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Award date:
2019

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UNIVERSITY OF PLYMOUTH

An exploration of sharps injuries within a nursing student population in the UK

by

Kevin Hambridge

A thesis submitted to the University of Plymouth in partial fulfilment for the degree of

Doctor of Philosophy

School of Nursing and Midwifery

November 2019

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ACKNOWLEDGEMENTS

Firstly I want to thank my supervisors Professor Ruth Endacott and Dr Andy Nichols. Over the past six years they have provided guidance, encouragement and support whilst I have been on this incredible journey. I am very grateful for their nurturing approach to my writing and research and the patience they have shown me. I will be forever thankful to them.

Secondly I would like to thank Dr Heather Skirton and Dr Ray Jones for their invaluable guidance in the early stages of the project when giving me enlightenment in regards to the utilisation of Survey Monkey.

Next I would like to thank Professor Bridie Kent who offered much support and illumination before the commencement of the systematic review. Thanks also to Pam Nelmes who kindly shared her expert experiences of Twitter, which pointed me in the right directions regarding data collection. I would also like to thank my academic colleagues, administration staff and nursing students who have encouraged me along my voyage. Thanks also to the University of Plymouth for supporting me.

Finally, I would like to acknowledge the love, encouragement and support of my family. My wife Tracey has been a rock over the past six years and has supported me enormously during the ups and downs of the journey. Thanks to my sons for putting up with me, my dog and to my new granddaughter for brightening up my life during the difficult times.

AUTHOR'S DECLARATION

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Doctoral College Quality Sub-Committee.

Work submitted for this research degree at the University of Plymouth has not formed part of any other degree either at the University of Plