.003	1	.957
	Overall Statistics		1.077	7	.993
Step 6[e]	Variables	emergencycombined	.332	2	.847
		emergencycombined(1)	.001	1	.971
		emergencycombined(2)	.331	1	.565
		pressurecombined	.838	2	.658
		pressurecombined(1)	.403	1	.526
		pressurecombined(2)	.311	1	.577
		availabilitycombined	.068	2	.967
		availabilitycombined(1)	.007	1	.935
		availabilitycombined(2)	.068	1	.794
		avoidpassingyesno(1)	.459	1	.498
		attendyesorno(1)	.000	1	.984
	Overall Statistics		1.537	8	.992
Step 7[f]	Variables	emergencycombined	.255	2	.880
		emergencycombined(1)	.001	1	.979
		emergencycombined(2)	.254	1	.615
		pressurecombined	.780	2	.677
		pressurecombined(1)	.406	1	.524
		pressurecombined(2)	.261	1	.609
		availabilitycombined	.095	2	.954
		availabilitycombined(1)	.005	1	.941
		availabilitycombined(2)	.095	1	.758
		avoidpassingyesno(1)	.361	1	.548
		attendyesorno(1)	.010	1	.919
		qualified	.576	1	.448
	Overall Statistics		2.113	9	.990
Step 8[g]	Variables	emergencycombined	.170	2	.919
		emergencycombined(1)	.004	1	.952
		emergencycombined(2)	.169	1	.681
		pressurecombined	.299	2	.861
		pressurecombined(1)	.235	1	.628
		pressurecombined(2)	.035	1	.851
		highriskcombined	3.568	2	.168
		highriskcombined(1)	.006	1	.941
		highriskcombined(2)	3.300	1	.069
		availabilitycombined	.162	2	.922

		availabilitycombined(1)	.002	1	.967
		availabilitycombined(2)	.158	1	.691
		avoidpassingyesno(1)	.248	1	.618
		attendyesorno(1)	.069	1	.792
		qualified	.737	1	.391
	Overall Statistics		5.665	11	.895
Step 9[h]	Variables	emergencycombined	1.086	2	.581
		emergencycombined(1)	.062	1	.804
		emergencycombined(2)	1.076	1	.300
		pressurecombined	.919	2	.632
		pressurecombined(1)	.283	1	.595
		pressurecombined(2)	.542	1	.462
		familiarcombined	3.628	2	.163
		familiarcombined(1)	1.613	1	.204
		familiarcombined(2)	2.887	1	.089
		highriskcombined	2.095	2	.351
		highriskcombined(1)	.000	1	.994
		highriskcombined(2)	1.994	1	.158
		availabilitycombined	.027	2	.987
		availabilitycombined(1)	.005	1	.943
		availabilitycombined(2)	.016	1	.900
		avoidpassingyesno(1)	.281	1	.596
		attendyesorno(1)	.111	1	.739
		qualified	.607	1	.436
	Overall Statistics		9.218	13	.756
Step 10[i]	Variables	emergencycombined	.651	2	.722
		emergencycombined(1)	.011	1	.917
		emergencycombined(2)	.651	1	.420
		pressurecombined	.916	2	.633
		pressurecombined(1)	.468	1	.494
		pressurecombined(2)	.349	1	.555
		familiarcombined	2.774	2	.250
		familiarcombined(1)	1.181	1	.277
		familiarcombined(2)	2.257	1	.133
		highriskcombined	2.175	2	.337
		highriskcombined(1)	.029	1	.866

highriskcombined(2)	2.150	1	.143
patientnothoghriskcombined	3.636	2	.162
patientnothoghriskcombined(1)	2.779	1	.095
patientnothoghriskcombined(2)	.012	1	.912
availabilitycombined	.095	2	.954
availabilitycombined(1)	.008	1	.928
availabilitycombined(2)	.071	1	.789
avoidpassingyesno(1)	.317	1	.574
attendyesorno(1)	.149	1	.699
qualified	.684	1	.408
Overall Statistics	12.890	15	.611

. Variable(s) removed on step 2: attendyesorno.

. Variable(s) removed on step 3: emergencycombined.

. Variable(s) removed on step 4: availabilitycombined.

. Variable(s) removed on step 5: pressurecombined.

. Variable(s) removed on step 6: avoidpassingyesno.

. Variable(s) removed on step 7: qualified.

. Variable(s) removed on step 8: highriskcombined.

. Variable(s) removed on step 9: familiarcombined.

. Variable(s) removed on step 10: patientnothoghriskcombined.

Statistically non-significant results

The following bivariate analyses yielded results which were statistically non-significant:

Table A16.1: list of tables describing statistically non-significant results

Table	Relationship explored
A16.2	Comparison of demographic characteristics between respondents to various mail shots - profession
A16.3	Comparison of demographic characteristics between respondents to various mail shots - length of time qualified
A16.4	Comparison of demographic characteristics between respondents to various mail shots - length of time in current speciality
A16.5	Comparison of demographic characteristics between respondents to various mail shots - surgeons' speciality
A16.6	Splash to broken skin within 1 year and profession
A16.7	Splash to broken skin within last 5 years and profession
A16.8	Sustaining inoculation injury with past year and length of time qualified
A16.9	Sustaining inoculation injury with past 5 years and length of time qualified
A16.10	Sustaining inoculation injury with past year and surgeon's speciality
A16.11	Sustaining inoculation injury with past 5 years and surgeon's speciality
A16.12	Sustaining a splash to broken skin within the past year and attending training session on the prevention and management of inoculation injury
A16.13	Sustaining splash to mucous membranes within last 1 year and attending training session on the prevention and management of inoculation injury
A16.14	Sustaining splash to broken skin within last 5 years and attending training session on the prevention and management of inoculation injury
A16.15	Belief that inoculation injuries are most likely when working under pressure and profession
A16.16	Belief that inoculation injuries are more likely to occur during emergency procedures and attending training sessions
A16.17	Belief that inoculation injuries are more likely to occur when staff are working under pressure and attending training sessions
A16.18	Being injured between the steps in a procedure and profession
A16.19	Belief that inoculation injuries are more likely when staff undertake procedures with which they are not familiar and attending training sessions
A16.20	Sustaining a sharps injury within 1 year and belief inoculation injuries are more likely during an emergency
A16.21	Sustaining a sharps injury within 1 year and belief inoculation injuries are more likely when working under pressure
A16.22	Sustaining a sharps injury within 1 year and belief inoculation injuries are more likely undertaking unfamiliar procedures
A16.23	Sustaining a sharps injury within 1 year and belief it is acceptable to take fewer precautions when the patient is not high risk
A16.24	Sustaining a sharps injury within 1 year and belief that inoculation injuries are influenced by the availability of safety devices
A16.25	Sustaining a splash to the mucous membranes within 1 year and belief that inoculation injuries are more likely during an emergency procedure
A16.26	Sustaining a splash to the mucous membranes within 1 year and belief that inoculation

	injuries are more likely when working under pressure
A16.27	Sustaining a sustaining a splash to the mucous membranes within 1 year and belief that inoculation injuries are influenced by the availability of safety devices
A16.28	Sustaining a sharps injury within 5 years and belief inoculation injuries are more likely during an emergency
A16.29	Sustaining a sharps injury within 5 years and belief inoculation injuries are more likely when working under pressure
A16.30	Sustaining a sharps injury within 5 years and belief inoculation injuries are more likely undertaking unfamiliar procedures
A16.31	Sustaining a sharps injury within 5 years and belief that inoculation injuries are influenced by the availability of safety devices
A16.32	Sustaining a splash to the mucous membranes within 5 years and belief that inoculation injuries are more likely when working under pressure
A16.33	Sustaining a splash to the mucous membranes within 5 years and belief it is acceptable to take fewer precautions when the patient is not high risk
A16.34	Sustaining a splash to the mucous membranes within 5 years and belief inoculation injuries are an occupational hazard
A16.35	Sustaining a splash to the mucous membranes within 5 years and belief that inoculation injuries are influenced by the availability of safety devices
A16.36	Between being injured while preparing to re-use an instrument and profession
A16.37	Being injured while cutting tissue and profession
A16.38	Being injured while clearing away and profession
A16.39	Being injured by sharp object protruding from a sharps box and profession
A16.40	Cause of inoculation injury and length of time qualified
A16.41	Cause of inoculation injury and length of time qualified continued
A16.42	Cause of inoculation injury and length of time in current speciality
A16.43	Cause of inoculation injury and length of time in current speciality continued
A16.44	Being injured during the use of a sharp instrument and attending training session
A16.45	Training session and being injured between the steps in a procedure
A16.46	Between being injured while preparing to re-use an instrument and attending training session
A16.47	Being injured while passing instruments from hand to hand attending training session
A16.48	Attending training session and being injured while cutting tissue
A16.49	Between being injured while clearing away and attending training session
A16.50	Being injured by sharp object being left in an inappropriate place and attending training session
A16.51	Being injured by sharp object protruding from a sharps box and attending training session
A16.52	Between sustaining sharps injury within 1 year and double gloving
A16.53	Sustaining sharps injury within 1 year and avoiding passing sharps from hand to hand
A16.54	Sustaining sharps injury within 1 year and using a safety device
A16.55	Sustaining sharps injury within 5 years and double gloving
A16.56	Sustaining sharps injury within 5 years and avoiding passing sharps from hand to hand
A16.57	Sustaining sharps injury within 5 years and using a safety device
A16.58	Sustaining splash to mucous membranes within the past year and wearing eye protection/full face visor
A16.59	Sustaining splash to mucous membranes within the past five years and wearing eye protection/full face visor
A16.60	Sustaining a sharps injury within 1 year and compliance with using safety devices
A16.61	Sustaining a sharps injury within 5 years and compliance with avoiding passing sharps

	from hand to hand
A16.62	Sustaining a sharps injury within 5 years and compliance with using safety devices
A16.63	Sustaining splash to mucous membranes within 1 year and compliance with eye protection/full face visor
A16.64	Sustaining splash to mucous membranes within 5 years and compliance with eye protection/full face visor
A16.65	Double gloving and profession
A16.66	Avoiding passing sharps from hand to hand and profession
A16.67	Adopting protective measures and length of time since qualifying
A16.68	Adopting protective measures and length of time spent in current speciality
A16.69	Double gloving and surgeon's speciality
A16.70	Using a safety device and surgeon's speciality
A16.71	Double gloving and attending training
A16.72	Wearing eye protection/full face visor and attending training
A16.73	Passing sharps from hand to hand and attending training
A16.74	Reporting injuries and lack of familiarity with reporting procedure
A16.75	Reporting injuries and not knowing correct procedure
A16.76	Reporting injuries and not knowing where to find policy
A16.77	Reporting injuries and being discouraged by managers to do so
A16.78	Familiarity with reporting mechanism and length of time since qualification and length of time in current speciality
A16.79	Reporting inoculation injuries and surgeon's speciality
A16.80	Failure to report injuries because of not knowing what action to take and profession
A16.81	Failure to report injuries because of not knowing where to find relevant policy and profession
A16.82	Failure to report injuries because of pressure of work and profession
A16.83	Failure to report injuries because reporting mechanism is too cumbersome and profession
A16.84	Failure to report injuries because they were dissatisfied with follow up procedure after reporting a previous injury and profession
A16.85	Failure to report injuries because the patient was 'low risk' and profession
A16.86	Failure to report injuries because the injury was too minor to report and profession
A16.87	Failure to report injuries because inoculation injuries are an occupational hazard and profession
A16.88	Failure to report injuries because managers discourage reporting and profession
A16.89	Reasons why inoculation injuries may not be reported and length of time since qualification
A16.90	Reasons why inoculation injuries may not be reported and length of time since qualification (continued)
A16.91	Reasons why inoculation injuries may not be reported and length of time in current speciality
A16.92	Reasons why inoculation injuries may not be reported and length of time in current speciality (continued)
A16.93	Failure to report because lack of familiarity with reporting procedure and surgeon's speciality
A16.94	Failure to report because unable to find policy and surgeon's speciality
A16.95	Failure to report because of pressure of work and surgeon's speciality
A16.96	Failure to report because reporting mechanism was too cumbersome and surgeon's speciality
A16.97	Failure to report because dissatisfaction with action taken following previous injury and

	surgeon's speciality
A16.98	Failure to report injuries are an occupational hazard injury and surgeon's speciality
A16.99	Failure to report because managers discourage reporting and surgeon's speciality
A16.100	Attending training and failure to report injuries because of not knowing what action to take
A16.101	Attending training and failure to report injuries because of not knowing where to find relevant policy
A16.102	Attending training and failure to report injuries because of pressure of work
A16.103	Attending training and failure to report injuries because reporting mechanism is too cumbersome
A16.104	Attending training and failure to report injuries because they were dissatisfied with follow up procedure after reporting a previous injury
A16.105	Attending training and failure to report injuries because the patient was 'low risk'
A16.106	Attending training and failure to report injuries because the injury was too minor to report
A16.107	Attending training and failure to report injuries because inoculation injuries are an occupational hazard
A16.108	Attending training and failure to report injuries because managers discourage reporting

Table A16.2: Comparison of demographic characteristics between respondents to various mail shots - profession

	Surgeons	Scrub nurses	Total
All respondents	180 (55%)	135 (45%)	315 (100%)
Responding to mail shot 1	90 (53.9%)	77 (46.1%)	167 (100%)
Responding to mail shot 2	56 (59.6%)	38 (40.4%)	94 (100%)
Responding to mail shot 3	34 (63%)	20 (37%)	54 (100%)

Table A16.3: Comparison of demographic characteristics between respondents to various mail shots - length of time qualified

	Number	Mean	Median	Range in years (Minimum-maximum)	Standard deviation
All respondents	313	19.71	20.00	42.25 (1.75-44)	9.52
Responding to mail shot 1	166	19.94	20.00	38 (2-40)	9.62
Responding to mail shot 2	93	18.98	17.00	38.25 (2.5-40.75)	9.65
Responding to mail shot 3	54	20.27	20.00	40.25 (1.75-44.0)	9.07

Table A16.4: Comparison of demographic characteristics between respondents to various mail shots - length of time in current speciality

	Number	Mean	Median	Range in years (Minimum-maximum)	Standard deviation
All respondents	313	14.57	13.75	37.0 (0-37.0)	8.83
Responding to mail shot 1	167	14.95	14.5	37.0 (0-37.0)	9.27
Responding to mail shot 2	92	13.62	11.0	36.0 (0-36.0)	8.57
Responding to mail shot 3	54	15.0	16.0	32.75 (1.25-34.0)	7.88

Table A16.5: Comparison of demographic characteristics between respondents to various mail shots - surgeons' speciality (where T&O –trauma and orthopaedics, O&G – obstetrics and gynaecology, Max fax – maxillo facial)

	General	ENT	Urology	T &O	O&G	Oral/Max fax
All respondents	55 (17.5%)	22 (7%)	13 (4.1%)	39 (12.4%)	43 (13.7%0	4 (1.3%)
Responding to mail shot 1	29 (17.4%)	13 (7.8%)	6 (3.6%)	22 (13.2%)	18 (10.8%)	1 (0.6%)
Responding to mail shot 2	14 (14.9%)	8 (8.5%)	3 (3.2%)	11 (11.7%)	15 (16%)	3 (3.2%)
Responding to mail shot 3	12 (22.2%)	1 (1.9%)	4 (7.4%)	6 (11.1%)	10 (18.5%)	0 (0%)

Table A16.6: Relationship between sustaining splash to broken skin within last year a6d profession (response rate 315/315, 100%).

		Splash to broken skin sustained within 1 year		Total
		None	**1 or more**	
Surgeons	Count (% within profession)	177 (98.3%)	3 (1.7%)	180 (100%)
Scrub nurses	Count (% within profession)	133 (98.5%)	2 (1.5%)	135 (100%)
Total	Count (%)	310 (98.4%)	5 (1.6%)	315 (100%)

Only a total of 5 respondents reported splashing blood or body fluid onto broken skin within the last year 3/180 surgeons (1.7%) and 2/135 scrub nurses (1.5%) (table A1). The expectation that 80% of cells have an expected frequency >5 is not fulfilled, therefore the χ^2 test cannot be used (Altman, 1991). Consequently, Fisher's Exact Test was used to explore statistical significance. This test was interpreted with caution due to the sample size, but confirmed that his relationship is not statistically significant (Exact sig. 2-sided = 1.0, df=1, odds ratio (OR) 0.88, 95% confidence interval (CI) 0.15-5.39).

Table A16.7: Relationship between sustaining splash to broken skin within last 5 years and profession (response rate 315/315, 100%).

		Splash to broken skin sustained within 5 years		Total
		None	**1 or more**	
Surgeons	Count (% within profession)	170 (94.4%)	10 (5.6%)	180 (100%)
Scrub nurses	Count (% within profession)	133 (98.5%)	2 (1.5%)	135 (100%)
Total	Count (%)	303 (96.2%)	12 (3.8%)	315 (100%)

Only 10/180 surgeons (5.6%) and 2/135 of scrub nurses (1.5%) reported sustaining a blood splash to broken skin within the last 5 years (table A2). One cell has an observed count of 2. However, as 0 cells have an expected count of <5 and 80% of cells have an expected frequency of >5, the χ^2 test can be used to explore statistical significance (Altman, 1991). This relationship was not statistically significant (χ^2 = 2.27, P =0.116, df=1, odds ratio (OR) 0.26, 95% confidence interval (CI) 0.06-1.19). Using Fisher's exact test cautiously, although statistical significance is not apparent a trend in favour of the relationship is indicated at best (Exact sig, 2-sided = 0.077).

Table A16.8: Relationship between sustaining an inoculation injury within past year and length of time qualified (n=313)

	Sharps injury	Splash to broken skin	Splash to mucous membranes
Mann-Whitney U	9779.0	524.5	4387.0
Z	-0.701	-1.223	-1.603
Asymp. Sig (2-tailed)	0.484	0.221	0.109

Table A16.9: Relationship between sustaining an inoculation injury within past five years and length of time qualified (n=295)

	Sharps injury	Splash to broken skin	Splash to mucous membranes
Mann-Whitney U	10144.0	1456.0	6472.0
Z	-0.601	-0.836	-1.652
Asymp. Sig (2-tailed)	0.548	0.403	0.099

Table A16.10: Relationship between sustaining an inoculation injury within past year and surgeon's speciality (n=313)

Surgeon's speciality	Sharps injury	Splash to broken skin	Splash to mucous membranes
Chi-square	6.98	9.11	1.47
df	4	4	4
Asymp. Sig.(2 tailed)	0.137	0.058	0.832

Table A16.11: Relationship between sustaining an inoculation injury within past five years and surgeon's speciality (n=295)

Surgeon's speciality	Sharps injury	Splash to broken skin	Splash to mucous membranes
Chi-square	4.04	9.21	2.43
df	4	4	4
Asymp. Sig.(2 tailed)	0.40	0.056	0.66

Table A16.12: Relationship between sustaining a splash to broken skin within the past year and attending training session on the prevention and management of inoculation injury (response rate 314/315, 99.7%).

Splash to broken skin within 1 year	Attended training		Total
	Yes	No	
Yes (%)	107 (34.6%)	202 (65.4%)	309 (100%)
No (%)	3 (60.0%)	2 (40.0%)	5 (100%)
Total	110 (35.0%)	65 (65.0%)	314 (100%)

In this relationship (table A7), the expectation that 80% of cells have an expected frequency >5 is not fulfilled as two cells (50%) have an expected frequency count of <5. Therefore the χ^2 test cannot be used (Altman, 1991). Consequently, Fisher's Exact Test was used with caution due to the large sample size to explain statistical significance. This test confirmed that this relationship is not statistically significant (Exact sig. 2-sided = 0.358, df=1, odds ratio (OR) 0.35, 95% confidence interval (CI) 0.06-2.15).

Table A16.13: Relationship between sustaining splash to mucous membranes within last 1 year and attending training session on the prevention and management of inoculation injury (response rate 314/315, 99.7%).

Splash to mucous membranes within 1 year	Attended training		Total
	Yes	No	
Yes (%)	101 (36.6%)	175 (63.4%)	278 (100.0%)
No (%)	9 (23.7%)	29 (76.3%)	38 (100%)
Total	110 (35.0%)	204 (65.0%)	314 (100%)

No statistical significance was identified in relation to these two variables (χ^2 = 1.912, P = 0.167, df=1, odds ratio (OR) 0.186, 95% confidence interval (CI) 0.85-4.09).

Table A16.14: Relationship between sustaining splash to broken skin within last 5 years and attending training session on the prevention and management of inoculation injury (response rate 314/315, 99.7%).

Splash to broken skin within 5 years	Attended training		Total
	Yes	No	
Yes (%)	105 (34.8%)	197 (65.2%)	302 (100%)
No (%)	5 (41.7%)	7 (58.3%)	12 (100%)
Total	110 (35.0%)	204 (65%)	314 (100%)

One cell (25%) has an expected count of <5 and so χ^2 was not used (Altman, 1991). Using Fisher's exact test cautiously, it was determined that this relationship was not statistically significant (Exact sig. 2-sided = 0.759, df=1, odds ratio (OR) 0.75, 95% confidence interval (CI) 0.23-2.14).

Table A16.15: Relationship between the belief that inoculation injuries are most likely when working under pressure and profession (response rate 313/315, 99.4%)

Profession		Inoculation injuries are more likely when working under pressure			Total
		Strongly agree/agree	**Uncertain**	**Strongly disagree/ disagree**	
Surgeons	Count within profession (%)	138 (77.1%)	21 (11.7%)	20 (11.2%)	**179 (100%)**
Scrub nurses	Count within profession (%)	103 (76.9%)	8 (6.0%)	23 (17.2%)	**1134 (100%)**
Total	Count (%)	241 (77.0%)	29 (9.3%)	43 (13.7%)	**313 (100%)**

No statistically significant difference was identified between the professions in respect to this variable (χ^2=4.748, P=0.093, df=2).

Table A16.16: Relationship between belief that inoculation injuries are more likely to occur during emergency procedures and attending training sessions

Attended training	Inoculation injuries are more likely to occur during emergency procedures			
	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
Yes (%)	70 (64.2%)	8 (7.3%)	31 (28.4%)	109 (100%)
No (%)	138 (67.6%)	19 (9.4%)	47 (23.0%)	204 (100%)
Total	208 (66.5%)	27 (8.6%)	78 (24.9%)	313 (100%)

There was no significant difference demonstrated in respect of these two variables (χ^2 1.278, P = 0.528, df=2).

Table A16.17: Relationship between belief that inoculation injuries are more likely to occur when staff are working under pressure and attending training sessions

Attended training	Inoculation injuries are more likely to occur when staff are working under pressure			
	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
Yes (%)	86 (78.9%)	7 (6.4%)	16 (14.7%)	109 (100%)
No (%)	155 (76%)	22 (10.8%)	27 (13.2%)	204 (100%)
Total	241 (77%)	29 (9.3%)	43 (13.7%)	313 (100%)

Once again, no statistical significance was demonstrated (χ^2 1.645, P = 0.439, df=2).

Table A16.18: Relationship between being injured between the steps in a procedure and profession

		Injured between steps in a procedure		Total (%)
		Yes	No	
Surgeons	Count (% injured between steps)	45 (57.0%)	91 (71.1%)	136 (65.7%)
Scrub nurses	Count (% injured between steps)	34 (43.0%)	37 (28.9%)	71 (34.3%)
Total	Count (% injured between steps)	79 (100%)	128 (100%)	207 (100%)

No statistical significance could be demonstrated when considering the difference between professions and being injured between different steps in the same procedure (χ^2 3.725, P = 0.054, df=1).

Table A16.19: Relationship between belief that inoculation injuries are more likely when staff undertake procedures with which they are not familiar and attending training sessions

	Inoculation injuries are more likely when staff undertake procedures with which they are not familiar			
Attended training	**Agree or strongly agree (%)**	**Uncertain (%)**	**Disagree or strongly disagree (%)**	**Total (%)**
Yes (%)	59 (54.1%)	13 (11.9%)	37 (33.9%)	109 (100%)
No (%)	109 (53.7%)	39 (27.1%)	55 (27.1%)	203 (100%)
Total	168 (53.8%)	52 (18.7%)	92 (29.5%)	312 (100%)

No statistical relationship exists between these variables (χ^2 3.39, P = 0.184, df=2).

Table A16.20: Relationship between sustaining a sharps injury within 1 year and belief inoculation injuries are more likely during an emergency (response rate 313/315, 99.4%)

	Inoculation injuries are more likely during an emergency			
Sharps injury within 1 year	**Agree or strongly agree (%)**	**Uncertain (%)**	**Disagree or strongly disagree (%)**	**Total (%)**
None	141 (65%)	18 (8.3%)	58 (26.7%)	217 (100%)
1 or more	67 (69.8%)	9 (9.4%)	20 (20.8%)	96 (100%)
Total	208 (66.5%)	27 (8.6%)	78 (24.9%)	313 (100%)

This relationship was not statistically significant (χ^2 1.250, P = 0.535, df=2).

Table A16.21: Relationship between sustaining a sharps injury within 1 year and belief inoculation injuries are more likely when working under pressure (response rate 313/315, 99.4%)

Sharps injury within 1 year	Inoculation injuries are more likely when working under pressure			
	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
None	166 (76.5%)	17 (7.8%)	34 (15.7%)	217 (100%)
1 or more	75 (78.1%)	12 (12.5%)	9 (9.4%)	96 (100%)
Total	241 (100%)	29 (9.3%)	43 (13.7%)	313 (100%)

This relationship was not statistically significant (χ^2 3.505, P = 0.173, df=2).

Table A16.22: Relationship between sustaining a sharps injury within 1 year and belief inoculation injuries are more likely undertaking unfamiliar procedures (response rate 312/315, 99%)

Sharps injury within 1 year	Inoculation injuries are more likely when undertaking unfamiliar procedures			
	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
None	116 (53.5%)	35 (16.1%)	66 (30.4%)	217 (100%)
1 or more	52 (54.7%)	17 (17.9%)	26 (27.4%)	95 (100%)
Total	168 (53.8%)	52 (16.7%)	92 (29.5%)	312 (100%)

This relationship was not statistically significant (χ^2 0.352, P = 0.839, df=2).

Table A16.23: Relationship between sustaining a sharps injury within 1 year and belief it is acceptable to take fewer precautions when the patient is not high risk (response rate 313/315, 99.4%)

Sharps injury within 1 year	Belief that it is acceptable to take fewer precautions when patients are not 'high risk'			
	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
None	19 (8.8%)	18 (7.4%)	182 (83.9%)	217 (100%)
1 or more	15 (15.6%)	7 (7.3%)	74 (77.1%)	96 (100%)
Total	34 (10.9%)	23 (7.3%)	256 (81.8%)	313 (100%)

This relationship was not statistically significant (χ^2 3.267, P = 0.195, df=2).

Table A16.24: Relationship between sustaining a sharps injury within 1 year and belief that inoculation injuries are influenced by the availability of safety devices (response rate 309/315, 98.1%)

Sharps injury within 1 year	Inoculation injuries are influenced by the availability of safety devices			
	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
None	130 (60.5%)	40 (18.6%)	45 (20.9%)	215 (100%)
1 or more	52 (55.3%)	24 (25.5%)	18 (19.1%)	94 (100%)
Total	182 (58.9%)	64 (20.7%)	63 (20.4%)	309 (100%)

This relationship was not statistically significant (χ^2 1.911, P = 0.385, df=2).

Table A.17.25: Relationship between sustaining a splash to the mucous membranes within 1 year and belief that inoculation injuries are more likely during an emergency procedure (response rate 313/315, 99.4%)

	Inoculation injuries are more likely to occur during emergency procedures			
Splash to mucous membranes within 1 year	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
None	179 (65.1%)	25 (9.1%)	71 (25.8%)	275 (100%)
1 or more	29 (76.3%)	2 (5.3%)	7 (18.4%)	38 (100%)
Total	208 (66.5%)	27 (8.6%)	78 (24.9%)	313 (100%)

This relationship was not statistically significant (χ^2 1.933, P = 0.380, df=2).

Table A16.26: Relationship between sustaining a splash to the mucous membranes within 1 year and belief that inoculation injuries are more likely when working under pressure (response rate 313/315, 99.4%)

	Inoculation injuries are more likely to occur when working under pressure			
Splash to mucous membranes within 1 year	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
None	207 (75.3%)	28 (10.2%)	40 (14.5%)	275 (100%)
1 or more	34 (89.5%)	1 (2.6%)	3 (7.0%)	38 (100%)
Total	241 (77%)	29 (9.3%)	43 (13.7%)	313 (100%)

This relationship was not statistically significant (χ^2 4.004, P = 0.135, df=2).

Table A16.27: Relationship between sustaining a sustaining a splash to the mucous membranes within 1 year and belief that inoculation injuries are influenced by the availability of safety devices (response rate 309/315, 98.1%)

Splash to mucous membranes within 1 year	Inoculation injuries are influenced by the availability of safety devices			
	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
None	160 (58.8%)	56 (20.6%)	56 (20.6%)	272 (100%)
1 or more	22 (59.5%)	8 (21.6%)	7 (18.9%)	37 (100%)
Total	182 (58.9%)	64 (20.7%)	63 (20.4%)	309 (100%)

This relationship was not statistically significant (χ^2 0.064, P = 0.969, df=2).

Table A16.28: Relationship between sustaining a sharps injury within 5 years and belief inoculation injuries are more likely during an emergency (response rate 313/315, 99.4%)

Sharps injury within 5 years	Inoculation injuries are more likely to occur during emergency procedures			
	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
None	89 (68.5%)	10 (7.7%)	31 (23.8%)	130 (100%)
1 or more	119 (65%)	17 (9.3%)	47 (25.7%)	183 (100%)
Total	208 (66.5%)	27 (8.6%)	78 (24.9%)	313 (100%)

This relationship was not statistically significant (χ^2 0.463, P = 0.793, df=2).

Table A16.29: Relationship between sustaining a sharps injury within 5 years and belief inoculation injuries are more likely when working under pressure (response rate 313/315, 99.4%)

Sharps injury within 5 years	Inoculation injuries are more likely to occur when working under pressure			
	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
None	105 (80.8%)	9 (6.9%)	16 (12.3%)	130 (100%)
1 or more	136 (74.3%)	20 (10.9%)	27 (14.8%)	183 (100%)
Total	241 (77%)	29 (9.3%)	43 (13.7%)	313 (100%)

This relationship was not statistically significant (χ^2 2.059, P = 0.357, df=2).

Table A16.30: Relationship between sustaining a sharps injury within 5 years and belief inoculation injuries are more likely undertaking unfamiliar procedures (response rate 312/315, 99%)

Sharps injury within 5 years	Inoculation injuries are more likely to occur during emergency procedures			
	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
None	71 (54.6%)	23 (17.7%)	36 (27.7%)	130 (100%)
1 or more	97 (53.3%)	29 (15.9%)	56 (30.8%)	182 (100%)
Total	168 (53.8%)	52 (16.7%)	92 (29.5%)	312 (100%)

This relationship was not statistically significant (χ^2 2.059, P = 0.357, df=2).

Table A16.31: Relationship between sustaining a sharps injury within 5 years and belief that inoculation injuries are influenced by the availability of safety devices (response rate 309/315, 98.1%)

Sharps injury within 5 years	Inoculation injuries are influenced by the availability of safety devices			
	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
None	72 (56.7%)	26 (20.5%)	29 (22.8%)	127 (100%)
1 or more	110 (60.4%)	38 (20.9%)	34 (18.7%)	182 (100%)
Total	182 (58.9%)	64 (20.7%)	63 (20.4%)	309 (100%)

This relationship was not statistically significant (χ^2 0.817, P = 0.665, df=2).

Table A16.32: Relationship between sustaining a splash to the mucous membranes within 5 years and belief that inoculation injuries are more likely when working under pressure (response rate 313/315, 99.4%)

Splash to mucous membranes within 5 years	Inoculation injuries are more likely to occur when working under pressure			
	Agree or strongly agree (%)	Uncertain (%)	Disagree or strongly disagree (%)	Total (%)
None	182 (74.3%)	26 (10.6%)	37 (15.1%)	245 (100%)
1 or more	59 (86.8%)	3 (4.4%)	6 (8.8%)	68 (100%)
Total	241 (77%)	29 (9.3%)	43 (13.7%)	313 (100%)

This relationship was not statistically significant (χ^2 4.812, P = 0.090, df=2).

Table A16.33: Relationship between sustaining a splash to the mucous membranes within 5 years and belief it is acceptable to take fewer precautions when the patient is not high risk (response rate 313/315, 99.4%)

	Belief that it is acceptable to take fewer precautions when patients are not 'high risk'			
Splash to mucous membranes within 5 years	**Agree or strongly agree (%)**	**Uncertain (%)**	**Disagree or strongly disagree (%)**	**Total (%)**
None	26 (10.6%)	15 (6.1%)	204 (83.3%)	245 (100%)
1 or more	8 (11.8%)	8 (11.8%)	52 (76.9%)	68 (100%)
Total	34 (10.9%)	23 (7.3%)	256 (81.8%0	313 (100%)

This relationship was not statistically significant (χ^2 2.671, P = 0.263, df=2).

Table A16.34: Relationship between sustaining a splash to the mucous membranes within 5 years and belief inoculation injuries are an occupational hazard (response rate 312/315, 99%)

	Inoculation injuries are an occupational hazard			
Splash to mucous membranes within 5 years	**Agree or strongly agree (%)**	**Uncertain (%)**	**Disagree or strongly disagree (%)**	**Total (%)**
None	154 (63.1%)	21 (8.6%)	69 (28.3%)	244 (100%)
1 or more	51 (75%)	6 (8.8%)	11 (16.2%)	68 (100%)
Total	205 (65.7%)	27 (8.7%)	80 (25.6%)	312 (100%)

This relationship was not statistically significant (χ^2 4.184, P = 0.123, df=2).

Table A16.35: Relationship between sustaining a sustaining a splash to the mucous membranes within 5 years and belief that inoculation injuries are influenced by the availability of safety devices (response rate 309/315, 98.1%)

	Staff take fewer precautions when patients are not 'high risk'			
Splash to mucous membranes within 5 years	**Agree or strongly agree (%)**	**Uncertain (%)**	**Disagree or strongly disagree (%)**	**Total (%)**
None	140 (57.9%)	51 (21.1%)	51 (21.1%)	242 (100%)
1 or more	42 (62.7%)	13 (19.4%)	12 (17.9%)	67 (100%)
Total	182 (58.9%)	64 (20.4%)	63 (20.4%)	309 (100%)

This relationship was not statistically significant (χ^2 0.537, P = 0.765, df=2).

Table A16.36: Relationship between being injured while preparing to re-use an instrument and profession

		Injured while preparing to re-use instrument		Total (%)
		Yes	No	
Surgeons	Count (% injured while preparing to re-use)	4 (40%)	132 (97.1%)	136 (66.0%)
Scrub nurses	Count (% injured while preparing to re-use)	6 (8.6%)	64 (91.4%)	70 (34.0%)
Total	Count (% injured while preparing to re-use)	10 (100%)	196 (100%)	206 (100%)

As one cell (25%) has an expected count of <5 (minimum expected count is 3.4) χ^2 could not be used to test for significance. However, this relationship was found not to be statistically significant when applying the Fisher's exact test (Exact sig. 2-sided=0.092,).

Table A16.37: Relationship between being injured while cutting tissue and profession

		Injured while cutting tissue		Total (%)
		Yes	No	
Surgeons	Count (% injured while cutting)	12 (85.7%)	123 (65.1%)	135 (65.5%)
Scrub nurses	Count (% injured while cutting)	2 (14.3%)	69 (35.9%)	71 (34.5%)
Total	Count (% injured while cutting)	14 (100%)	192 (100%)	206 (100%)

As one cell (25%) had an expected count of <5 (minimum expected count is 4.83) χ^2 could not be used to test for significance. However, Fisher's exact test identified no statistically significant relationship (Exact sig. 2-sided =0.145).

Table A16.38: Relationship between being injured while clearing away and profession

		Injured while clearing away		Total (%)
		Yes	No	
Surgeons	Count (% injured clearing away)	0 (0%)	135 (67.5%)	135 (65.5%)
Scrub nurses	Count (% injured clearing away)	6 (100%)	65 (32.5%)	71(34.3%)
Total	Count (% injured clearing away)	6 (100%)	200 (100%)	206 (100%)

Two cells (50%) had expected count of <5. The minimum expected count is 2.07. The minimum observed count is 0. Consequently, no tests for significance are applicable.

Table A16.39: Relationship between being injured by sharp object protruding from a sharps box and profession

		Injured by sharp object protruding from sharps box		Total (%)
		Yes	No	
Surgeons	Count (% injured by object protruding from sharps box)	1 (100%)	134 (65.4%)	135 (65.5%)
Scrub nurses	Count (% injured by object protruding from sharps box)	0 (0%)	71 (100%)	71(34.5%)
Total	Count (% injured by object protruding from sharps box)	1 (100%)	205(100%)	206 (100%)

Two cells (50%) had expected count of <5. The minimum expected count is 0.34. The minimum observed count is 0. Consequently, no tests for significance are applicable.

Table A16.40: Relationship between cause of inoculation injury and length of time qualified (n=205)

	During use	Between steps	After use	Preparing to re-use	During disposal
Mann-Whitney U	4409.500	4186.500	3581.000	851.000	1106.000
Z	-0.934	-1.913	-0.520	-0.654	-1.416
Asymp. Sig (2-tailed)	0.350	0.056	0.603	0.513	0.157

Table A16.41: Relationship between cause of inoculation injury and length of time qualified continued (n=205)

	While passing sharps	While cutting	Sharp left in inappropriate place	Protruding sharp
Mann-Whitney U	2856.500	966.500	1226.500	39.000
Z	-0.770	-1.706	-0.073	-1.062
Asymp. Sig (2-tailed)	0.441	0.088	0.942	0.288

These relationships were not statistically significant

Table A16.42: Relationship between cause of inoculation injury and length of time in current speciality (n=206)

	During use	After use	During disposal
Mann-Whitney U	4219.000	3629.000	1164.000
Z	-1.554	-0.451	-1.181
Asymp. Sig (2-tailed)	0.120	0.652	0.238

Table A16.43: Relationship between cause of inoculation injury and length of time in current speciality continued (n=206)

	While passing sharps	Clearing away	Sharp left in inappropriate place	Protruding sharp
Mann-Whitney U	2597.000	366.500	1115.000	32.500
Z	-1.614	-1.612	-0.643	-1.176
Asymp. Sig (2-tailed)	0.107	0.107	0.520	0.240

These relationships were not statistically significant

Table A16.44: Relationship between being injured during the use of a sharp instrument and attending training session

Attended training session		**Injured during the use of a sharp instrument**		**Total (%)**
		Yes	**No**	
Yes	Count (% injured during use)	20 (41.7%)	40 (25.2%)	60 (29.0%)
No	Count (% injured during use)	28 (58.3%)	119 (74.8%)	147 (71.0%)
Total	Count (% injured during use)	48 (100%)	159 (100%)	207 (100%)

No statistically significant relationship could be demonstrated here (χ^2 0.113, P=0.737).

Table A16.45: Relationship between attending training session and being injured between the steps in a procedure

Attended training session		Injured between steps in a procedure		Total (%)
		Yes	No	
Yes	Count (% injured between steps)	29 (36.7%)	31 (24.2%)	60 (29.0%)
No	Count (% injured between steps)	50 (63.3%	97 (75.8%)	147 (71.0%)
Total	Count (% injured between steps)	79 (100%)	128 (100%)	207 (100%)

Once again, no statistical significance could be demonstrated (χ^2 3.12, P=0.077).

A16.46: Relationship between being injured while preparing to re-use an instrument and attending training session

Attended training session		Injured while preparing to re-use instrument		Total (%)
		Yes	No	
Yes	Count (% injured while preparing to re-use)	5 (50%)	54 (27.6%)	59 (28.6%)
No	Count (% injured while preparing to re-use)	5 (50%)	142 (72.4%)	147 (71.4%)
Total	Count (% injured while preparing to re-use)	10 (100%)	196 (100%)	206 (100%)

One cell (25%) had expected count of <5. The minimum expected count is 2.86. Therefore χ^2 could not be used to test for significance. However, when applying Fisher's exact test no statistical significance was found (Exact sig. 2-sided = 0.154).

Table A16.47: Relationship between being injured while passing instruments from hand to hand attending training session

Attended training session		Injured passing sharps		Total (%)
		Yes	No	
Yes	Count (% injured passing sharps)	16 (43.2%)	44 (25.9%)	60 (29.0%)
No	Count (% injured passing sharps)	21 (58.6%)	126 (74.1%)	147 (71.0%)
Total	Count (% injured passing sharps)	37 (100%)	170 (100%)	207 (100%)

No statistical significance was demonstrated in relation to attending training sessions and sustaining an injury while passing sharps from hand to hand (χ^2 3.646, P=0.056).

Table A16.48: Relationship between attending training session and being injured while cutting tissue

Attended training session		Injured while cutting tissue		Total (%)
		Yes	No	
Yes	Count (% injured while cutting)	3 (21.4%)	57 (29.7%)	60 (29.1%)
No	Count (% injured while cutting)	11 (78.6%)	135 (79.3%)	146 (70.9%)
Total	Count (% injured while cutting)	14 (100%)	192 (100%)	206 (100%)

One cell (25%) had expected count of <5. The minimum expected count is 4.08. Therefore the χ^2 test could not be applied. However, when applying Fisher's exact test, the relationship was found not to be statistically significant (Exact sig. 2-sided =0.762).

Table A16.49: Relationship between being injured while clearing away and attending training session

Attended training session		Injured while clearing away		Total (%)
		Yes	No	
Surgeons	Count (% injured clearing away)	3 (50%)	57 (28.5%)	60 (29.1%)
Scrub nurses	Count (% injured clearing away)	3 (50%)	143 (71.5%)	146 (70.9%)
Total	Count (% injured clearing away)	6 (100%)	200 (100%)	206 (100%)

As two cells (50%) had expected count of <5, the relationship between attending training and being injured during clearing away could not be tested using χ^2. The minimum expected count is 1.75. This relationship was found not to be statistically significant when Fisher's exact test was applied (Exact sig. 2-sided =0.36).

Table A16.50: Relationship between being injured by sharp object being left in an inappropriate place and attending training session

Attended training session		Injured by sharp object in inappropriate place		Total (%)
		Yes	No	
Yes	Count (% injured by sharp in inappropriate place)	7 (53.8%)	53 (27.5%)	60 (29.1%)
No	Count (% injured by sharp in inappropriate place)	6 (46.2%)	140 (72.5%)	146 (70.9%)
Total	Count (% injured by sharp in inappropriate place)	13 (100%)	193 (100%)	206 (100%)

One cell (25%) had expected count of <5. Minimum expected count is 3.79. Therefore the χ^2 test could not be applied. On applying Fisher's exact test, the relationship was not statistically significant (Exact sig. 2-sided =0.058).

Table A16.51: Relationship between being injured by sharp object protruding from a sharps box and attending training session

Attended training session		Injured by sharp object protruding from sharps box		Total (%)
		Yes	No	
Yes	Count (% injured by object protruding from sharps box)	0(0%)	60 (29.3%)	60 (29.1%)
No	Count (% injured by object protruding from sharps box)	1 (100%)	145 (70.7%)	146 (70.9%)
Total	Count (% injured by object protruding from sharps box)	1 (100%)	205 (100%)	206 (100%)

No test of significance could be applied to test this relationship as two cells (50%) had expected count of <5 and the minimum observed count is 0.

Table A16.52: Relationship between sustaining sharps injury within 1 year and double gloving (response rate 306/315)

Sharps injury within 1 year		Double gloving: Always	Suspected or known blood-borne viral infection	Never	Total (n=300)
None	Count (% of those who have had sharps injury in past year)	48 (22.6%)	142 (67.0%)	22 (10.4%)	**212 (100%)**
1 or more	Count (% of those who have had sharps injury in past year)	24 (25.5%)	65 (69.1%)	5 (5.3%)	**94 (100%)**
Total	Count (% of those who have had sharps injury in past year)	72 (23.5%)	207 (67.6%)	27 (8.8%)	**306 (100%)**

No statistically significant relationship was identified between these two variables (97.1%, χ^2 = 2.165, P = 0.339, df=2).

Table A16.53: Relationship between sustaining sharps injury within 1 year and avoiding passing sharps from hand to hand (response rate 300/315, 95.2%)

Sharps injury within 1 year		Avoid passing sharps from hand to hand: Always	Suspected or known blood-borne viral infection	Never	Total (n=300)
None	Count (% of those who have had sharps injury in past year)	189 (89.2%)	14 (6.6%)	9 (4.2%)	**212 (100%)**
1 or more	Count (% of those who have had sharps injury in past year)	70 (79.5%)	12 (13.6%)	6 (6.8%)	**88 (100%)**
Total	Count (% of those who have had sharps injury in past year)	259 (86.3%)	26 (8.7%)	15 (5.0%)	**300 (100%)**

Once again, no statistically significant relationship was identified (χ^2 = 5.037, P = 0.081, df=2).

Table A16.54: Relationship between sustaining sharps injury within 1 year and using a safety device (response rate 258/315, 81.9%)

Sharps injury within 1 year		Using a safety device: Always	Suspected or known blood-borne viral infection	Never	Total (n=258)
None	Count (% of those who have had sharps injury in past year)	47 (25.8%)	45 (24.7%)	90 (49.5%)	**182 (100%)**
1 or more	Count (% of those who have had sharps injury in past year)	17 (22.4%)	18 (23.7%)	41 (53.9%)	**76 (100%)**
Total	Count (% of those who have had sharps injury in past year)	64 (24.8%)	63 (24.4%)	131 (50.8%)	**258 (100%)**

No statistically significant relationship found between using a safety device and sustaining sharps injury within the past year ($\chi^2 = 0.495$, P = 0.781, df=2).

Table A16.55: Relationship between sustaining sharps injury within 5 years and double gloving (response rate 306/315, 97.1%)

Sharps injury within 5 years		Double gloving: Always	Suspected or known blood-borne viral infection	Never	Total (n=300)
None	Count (% of those who have had sharps injury in past year)	29 (22.7%)	83 (64.8%)	16 (12..5%)	**128 (100%)**
1 or more	Count (% of those who have had sharps injury in past year)	43 (24.2%)	124 (69.7%)	11 (6.2%)	**178 (100%)**
Total	Count (% of those who have had sharps injury in past year)	72 (23.5%)	207 (67.6%)	27 (8.8%)	**306 (100%)**

Sustaining a sharps injury within the past five years was not influenced by double gloving (χ^2 = 3.698, P = 0.157, df=2).

Table A16.56: Relationship between sustaining sharps injury within 5 years and avoiding passing sharps from hand to hand (response rate 300/315, 95.2%)

Sharps injury within 5 years		Avoid passing sharps from hand to hand: Always	Suspected or known blood-borne viral infection	Never	Total (n=300)
None	Count (% of those who have had sharps injury in past year)	189 (89.2%)	14 (6.6%)	9 (4.2%)	**212 (100%)**
1 or more	Count (% of those who have had sharps injury in past year)	70 (79.5%)	12 (13.6%)	6 (6.8%)	**88 (100%)**
Total	Count (% of those who have had sharps injury in past year)	259 (86.3%)	26 (8.7%)	15 (5.0%)	**300 (100%)**

Sustaining a sharps injury at five years was not influenced by avoiding passing sharps from hand to hand ($\chi^2 = 2.136$, $P = 0.344$, df=2).

Table A16.57: Relationship between sustaining sharps injury within 5 years and using a safety device (response rate 258/315, 81.9%)

Sharps injury within 5 years		Using a safety device: Always	Suspected or known blood-borne viral infection	Never	Total (n=258)
None	Count (% of those who have had sharps injury in past year)	30 (28.3%)	25 (23.6%)	51 (48.1%)	**106 (100%)**
1 or more	Count (% of those who have had sharps injury in past year)	34 (22.4%)	38 (25.0%)	80 (52.6%)	**152 (100%)**
Total	Count (% of those who have had sharps injury in past year)	64 (24.8%)	63 (24.4%)	131 (50.8%)	**258 (100%)**

Similarly, using a safety device had no influence ($\chi^2 = 1.189$, $P = 0.552$, df=2).

Table A16.58: Relationship between sustaining splash to mucous membranes within the past year and wearing eye protection/full face visor (response rate 299/315, 94.9%)

Splash to mucous membranes within 1 year		Wearing eye protection/full face visor: Always	Suspected or known blood-borne viral infection	Never	Total (n=229)
None	Count (% of those who have had splash to mucous membrane in past year)	128 (48.3%)	118 (44.5%)	19 (7.2%)	**265 (100%)**
1 or more	Count (% of those who have had splash to mucous membrane in past year)	13 (38.2%)	18 (52.9%)	3 (8.8%)	**34 (100%)**
Total	Count (% of those who have had splash to mucous membrane in past year)	141 (47.2%)	136 (45.5%)	22 (7.4%)	**299 (100%)**

In table A55, one cell had an expected count of less than 5. The minimum expected count is 2.5 however, the actual count is 3.0. Therefore, the χ^2 test was used to explain statistical significance (Altman, 1991). This relationship is not statistically significant (χ^2=1.228, P=0.541, df=2).

Table A16.59: Relationship between sustaining splash to mucous membranes within the past five years and wearing eye protection/full face visor (response rate 299/315, 94.9%)

Splash to mucous membranes within 5 years		Wearing eye protection/full face visor: Always	Suspected or known blood-borne viral infection	Never	Total (n=258)
None	Count (% of those who have had splash to mucous membrane in past 5 years)	115 (48.5%)	102 (43.0%)	20 (8.4%)	**237 (100%)**
1 or more	Count (% of those who have had splash to mucous membrane in past 5 years)	26 (41.9%)	34 (54.8%)	2 (3.2%)	**62 (100%)**
Total	Count (% of those who have had splash to mucous membrane in past 5 years)	141 (47.2%)	136 (45.5%)	22 (7.4%)	**299 (100%)**

One cell had an expected count of less than 5. The minimum expected count is 4.56 however, the actual count is 2.0. However, as >80% of cells have an expected count of >5, χ^2 can be used to explore significance (Altman, 1991). However, no statistical significance was found (χ^2 =3.772, P=0.152, df=2).

Table A16.60 -: Relationship between sustaining a sharps injury within 1 year and compliance with using safety devices

Sharps injury within 1 year		Use a safety device: Full compliance	Use a safety device: Partial or non compliance	Total
None	Count (% of those who have had sharps injury in past year)	47 (25.8%)	135 (74.2%)	**182 (100%)**
1 or more	Count (% of those who have had sharps injury in past year)	17 (22.4%)	59 (77.6%)	**76 (100%)**
Total	Count (% of those who have had sharps injury in past year)	64 (24.8%)	194 (75.2%)	**258 (100%)**

The relationship between these two variables was not statistically significant (χ^2 0.18, P = 0.669, df=1, odds ratio (OR) 1.21, 95% confidence interval (CI) 0.64-2.23).

Table A16.61 -: Relationship between sustaining a sharps injury within 5 years and compliance with avoiding passing sharps from hand to hand

Sharps injury within 5 years		Avoid passing sharps from hand to hand: Full compliance	Avoid passing sharps from hand to hand: Partial or non compliance	Total n=300
None	Count (% of those who have had sharps injury in past 5 years)	110 (86.6%)	17 (13.4%)	**127 (100%)**
1 or more	Count (% of those who have had sharps injury in past 5 years)	149 (86.1%)	24 (13.9%)	**173 (100%)**
Total	Count (% of those who have had sharps injury in past 5 years)	259 (86.3%)	41 (13.7%)	**300 (100%)**

The relationship between these two variables was not statistically significant (χ^2 0.00, P = 1.000, df=1, odds ratio (OR) 1.04, 95% confidence interval (CI) 0.53-2.03).

Table A16.62 -: Relationship between sustaining a sharps injury within 5 years and compliance with using safety devices

Sharps injury within 5 years		Use a safety device: Full compliance	Partial or non compliance	Total n=258
None	Count (% of those who have had sharps injury in past 5 years)	30 (28.3%)	76 (71.7%)	**106 (100%)**
1 or more	Count (% of those who have had sharps injury in past 5years)	34 (22.4%)	118 (177.6%)	**152 (100%)**
Total	Count (% of those who have had sharps injury in past year)	(64 (24.8%)	194 (75.2%)	**258 (100%)**

No statistical significance was demonstrated between use of safety device and sustaining a sharps injury with five years (χ^2 0.88, P = 0.348, df=1, odds ratio (OR) 1.37, 95% confidence interval (CI) 0.78-2.42).

Table A16.63: Relationship between sustaining splash to mucous membranes within 1 year and compliance with eye protection/full face visor

Splash of blood to mucous membranes within 1 year		Eye protection/full face visor: Full compliance	Partial or non compliance	Total N=299
None	Count (% of those who have had splash to mucous membrane in past 1 year)	128 (48.3%)	137 (51.7%)	**265 (100%)**
1 or more	Count (% of those who have had splash to mucous membrane in past 1 year)	13 (38.2%)	21 (61.8%)	**34 (100%)**
Total	Count (% of those who have had splash to mucous membrane in past 1 year)	141 (47.2%)	158 (52.8%)	**299 (100%)**

There was no statistical significance in the relationship between use of eye protection/full face visor and sustaining a sharps injury within one year (χ^2 0.86, P = 0.355, df=1, odds ratio (OR) 1.51, 95% confidence interval (CI) 0.73-3.14).

Table A16.64: Relationship between sustaining splash to mucous membranes within 5 years and compliance with eye protection/full face visor

Splash of blood to mucous membranes within 5 years		Eye protection/full face visor: Full compliance	Eye protection/full face visor: Partial or non compliance	Total
None	Count (% of those who have had splash to mucous membrane in past 5 years)	115 (48.5%)	122 (51.5%)	**237 (1005)**
1 or more	Count (% of those who have had splash to mucous membrane in past 5 years)	26 (41.9%)	36 (58.1%)	**62 (100%)**
Total	Count (% of those who have had splash to mucous membrane in past 5 years)	141 (47.2%)	158 (52.8%)	**299 (100%)**

No statistical significance was demonstrated between use of eye protection/full face visor and sustaining a splash injury within five years (χ^2 6.12, P = 0.434, df=1, odds ratio (OR) 1.31, 95% confidence interval (CI) 0.74-2.30).

Table A16.65: Relationship between double gloving and profession

Profession		Double glove: Full compliance	Double glove: Partial or non compliance	Total
Surgeons	Count (% within profession)	40 (22.9%)	135 (77.1%)	175 (100%)
Scrub nurses	Count (% within profession)	32 (24.4%)	99 (75.6%)	131 (100%0
Total	Count (%)	72 (23.5%)	234 (76.5%)	306 (100%)

The relationship between profession and double gloving is not statistically significant (χ^2 0.34, P = 0.854, df=1, odds ratio (OR) 0.92, 95% confidence interval (CI) 0.54-1.56).

Table A16.66: Relationship between avoiding passing sharps from hand to hand and profession

Profession		Avoid passing sharps from hand to hand		Total
		Full compliance	Partial or non compliance	
Surgeons	Count (% within profession)	144 (83.7%)	28 (16.3%)	172 (100%)
Scrub nurses	Count (% within profession)	115 (89.8%)	13 (10.2%)	128 (100%)
Total	Count (%)	259 (86.3%)	41 (13.7%)	300 (100%)

Profession did not influence whether sharps were passed directly from hand to hand (χ^2 1.842, P = 0.175, df=1, odds ratio (OR) 0.58, 95% confidence interval (CI) 0.29-1.17).

Table A16.67: Relationship between adopting protective measures and length of time since qualifying

	Double gloving	Eye protection/full face visor	Avoid passing sharps from hand to hand	Using a safety device
Mann-Whitney U	7381.5	10302.5	4585.0	6016.0
Z	-1.49	-9.41	-1.134	-0.25
Asymp. Sig. (2 tailed)	0.136	0.347	0.257	0.803

Table A16.68: Relationship between adopting protective measures and length of time spent in current speciality

	Double gloving	Eye protection/full face visor	Avoid passing sharps from hand to hand	Using a safety device
Mann-Whitney U	7593.0	10913.5	4553.0	5562.5
Z	-1.165	-0.114	-1.198	-1.134
Asymp. Sig. (2 tailed)	0.244	0.909	0.231	0.257

This relationship could not be tested as the minimum observed count was 0.

Table A16.69: Relationship between double gloving and surgeon's speciality

Speciality	Double gloving		Total (%)
	Full compliance (%)	Partial or non compliance (%)	
General	1 (1.9%)	53 (98.1%)	54 (100%)
Ear, nose and throat	0 (0%)	22 (100%)	22 (100%)
Urology	2 (15.4%)	11 (84.6%)	13 (100%)
Trauma and orthopaedics	34 (89.5%)	4 (10.5%)	38 (100%)
Obstetrics and gynaecology	1 (2.5%)	39 (97.5%)	40 (100%)
Total	38 (22.8%)	129 (77.2%)	167 (100%)

This relationship could not be tested as the minimum observed count was 0.

Table A16.70: Relationship between using a safety device and surgeon's speciality

Speciality	Use a safety device		Total (%)
	Full compliance (%)	Partial or non compliance (%)	
General	10 (20%)	40 (80%)	50 (100%)
Ear, nose and throat	0 (0%)	21 (100%)	21 (100%)
Urology	5 (41.7%)	7 (58.3%)	12 (100%)
Trauma and orthopaedics	4 (10.5%)	34 (89.5%)	38 (100%)
Obstetrics and gynaecology	14 (40%)	21 (60%)	35 (100%)
Total	33 (21.2%)	123 (78.8%)	156 (100%)

Table A16.71: Relationship between double gloving and attending training

Attended training session	Double gloving		Total
	Full compliance	Partial or non compliance	
Yes (%)	24 (22.4%)	83 (77.6%)	107 (100%)
No (%)	48 (24.2%)	150 (75.8%)	198 (100%)
Total	72 (23.6%)	233 (76.4%)	305 (100%)

This relationship was not statistically significant (χ^2 =0.046, P=0.830, df=1, OR= 0.904, 95% CI = 0.517-1.58).

Table A16.72: Relationship between wearing eye protection/full face visor and attending training

Attended training session	Wearing eye protection/full face visor		Total
	Full compliance	Partial or non compliance	
Yes (%)	56 (51.9%)	52 (49.1%)	108 (100%)
No (%)	85 (44.7%)	105 (55.3%)	190 (100%)
Total	141 (47.3%)	157 (52.7%)	298 (100%)

No statistical significance was detected here (χ^2 =1.128, P=0.288, df=1, OR= 1.33, 95% CI = 0.829-2.136).

Table A16.73: Relationship between passing sharps from hand to hand and attending training

Attended training session	Passing sharps from hand to hand		Total
	Full compliance	Partial or non compliance	
Yes (%)	97 (91.5%)	9 (8.5%)	106 (100%)
No (%)	161 (83.4%)	32 (16.6%)	193 (100%)
Total	258 (86.3%)	41 (13.7%)	299 (100%)

Once again, no statistical significance was detected (χ^2 =3.132, P=0.077, df=1, OR= 2.142, 95% CI = 0.981-4.679). Neither was a trend identified (Linear by linear association 3.722, P=0.052).

Table A16.74: Relationship between reporting an inoculation injury and familiarity with the reporting procedure

	Injuries reported (%)				
	All	>50%	<50%	None	Total
Very/quite likely	105 (57.7%)	22 (12.1%)	31 (17.0%)	24 (13.2%)	182 (100%)
Very/quite unlikely	7 (31.8%)	1 (4.5%)	3 (13.6%)	11 (50.0%0	22 (100%)
Total	112 (54.9%)	23 (11.3%)	34 (16.7%)	35 (17.2%)	204 (100%)

As 3 cells (37.5%) had an expected count of < 5 χ^2 could not be used to test significance.

Table A16.75: Relationship between reporting an inoculation injury and not knowing the reporting procedure

	Injuries reported (%)				
	All	>50%	<50%	None	Total
Very/quite likely	25 (61.0%)	5 (12.2%)	5 (12.2%)	6 (14.6%)	41 (100%)
Very/quite unlikely	59 (60.8%)	13 (13.4%)	14 (14.4%)	11 (11.3%)	97 (100%)
Total	84 (60.9%)	18 (13.0%)	19 (13.8%)	17 (12.3%)	138 (100%)

No statistical significance was found (χ^2=0.391, P=0.942, df=3).

Table A16.76: Relationship between reporting an inoculation injury and not knowing where to find policy

	Injuries reported (%)				
	All	>50%	<50%	None	Total
Very/quite likely	25 (69.4%)	4 (11.1%)	1 (2.8%)	6 (16.7%)	36 (100%)
Very/quite unlikely	59 (57.8%)	12 (11.8%)	18 (17.6%)	13 (12.7%)	102 (100%)
Total	84 (60.9%)	16 (11.6%)	19 (13.8%)	19 (13.8%)	138 (100%)

As 3 cells (37.5%) had an expected count of < 5 χ^2 could not be used to test significance.

Table A16.77: Relationship between reporting an inoculation injury and being discouraged by managers to do so

	Injuries reported (%)				
	All	>50%	<50%	None	Total
Very/quite likely	5 (83.3%)	1 (16.7%)	0 (0%)	0 (0%)	6 (100%)
Very/quite unlikely	84 (58.3%)	15 (10.4%)	25 (17.4%)	20 (13.9%)	144 (100%)
Total	89 (59.3%)	16 (10.7%)	25 (16.7%)	20 (13.3%)	150 (100%)

As 4 cells (50%) had an expected count of <5 χ^2 could not be used to test significance.

Table A16.78: Relationship between familiarity with reporting mechanism and length of time since qualification and length of time in current speciality

	Length of time since qualifying	Length of time in current speciality
Mann-Whitney U	1827.5	1891.0
Z	-0.744	-0.543
Asymp. Sig. (2 tailed)	0.457	0.587

Table A16.79: Relationship between reporting inoculation injuries and surgeon's speciality

	Injuries reported (%)				
	All	**>50%**	**<50%**	**None**	**Total**
General	11 (26.6%)	5 (12.2%)	14 (34.1%)	11 (26.8%)	41 (100%)
ENT	6 (42.2%)	3 (23.1%)	1 (7.7%)	3 (23.1%)	13 (100%)
Urology	5 (50%)	0 (0%)	1 (10.0%)	4 (40.0%)	10 (100%)
Trauma and Orthopaedics	13 (44.8%)	5 (17.2%)	7 (24.1%)	4 (13.8%)	29 (100%)
Obstetrics and Gynaecology	11 (32.4%)	8 (23.5%)	8 (23.5%)	7 (20.6%)	34 (100%)
Total	46 (36.2%)	21 (16.5%)	31 (24.2%)	29 (22.8%)	127 (100%)

None cells (45%) have expected count of <5. the minimum expected count is 1.65. Minimum observed count is 0. Therefore, no tests for significance can be applied.

Table A16.80: Relationship between failure to report injuries because of not knowing what action to take and profession

		Did not know what action to take			
Profession		**Very/quite likely**	**No influence**	**Very/quite unlikely**	**Total**
Surgeons	Count within profession (%)	12 (20.0%)	22 (36.7%)	26 (43.3%)	**60 (100%)**
Scrub nurses	Count within profession (%)	0 (0%)	3 (50%)	3 (50%)	**6 (100%)**
Total	Count (%)	12 (18.2%)	25 (37.9%)	29 (43.9%)	**66 (100%)**

Three cells (55%) have expected count of <5. the minimum expected count is 1.09. Minimum observed count is 0. Therefore, no tests for significance can be applied.

Table A16.81: Relationship between failure to report injuries because of not knowing where to find relevant policy and profession

Profession		Did not know where to find relevant policy			
		Very/quite likely	No influence	Very/quite unlikely	Total
Surgeons	Count within profession (%)	8 (13.3%)	20 (33.3%)	32 (53.3%)	**60 (100%)**
Scrub nurses	Count within profession (%)	0 (0%)	2 (33.3%)	4 (66.7%)	**6 (100%)**
Total	Count (%)	8 (12.1%)	22 (33.3%)	36 (54.5%)	**66 (100%)**

Three cells (50%) have expected count of <5. the minimum expected count is 0.73. Minimum observed count is 0. Once again, significance cannot be tested.

Table A16.82: Relationship between failure to report injuries because of pressure of work and profession

Profession		Pressure of work			
		Very/quite likely	No influence	Very/quite unlikely	Total
Surgeons	Count within profession (%)	34 (54.8%)	18 (29.0%)	10 (16.1%)	**62 (100%)**
Scrub nurses	Count within profession (%)	3 (42.9%)	3 (42.9%)	1 (14.3%)	**7 (100%)**
Total	Count (%)	37 (53.6%)	21 (30.4%)	11 (15.9%)	**69 (100%)**

Three cells (50%) have expected count of <5. the minimum expected count is 1.12. Minimum observed count is 1. As >20% of cells have lower than the expected count, χ^2 is not a reliable predictor of significance.

Table A16.83: Relationship between failure to report injuries because reporting mechanism is too cumbersome and profession

Profession		Reporting mechanism is too cumbersome			
		Very/quite likely	No influence	Very/quite unlikely	Total
Surgeons	Count within profession (%)	51 (77.3%)	10 (15.2%)	5 (7.6%)	**66 (100%)**
Scrub nurses	Count within profession (%)	4 (66.7%)	1 (16.7%)	1 (16.7%)	**6 (100%)**
Total	Count (%)	55 (76.4%)	11 (15.3%)	6 (8.3%)	**72 (100%)**

Three cells (50%) have expected count of <5. the minimum expected count is 0.5. Minimum observed count is 1. Once again χ^2 is not a reliable predictor of significance because >20% of cells have an expected count of <5.

Table A16.84: Relationship between failure to report injuries because they were dissatisfied with follow up procedure after reporting a previous injury and profession

Profession		Dissatisfied with follow up procedure after reporting a previous injury			
		Very/quite likely	No influence	Very/quite unlikely	Total
Surgeons	Count within profession (%)	23 (41.8%)	23 (41.8%)	9 (16.4%)	**55 (100%)**
Scrub nurses	Count within profession (%)	1 (16.7%)	2 (33.3%)	3 (50%)	**6 (100%)**
Total	Count (%)	24 (39.3%)	25 (41%)	12 (19.7%)	**61 (100%)**

Three cells (50%) have expected count of <5. the minimum expected count is 1.18. Minimum observed count is 1. Yet again χ^2 is an inappropriate test.

Table A16.85: Relationship between failure to report injuries because the patient was 'low risk' and profession

Profession		The patient was 'low risk'			
		Very/quite likely	No influence	Very/quite unlikely	Total
Surgeons	Count within profession (%)	50 (75.8%)	9 (13.6%)	7 (10.6%)	**66 (100%)**
Scrub nurses	Count within profession (%)	4 (66.7%)	2 (33.3%)	0 (0%)	**6 (100%)**
Total	Count (%)	54 (75%)	11 (15.3%)	7 (9.7%)	**72 (100%)**

Three cells (50%) have expected count of <5. the minimum expected count is 0.58. Minimum observed count is 0. Therefore, no tests for significance can be applied.

Table A16.86: Relationship between failure to report injuries because the injury was too minor to report and profession

Profession		Injury to minor to report			
		Very/quite likely	No influence	Very/quite unlikely	Total
Surgeons	Count within profession (%)	45 (68.2%)	10 (15.2%)	11 (16.7%)	**66 (100%)**
Scrub nurses	Count within profession (%)	4 (66.7%)	2 (33.3%)	0 (0%)	**6 (100%)**
Total	Count (%)	49 (68.1%)	12 (16.7%)	11 (15.3%)	**72 (100%)**

Three cells (50%) have expected count of <5. the minimum expected count is 0.92. Minimum observed count is 0. As before, no tests for significance can be applied.

Table A16.87: Relationship between failure to report injuries because inoculation injuries are an occupational hazard and profession

Profession		Inoculation injuries are an occupational hazard			
		Very/quite likely	No influence	Very/quite unlikely	Total
Surgeons	Count within profession (%)	31 (48.4%)	18 (28.1%)	15 (23.4%)	**64 (100%)**
Scrub nurses	Count within profession (%)	3 (50%)	0 (0%)	3 (50%)	**6 (100%)**
Total	Count (%)	34 (48.6%)	18 (25.7%)	18 (25.7%)	**70 (100%)**

Three cells (50%) have expected count of <5. the minimum expected count is 1.54. Minimum observed count is 0. Once again, significance cannot be tested.

Table A16.88: Relationship between failure to report injuries because managers discourage reporting profession

Profession		Managers discourage reporting			
		Very/quite likely	No influence	Very/quite unlikely	Total
Surgeons	Count within profession (%)	1 (1.7%)	14 (24.1%)	43 (74.1%)	**58 (100%)**
Scrub nurses	Count within profession (%)	0 (0%)	0 (0%)	6 (100%)	**6 (100%)**
Total	Count (%)	1 (1.6%)	14 (21.9%)	49 (76.6%)	**64 (100%)**

Four cells (66.7%) have expected count of <5. the minimum expected count is 0.9. Minimum observed count is 0. Consequently, no tests for significance are applicable.

Table A16.89: Relationship between reasons why inoculation injuries may not be reported and length of time since qualification

Length of time qualified	Did not know procedure	Could not find procedure	Pressure of work	Procedure too cumbersome	Dissatisfied last time
Chi-square	3.835	0.695	0.509	2.207	0.350
df	2	2	2	2	2
Asymp. Sig.	0.147	0.706	0.775	0.332	0.840

Table A16.90: Relationship between reasons why inoculation injuries may not be reported and length of time since qualification (continued)

Length of time qualified	Patient was low risk	Injury too minor	Injuries are occupational hazard	Managers discourage reporting
Chi-square	5.014	0.269	2.575	0.188
df	2	2	2	2
Asymp. Sig.	0.081	0.874	0.276	0.910

Table A16.91: Relationship between reasons why inoculation injuries may not be reported and length of time in current speciality

Length of time in current speciality	Did not know procedure	Could not find procedure	Pressure of work	Procedure too cumbersome	Dissatisfied last time
Chi-square	3.261	1.254	1.487	2.391	1.168
df	2	2	2	2	2
Asymp. Sig.	0.196	0.534	0.476	0.303	0.558

Table A16.92: Relationship between reasons why inoculation injuries may not be reported and length of time in current speciality (continued)

Surgeon's speciality	Patient was low risk	Injury too minor	Injuries are occupational hazard	Managers discourage reporting
Chi-square	4.660	0.599	1.826	1.076
df	2	2	2	2
Asymp. Sig.	0.097	0.741	0.401	0.584

Table A16.93: Relationship between failure to report because lack of familiarity with reporting procedure and surgeon's speciality

Surgeon's speciality	Patient was 'low risk'		
	Very/quite likely	Very/quite unlikely	Total
General	34 (81%)	8 (19.0%)	**42 (100%)**
ENT	12 (92.3%)	1 (7.7%)	**13 (100%)**
Urology	9 (90%)	1 (10%)	**10 (100%)**
Trauma and orthopaedics	25 (83.3%)	5 (16.7%)	**30 (100%)**
Obstetrics and gynaecology	30 (85.7%)	5 (14.3%	**35 (100%)**
Total	110 (84.6%)	20 (15.4%)	**130 (100%)**

3 cells (30%) have an expected count of <5. Minimum observed count is 1.54. Therefore, χ^2 is an inappropriate test.

Table A16.94: Relationship between failure to report because unable to find policy and surgeon's speciality

Surgeon's speciality	Patient was 'low risk'		
	Very/quite likely	Very/quite unlikely	Total
General	6 (27.3%)	16 (72.7%)	**22 (100%)**
ENT	4 (36.4%)	7 (63.6%)	**11 (100%)**
Urology	1 (16.7%)	5 (83.3%)	**6 (100%)**
Trauma and orthopaedics	4 (21.1%)	15 (78.9%)	**19 (100%)**
Obstetrics and gynaecology	8 (34.8%)	15 (65.2%)	**23 (100%)**
Total	23 (28.4%)	58 (71.6%)	**82 (100%)**

3 cells (30%) have an expected count of <5. Minimum observed count is 1.70. Once again, χ^2 is an inappropriate test.

Table A16.95: Relationship between failure to report because of pressure of work and surgeon's speciality

Surgeon's speciality	Patient was 'low risk'		
	Very/quite likely	Very/quite unlikely	Total
General	15 (55.6%)	12 (44.4%)	**27 (100%)**
ENT	7 (53.8%)	6 (46.2%)	**13 (100%)**
Urology	5 (83.3%)	1 (16.7%)	**6 (100%)**
Trauma and orthopaedics	14 (66.7%)	7 (33.3%)	**21 (100%)**
Obstetrics and gynaecology	15 (78.9%)	4 (21.1%)	**19 (100%)**
Total	56 (65.1%)	30 (34.9%)	**86 (100%)**

3 cells (30%) have an expected count of <5. Minimum observed count is 2.09. Once again, χ^2 is an inappropriate test.

Table A16.96: Relationship between failure to report because reporting mechanism was too cumbersome and surgeon's speciality

Surgeon's speciality	Patient was 'low risk'		
	Very/quite likely	Very/quite unlikely	Total
General	26 (81.3%)	6 (18.8%)	**32 (100%)**
ENT	5 (45.5%)	6 (54.5%)	**11 (100%)**
Urology	5 (83.3%)	1 (16.7%)	**6 (100%)**
Trauma and orthopaedics	19 (76.0%)	6 (24.0%)	**25 (100%)**
Obstetrics and gynaecology	26 (86.7%)	4 (13.3%)	**30 (100%)**
Total	81 (77.9%)	23 (22.1%)	**104 (100%)**

3 cells (30%) have an expected count of <5. Minimum observed count is 1.33. Consequently, χ^2 is an inappropriate test.

Table A16.97: Relationship between failure to report because dissatisfaction with action taken following previous injury and surgeon's speciality

Surgeon's speciality	Patient was 'low risk'		
	Very/quite likely	Very/quite unlikely	Total
General	13 (56.5%)	10 (43.5%)	**23 (100%)**
ENT	3 (30.0%)	7 (70.0%)	**10 (100%)**
Urology	3 (60.0%)	2 (40.0%)	**5 (100%)**
Trauma and orthopaedics	10 (52.6%)	9 47.4)	**19 (100%)**
Obstetrics and gynaecology	16 (76.2%)	5 (23.8%)	**21 (100%)**
Total	45 (57.7%)	33 (42.3%)	**78 (100%)**

3 cells (30%) have an expected count of <5. Minimum observed count is 2.12. χ^2 is an inappropriate test.

Table A16.98: Relationship between failure to report injuries are an occupational hazard injury and surgeon's speciality

Surgeon's speciality	Patient was 'low risk'		
	Very/quite likely	Very/quite unlikely	Total
General	20 (69.0%)	9 (31.0%)	**29 (100%)**
ENT	4 (33.3%)	8 (66.7%)	**12 (100%)**
Urology	5 (71.4%)	2 (28.6%)	**7 (100%)**
Trauma and orthopaedics	15 (68.2%)	7 (31.8%)	**22 (100%)**
Obstetrics and gynaecology	11 (61.1%)	7 (39.2%)	**18 (100%)**
Total	55 (62.5%)	33 (37.5%)	**88 (100%)**

3 cells (30%) have an expected count of <5. Minimum observed count is 2.63. Again, χ^2 is an inappropriate test.

Table A16.99: Relationship between failure to report because managers discourage reporting and surgeon's speciality

Surgeon's speciality	Patient was 'low risk'		
	Very/quite likely	Very/quite unlikely	Total
General	1 (3.7%)	26 (96.3%)	**27 (100%)**
ENT	2 (15.4%)	11 (84.6%)	**13 (100%)**
Urology	0 (0%)	6 (100%)	**6 (100%)**
Trauma and orthopaedics	0 (0%)	22 (100%)	**22 (100%)**
Obstetrics and gynaecology	1 (4.3%)	22 (95.7%)	**23 (100%)**
Total	4 (4.4%)	87 (95.6%)	**91 (100%)**

As 2 cells have an observed count of 0, no tests of significance can be applied.

Table A16.100: Relationship between attending training and failure to report injuries because of not knowing what action to take

Attended training	Did not know what action to take			
	Very/quite likely	No influence	Very/quite unlikely	Total
Yes (%)	1 (11.1%)	4 (44.1%)	4 (44.5%)	**9 (100%)**
No (%)	10 (19.6%)	20 (39.2%)	21 (41.2%)	**51 (100%)**
Total	11 (18.3%)	24 (40%)	25 (41.7%)	**60 (100%)**

Three cells (50%) had an expected count of <5, therefore χ^2 was not a suitable test of significance.

Table A16.101: Relationship between attending training and failure to report injuries because of not knowing where to find relevant policy

Attended training	Did not know where to find relevant policy			
	Very/quite likely	No influence	Very/quite unlikely	Total
Yes (%)	1 (11.1%)	4 (44.1%)	4 (44.5%)	**9 (100%)**
No (%)	6 (12%)	17 (34%)	27 (54%)	**50 (100%)**
Total	7 (11.9%)	21 (35.6%)	31 (52.5%)	**59 (100%)**

Three cells (50%) had an expected count of <5, therefore χ^2 could not be used to explore significance.

Table A16.102: Relationship between attending training and failure to report injuries because of pressure of work

Attended training	Pressure of work			
	Very/quite likely	No influence	Very/quite unlikely	Total
Yes (%)	3 (33.3%)	5 (55.6%)	1 (11.1%)	**9 (100%)**
No (%)	30 (56.6%)	14 (26.4%)	9 (17%)	**53 (100%)**
Total	33 (53.2%)	19 (30.6%)	10 (16.1%)	**62 (100%)**

Three cells (50%) had an expected count of <5, therefore significance was not explored.

Table A16.103: Relationship between attending training and failure to report injuries because reporting mechanism is too cumbersome

Attended training	Reporting mechanism is too cumbersome			
	Very/quite likely	No influence	Very/quite unlikely	Total
Yes (%)	6 (66.7%)	2 (22.2%)	1 (11.1%)	**9 (100%)**
No (%)	43 (78.2%)	7 (12.7%)	5 (9.1%)	**55 (100%)**
Total	49 (76.6%)	9 (14.1%)	6 (9.4%)	**64 (100%)**

Two cells (33.3%) had an expected count of <5. Therefore, χ^2 could not be used to explore significance.

Table A16.104: Relationship between attending training and failure to report injuries because they were dissatisfied with follow up procedure after reporting a previous injury

Attended training	Dissatisfied with follow up procedure after reporting a previous injury			
	Very/quite likely	No influence	Very/quite unlikely	Total
Yes (%)	1 (11.1%)	6 (66.7%)	2 (22.2%)	**9 (100%)**
No (%)	21 (46.7%)	15 (33.3%)	9 (20%)	**45 (100%)**
Total	22 (40.7%)	21 (38.9%)	11 (20.4%)	**54 (100%)**

Once again χ^2 could not be used to explore significance as 3 cells (50%) had an expected count of <5.

Table A16.105: Relationship between attending training and failure to report injuries because the patient was 'low risk'

Attended training	Patient was 'low risk'			
	Very/quite likely	No influence	Very/quite unlikely	Total
Yes (%)	7 (70%)	3 (30%)	9 (0%)	**10 (100%)**
No (%)	41 (74.5%)	7 (12.7%)	7 (12.7%)	**55 (100%)**
Total	48 (73.8%)	10 (15.4%)	7 (10.8%)	**65 (100%)**

As one cell has an observed count of 0, no tests for significance can be applied.

Table A16.106: Relationship between attending training and failure to report injuries because the injury was too minor to report

Attended training	Injury was too minor to report			
	Very/quite likely	No influence	Very/quite unlikely	Total
Yes (%)	6 (60%)	4 (40%)	0 (0%)	**10 (100%)**
No (%)	38 (69.1%)	7 (12.7%)	10 (18.2%)	**55 (100%)**
Total	44 967.7%)	11 (16.9%)	10 (15.4%)	**65 (100%)**

Once again one cell has an observed count of 0, therefore, no tests for significance can be applied.

Table A16.107: Relationship between attending training and failure to report injuries because inoculation injuries are an occupational hazard

Attended training	Inoculation injuries are an occupational hazard			
	Very/quite likely	No influence	Very/quite unlikely	Total
Yes (%)	4 (40%)	4 (40%)	2 (20%)	**10 (100%)**
No (%)	29 (54.7%)	11 (20.8%)	13 (24.5%)	**53 (100%)**
Total	33 (52.4%)	15 (23.8%)	15 (23.8%)	**63 (100%)**

Two cells (33.3%) had an expected count of <5. Consequently, χ^2 could not be used to explore significance.

Table A16.108: Relationship between attending training and failure to report injuries because managers discourage reporting

Attended training	Managers discourage reporting			
	Very/quite likely	No influence	Very/quite unlikely	Total
Yes (%)	3 (33.3%)	0 (0%)	6 (66.7%)	**9 (100%)**
No (%)	9 (18.8%)	0 (0%)	39 (81.3%)	**48 (100%)**
Total	12 (21.1%	0 (0%)	45 (78.9%)	**57 (100%)**

As three cells (50%) contained an observed count of 0, no test of significance could be applied.

Appendix 17

Categories and themes emerging from the questionnaires and interviews. (I) denotes new categories emerging during the interviews.

Category 1: Guideline adherence (AD)
AD/FULL – full compliance with guidelines as determined by the UK Health Departments (1998) AD/POS – positive attitude demonstrated towards efficacy of current guidelines AD/ENC – adherence encouraged (I) AD/TRUST – adherence is trust policy (I)
Category 2: Guideline violation (VIO)
VIO/LOS – violations related to length of service VIO/OTH – violations identified by other healthcare professionals VIO/CON – violations due to lack of confidence in efficacy of guidelines/protective measures VIO/DIS – violations due to discomfort caused by protective clothing VIO/KNOW – violations due to lack of knowledge or perception of risk VIO/SELF – violation or compliance due to self selected circumstances VIO/OTH – compliance and violation of guidelines determined by another healthcare professional VIO/EQ – violations due to inadequacies in existing equipment (I) VIO/SELECT – selective precautions taken (I) VIO/FIRST – first aid protocol not followed (I) VIO/EDU – violations due to differences in education (I) VIO/CULT – violations due to cultural differences (I) VIO/PROT – violations due to dislike of protocols (I) VIO/HIER – violations and compliance influenced by hierarchy within profession (I) VIO/LOW – violations because risk assumed to be low (I) VIO/HIGH - improved compliance because risk assumed to be high (I) VIO/PROF – compliance or violation influenced by profession (I) VIO/COST – violations due to cost constraints (I) VIO/TIME – violations due to time constraints (I) VIO/PAT – compliance influenced by patient (I) VIO/PERS – compliance or violation influenced by personality (I) VIO/WOK – compliance or violation influenced by workload (I) VIO/LIT – violations or compliance influenced by fear of litigation (I) VIO/RISK – violation or compliance influenced by risk assessment (I)
Category 3: Reporting (REP)
REP/CUM – reporting mechanism too cumbersome REP/FEED – no feedback received after reporting injuries REP/TIM – action would depend on the timing of the accident REP/PEP – accidents not reported because participant would not take post exposure prophylaxis REP/MIN – would not report minor injuries REP/DRS – doctors are unlikely to report REP/CEN – censorship for allowing inoculation injuries to occur REP/OCC – do not report injuries because participants are dissatisfied with response from the Occupational Health department REP/CAT – not all injuries fit into available categories REP/POS – positive attitude to reporting procedure REP/HIGH – reported if patient known or suspected high risk (I)

REP/LOW – reporting influenced by perceived low risk (I)
REP/KNOW – not reported because did not know guidelines (I)
REP/POS – positive attitude to reporting (I)
REP/PROF – professional differences in reporting (I)
REP/HIER – reporting influenced by hierarchy within professions (I)
REP/STR – streamlining reporting process (I)
REP/POL – testing policy not followed (I)
REP/ACTION – appropriate action taken to reduce further risk (I)
REP/OTH – reporting influenced by another member of staff (I)

Category 4: Training (TRA)

TRA/NEG - negative attitude towards training
TRA/POS - positive attitude towards training
TRA/KNOW – participant would like to know more about current training
TRA/IND - training carried out on induction (I)
TRA/OTH – training needs of other healthcare professionals identified (I)
TRA/PROF – professional differences in training/education (I)
TRA/AWA – awareness of training sessions (I)
TRA/TIME – insufficient time to attend training sessions (I)
TRA/BAS – principles learned in basic training (I)
TRA/CAS – training cascaded by members of the team (I)

Category 5: Availability of equipment (AVA)

AVA/SD - availability of safety devices/equipment
AVA/BLA – availability of retractable blades/needles
AVA/DIS – availability of safe disposal equipment
AVA/COST – availability influenced by cost (I)
AVA/AWA – awareness of safety equipment (I)
AVA/CONT – availability of appropriately decontaminated equipment (I)
AVA/CORR – fear of corruption by company representatives (I)

Category 6: Pressure of work (PRE)

PRE/SPE – pressure to increase speed
PRE/CARE – pressure and carelessness
PRE/LIFE – pressure due to emergency or life threatening event

Category 7: Occupational hazard (OCC)

OCC/AVO – inoculation injuries are an avoidable hazard
OCC/UNAVO - inoculation injuries are an unavoidable hazard
OCC/NOT - inoculation injuries are not an occupational hazard
OCC/RISK – assessment of risk by surgical team
OCC/OTHER –inevitable injury to another member of the team

Category 8: Compensation/support (COM)

COM/COM – compensation following occupational acquisition of blood-borne viral infection
COM/SUP – support mechanisms available following occupational acquisition of blood-borne viral infection
COM/INS – relating to critical illness insurance policy

Category 9: Teamwork (TEA)

TEA/PRES – teamwork present (I)
TEA/IMP - teamwork important (I)
TEA/CON – consistent team members (I)

Category 10: Sustaining an injury (INJ)

INJ/CAR – injury caused by carelessness (I)
INJ/NEG – injury caused by negligence (I)

INJ/ACC – injury caused by difficult access (I)
INJ/SKILL – risk of injuries influenced by skill (I)
INJ/VUL – vulnerability of exposure to blood and body fluids (I)
INJ/SELF – injury caused by self (I)
INJ/OTH – injury caused by another (I)
INJ/PAT – risks to patient following injury (I)
INJ/RISK – risk of bloodborne viral infection following injury (I)
INJ/CARE – injury caused by carelessness (I)
INJ/SPLASH – injury caused by splash of blood (I)

Category 11: The study (STU)

STU/QUES – comments relating to the questionnaire
STU/NEG – negative comments related to questionnaire
STU/POS – positive comments related to questionnaire
STU/DEF – comments relating to definitions
STU/APP - applicability of the study
STU/PRO – relating to profession
STU/INT – interested in the study

Category 12: Other (OTH)

OTH/HIV – relating to compulsory HIV testing of patients
OTH/NEE – relating to suture needles
OTH/DEV – relating to other devices
OTH/SELF – injuries caused by own actions
OTH/REIN - reinforcement of philosophy of protection
OTH/FREQ – frequency of injuries
OTH/PER – relating to compulsory testing of personnel (I)

<u>**Appendix 18**</u>

Content analysis – questionnaires

Table A18.1: Category 1 -Guideline adherence (AD)

	COMMENT	**THEME SUB CODE**
1	I feel that the best way to reduce the incidence of inoculation injuries is to wear gloves at all times whilst performing invasive procedures and preferably double gloving while operating. It is also important to wear adequate eye protection and avoid passing sharp instruments and needles directly to hand during operations. 3.S.35 (T&O)	**AD/FULL**
2	There are no excuses for needle stab injuries during any procedure if guidelines are followed. 1.S.13	**AD/FULL**
3	I think we should take the necessary precautions for all patients, not just the known high risk. 1.N. 3	**AD/FULL**
4	Full Howarth Hood System for hip and knee surgery. Education of staff and provision of equipment. 3.N.7	**AD/FULL**
5	Working in orthopaedics I am aware of the need for constant 'updating'. Always double glove, frequent glove change, full Howarth system for each op. *(SIC)* 3.N.7	**AD/FULL**
6	I treat every patient the same – I assume they all could be HIV or Hep B/C *(SIC)*. 5.N.23	**AD/FULL**
7	Routine blunt needles used. Clips for skin 4.S.40	**AD/FULL**
8	If you're used to safe practice then whatever the circumstances you shouldn't sustain any injuries. If you do it's as I've seen it's purely accidental i.e. a needle sticking through a sharps pad or assisting the surgeon who slips. 3.N.11	**AD/POS**
9	Personally very satisfied and confident with the policy in place. 3.N.13	**AD/POS**
10	I was taught as soon as I was scrubbing to be aware of sharps and to place them in a safe container or on a sharps pad. I have sometimes been aware of other peoples practice that I have felt is not very safe practice. There should be more awareness about sharps to all theatre staff including surgeons. If bad practice is passed down the line, unfortunately it then becomes a problem to re-educate nurses who have done this for years. 3.N.11	**AD/POS**
11	Universal precautions and training can only help further to reduce injuries. Working in the orthopaedic theatre we always wear masks and eye protection and double glove routinely. 4.N.42	**AD/POS**
12	All patients should be treated as "High Risk". The likelihood of accidents happening are higher if staff become over anxious when "high risk" patients come through theatre. 4.N.53	**AD/POS**
13	Sharps injuries should ALWAYS be reported. 4.N.73	**AD/POS**
14	All staff are encouraged to follow policy and have it explained to them why they should follow policy 4.N.20	**AD/POS**
15	In addition to some ENT procedures I undertake minor surgery in my practice. All patients should be regarded as high risk. All procedures should be done carefully giving particular respect to "sharps" 4.S.32	**AD/POS**
16	Handle needles with forceps and needle holders not fingers 4.S.17	**AD/POS**
17	More use of retractable instruments and blunt needles may be helpful	**AD/POS**

	4.S.53	
18	Am fully aware of policy and always follow it. 4.N.20	**AD/FULL**

Key:
AD/FULL – full compliance with guidelines as determined by the UK Health Department (1998)
AD/POS – positive attitude demonstrated towards efficacy of current guidelines

Table A18.2: Category 2 - Guideline violations (VIO)

	COMMENT	THEME SUB CODE
1	Do not usually take additional precautions. In the event of known risk would take the advice from infection control. 6.S.39 (O&G)	VIO/KNOW
2	Mucosal contamination may be un-noticed by surgeon. 1.S.16 (ENT)	VIO/KNOW
3	? safety devices. 3.S.31 (T&O)	VIO/KNOW
4	Young doctors more clued up and ready to act promptly and efficiently. Old school doctors are dismissive of the implications of needlestick injuries – make you feel you are first making a fuss over nothing – which of course you are not. 6.N.6	VIO/LOS
5	I started my training 5.5 years ago and qualified in 2003. I find that younger people who qualified recently do take precautions against inoculation injuries. However, the mature scrub nurses don't take as many precautions especially wearing a visor (or any eye protection). 1.N.23	VIO/LOS
6	I have worn visors in the past but they are all uncomfortable. 5.N.23	VIO/DIS
7	Use of double gloves can reduce the manual dexterity hence most surgeons don't do it. 6.S.34 (Laparoscopic/colorectal)	VIO/DIS
8	Visors do interfere with surgical procedures, more suitable and practical face cover may be helpful 4.S.53	VIO/DIS
9	I don't see the point of double gloving. Surely one pair is enough! 5.N.23	VIO/CON
10	Most recent (accident) was splashing of mucous membranes to eyes on surgeon removing an instrument during procedure. 4.N.74	VIO/SELF
11	Double glove for joint replacements and any other procedure involving metalware *(SIC)* 4.S.39	VIO/SELF
12	Orthopaedic surgery (Double glove). 6.N.3	VIO/SELF
13	Orthopaedic/trauma (double glove). 4.N.150	VIO/SELF
14	Double glove in orthopaedics. 1.2.N3	VIO/SELF
15	Orthopaedic surgery (double glove). 2.N.1	VIO/SELF
16	Orthopaedic surgery (double glove). 6.N.10	VIO/SELF
17	Routine double gloving for ALL ortho *(SIC)* procedures except minor surgery. 3.S.30	VIO/SELF
18	For all orthopaedic cases (double glove). 3.N.9	VIO/SELF
19	Orthopaedics/ trauma (double glove). 6.N.8	VIO/SELF
20	Double glove for joint replacement. 3.N.17	VIO/SELF
21	Orthopaedics (double glove). 1.N.3	VIO/SELF
22	Joint surgery (double glove). 2.6.N	VIO/SELF
23	Prosthetic implant surgery. 4.N.76	VIO/SELF
24	Orthopaedics, some max/fax *(SIC)* cases and general (double glove, face protection, safety devices). 5.N.13	VIO/SELF
25	Ortho (double glove). 1.N.8	VIO/SELF
26	Plus Kevlar gloves though these are not easy to use for fiddly ops (double glove) 4.S.51	VIO/SELF
27	I wear normal glasses which offer some protection (I know limited). 5.N.23	VIO/SELF
28	Wear glasses (eye protection). 2.S.18	VIO/SELF
29	Wear glasses (eye protection) 4.N.20	VIO/SELF
30	Have glasses (eye protection). 3.S.58	VIO/SELF

31	I wear my own glasses (eye protection) 4.S.12	**VIO/SELF**
32	Glasses (eye protection). 5.S.41	**VIO/SELF**
33	Glasses (eye protection). 2.S.22	**VIO/SELF**
34	Glasses (eye protection). 2.N.13	**VIO/SELF**
35	Eye protection and I wear glasses. 3.N.17	**VIO/SELF**
36	Reading glasses 4.S.54	**VIO/SELF**
37	Eyes often protected by microscope/laser goggles etc so face visor is not relevant. 2.S.25	**VIO/SELF**
38	Ortho *(SIC),* caesarean section 1.N.8	**VIO/SELF**
39	Eye protection for all joint replacements. 3.S.30	**VIO/SELF**
40	Joint replacement (eye protection). 2.3.S5 (T&O)	**VIO/SELF**
41	Total joint replacements (eye protection). 3.S.31	**VIO/SELF**
42	Orthopaedics/trauma (eye protection). 6.N.8	**VIO/SELF**
43	Eye protection – hip/knee replacements, vascular cases, other cases where fluid prone to splashing. 6.N.20	**VIO/SELF**
44	Only joint replacements, not for minor ops. *(SIC)* (eye protection) 2.S.70	**VIO/SELF**
45	When using drilling equipment especially as aerosol of irrigation fluid occurs (eye protection). 1.S.16	**VIO/SELF**
46	When using mechanical saw (eye protection). 2.4.S	**VIO/SELF**
47	Certain procedures (eye protection). 2.5.S8	**VIO/SELF**
48	Also wear eye protection for other cases during which splashing may occur e.g. abdominal aortic aneurism repair. 1.N.8	**VIO/SELF**
49	Risk of splashing (eye protection). 2.S.71	**VIO/SELF**
50	Any case that is likely to involve splattering of fluids e.g. washouts and high risk cases (eye protection). 2.N.45	**VIO/SELF**
51	Patient with epistaxis use eye protection. 6.S.15	**VIO/SELF**
52	Generally starting to use visor more regularly for non-risk patients. 3.S.12	**VIO/SELF**
53	Sometimes (eye protection). 2.N.13	**VIO/SELF**
54	Use blunt needles during caesarean sections but not otherwise. 2.S.18 (O&G)	**VIO/SELF**
55	Blunt needles for closing abdomens. 6.S.6	**VIO/SELF**
56	Use blunt suture needles in places where possible but not always. 3.5.S2	**VIO/SELF**
57	Blunt needles where possible. 2.S.2	**VIO/SELF**
58	Blunt suture needles used but not routinely 4.S.55	**VIO/SELF**
59	Always use blunt suture needles. Don't have retractable blades. 2.N.54	**VIO/SELF**
60	Occasionally for laparoscopic surgery (retractable blade) or abdominal closure (blunt needle) 4.S.48	**VIO/SELF**
61	We use skin staples for skin closure now not cutting needles. We use blunt needles for closure. 2.N.39	**VIO/SELF**
62	We use diathermy blade rather than knife for dissection. 2.S.22	**VIO/SELF**
63	Ophthalmology (safety device). 6.N.10	**VIO/SELF**
64	Most (safety device). 1.S.11	**VIO/SELF**
65	Occasionally (safety device). 2.N.13	**VIO/SELF**
66	When possible (safety device). 6.S.25	**VIO/SELF**
67	Occasionally (safety device). 5.N.15	**VIO/SELF**
68	Only retractable needle for syringe (safety device). 2.N.50	**VIO/SELF**

69	Safety syringes and needle for local anaesthetics. 5.S.31	**VIO/SELF**
70	Include local anaesthetic syringes used by OMFS *(SIC)* /dental etc. 5.S.31	**VIO/SELF**
71	Disarming sharps container to remove scalpel blades and store other sharps. Some ortho *(SIC)* instruments although sharp have to be handled e.g. saw blades etc. 1.N.2	**VIO/SELF**
72	Use a plastic tray as our deposit and pick up point for sharps during surgery. DO NOT HAND SHARPS TO ANYONE, but use this tray as a go between. 3.N.7	**VIO/SELF**
73	Receiver (passing sharps). 6.N.9	**VIO/SELF**
74	Only scalpels via a disposable dish. 5.S.30	**VIO/SELF**
75	Occasionally (passing sharps). 2.5.S8	**VIO/SELF**
76	Try to avoid (passing sharps). 6.S.25	**VIO/SELF**
77	My own (passing instrument hand to hand). My injury occurred while I was placing the sharp (needle) in a sharps disarmer! User error. 1.N.15	**VIO/SELF**
78	Minimise using sharp instruments. 6.S.34	**VIO/SELF**
79	I will avoid sharp instruments as much as possible. 6.S.34	**VIO/SELF**
80	I do not handle needles with my fingers but only with tissue forceps or artery clips as an aid to a needle holder. 1.S.43	**VIO/SELF**
81	Familiarity with procedures, being careful! Common sense and a sensitivity to the instruments used is all that's required to prevent problems. 2.S.23	**VIO/SELF**
82	Development of minimal access surgery can reduce the inoculation injury. 6.S.34	**VIO/SELF**
83	Most sharps injuries occur due to surgeons not handing sharps back properly. 5.N.26	**VIO/OTH**
84	Surgeons could be made more aware of sharps protocol and handling/passing of sharps, the sharps injury I sustained was clean suture, the other injury I and colleagues have sustained were due to direct interaction with surgeons. 5.N.13	**VIO/OTH**
85	I think the surgeons need training in passing sharps safely as well as the nurses – my incident occurred due to a surgeon not securing a used suture needle to the needle holder. 6.N.13	**VIO/OTH**
86	I would just like to add that BOTH my needlestick injuries were the fault of the surgeon – NOT MYSELF. The surgeons were distracted which was why the injuries occurred. 4.N.73	**VIO/OTH**
87	Orthopaedics surgery i.e. joints double glove and some surgeons prefer blunt needles for mass closure. 1.N.13	**VIO/OTH**
88	Some surgeons choose to use blunt sutures. 4.N.42	**VIO/OTH**
89	Most surgeons use blunt needles for deep wounds but sharp for skin. 4.N.67	**VIO/OTH**
90	Engineered safety device depends on surgeon and operation. 6.N.20	**VIO/OTH**
91	Occasionally dependant on preference of surgeon (safety device). 5.N.7	**VIO/OTH**
92	At surgeon's preference or request (safety device). 6.N.30	**VIO/OTH**
93	Depends on the surgeon's preference (safety device). 2.N.18	**VIO/OTH**
94	Surgeon's preference (safety devices). 2.N.32	**VIO/OTH**
95	Engineered safety device depends on surgeon and operation. 6.N.20	**VIO/OTH**
96	Only 1 surgeon uses blunt needle. 4.N.73	**VIO/OTH**
97	Blunt suture for one consultant (safety device). 2.N.33	**VIO/OTH**

98	Blunt suture needle used by some surgeons. 6.N.4	**VIO/OTH**
99	Some surgeons prefer a blunt suture needle. 4.N.9	**VIO/OTH**
100	Blunt sutures for some cases 4.N.20	**VIO/OTH**
101	Only one surgeon uses blunt needles on every patient, otherwise never. 2.N.36	**VIO/OTH**
102	Most cases depends on who's the surgeon (avoid passing sharps). 2.N.18	**VIO/OTH**
103	I was taught as soon as I was scrubbing to be aware of sharps and to place them in a safe container or on a sharps pad. I have sometimes been aware of other peoples practice that I have felt is not very safe practice. There should be more awareness about sharps to all theatre staff including surgeons. If bad practice is passed down the line, unfortunately it then becomes a problem to re-educate nurses who have done this for years. 3.N.11	**VIO/OTH**
104	It is all dependent on the consultant surgeon. If the consultant surgeon practices safety then the junior staff will practice automatically. 6.S.34	**VIO/OTH**
105	Pass hand to hand when surgeon working with microscope 4.N.68	**VIO/OTH**

Key:
VIO/LOS – violations related to length of service
VIO/OTH – violations identified by other healthcare professionals
VIO/CON – violations due to lack of confidence in efficacy of guidelines
VIO/DIS – violations due to discomfort caused by protective clothing
VIO/KNOW – violations due to lack of knowledge or recognition of risk
VIO/SELF – violation due to self selected circumstances
VIO/OTH – violation of guidelines determined by another healthcare professional

Table A18.3: Category 3 - Reporting (REP)

	COMMENT	THEME SUB CODE
1	The main reason for non-reporting - extensive paper and never had any feedback when done in past. 3.S.12 (Breast surgery)	REP/CUM REP/FEED
2	It is probably a cumbersome process of filling appropriate form, chasing patient, obtaining blood from the patients and the whole process disrupts the whole day. 1.S.43 (General)	REP/CUM
3	I find the reporting of needlestick injury is too cumbersome. Sometimes you can have a minor scratch and you are forced to go through the same procedure. 6.S.22 (O&G)	REP/CUM
4	Lengthy procedure (influence decision to report). 6.N.2	REP/CUM
5	The process of reporting is complicated, filling forms, looking for witnesses, phoning occupational health etc. I suggest automatic report …… …….. ……*(SIC)* Sent to occupational health with the injury and taking instant blood sample from both patient and doctor with no need to wait to go to occupational health. Example of making the report and tests much easier and quicker. 2.S.68	REP/CUM
6	It is the amount of time involved and the interruption to work (which usually cannot be covered) that causes me to ignore the injury. 5.S.17	REP/CUM
7	Simplify reporting forms and make it mandatory to report all inoculation injuries. 6.S.30	REP/CUM
8	The main problem is it is incredibly time consuming and cumbersome to report, get yourself and the patient bled. Health at work should organise this all for you. Reporting would be improved if Health at Work sorted out the paperwork, came to find you and the patient for blood tests. It is far too cumbersome to be bothered to do this and though I generally do report the mechanism is far from satisfactory. 4.S.51	REP/CUM
9	Occupational department was not located in hospital 'til recently, making it difficult to report and follow procedures 4.S.53	REP/CUM
10	If the inoculation injury had occurred prior to the start of the case I am less likely to report it. 2.N.45	REP/TIM
11	I do not believe it would be any benefit to me as I do not intend to live on retroviral therapy 'just in case' (reporting). 2.S.76	REP/PEP
12	Provided they are minor, gloved and from non hollow needles (reporting) 6.S. 25 (General)	REP/MIN
13	Getting doctors to report needlestick injuries is very difficult, they don't like filling in forms, going to staff health. Normally left to nurse in charge to fill in relevant documents and to follow up investigations straight away while everything is fresh in everyone's mind. Also nurse normally has to get patient's permission to take bloods. 5.N.22	REP/DRS
14	Theatre nursing staff fill in incidence forms 4.S.54	REP/DRS
15	*Truth in the practice will* increase the reporting. 6.S.34 (Laparoscopic/colorectal)	REP/
16	OH *(SIC)* not always available. 6.N.6	REP/OCC
17	I have completed incident form for sharps injury and telephoned	REP/OCC

	occupational health for blood sampling – message left on answer phone but no further contact from occ *(SIC)* health, therefore no blood sample was taken on this occasion. 2.N.26	
18	Also some feedback from critical incidents when filled in. 2.N.48	**REP/FEED**
19	There should be space to report an injury that does not come under the normal category. 1.N.2	**REP/CAT**
20	I reported my inoculation injury. I went through the correct channels. If it happened again I'd do the same. 1.N.23	**REP/POS**
21	A standard protocol for avoiding/reporting/follow up action following inoculation injury should be laminated and displayed in a prominent place in all operation theatres. 6.S.16 (ENT)	**REP/POS**
22	Question 15. I personally would report any injuries or encourage others to report injuries, so would not find anything that would prevent me from doing this. So not sure about answer should be no influence or very unlikely. 4. N.150	**REP/POS**
23	Sharps injuries should ALWAYS be reported. 4. N.73	**REP/POS**
24	Reporting rate possibly increased by training on risks and harm minimisation. 4.N.88	**REP/POS**
25	Expect censorship not support for allowing it to happen. 2.S.3 (O&G)	**REP/CEN**
26	I find doctors need more training on the understanding of sharps – most incident forms are completed due to doctors receiving injuries. 1.N.6	**REP/DRS**
27	Need to encourage medical staff to report inoculation injuries more often. 4.S.9 (General/colorectal)	**REP/DRS**

Key:

REP/CUM – reporting mechanism too cumbersome
REP/FEED – no feedback received after reporting injuries
REP/TIM – reporting would depend on the timing of the accident
REP/PEP – accidents not reported because participant would not take post exposure prophylaxis
REP/MIN – would not report minor injuries
REP/DRS – doctors are unlikely to report
REP/CEN – Censorship for allowing inoculation injuries to occur
REP/OCC – do not report injuries because participants are dissatisfied with response from the Occupational Health department
REP/CAT – not all injuries fit into available categories
REP/POS – positive attitude to reporting procedure

Table A18.4: Category 4 - Training (TRA)

	COMMENT	THEME SUB CODE
1	Strictly regular training/awareness sessions on preventing/action on needlestick injuries. 6.N.6	TRA/POS
2	Significant, ongoing education of all levels of surgical/medical staff on the management and handling of 'sharps' when working in an operating theatre would reduce (potentially) 50% of injuries as they often cause them. 2.N.12	TRA/POS
3	Inoculation injuries could be reduced with more widespread and relevant training for frontline staff. 2.N.48	TRA/POS
4	Universal precautions and training can only help further to reduce injuries. Working in the orthopaedic theatre we always wear masks and eye protection and double glove routinely. 4.N.42	AD/POS
5	Inoculation injuries would be reduced by having more reinforced education and by having safe disposal equipment freely available. 1.N.8	TRA/POS
6	More study days on sharps awareness. 5.N.10	TRA/POS
7	Sharps policies in place for safe handling – ensuring staff comply. Education of surgeons and anaesthetists on sharps handling and self protection. 2.N.23	TRA/POS
8	I would welcome training/management of these injuries for all staff in the operating department. 1.N.17	TRA/POS
9	DISPLAY OF POSTERS. Training in handling and passing of instruments for scrub nurses and doctors. 3.N.17	TRA/POS
10	Proactive poster campaign (as for handwashing) would be an advantage to state importance. 3.N.20	TRA/POS
11	Provide adequate protective items re visors and training sessions and make sure the policies are in place and are followed by staff at all times. 1.N.13	TRA/POS
12	Training in preventing the occurrence of inoculation injuries should be encouraged in all members of staff who are susceptible. 1.N.24	TRA/POS
13	Appropriate training should be given in house to all staff 4.N.20	TRA/POS
14	Would like to know more about the training session for prevention of inoculation injury and to have it done for the department. 6.S.19 (O&G)	TRA/POS
15	Reporting rate possibly increased by training on risks and harm minimisation. 4.N.88	REP/POS
16	Better training	REP/POS
17	And it will be of no use (Training). 1.S.17 (T&O)	TRA/NEG
18	I think the surgeons need training in passing sharps safely as well as the nurses – my incident occurred due to a surgeon not securing a used suture needle to the needle holder. 6.N.13	TRA/OTH
19	We provide in service training 4.N.139	TRA/OTH
20	I find doctors need more training on the understanding of sharps – most incident forms are completed due to doctors receiving injuries. 1.N.6	TRA/OTH
21	I believe that surgeons require training on the safe handling of sharps etc. 4.N.67	TRA/OTH
22	I think inoculation injuries training must be done for all the TA's	TRA/OTH

	(SIC) working inside the theatre and other staff as well like cleaners. They must be orientated before the start of their work especially if they don't have any medical background at all or hospital experience. This kind of training must be done annually to update the staff about latest cases that must be reviewed by the department. 2.N.58	
23	Part of day to day theatre teaching (training session). 6.S.25 (General)	**TRA/DAY**
24	On induction by mentor (training). 6.N.20	**TRA/IND**

Key:
TRA/POS - positive attitude towards training
TRA/NEG - negative attitude towards training
TRA/OTH – training needs of other healthcare professionals identified
TRA/IND - training carried out on induction

Table A18.5: Category 5 - Availability of equipment (AVA)

	COMMENT	THEME SUB CODE
1	Only when speciality provides it (Safety device). 6.N. 3	AVA/SD
2	As available (safety devices). 2.S.3 (O&G)	AVA/SD
3	Blunt needles used in preference by some surgeons. Other safety devices not at present available in our department. 1.S.4 (Breast surgery)	AVA/SD
4	Provide adequate protective items re visors and training sessions and make sure the policies are in place and are followed by staff at all times. 1.N.13	AVA/SD
5	If in stock (safety devices). 6.N.41	AVA/SD
6	My injury occurred while I was folding the sharps discarder pad. One of the sutures protruded through the pad as I was folding it. A discarder pad that does not require folding would be an improvement and would reduce the risk of inoculation injuries. NWWN23	AVA/SD
7	There is a problem with our Trust about availability of proper (Kevlar) protective gloves and Stryker exhaust hoods – purely on the grounds of cost. 4.S.37	AVA/SD
8	Availability of better instruments. Availability of safety devices – reducing the number of blades and knives, perhaps increased use of diathermy cutting knife 4.S.54	AVA/SD
9	Retractable blades would be helpful in reducing inoculation injuries. 2.N.54	AVA/BLA
10	Always use blunt suture needles. Don't have retractable blades. 2.N.54	AVA/BLA
11	Only where appropriate materials are available e.g. blunt needles for abdominal wall closure. 4.S.4	AVA/BLA
12	Depends on surgeon's preference. DO NOT STOCK RETRACTABLE BLADES. 1.N.9	AVA/BLA
13	Inoculation injuries would be reduced by having more reinforced education and by having safe disposal equipment freely available. 1.N.8	AVA/DIS
14	Cheap sticky sharps pads with no weight in them are more likely to cause injuries than the slightly more expensive weighty ones. Not necessarily the very expensive ones just the heavier than basic ones. 2.N.45	AVA/DIS

Key:
AVA/SD - availability of safety devices
AVA/DIS – availability of safe disposal equipment
AVA/BLA – availability of retractable blades

Table A18.6: Category 6 - Pressure of work (PRE)

	COMMENT	THEME SUB CODE
1	With regard to surgery, then only one person doing any procedure at any one time as when two surgeons are working together on the same case to speed up the procedure then accidental inoculation injuries are more likely in my experience. 2.S.32 (T&O)	**PRE/CARE**
2	Suture needle injuries are a fact of life. I have reflected on this subject. Most of the injuries I have sustained are during emergency procedures and while large wounds are being closed. It is partly pressure and partly carelessness when proper techniques (taught to all surgeons) are not followed properly. I would say it is an attitude problem rather than complacency especially when surgeon is off guard following a difficult and prolonged procedure where one has to concentrate a lot! 5.S.8 (General surgery)	**PRE/CARE**
3	Be calm and take your time, operate without making too much mess! 4.S.52 (Obstetrics and Gynaecology)	**PRE/CARE**
4	Reduce pressure of work 4.S.54	**PRE/INC**
5	Mindfulness when assembling/disassembling kit necessary to prevent injuries. Anything which distracts or puts pressure on staff and this point increases risk. 4.N.88	**PRE/INC**
6	Issues such as staffing levels, workloads, team dynamics, skill mix all contribute to increased risk of injuries 4.N.88	**PRE/INC**
7	Minimum staffing levels e.g. out of hours work, can mean policy – i.e. de-scrubbing would be difficult to achieve 4.N.88	**PRE/INC**

Key:
PRE/CARE – pressure and carelessness
PRE/INC – high pressure increases risk

Table A18.7: Category 7 - Occupational hazard (OCC)

	COMMENT	THEME SUB CODE
1	'Sharps' injuries are an occupational hazard that can be avoided. 1.N. 2	**OCC/AVO**
	A preventable occupational hazard 4.S.4	**OCC/AVO**
2	Surgery will always involve sharp instruments often being held in difficult corners. No totally safe system will be possible. Please engineer any responses to be appropriate and commensurate with getting a difficult job done. Some risk will always be present. 6.S.25 (General)	**OCC/UNAVO**
3	In surgical field, one can only minimise but cannot completely avoid sharp injury. It is a professional hazard. 6.S.22 (O&G)	**OCC/UNAVO**
4	Injuries are inevitable when performing complex surgical procedures deep within the pelvis. 2.S.7 (urology)	**OCC/UNAVO**
5	Needlestick injuries are an occupational hazard for a surgeon. This does happen to every surgeon/assistant whether they report it or not. One should take all the precautions possible but it happens, it should not be mentioned/told 4.S.12 (general/breast)	**OCC/UNAVO**
6	An "occupational hazard" does not mean they are acceptable in any form 4.S.40	**OCC/UNACC**
7	Most of inoculation injuries occur in OT *(SIC)* while suturing. They are not reported as the process is too cumbersome. It should never be considered an occupational hazard. 3.S.32 (T&O)	**OCC/NOT**
8	The surgical team often feel they are not 'at risk'. It's often the case in general surgery that no mask or double gloves are worn at all. Just a hat and a gown for major surgical procedures. 3.N.7	**OCC/RISK**
9	In my experience there appears to be a higher incidence of inoculation injuries affecting doctors who assist surgeons than scrub nurses. 1.N.17	**OCC/RISK**
10	I've worked abroad where compulsory HIV testing is done. This leads to very careful technique. Also it's not the known things like hep B *(SIC)* and HIV it's the "unknown" – e.g. Hep C *(SIC)* or low risk patients with a problem. 2.S.22 (general)	**OCC/RISK**
11	Using power tools it has been demonstrated that an aerosol of blood is in the air, no inhalation is .... 2.S.11 (T&O)	**OCC/RISK**
12	Sharps injuries are ignored at times especially when patient not considered high risk. 6.S.36 (Urology)	**OCC/RISK**

Key:

OCC/AVO – inoculation injuries are an avoidable hazard
OCC/UNAVO - inoculation injuries are an unavoidable hazard
OCC/NOT - inoculation injuries are not an occupational hazard
OCC/RISK – assessment of risk by surgical team
OCC/UNACC – unacceptable hazard

Table A18.8: Category 8 - Compensation/Support (COM)

	COMMENT	THEME SUB CODE
1	It would be nice to be sure that if a serious infection was contracted during surgery substantial compensation would be forthcoming. 1.S.26 (Urology)	**COM/COM**
2	I would like to know what support/compensation we will get from NHS if we acquire serious inoculation injury infection acquired accidentally. 2.S.4 (general)	**COM/COM**
3	If someone contracts an infection at work (due to occupational exposure) what support mechanisms are in place? I would like to have some information on this. Does the trust have some policies on this? 2.S.84	**COM/SUP**
4	As I have critical illness policy which covers HIV, Hep B+ C *(SIC)* – I would have to show that I sustained illness from work so I would always report an injury purely for this fact. 6.N.3	**COM/INS**

Key:
COM/COM – compensation following occupational acquisition of blood-borne viral infection
COM/SUP – support mechanisms available following occupational acquisition of blood-borne viral infection
COM/INS – relating to critical illness insurance policy

Table A18.9 Category 9 - The study (STU)

	COMMENT	THEME SUB CODE
1	The questions to this (no 15) all assume that the injury was not reported – as this was reported the answers cannot be interpreted. If you want 15 to be answered properly you must put queries that would include factors that might motivate an individual to report an injury i.e. health protection, to try change practise etc. 1.S.2	STU/NEG
2	All your options in Q15 *(SIC)* are negative. Perhaps you could make them slightly more neutral. 5.S.35	STU/NEG
3	Difficult to identify specific events in relation to questions asked. 5.S.30	STU/REM
4	You have asked for very few facts – mostly opinions, and the subsequent report will be of little value therefore. 2.S.11	STU/NEG
5	Why should not we use electronic media (e mail) to send similar questionnaires! (Just a comment to be greener!!) 4.S.44	STU/NEG
6	It is difficult to remember number of incidents correctly 4.S.53	STU/REM
7	Good questionnaire. 2.S.77	STU/POS
8	Best of luck with this – a worthy subject. 6.N.6	STU/POS
9	Sharps injuries with clean needles/blades are included as injuries in your definition but are not a risk for inoculation. 2.S.25 (head and neck)	STU/DEF
10	I think the subject is more applicable to junior doctors and nursing staff. 5.S.16	STU/PRO

Key:
STU/NEG – negative comments related to questionnaire
STU/POS – positive comments related to questionnaire
STU/DEF – comments relating to definitions
STU/PRO – relating to profession
STU/REM – difficulty remembering injuries

Table A18.10 Category 10 - Other (OTH)

	COMMENT	THEME SUB CODE
1	All staff vaccinated for Heb B *(SIC)*. All patients should be screened for HIV (except emergency surgery). 1.S.28	OTH/HIV
2	*Turning* needle to protect while suturing. 2.S.17	OTH/NEE
3	Almost all are needlestick injuries that I inflict myself. I do worry about getting blood in my eyes – rare though. 3.S.9	OTH/SELF
4	Surgeons/assistants should have in mind that they can sustain an injury before starting every surgery and the lengthy procedure afterwards. They an minimise these injuries along with other measures of risk 4.S.12	OTH/REIN
5	The philosophy of protection still has to be re-enforced from the top down by theatre staff and senior surgeons. 1.S.16	OTH/REIN
6	Was a bystander not scrubbed	OTH/INJ

Key:
OTH/HIV – relating to compulsory HIV testing of patients
OTH/NEE – relating to suture needles
OTH/SELF – injuries caused by own actions
OTH/REIN - reinforcement of philosophy of protection
OTH/INJ – other cause of injury

Extracts from interviews

Table A19.1: Guideline adherence – extracts from interviews

Extract from surgeons' interviews		**Code**
JC	Have you ever had any splashes to your face that you're aware of?	
6.S.51	No, because I wear a visor all the time.	AD/POS
JC	Every time?	
6.S.51	Every time.	
JC	Marvellous. When you say that you use the blunt needles, you pass things through a neutral field, you wear your visors, is this common within the trust?	
6.S.51	Yes.	AD/TRUST
Extracts from nurses' interviews		
JC	Do you pass them *(instruments)* from hand to hand or do they go through a receiver or any other neutral field.	
2.N.29	Well I always use a kidney dish but some consultants will try to hand them straight back to you but if you say you'd rather use a kidney dish and pass it over to them, they will use that.	AD/POS
4.N.5	I always double glove.	
JC	For general and urology as well?	
4.N.5	For everything. I also use a visor for everything. I mount and dismount my blades using another instrument. I always try to keep sharp instruments in a container. Um, just general precautions.	AD/FULL

Key:
AD/FULL – full compliance with guidelines as determined by the UK Health Departments (1998)
AD/POS – positive attitude to efficacy of current guidelines
AD/TRUST – adherence is trust policy

Table A19.2: Guideline violation – extracts from interviews

Extracts from surgeons' interviews		Code
2.S.4	If I know the patient's high risk then I'm very careful. I try and be that bit more careful and if they're HIV, which is pretty uncommon in this part of the world or hepatitis B or C positive, I try and wear double gloves in those instances. Um, but there aren't many at the moment in this part of the world, thank God.	VIO/LOW
JC	So would it *(risk status)* change the equipment or the safety techniques you'd use in theatre?	
2.S.22	I would tend to double glove for the non fine bits of the operation.	VIO/SELF
JC	And how do you find double gloves then?	
2.S.22	Not brilliant. I can do things like open and close the abdomen washing out, draining pus, those sorts of things with double gloves on but things like suturing I can't do very well with two pairs of gloves on. I've tried but I can't; or something where you have to have a really nice edge to it not just chunks of tissue then I would take off the outer gloves to do that bit of the operation.	VIO/DIS
Extracts from nurses' interviews		
JC	You mentioned that you wear visors. Do you wear a visor for every case?	
4.N.1	No, I don't. No, only when there's a risk of splashing.	VIO/RISK
JC	So how would you determine that? *(pause)*Would your own experience tell you – I've done this procedure before, got splashed so I'll wear a visor for every case of this type in future or is it something else?	
4.N.1	Experience and perhaps foreknowledge of a patient's condition.	VIO/HIGH
JC	Right, OK. And what sort of conditions would you be thinking of then?	
4.N.1	HIV status, hepatitis, you know, the usual.	
JC	Do you wear your goggles or visors for every case or is it just for high risk cases?	
4.N.2	No, only for a high risk case. If I were going to do like…if I know I might have a splash. I know I'm supposed to wear it all the time. If it's a small case I don't but if it's a big case and I'm sure I'm going to stand there for hours and I could get a splash or if it's a dental case and it's going to go all around, then I wear my goggles.	VIO/HIGH
	You said something interesting there, and you know what you said,	

JC	you know you're supposed to wear them all the time but… Why don't you wear them all the time then?	
4.N.2	I know I should be wearing them all the time but well, I can't really give a reason, I don't know.	VIO/SELF

Key:
VIO/LOW – violation because risk assumed to be low
VIO/HIGH – improved compliance because risk assumed to be high
VIO/DIS – violation due to discomfort caused by protective clothing
VIO/RISK – violation or compliance influenced by risk assessment
VIO/SELF – violation or compliance affected by self selected circumstances

Table A19.3: Reporting – extracts from interviews

Extracts from surgeons' interviews		Code
JC	On the occasions where you have scratched yourself and drawn blood what did you do?	
2.S.4	I've ignored it usually.	
JC	You'd ignore it?	
2.S.4	I sometimes change my gloves to make sure I don't get more contamination into my hand. I change my gloves so that my hands then remain protected.	
JC	Right. Would you cover the wound at all?	
2.S.4	Not usually, no.	
JC	Would it depend on the extent of the wound perhaps?	
2.S.4	They're only little holes, so I don't cover them.	REP/MIN
JC	What do you commonly do after your injuries?	
2.S.35	Ah…nothing.	
JC	Ignore them? Why do you ignore them? Why don't you go through the reporting and blood collecting procedure afterwards?	
2.S.35	Um, I think the risk is very small in my speciality *(orthopaedics)* generally and in the UK. I don't do trauma anymore, I only see elective patients. I used to do trauma of course and the risk is higher. And um, its just such a faff [SIC] to get it done it takes ages out of your day and then there's all the forms, getting your bloods done and people sending emails. If it was really simple, just record it and have done then I think people would record it more. The emphasis appears to be, you've had the needlestick, you prove that you've come to some harm from it and maybe you might get some benefit from it in the end.	REP/LOW
Extract from nurses' interviews		
JC	So what did you do immediately afterwards?	REP/POS
4.N.3	Unscrubbed, washed it, went to Casualty. It was years ago. They took blood from the patient with the patient's consent.	
JC	Did you fill out a form?	
4.N.3	Filled out a form in Casualty and here.	
JC	Did you have bloods taken yourself?	
4.N.3	Yes.	

Key:
REP/LOW – reporting influenced by perceived low risk
REP/MIN – would not report minor injuries
REP/POS – positive attitude to reporting procedure

Table A19.4: Occupational hazard – extracts from interviews

Extract from surgeons' interviews		**Code**
2.S.7	I agree it's an interesting thing to look at, why people don't report needlestick injuries. That's it mainly. I'm not particularly concerned.	
JC	Why are you not particularly concerned?	
2.S.7	I take it as an occupational hazard.	OCC/CONS
Extract from nurses' interviews		
JC	What is the attitude then when they have them *(inoculation injuries)*?	
4.N.5	It's quite blasé, 'I've had hundreds of these'.	OCC/CONS
JC	It's an occupational hazard?	
4.N.5	Yes.	

Key:
OCC/CONS – inoculation injuries are a consequence of surgery

Table A19.5: Training – extracts from interviews

Extracts from surgeons' interviews		Code
JC	The sessions on the prevention of sharps injuries, would you be interested in attending any of the sessions at all?	
2.S.4	Well, if I had to do it, I would.	
JC	Right, what if you had to volunteer to go?	
2.S.4	Um, I'd consider it.	
JC	Do you think it would be of any use?	
2.S.4	Well, I know that pointed things are sharp and they hurt and they shouldn't stick into me but I don't know …. unless they are going to teach me different ways of practising in which case they should come into the theatre and tell me that anyway without me having to go off on a separate half day um… bonding session	TRA/NEG
JC	In terms of other things that the trust might do to improve safety, are you aware of any training or education sessions that they put on for various grades of staff, new staff on induction for example, or on-going training on the prevention and management of sharps injuries?	
2.S.35	I had heard they go on.	
JC	But you've never attended one?	
2.S.35	No.	
JC	Are they a useful thing do you think?	
2.S.35	I doubt it.	
JC	And why would that be?	
2.S.35	Well, I'm already an expert.	TRA/NEG
Extracts from nurses' interviews		
JC	Have you ever attended any training sessions on sharps safety, disposal and management of injuries for example?	
2.N.29	Well I've never been to a formal session where you sit and have a lecture on it.	
JC	So you've never had any training on it?	
2.N.29	Oh yeah. I've had sessions with my mentor when I started and we have link nurses who go to meetings and come back and talk to us about sharps	TRA/IND

	and things.	
JC	You've not all that long graduated, but since you have been a qualified nurse, have you had any extra training sessions on sharps handling, disposal and things like that? *(pause?)* Sessions held by infection control nurses, theatre coordinators or educators within the department?	
4.N.4	No.	
JC	If there ever were these sessions held do you think they would be useful?	
4.N.4	Yes. I think it's the type of subject that needs to be constantly reinforced like you have BLS, basic life support every six months or every year and I think 'I'm so glad I'm having this' because we are in an environment where we don't see many cardiac arrests like they do on the ward and I think 'that's good, that's refreshed my mind' and I do think infection control, every six months like we have fire training as well…it would be very beneficial. Probably after a couple of months people would slip back, but I think that if it was done regularly it would prevent a lot of things from happening or going unreported.	TRA/POS

Key:
TRA/NEG – negative attitude towards training
TRA/IND – training carried out on induction
TRA/POS – positive attitude towards training

Table A19.6: – Availability of equipment, extracts from interviews

Extract from surgeons' interviews		Code
2.S.4	But the other thing that hospitals have not done anything about, despite me asking, is um to have gowns with proper waterproof, protected sleeves as routine because when you're doing intra-cavity operations, your arms go in and you end up with blood on your skin.	AVA/SD VIO/EQ
JC	So the gowns that you wear are not waterproof?	
2.S.4	They are protected down the front but not the arms.	AVA/SD
JC	Oh right, because they are out there.	
2.S.4	Yeah, they're out there but the trust won't pay for them.	AVA/COST
Extract from nurses' interviews		
JC	The gowns you wear for orthopaedic surgery, are they different to the ones you wear for general surgery?	
4.N.5	They can be. Um, they are all disposable now. It depends on what sort of protection, what level. Some are fully protected, all the arms are protected. Some are just partially protected but the ones…even the ones that are not lined are still impervious. They are generally impervious.	AVA/SD
JC	Can you choose which ones you want to wear?	
4.N.5	Yeah, they are all there. Tall ones, short ones, wide ones.	AVA/SD

Key:
AVA/SD – availability of safety devices/equipment
AVA/COST – availability affected by cost
VIO/EQ – violation due to inadequacies in existing equipment

Table A19.7: Pressure of work, extracts from interviews

Extract from surgeons' interviews		**Code**
JC	Does pressure, may be in an emergency procedure perhaps increase the risk?	
6.S.51	Yeah, and I think we all put ourselves at risk in those situations. If somebody is bleeding to death you do don gloves, you do put on a gown, you do all those things because that's important for asepsis but I do think that for me, if a life is in danger, you go all out for helping them.	PRE/LIFE
Extract from nurses' interviews		
JC	You mentioned in an emergency it's all fast, do you think you are more likely to have an accident then?	PRE/LIFE
4.N.4	I would think so, yes.	

Key:
PRE/LIFE – pressure due to emergency or life threatening event

Table A19.8: Teamwork, extracts from interviews

Extract from surgeons' interviews		Code
JC	In terms of working with nursing staff, do you tend to work with the same nurses all the time?	
2.S.22	Ah, for your elective lists yes, but not for emergencies.	TEA/CON
JC	Right. Does that make a difference to you?	
2.S.22	Yes, because your emergency cases are the ones where you find the unpredictable things inside and sometimes you have to change your mind about what your actually going to do or react to what you see and of course you work in a different theatre to where you normally work, possibly with different instruments and a different nurse so all the unpredictable things come together.	TEA/IMP
JC	Do you find that the nurses you work with routinely are able to predict your movements and predict what you need?	
2.S.22	Yes, absolutely. Sometimes you hardly have to say a word and they've got it ready for you.	TEA/IMP
JC	Does that make it safer do you think?	
2.S.22	I think so yes.	TEA/IMP
Extract from nurses' interviews		
JC	So is there good teamwork in the department then?	
2.N.29	Yes on the whole.	TEA/PRES
JC	And how important do you think that is?	
2.N.29	Oh it's vital. You get to know each other quite well and if you've worked with the same surgeons for a long time, you get to know what he wants and it speeds things up.	TEA/IMP
JC	And makes things safer?	
2.N.29	Well yes I suppose because you know where each other's hands are and how you are going to pass instruments.	TEA/IMP

Key:
TEA/CON – consistent team members
TEA/PRES – teamwork present
TEA/IMP – teamwork important

Table A19.9: Sustaining an injury, extracts from interviews

Extracts from surgeons' interviews		**Code**
JC	Can you perhaps look back at one or two (injuries) and tell me what was going on when the injuries occurred	
2.S.4	When I've felt pain it's when I'm working at the limit of what I can work at and the instruments can work at. Usually depth. There's usually a pelvis, some pelvic bleeding. I want to put a stitch in the bleed, I'm trying to retract with a hand because instruments aren't long enough to get right down into the pelvis and stuck the needle in my finger.	INJ/SELF INJ/ACC
JC	Right.	
2.S.4	The other time it occurs is when I'm assisting a trainee and they've stuck the needle in me.	INJ/OTH
JC	According to your questionnaire, you've had about 50 injuries in the past five years. Can you tell me a little bit about the injuries?	
6.S.49	I tend to do most of them during vaginal prolapse surgery. I know I said I had a lot of injuries but very few of them drew blood. Most of them just scratched the skin, they hardly ever bleed so they're very superficial.	INJ/SELF
JC	What is it about vaginal prolapses that's so risky, is it because you can't see your fingers?	
6.S.49	You can't see and you work by touch. I would say that I prick myself during about 10% of these operations but I never report them.	INJ/ACC
Extract from nurses' interviews		
JC	Can you tell me a little bit about that? *(the injury)*	
4.N.3	I was taking a case and I was assisting a surgeon at the time. It was a laparoscopy and he wanted the knife which he had used in the past, but because I was assisting I went back and the knife was sticking up and the blade went through my hand.	INJ/OTH INJ/CAR
JC	Sticking up from where?	
4.N.3	The tray. It must have been put back sticking up on the tray not laid flat.	
JC	Right. So was it a severe injury?	
4.N.3	It went straight through but it missed the tendon.	

Key:
INJ/ACC – injury caused by difficult access
INJ/SELF – injury caused by self
INJ/OTH – injury caused by another
INJ/CAR – injury caused by carelessness

Appendix 20

Interview with 6.S.49
July 23rd 2008
Start time 2.05 pm
Finish time: 2.50 pm
Location – Office

JC Many thanks for agreeing to meet with me today. First of all, I'd just like to confirm that you have seen the information sheet and signed the consent form.

6.S.49 Yes

JC Great. By way of introduction can you just tell me a little bit about your career to date?

6.S.49 Well I'm from Ulster originally and I trained… went to medical school in Newcastle in 1980. Since then I have moved around a lot. I worked in general surgery for a while and then moved into obs and gynae [SIC] and ended up in ****** as a consultant about 13 years ago.

JC OK, thanks. You kindly filled out a questionnaire some time ago and now you've been kind enough to agree to be interviewed…..

6.S.49 Yes, did you get a good response rate?

JC Not bad, I had 315 questionnaire back, over 50% which when you read some surveys isn't bad is it?

6.S.49 No that's really good. Well done.

JC Thanks. Did you agree to participate because this is a subject particularly dear to you?

6.S.49 Not particularly, no. Not needlesticks although I am very interested in health and safety. Having said that, I am aware that some surgeons have far more needlestick injuries than others, so there must be a reason for that.

JC According to your questionnaire, you've had about 50 injuries in the past five years. Can you tell me a little bit about the injuries?

6.S.49 I tend to do most of them during vaginal prolapse surgery. I know I said I had a lot of injuries but very few of them drew blood. Most of them just scratched the skin, they hardly ever bleed so they're very superficial.

Comment [j1]: [redacted]

JC What is it about vaginal prolapses that is so risky, is it because you can't see your fingers then?

6.S.49 You can't see and you work by touch. I would say that I prick myself

Comment [j2]: [redacted]

during about 10% of these operations but I never report them.

JC What do you do then?

6.S.49 Well, I always change my gloves and that's all I need to do really because the wounds don't usually bleed although I did report a blood splash recently because everyone saw it happen and if I didn't report it I would have been nagged by the sister, so I just did it. I was looking at a haematoma and it just burst spectacularly all over me and blood got into my eyes. So I had to go and wash my eyes out and go to occupational health and have my bloods checked for hepatitis C. I knew I was OK for hep [SIC] B because when I had my flu jab last year the nurse told me I had a very high titre. We store blood for HIV as well in case the patient turns out positive so that we can be tested again and the results compared you know, so that could say that I wasn't positive before the accident and now I am. And the patient was bled. Of course, I couldn't bleed the patient myself, so one of my team had to do it. It all took a long time. Anyway, the patient was all clear, so that was that.

Comment [j3]: REP/MIN

Comment [j4]: REP/OTH

Comment [j5]: REP/CUM

JC You say that a lot of people saw that accident and that's why you did what you did, so does that mean then that if you hadn't been seen by so many people, you wouldn't have done all that?

6.S.49 Oh God no, I'd have just cleaned myself up and got on with my day.

Comment [j6]: REP/CUM

JC What do you normally do when you've scratched your finger but not drawn blood?

6.S.49 I'd just change my gloves.

Comment [j7]: REP/MIN

JC And what if you were bleeding?

6.S.49 Well, then I'd have to de-scrub and make it bleed for a while and when the bleeding stopped I'd put a plaster on and scrub up again.

Comment [j8]: REP/ACTION

JC OK. Is it the time factor that stops you reporting then?

6.S.49 Oh yeah. It takes ages and involves so many people. As I say, I can't bleed patients myself and occ [SIC] health isn't very convenient because it's away from the main building.

Comment [j9]: REP/CUM

JC What about the forms?

6.S.49 I've never filled in a form, but the AI forms are very long and you can't just describe what happened, you have to tick boxes to code the accident.

Comment [j10]: REP/CUM

JC AI forms?

6.S.49 Adverse incident forms.

JC Oh right. They seem to called something different everywhere you go.

6.S.49 Oh right.

JC You say that you wouldn't want to do one of these operations on a high risk patient, but sooner of later you might have a patient with a problem that can only be treated by this procedure. What would you do then?

6.S.49 Well, I'd have to operate on her obviously, but I would tell her that I was concerned about the risks to me and that I would have to do everything I could do to protect myself and stop the procedure if anyone stabbed themselves. I'd wear double gloves and things.

Comment [j11]: VIO/HIGH

JC OK. Going back to your needlestick injuries, are they usually caused by suture needles?

6.S.49 Yeah.

Comment [j12]: OTH/NEE

JC Do you use blunt needles at all?

6.S.49 Sometimes I do. For abdominal surgery I do but not for caesarean sections. Closing the abdominal wall is when injuries happen a lot and the blunt needles are really useful then.

Comment [j13]: VIO/SELECT VIO/SELF

JC Why not for caesarean sections?

6.S.49 I don't know really, I just don't but there's no reason why I shouldn't but as I say most of the injuries are so minor its not really a problem although a colleague of mine did cut her thumb once and it bled so much that I had to go and take over the operation for her. And the other thing is that I operate on low risk patients. I know no-one is completely no risk but we screen all our ante natal women and I have only ever dealt with one who was HIV positive and she came into the country half way into her pregnancy but she knew she was positive anyway and was quite open about it. Only one as far as I know anyway. The gynae [SIC] patients are low risk too, they're usually elderly and I know there is nothing to say that their husbands hadn't been unfaithful on a business trip to Thailand or something, and they may have given them HIV I think but that's unlikely really.

Comment [j14]: VIO/SELECTVIO/SELF

Comment [j15]: VIO/LOW

Comment [j16]: VIO/LOW

JC Do the antenatal women ever object to being tested?

6.S.49 Not at all. I've only had one who refused but most don't even question it and let's face it, it is their interest to know. Having HIV isn't like it used to be. Retroviral drugs are so good now so if they were found to be positive it would be good for them to know and start treatment. Having said that I haven't had anyone be positive yet on ante natal testing. And I know that they could become positive during their pregnancy but its not really very likely.

Comment [j17]: VIO/LOW

JC OK. Great. Um, going back to reporting injuries, you say that the reporting mechanism is cumbersome but is there anything that would make you report a needlestick injury or something?

6.S.49 Well, if I had a bad injury I'd report it then. I cut my leg with a scalpel once when I dropped it, but it hadn't been used. But if it had been used, I would probably have reported that and I suppose if the patient was high risk I'd report that as well but it hasn't happened yet. I know that's not the right answer and maybe I should think of myself and my family but well, you know…. It's so laborious.

Comment [j18]: REP/HIGH

Comment [j19]: REP/CUM

JC OK, right. Um, from the questionnaires that I have had back… I don't know whether you'd be surprised to know, but nurses are much more ready to report injuries than doctors. Can you offer any explanation for that?

6.S.49 Well, I'm not surprised really.

Comment [j20]: REP/PROF

JC Why do you think that is?

6.S.49 I don't think nurses get stabbed as often as surgeons in the first place so that may be part of the reason. We work very differently as well. Nurses don't need to think for themselves as much as doctors and don't need to risk assess. They have a routine, they know what they must do and they do it, but doctors need to react to different circumstances and risk assess. So they follow rules and regulations better than surgeons and also their managers don't let them deviate. They come down very hard if nurses act outside their normal routine so they obey the rules. I used to work in ********* hospital as well, I don't now but that's another story…. and the nurses there do risk assess and think for themselves more because they don't have obstetrician cover. They only have one on call doctor and he's a physician so in an emergency they just got on with it and did what was needed because they had more experience than the on call doctor. I don't mean we never discussed things but it was more sort of …. they would do it all and then let us know. But here they are not allowed to do that so doctors get called for every little thing.

Comment [j21]: [redacted]

Comment [j22]: VIO/HIER

JC So do you think that the nursing hierarchy prevents them acting on their own initiative?

6.S.49 Oh definitely.

Comment [j23]: VIO/HIER

JC Oh right. So does that mean that they can't risk assess and because of that they possibly don't take as many risks as the doctors? Does it make them work less autonomously do you think?

6.S.49 Yeah probably and it's a shame.

Comment [j24]: VIO/HIER

JC Why do you think that might be, is it training perhaps, or do the different professions attract different kinds of people?

6.S.49 I think its training. Nurses just seem to know about policies and I'm sure that's a good thing but doctors just don't do it. We are trained to risk assess and so we know what risks we are faced with I suppose and well, we use that risk assessment when we plan what we're going to do and of course some things wouldn't get done if we weren't prepared to take some risks.

Comment [j25]: TRA/PROF

Comment [j26]: VIO/PROF

JC OK, right. Now you've already mentioned blunt needles, what else do you do to protect yourself when you're operating?

6.S.49 Well, I always cover cuts with plasters before I start .... um, what other sort of things do you mean?

Comment [j27]: VIO/SELF, VIO/SELECT

JC Well, how do you pass sharps for example?

6.S.49 Well, scalpels I put into a kidney dish and sutures I always leave on the holder and hand the handle of the holder back to the scrub nurse handle first like, you know you do at home when you pass someone a knife. I've seen the odd registrar sort of clipping the sharp end of the needle into the holder like this (demonstrates how the tip of the blade can be clipped into the holder). It takes them ages and I've never done it because I've never hurt myself when passing a needle.

Comment [j28]: AD/TRUST

Comment [j29]: VIO/SELF, VIO/SELECT

JC I suppose it's safer for the scrub nurse though isn't it because they often get injured when sharps are passed?

6.S.49 I suppose it is, yes.

JC If a scrub nurse asked you to do that is it a technique you'd try?

Comment [j30]: VIO/OTH

6.S.49 Definitely, yes but no-one's ever asked.

JC Oh right, OK. Do you ever wear eye protection?

6.S.49 Yes all the time in theatre but I have had one splash when I wasn't wearing one but that was because it wasn't during an operation, I was examining her and a haematoma burst as I said. In delivery, I sometimes I wear one but not always.

Comment [j31]: AD/TRUST

Comment [j32]: VIO/SELF, VIO/SELECT

JC Why not always? Do you feel that splashes are less likely in the labour ward?

6.S.49 I don't know really, I just never got into the habit. Sometimes I think I should and I make the effort to use them for Ventouse and things but I usually forget and I know that's really silly and there's no excuse.

Comment [j33]: VIO/SELF, VIO/SELECT

JC Have you ever been aware of blood splashing in your face during a delivery?

6.S.49 Oh God, yes. I wear contact lenses and when I used to have to come in on call at night for problem deliveries I wouldn't bother with them and I'd have my glasses on and afterwards there would be blood all over them so I know that's all going into my eyes now.

Comment [j34]: [redacted]

JC And you still don't wear a visor routinely?

6.S.49 No, stupid isn't it. I mean, I'd have to scrub the lenses with a toothbrush to get the blood out from between the lens and frame. It's disgusting isn't it? I must make more of an effort.

Comment [j35]: VIO/SELF, VIO/SELECT

JC You make sure you do. Do you find visors comfortable or do they fog up or anything?

6.S.49 No they're fine. I have my own visor in theatre and it's perfectly comfortable but the junior staff complain sometimes that the ones they have are tight. They don't have individual ones you see and have to use disposable ones with elastic.

Comment [j36]: VIO/DIS

JC Does that mean that they stop wearing them?

6.S.49 They wouldn't dare or the theatre sister would tear a strip off them. We have a policy that says everyone should wear them. It's the same for using the kidney dishes.

Comment [j37]: VIO/OTH

Comment [j38]: AD/TRUST

JC Great. Um, do you ever double glove?

6.S.49 I have done occasionally, but only if there's a high risk case. I wouldn't do it for every case.

Comment [j39]: VIO/HIGH

JC Why's that?

6.S.49 It's uncomfortable. They get very tight around your wrist after a while. I've tried wearing a half size bigger than normal but then you get extra bits flapping around the ends of your fingers and that's not good either because you can't feel properly.

Comment [j40]: VIO/DIS

JC Do they compromise your dexterity?

6.S.49 Yeah, because if they're too tight it makes your hands ache after a while and if the fingers are too long, you can't make fine movements accurately. It's just different really.

Comment [j41]: VIO/DIS

JC Do you use double glove packs or just take two pairs of the usual gloves off the shelf?

6.S.49 Two pairs of the normal. We don't have special packs.

JC OK. You say that it feels different when you wear two pairs of gloves, do you think it's a feeling you might get used to if you did it more often?

6.S.49 Possibly, I don't know.

JC If they feel different, do you think that could make you more clumsy and increase the risk of needlestick injuries in an emergency or when you operate on a high risk patient because that's the very time you are at most risk isn't it?

6.S.49 Not really, because you still have to be careful.

JC Have you ever worn reinforced gloves, Kevlar gloves, that sort of thing?

6.S.49 Ooh, I don't know, I don't think so.

JC I think you'd know if you had.

6.S.49 OK right. Then I haven't.

JC What about the towel clips you use here, are they sharp?

6.S.49 No they're blunt. **Comment [j42]:** AD/TRUST

JC Like a ball and socket is it?

6.S.49 Yeah, that's right.

JC OK. Um, when you're working with junior staff, where do they take their cues form in terms of protection? Do they follow your lead or do they come with preconceived ideas or established practice.

6.S.49 A bit of both really. I mean, some of the things we do, we do because that is the way we do them in this trust, using a kidney dish and things like that but some things they follow me in. Others they already seem to know. I mean, I didn't show anyone how to hide the sharp end of the suture needle in the holder, they have learned that from someone else. I do insist on them wearing visors though and I know the theatre sister would shout anyway if they didn't.

Comment [j43]: AD/TRUST

Comment [j44]: VIO/SELF

Comment [j45]: VIO/OTH

JC Would you be prepared to follow their lead if they could convince you that they were safer than you?

6.S.49 Oh yeah. **Comment [j46]:** VIO/OTH

JC What about the nurses then, if they said I'd like you to do this, I've read about it and it stops injuries how would you feel about that?

6.S.49 I'd have no problem with that at all. **Comment [j47]:** VIO/OTH

JC Excellent. So do you think teamwork is important in theatres then?

6.S.49 Oh yes. You have to be able to work with people and get on with them. Everyone needs to know that they can express an opinion without being afraid of being shot down in flames.

Comment [j48]: TEA/IMP

JC Do you work with the same team of nurses all the time?

6.S.49 Well, there's a sort of pool of gynae [SIC] nurses who tend to scrub for me most of the time. They change slightly over the years because you know, people move on and retire etc but on the whole it's usually the same ones. Sometimes though if someone is off sick or something then a nurse from another team will scrub for me and I can hear them discussing it between themselves who the best person is to do the list. I don't think its because they don't want to work with me its just so that they can have the best person because I'm sure the nurses don't like doing unfamiliar procedures too much, no-one does do they?

Comment [j49]: TEA/CON

JC No, not at all. Do you think it can compromise safety if you have nurses who don't usually do gynae [SIC] surgery?

6.S.49 Well, yes and no. I find myself having to do a lot more talking. If a regular nurse works with me, she knows the surgery, she can see where I am and what I am doing and will automatically know what I need next and I don't even need to ask her for instruments, she just knows what I need. But if a different nurse is with me I find I have to do a lot more talking and I have to say in a minute I will need such and such, it's that one over there on your left and then I will need that one over there so it's a little bit harder work really but it can't be helped and it doesn't really slow me down or anything because I can usually predict what I need and tell them in plenty of time. In terms of safety, I suppose in an emergency it could be a problem again because the regular nurses know what to do and just do it and can sort of predict what is going to happen as well as me, but I've never really been in that sort of situation with one of the other nurses so I don't really know. Anyway, most things that happen in theatre are fairly straightforward

Comment [j50]: TEA/POS

Comment [j51]: PRE/LIFE

JC In the obstetric theatres do the midwives scrub or do the nurses come over from the gynae [SIC] theatre?

6.S.49 The gynae [SIC] team come over.

JC OK, great. Um, apart from the things we have already talked about, is there anything else that you do to reduce the risk from blood?

6.S.49 Well, when I first came here I asked for these drapes for vaginal surgery with a sort of pouch at the bottom to stop blood going all over the floor. So I use them.

Comment [j52]: VIO/SELF

JC And they are effective at that are they?

6.S.49 They're not bad, sometimes you still get blood on the floor but its not all swimming around you know?

JC You say you asked for them. Is the trust good about things like that? I mean are they responsive?

6.S.49 I suppose so, but cost is always a big factor.

Comment [j53]: VIO/COST

JC At the expense of quality do you think?

6.S.49 Oh yes. I mean for example, we've have had different gowns which don't seem so waterproof to me and they seem more flimsy than the old ones. They seem to tear under the sleeves and things like that and every so often, things like this seem to turn up in the department.

Comment [j54]: VIO/COST

JC Are they re-usable gowns then or disposable.

6.S.49 They're all disposable now.

JC Oh right OK. If that sort of thing happens do you report it as a clinical incident?

6.S.49 Yeah. I fill in an AI form and then that goes to the Clinical Governance Committee or whatever.

Comment [j55]: REP/ACTION

JC Do you get feedback then?

6.S.49 Well that's a problem. I'm part of a health and safety reporting group at the moment which is looking at these AI reports and trying to simplify them. You know, streamline the forms so that it's more like storytelling. You describe what happens and then someone else ticks all the boxes to put the incident into categories and then we need to make sure that there is feedback for people.

Comment [j56]: REP/STR

JC Do you think that might improve needlestick injury reporting then?

6.S.49 It might do.

JC OK, that's good. Um, going back to the gowns then, are you ever involved in the decision making when new things like these gowns are introduced. You know, do you take part in trials?

6.S.49 Yes, there's often a trial going on, new gloves and things and then the surgeons and scrub nurses all give their opinion but the trust don't always listen and sometimes we get things we're not particularly happy with because cost is important. The trust is very money driven.

Comment [j57]: VIO/COST

JC Oh, is it?

6.S.49 Yeah. They probably all are but I'm sure we waste a lot of money because of this though because sometimes you might have to change your gown because it's torn or something so you're using twice as many then and that can't be cost effective.

Comment [j58]: VIO/COST

JC So being cheap isn't the same as being value for money?

6.S.49 Well no it's not is it? And there is a lot of stuff that is cheaper than the things we've used in the past and it's just as good, but it's not always you know?

Comment [j59]: VIO/COST

JC No, you're right. So how do you get to know about new things on the market, do you see reps [SIC]?

6.S.49 Yeah, I see reps [SIC] sometimes but there are so many of them so I can't see them all.

Comment [j60]: AVA/SD

JC No, true.

6.S.49 So there is a user group and there are surgeons and nurses on that as well and the theatre sister sees some as well.

Comment [j61]: AVA/SD, AVA/AWA

JC Right, so have you ever had a reps [SIC] come to talk to you about other safety devices like retractable scalpels for example?

6.S.49 No I've never seen a retractable scalpel. I suppose they're disposable are they?

Comment [j62]: AVA/AWA, AVA/BLA

JC Ah, yeah. Swann Morton make them and they probably supply most of the blades in the UK I'd imagine don't they?

6.S.49 Yes they do.

JC So you've never seen these then?

6.S.49 No.

JC They're not doing a very good marketing job are they?

6.S.49 No they're not. We do use retractable things in laparoscopies ....

Comment [j63]: AVA/BLA

JC Trocars?

6.S.49 That's it. But I've never seen a retractable scalpel.

JC Would it be something you'd consider if they performed as well as the ones you use now then?

6.S.49 Definitely. I'd give it a try but I suppose they're quite expensive if they're disposable. At the moment, you see, we re-use handles and just buy the

	blades.
JC	Yeah, I'm sure they' are actually. I don't know the cost to be honest, but I doubt if they are as cheap as the ones you use now. I know that retractable needles are much more expensive than the ordinary ones.
6.S.49	I've seen those on some pre-filled syringes for vaccines and things. They're really good and just disappear once you've given the injection.
JC	Yeah, that's right. So you'd be happy to give those a try?
6.S.49	Oh yes.
JC	OK, right. So if one of the team came to you and said would you like to try this equipment… say for example one of the theatre sisters had been to an exhibition and seen something like a retractable scalpel, would you be happy to give it a go?
6.S.49	Yes, of course.
JC	Um, are there any other measures that you take?
6.S.49	Well, I've said about the visors and things. We've also had new drapes. We used to use cotton drapes and they soaked up the blood but now we have disposable ones which aren't absorbent which I suppose is the point but the blood just runs off them and trickles onto the floor so they're not really as good you know. And then for caesareans we have these drapes with sort of pockets to collect the fluid. They're OK.
JC	Right. Is there anything else that you've seen or heard of that you'd like to have but the trust doesn't provide for whatever reason?
6.S.49	Not that I can think of.
JC	And if you had a high risk patient, what might you do differently?
6.S.49	Just double glove I suppose because I like to think that I'm pretty careful and safe anyway and we already use the visors and the kidney dishes, so double gloves….. yeah.
JC	And how would you decide that someone was high risk?
6.S.49	The usual, drug users mainly.
JC	OK fair enough. Changing the subject slightly then, you said on the questionnaire that you weren't aware of whether the trust provides training sessions on the prevention and management of inoculation injures…
6.S.49	That's right.

Comment [j64]: AVA/COST

Comment [j65]: AVA/AWA

Comment [j66]: AD/TRUST

Comment [j67]: VIO/SELF, VIO/SELECT

Comment [j68]: TRA/AWA

JC Well they do actually. The infection control team hold them.

6.S.49 Is that on the induction for new house officers?

JC Induction for all new staff as well as sessions throughout the year as part of the mandatory training sessions.

6.S.49 Oh right, I wasn't aware of that. I don't know how they advertise the sessions but I've never seen an ad [SIC]. Maybe they send out to certain people.

Comment [j69]: TRA/AWA

JC I don't know to be honest. Would it surprise you to know that nurses attend these sessions far more often than doctors?

6.S.49 Not at all.

Comment [j70]: TRA/PROF

JC Why do you think that is then? Is it time, or is there anything else it could be?

6.S.49 I don't know really, I suppose part of it is time. We have a lot of things we should do on our study leave. I've never even been to a fire lecture since I've been in the trust.

Comment [j71]: TRA/TIME

JC There's a lot of mandatory training to get through isn't there?

6.S.49 Yes there is.

JC Do you think the nurses have more time to attend this sort of thing?

6.S.49 I think they have protected time so these things don't compete with other things that we might consider more important. Though I think I will speak to the infection control nurses and ask if they can come to theatre and do a session for the house officers specifically relevant to surgery.

Comment [j72]: TRA/TIME

Comment [j73]: TRA/POS

JC Right OK. I'm sure they'd be happy to do it.

6.S.49 Great.

JC What about training if it could be done in a way that suited you and your staff? Cascade training perhaps, you know one person goes to a study day or study session and then comes back and teaches the rest of the department perhaps on an audit day or another time when there weren't any lists going on?

6.S.49 That would be a good idea, wouldn't it because it would save time and they could make the session relevant to theatres then.

Comment [j74]: TRA/CAS

JC So is there anything else you think could be done by the trust, as things stand now, that could protect staff more?

6.S.49	Not really.
JC	So you think the trust is committed to safety?
6.S.49	Yes it is. I'm sure that the threat of litigation and having to pay compensation is quite real for them and I think that they try to do everything they can within resources to ensure that claims aren't made because you know these claims can cost hundreds of thousands and its probably cheaper to provide some things than pay the claim but they do worry about the cost of things. So yes, I think they do what they can.
JC	You mentioned within resources and of course money is tight in the NHS now isn't it?
6.S.49	Mmm.
JC	So if you had unlimited resources and a wish list, what would you wish for?
6.S.49	Ah well, because I knew you were coming, I was anticipating this question and I've given it a lot of thought. It would be good if we could test all patients, elective patients of course, not emergencies....
JC	For HIV?
6.S.49	And hepatitis as well.
JC	Right, and you think that would go down well with patients?
6.S.49	I don't think they'd mind really. As I said before, I don't think the stigma of HIV is as bad as it used to be and it would be in their interest to know so that they could get treatment which is very good nowadays and I know that you can't always treat hepatitis C...
JC	But you can treat it sometimes, particularly if you catch it early....
6.S.49	Well, that's right, so I don't think they would mind.
JC	What about emergencies then?
6.S.49	Well, you'd still have to be careful of course, but most of my gynae [SIC] patients are elective and the obstetric patients are tested anyway.
JC	OK, what then, if a patient said to you, you've tested me, you know I'm OK but if you cut yourself when your hands are in my body and you bleed into me you can infect me as well so I want you to be tested before I allow you to operate on me?
6.S.49	Well, that would be fair enough I suppose although the odds of cutting yourself so badly that you bleed into the patients are low. Having said

Comment [j75]: VIO/LIT
Comment [j76]: VIO/COST
Comment [j77]: OTH/HIV
Comment [j78]: OTH/HIV
Comment [j79]: OTH/HIV
Comment [j80]: OTH/HIV

that I've told you about my colleague. Not that she bled into the patient you understand but her glove filled up with blood and it took so long to stop I had to finish the operation for her. So I suppose it could happen. So I wouldn't mind if we had to be tested as well. I suppose it's a good thing that we know as well but nobody does it though do they?

Comment [j81]: OTH/PER

JC Well, a few years ago the Department of Health brought out guidance which did say that staff doing exposure prone procedures should be tested in the same way as patients are if they stab themselves during a procedure. So the procedure is reversed really with the emphasis on protecting the patient as much as the member of staff so they could get PEP, vaccinations etc. But as far as I know, not many trusts have incorporated this into their policies.

6.S.49 Oh, right. I suppose most surgeons who have been positive have found out in this way have they?

Comment [j82]: OTH/PER

JC Possibly.

6.S.49 Right. Of course, we are tested for hepatitis B aren't we because we're vaccinated and have to have blood tests and boosters if our titres are low but no-one is tested for hep [SIC] C and HIV in the same way.

Comment [j83]: OTH/PER

JC Of course.

6.S.49 The other thing I suppose is how often we should be tested. We should probably be tested annually because there is no way of knowing whether you've been exposed otherwise is there? And of course for a surgeon having a positive HIV test is the end of their career isn't it.

Comment [j84]: OTH/PER

JC Is there anything else on your wish list?

6.S.49 Better gowns I suppose and a more streamlined reporting procedure but we are looking at that. Oh, and retractable scalpels.

JC Yeah, right. Anything else?

6.S.49 I don't think so. Oh yes, better disposable visors. I have my own but the registrars have to wear disposable ones and they complain that they are too tight. I have seen some which have a sort of foam padding across the forehead and elastic around the head and they seem comfortable but we don't have them. We do have goggles which some of them wear but of course, you have to wear a mask with them. I hate wearing a mask nowadays. They feel so...... so claustrophobic you know. You get hot and they slip or feel too tight on the bridge of your nose. We used to wear them all the time didn't we, but I suppose we've just got out of the habit now because the visors cover your mouth as well and they are really comfortable.

Comment [j85]: VIO/EQ

Comment [j86]: VIO/DIS

JC Yeah, I know. I've seen some nice visors that have that foam strip the same as the ones you were talking about, but clip over your ears like glasses.

6.S.49 Oh right. There are lots about I suppose. We should have different types so that people can choose, because we're all different, you know, we have different shaped heads and so on, and what suits one doesn't always suit everybody, but it's back to cost and I suppose that's why it's on my wish list.

Comment [j87]: VIO/DIS

Comment [j88]: VIO/COST

JC Yeah, right. Well, that's all I want to ask you I think. Is there anything you'd like to ask me?

6.S.49 No, I don't think so. Good luck with your research.

JC Thanks very much.

6.S.49 Have a safe journey back, will you drive back today?

JC Oh yes. It's a lovely day for driving and the scenery is lovely.

Appendix 21

Further interview transcript

Interview with 4.N.4
August 18th 2008
Start time: 2.25pm
Finish time: 3.10pm
Location – Consulting Room, Day Surgical Unit

JC Can I just say thanks very much for agreeing to be interviewed for this study. Could you just confirm for the recording that you have seen the information form and signed the consent form?

4.N.4 Yes, I have.

JC Thank you very much. Just to start off perhaps you could give me a little bit of background about your career from when you started your nurse training to now.

4.N.4 Well I started my training in 2003 at the ****** campus in ********** and I knew that I wanted to work in theatre from the onset and in my last placement I did my critical care placement in theatre in **** ***** and the were taking on staff and I applied and I had the job. So I started in the September so just basically I had the job here in ****** ******* so I'm learning how to scrub. I started in 2006 but I had meningitis last year so I have been off for five months and then I discovered I was pregnant as well, so I have had a good ten months off.

JC But apart from that, as a qualified nurse, you've worked in theatre apart from those interruptions?

4.N.4 Yes.

JC So theatre is something that you obviously enjoy?

4.N.4 I love it.

JC You can't see yourself working anywhere else?

4.N.4 No, never.

JC Right. Is the threat of having a sharps injury or having a splash of blood into your face something that you are concerned about?

4.N.4 It never did concern me before until recently and when you're actually in that situation where a spurt of blood does pass your face and I had a needlestick injury today.

JC Did you. Oh, right. So what happened?

4.N.4 I was passing a skin stitch to the registrar and he decided to diathermy first and he put it down on the drape and I went to grab it from the quiver to put back on my tray because we were nearly finishing and I just… basically, the needle penetrated my thumb but it hadn't been used so it was clean.

JC Have you ever been injured with a used needle or anything else sharp?

4.N.4 No. I haven't.

JC Do you think that's just good luck because you take all the precautions you can?

4.N.4 Just good luck.

JC What about splashes of blood into your face, have you ever been aware that that has happened?

4.N.4 Yes. It happened once when after I de-scrubbed I noticed blood on my mask so I thought to myself where else has that gone that I haven't noticed it and then last week I had a spurt near my eye you know.

JC Do you think any of that could have got in your eye?

4.N.4 Yes. Well it happens to the surgeons all the time and I think 'oh gosh'. They don't seem to be bothered but I think you know…

JC Do they get more or less bothered than you?

4.N.4 It surprises me sometimes when I see some surgeons take it with a pinch of salt and don't even acknowledge it.

JC Really?

4.N.4 Yeah.

JC Just blood splashes or sharps injuries as well?

4.N.4 Just blood splashes I've noticed.

JC What about sharps injuries, how do you think they take those?

4.N.4 I don't…I think scrub nurses are a lot more aware of what you should do about making it bleed and reporting it and things but as far as surgeons go, no.

JC Do you think they aren't aware or that they just don't bother?

4.N.4 I don't think they bother.

JC Why do you think that might be then?

4.N.4 It's the same thing as doctors going from patient to patient without washing their hands. It's sort of…I don't know, they don't seem to think that they need to, do you know?

JC Is that because they get so many sharps injuries that it's an occupational hazard or do they genuinely think that they are not at risk of infection?

4.N.4 I don't know. I think it's a bit of both and I think that a lot of them are so busy and need to get the next case on the table, or they need to get over to the ward to sort something out and filling in a form or something like that is the least of their worries.

JC Right OK. So is it your experience then, that they just don't bother reporting?

4.N.4 I've never come across it. I've seen many surgeons having needlestick injuries but never seen the correct procedure being followed.

JC Really, in two years?

4.N.4 Never, no.

JC That's interesting. So have you seen plenty of nurses doing it correctly?

4.N.4 Yes, but I must say that when I told someone today that I'd had a needlestick injury but that it was a clean needle, we sort of agreed that there was no need to fill in a form but I have…the scrub nurses that I have seen…it happened a few weeks ago and she got the procedure and followed it to the letter.

JC Would you know what the procedure was if yours had been a dirty needle? What would you have done?

4.N.4 Um, the form which I saw her filling in on-line is the new IR2 I think. She made it belled and then she had her bloods done and just filled in the form.

JC Did she get the patient checked?

4.N.4 No, I didn't hear any mention of that. I wasn't aware of that either.

JC OK. The patient should be checked for bloodborne viruses, with their consent obviously and if they decide to withhold consent that's it. Do you think that if you had a needlestick injury or any other sharps injury with a dirty needle, would you be worried that you could contract a bloodborne virus, either hepatitis or HIV?

4.N.4 Um, I think I would make it my business to look at the patient's notes or something like that. It probably would cross my mind but I don't think I'm the sort of person who would lose any sleep over it.

JC Right OK. You say that you don't think you're that sort of person, does it depend on temperament then do you think?

4.N.4 I think so yes.

JC Have you seen people who have been worried?

4.N.4 Oh yeah.

JC And what are they like afterwards?

4.N.4 Oh, I've seen…but I think that whatever happened with them they are just sort of worried and uptight until things are sorted.

JC Right, but you're more laid back about it?

4.N.4 Um, I just don't think that I'd lose too much sleep over it.

JC Would that stop you going through all the steps?

4.N.4 Oh no, I'd still do all that but I just don't think that I'd be worried until I had to be.

JC Right, fair enough. What sort of thing you do to protect yourself and prevent having these sorts of injuries?

4.N.4 I double glove because the orthopaedic scrub nurses tell us up in general that we should be doing that which obviously with a needlestick in jury isn't really going to make that much difference but that extra layer of latex glove does stop a bit.

JC Do you do that for all cases or just orthopaedics?

4.N.4 No, well the orthopaedic scrub nurses say that you should do it for general as well and because they are the ones that taught me I do double glove for all cases. Some double glove for general, some don't. I don't wear an eye mask because I find that with a face mask and an eye mask it gets steamed up and if it's a long case it gets very, very…but some nurses do and they say that you should always do it because of splashes and things.

JC Yeah, and you said you've had splashes of blood in your eyes.

4.N.4 Yeah, yeah I know.

JC Would you report blood in your eyes using the same forms and get you bloods done and all the rest of it in the way you would a sharps injury?

4.N.4 I don't know. I would seek advice from my manager you know or one of the sisters but I don't know what the procedure is.

JC You should do because there is a risk of bloodborne infection by this route as well, so you should go through the same rigmarole as you do for sharps injuries.

4.N.4 Right, thanks.

JC Sorry, I interrupted your flow then. So you don't wear visors routinely, do you wear a face mask for all cases?

4.N.4 Yeah. All the time.

JC What sort of gowns do you wear?

4.N.4 Just normal. In orthopaedics they are the reinforced gowns but in general they're just normal. I don't know what they are.

JC Are they disposable gowns?

4.N.4 Yes.

JC Are they water repellent?

4.N.4 To some extent, yes.

JC Do you find you get blood coming through sometimes?

4.N.4 Sometimes on the arms, yeah.

JC Just on the arms, not on the front?

4.N.4 No, because I do… if we're doing a bloody case like veins and things the gloves are absolutely saturated and I always tend to use my gown to wipe the blood off my gloves because they are slippery, but no nothing penetrates.

JC That's good. What about drapes, what sort do you use?

4.N.4 The same as the gowns. They are disposable but they are water repellent.

JC Right. One of the comments I had from someone in a different trust about those that they are good in terms of repelling fluid but for drapes because they don't absolutely absorb water, water, not water, blood tends to trickle off onto the floor or the clogs. Do you find that?

4.N.4 On the floor, yes. I've never had blood in my clogs really but the floor is always…depending on how bloody the case is yes.

JC I don't suppose you've ever worked with the old green cotton gowns?

4.N.4 Well, when I started that's what I learned to use when I was scrubbing because they had two months left here when I started.

JC Right, so did they absorb fluid?

4.N.4 Yes, they were horrible.

JC They didn't protect you either then did they?

4.N.4 No.

JC Um, you said about orthopaedics and general, do you do both?

4.N.4 Just general I'm still learning the big cases.

JC OK. People who have been here a number of years, do they tend to always work with one team or rotate around.

4.N.4 They rotate but you do have some nurses who have been here a long time and specialise in hip replacements and knee replacements so they stay down in their area.

JC Right.

4.N.4 Then you've got some sisters who work just in urology or general.

JC Right, so some cross over but not all?

4.N.4 Yeah

JC Do you find while working with working with different surgical teams and different consultants they have different ways and different preferences?

4.N.4 Not too much with the ones that we work with in general, no. But when you do happen to go down to orthopaedics to cover lunch break or anything like that they are a lot stricter about face masks and double gloving and things like this. It's a lot more, you know rigid down there.

JC And is that coming from the nurses do you think or the nurses?

4.N.4 I think it stems from the surgeons. The nurses who are there…I have to say the nurses who are there, the orthopaedic nurses are a lot more focussed on double gloving and wearing eye protection. I've noticed that.

JC You know you said about the eye protection you wear, is there a choice of different types for you, for example are full face visors available, or goggles or do you have to take what you are given?

4.N.4 Take what you are given.

JC OK.

4.N.4 There is one scrub nurse here who is allergic or has a reaction to diathermy smoke so she has special masks ordered in for her but I think she has asked for them and I think that because we have never queried it we just help ourselves to whatever is there.

JC Are you ever allowed any influence over what is bought here?

4.N.4 Not as a new one in, no.

JC So if there was a new product on the market or the Welsh contract changed or was about to change, have you ever been involved in a trial or anything?

4.N.4 Gloves. That happens quite a lot. We're always being told there's a box of gloves there on trial try and use them and fill in the feedback forms.

JC And do you fill in the forms?

4.N.4 Yes.

JC And then if you feedback and say that the gloves are rubbish…

4.N.4 Which has happened recently.

JC Right, and were they bought anyway or did the trust listen?

4.N.4 No, I think the trust listens.

JC Good, so do you think they are responsive to concerns generally about safety?

4.N.4 Um, I think things have been so for so many years probably not enough people make noise about things so they are just left.

JC So people just accept the status quo then do they?

4.N.4 Yes they do.

JC How will anything ever get better then if people are always going to prepared to accept what is given to them?

4.N.4 I suppose if they are left like that I think it would have to be…they always say something big has got to go wrong before changes are made.

JC Yeah.

4.N.4 Um, I think that more people need to well, not complain but say 'shall we try some new things?' or sometimes people come in to assess what the procedures are in theatre and maybe someone should come in and see how nurses are sort of around…sort of infection and needlestick injuries and how they glove up and how they gown up and you know.

JC Right, OK. If as you say you are always doing trials on new gloves and I know that contracts do change on a fairly regular basis, do you think cost is ever a deciding factor in what is bought?

4.N.4 Yes, I do think that especially with the NHS being in debt and things like that. I think we do have gloves that the surgeons like and then we've got cheaper ones on top. We are told not to use the surgeons' gloves even though they are lovely to use.

JC And presumably more expensive?

4.N.4 Oh a lot more, yes.

JC So why is the surgeons' product better than yours do you think? If you like the gloves and you said they are lovely, why can't you use them?

4.N.4 I don't know, it's who are we isn't it? That's what I think. Sometimes I have used the surgeons' gloves because they are nice but we have been told lots of times not to use the Biogel gloves they are for the surgeons. I don't know.

JC And the ones that you use are obviously cheaper?

4.N.4 Cheaper.

JC Do you think they are an inferior product?

4.N.4 I just wouldn't say inferior but I just think the surgeons don't like to use them for a reason because they prefer the Biogel because they are better and I think that maybe we should be allowed to use them as well. We've got to handle more instruments than the surgeons in some operations so…I don't know.

JC Do they tear more easily or do you notice you've got blood on your hands after using them.

4.N.4 It's just a nice feel to them when you're handling the instruments and they've got a better grip on them. When an operation gets bloody they are not so slippery.

JC So could they compromise safety then if you haven't got a good grip?

4.N.4 I haven't thought about that. I suppose they could, yeah. I just thought of it as making my job easier you know. But as far as safety, what does happen is that instruments slip to the floor and then they're unsterile so that is lost and things like that happen.

JC And then you have to open a new pack?

4.N.4 Yeah.

JC So cost wise it may not be as cheap as they think then.

4.N.4 No.

JC So being cheap isn't the same as being value for money then is it?

4.N.4 No.

JC Do you think that is taken into consideration or is it just the bottom line that's important? This is how much we are spending on gloves and it mustn't go above a certain amount?

4.N.4 I think that is the case, yeah. And the same goes for the masks. There are one or two who have special masks but we just grab what's there.

JC And do you ever complain that they fog up or anything? Who would you tell and how would you go about making that known?

4.N.4 I don't know who. I suppose I would speak to our theatre coordinator and make her aware but I think it depends who it comes from. If it's just one nurse then I would think they're not going to listen to me so why bother.

JC Do you talk among yourselves and say 'oh those masks, they're terrible'?

4.N.4 Yes, we do.

JC So would strength of number be more respected than just one of you?

4.N.4 Yeah. When it comes down to it, one person may say something but the others wouldn't agree.

JC That's always the way isn't it?

4.N.4 Yeah

JC If you're passing sharps to one another, do you pass them directly from hand to hand or do you pass them through something?

4.N.4 Well, on a needle holder and I usually put it in a receiver. Pass the receiver and he'll take it out of the receiver and I'll keep the receiver then until he's finished and he'll put it back in the bowl. But you know, in some instances when time is sort of…if you've hit something or there's a big bleed you've just got to pass something quick. But we usually use receivers.

JC And are all the surgeons happy with that?

4.N.4 Yeah.

JC OK. You mentioned in an emergency it's all quick. Do you think you are more likely to have an accident then?

4.N.4 I would think so, yes. Yeah.

JC And is that something that you've seen.

4.N.4 No, I haven't actually seen it but um I would thin k that a lot of things happen in emergency situation where you have to act quick or pass things quick and you don't sort of look what's around you, you know.

JC Yeah, more pressure.

4.N.4 Oh definitely. Especially in surgery, I think there's quite a lot of pressure if things don't go right.

JC One of the things we've touched on is that doctors don't report injuries and this is something that has come up before, reporting and that doctors are less likely to wear protective clothing for example. Can you offer any explanation for that?

4.N.4 No, I can't. It's a…I find…like I say, when I was doing my training, doctors when they go between patients, they don't wash their hands. They don't think that they need to. They think 'I'm a doctor, I don't need to wash my hands'. You have to constantly remind them and I think it's the same sort of mentality for things like reporting injuries.

JC Do you think there could be differences between nurse training and medical training that could account for the different attitudes?

4.N.4 Um, I can't think of any. As nurses we sort of think about the patient and we are supposed to be self aware and things like that and I think doctors seem to treat the illness rather than the patient.

JC So do you think medicine seems to attract different personality types than nurses?

4.N.4 Oh, definitely.

JC What sort of types would go for each one?

4.N.4 I think nurses are people who want to good by everyone and want to help people. I know doctors are that as well but there is a big difference and I don't know what it is.

JC Right.

4.N.4 I don't know whether it is ambition and where you want to be in your career or is it the type of person? I'm not sure.

JC That's OK. Do you think nurses are better at following rules than doctors?

4.N.4 Yes.

JC Any idea why?

4.N.4 No.

JC What about the sort of hierarchy within nursing? Are nurses scared…that's probably not the right word, but might they think 'I've stabbed myself so I'd better report this now or sister's going to be on my case'? Does that sort of attitude prevail among nurses more than doctors perhaps?

4.N.4 Oh yes, and in a way it's a good thing that we've got that hierarchy there or people wouldn't report. But yes, if I didn't report I would think so and so will be looking for my report and ask me 'where is this?' and 'why haven't you done that?' but I don't think doctors have got that person there saying 'you must do this'.

JC So they manage themselves then?

4.N.4 They do, yes.

JC Right OK. You might not be able to answer this but in your experience when you've seen junior staff coming through such as the registrars in training who do they take their cues from? Do they come in already wearing their visors for example, or would they...if they worked with a consultant who never wears one, would they do the same? Are they led by their hierarchy?

4.N.4 Yeah. And it depends what sort of person they are. There are a few , I shouldn't say cocky, but a few registrars who are quite confident and they come in and do their own thing and there are some who follow the lead and do exactly what the surgeon does. It depends on their personalities.

JC And do the consultants like to impose their personalities on their juniors?

4.N.4 Some do, yes.

JC You've not all that long graduated, but since you have been a qualified nurse, have you had any extra training sessions on sharps handling, disposal and things like that? Sessions held by infection control nurses, theatre coordinators or educators within the department?

4.N.4 No.

JC If there ever were these sessions held do you think they would be useful?

4.N.4 Yes. I think it's the type of subject that needs to be constantly reinforced like you have BLS, basic life support every six months or every year and I think 'I'm so glad I'm having this' because we are in an environment where we don't see as many cardiac arrests like they do on the ward and I think 'that's good, that's refreshed my mind' and I do think infection control, every six months like we have fire training as well...it would be very beneficial. Probably after a couple of months people would slip back, but I think that if it was done regularly it would prevent a lot of things from happening or going unreported.

JC Did you have such a session on induction when you first qualified or when you first came to work in theatre?

4.N.4 No. There was a course we went on for newly qualifieds [SIC] for a year and I think infection control was covered in that, disposal of sharps and things like that but only briefly and it was more towards ward nurses and things like that because the girls and I that went on it felt that it wasn't relevant to us.

JC Do you think you needed something separate?

4.N.4 Definitely.

JC Would it surprise you to know that where these sessions are held that doctors don't attend them regularly?

4.N.4 No it wouldn't surprise me at all.

JC No? Why wouldn't it surprise you?

4.N.4 Because it's something that they don't think they should worry about. They're not part of it you know. It's the nurse's job.

JC Do you think that there's teamwork in the theatre where everyone's views are equally respected and taken into consideration?

4.N.4 Yes. It has surprised me a bit how much of a team theatre is…do you mean doctors and nurses together?

JC However you want to define a team really.

4.N.4 Well it has surprised me how you can sit down in the coffee room and have a chat with the consultants you know. It's not like where I worked as a student where there's a line between you and you don't talk to the doctors. It is more sort of you know teamwork here.

JC And if you were to say to a surgeon and say 'I've just been to a conference or I've just been to an infection control update and they say that this is a safer way of doing this', do you think they'd listen?

4.N.4 It depends. I'd be happy to say that to some of the surgeons and I think some would be happy to listen but some others would tell us not to waste their time. So you get to know who you can tell.

JC It comes from them rather than from the nurses?

4.N.4 Yes.

JC Is that a confidence issue on your behalf, or an attitude issue on their behalf?

4.N.4 Both, I think. I'm more confident speaking to some, and you can speak to some surgeons quite personally, and others you know, they don't like you speak to them. So it's my confidence with some and the attitude in others.

JC Have you noticed while working with different surgeons they might have different behaviours in terns of sharp safety? Some might use blunt needles for tissue closure and others will insist on sharp needles only for example or even have different techniques for the same operation?

4.N.4 Oh yes. A lot of our surgeons use different methods of closure, some use blunt needles, some use cutting needles.

JC What about skin closure, do some use staples and some sue sutures for example?

4.N.4 Yeah. We are doing a trial at the moment and some are using glue and some are using staples. It totally depends.

JC Is that ion their experience or just because they don't want to try new things?

4.N.4 Some are happy to try new things ad some you know, you can suggest something to some surgeons, you know 'so and so likes this' and some are happy but others will stick to what they know.

JC Does that make it difficult for you working with different people?

4.N.4 Well no, but it makes it difficult when we have reps [SIC] coming ion with new sutures or new products and some surgeons just close the door on them and that makes it difficult because as a department you like to move on and try new things and some surgeons won't adopt new ideas.

JC Do you get a lot of reps [SIC]?

4.N.4 Yes. With different things. More so with orthopaedics, but we get a lot with laparoscopic instruments and things like that.

JC Do you speak to them or do they tend to speak to the surgeons and sisters?

4.N.4 No, we speak to them because if I'm not scrubbed I'll be circulating so I can be with the rep [sic]. They speak to us and they come to the coffee room with us and we look after them while they are with us.

JC Have you ever seen scalpels with retractable blades?

4.N.4 I think I might have seen one while I was training in ********** but not up here.

JC Were they used much?

4.N.4 No.

JC Have you ever talked about using them here?

4.N.4 No.

JC Do you think they would be a good idea?

4.N.4 I think they would be a brilliant idea.

JC Why do you think they've not been introduced here?

4.N.4 Cost. You know, we've got blade handles which by the look of them have been in the packs for years and years and a box of blades which we add to them, and I think they are probably pence cost wise. Whereas retractable ones…I don't know but… I think it's probably down to cost. They would be very good.

JC Do you think surgeons would be happy to use them?

4.N.4 I think so. Some would, yeah.

JC You get change in slowly don't you?

4.N.4 And sometimes if you've got a highly respected consultant who's willing to try something new and he would be speaking with another surgeons and say 'Mr ******* likes to use that', others would say 'oh does he?' and that has happened a few times and because he is a respected surgeon that's how a lot of them work.

JC So there are movers and shakers in the department that others follow?

4.N.4 Oh definitely, yes.

JC So they are the people to tackle if you want to introduce any new products or training or anything like that?

4.N.4 Yeah. Sometimes the nurses will say 'tell so and so that Mr ******* uses that and he'll have a go at it as well'. So it is very much like that.

JC What if you had a patient in who was high risk, you knew for example that he had HIV, would you change anything that you do?

4.N.4 I think we would probably have one…whereas we have two sharps boxes in theatre throughout the day and we open and close them to dispose of the sharps, if we had a patient that we knew was hepatitis or HIV we would have a sharps box in just for that patient, lock it straight away and dispose of it correctly.

JC Would you use extra protection?

4.N.4 I would use a visor if I knew the patient was high risk, I would double glove and use a visor, yes.

JC And how would you know?

4.N.4 Well, you probably wouldn't unless the ward passes the information on, but I don't know that you would.

JC Right. If you were dealing with a drug user for example, would you make assumptions that they were high risk and add to your normal precautions or would you rely on the fact that they were known to be positive?

4.N.4 I suppose I would take more precautions?

JC If you had unlimited money and there was this fantastic price of equipment that if you could afford it you'd use it or you could think of something that you have already seen or heard of, what would it be?

4.N.4 Well I like your idea of the retractable blade. I think that would be very good to be honest. I don't know, I can't think. Something that would sort of …we've got these Discardapads which we pit needles on you know and I think something along that line that we could put on the drapes because a lot of surgeons will take a needle off you and then they are not ready or they say they are ready and then go and do something else. That what was happened this morning and then they leave the needle on the patient and I wish there was some kind of Discardapad to put there that would hold the needle.

JC Does the trust take safety seriously?

4.N.4 No, I don't think they take it seriously. I think they try to look as if they are but I don't think there enough is being done. And it's not something that I think of very often unless something happens and I think that could have gone in my eye or that could have been a dirty needles. But if the trust took it more seriously there would be more training you know especially in a department like theatre.

JC OK. Do you ever get any feedback from Health and Safety or Clinical Governance about injures that have happened in the department?

4.N.4 I think may be the sisters and coordinators do but it's not passed down.

JC So you wouldn't get to know how many injuries there were or whether there had been any increase?

4.N.4 No.

JC OK. Who keeps all these figures? Who has ownership of this information?

4.N.4 I don't know whether it would be the surgical director or the theatre coordinator. I don't know.

JC OK. Is there anything else that you'd like to see done? Have you ever spoken to people in other hospitals that have got things that you haven't got?

4.N.4 Um, no I haven't but it's only when you actually talk about it that you realise you know.

JC Yeah.

4.N.4 It didn't cross my mind until I talked to you know that we should be doing a lot more you know and things should be more highlighted and we should have more training. No I can't think of anything.

JC I think that's all I want to ask you. Is there anything you'd like to add?

4.N.4 No.

JC Well I know I've taken time out of your working day, but I really appreciate it. It has been great. Thank you very much indeed.

4.N.4 Thank you.

Appendix 22

Factors influencing sustaining and reporting percutaneous and mucocutaneous exposure to blood and body fluids in the operating theatre

Interview schedule - managers

Biographical details

Could you tell me a little about yourself and your career to date?

Can you tell me a little bit about what your current role entails?

Frequency of injuries/reporting

How frequently do staff in your theatres sustain inoculation injuries when operating?

Please describe a typical inoculation injury that you have dealt with.

Please describe the action you usually take following such an injury.

Do you think all injuries are reported?

The literature describes differences between doctors and nurses in relation to guideline adherence. Are you able to comment on this?

Education and training

Do you feel that your Trust provide adequate education on the prevention and management of inoculation injuries?

What provision is made in the department for on-going training?

Who typically attends such training?

The literature describes differences between doctors and nurses in relation to attendance at training sessions. Are you able to comment on this?

Personal protection

What measures do staff in your theatres take routinely to reduce exposure to blood and body fluids when operating?

Are these measures optional or are they covered by a Trust policy on protective clothing?

If so, how would such a policy be enforced?

Do you consider these measures to be effective?

Do you consider any other protective measures to be successful in reducing the risk of infection?

What is the mechanism by which new products are purchased for the department?

Some papers I've read suggest that purchasing can, on occasions be driven by the need to reduce costs, rather than other priorities, such as employees' safety. Are you able to reflect on this? /What is your reaction to that?

Way forward

What more do you think can be done to protect healthcare workers from the risk of inoculation injuries and exposure to blood-borne viral infections?

What would you like to be done within your Trust?

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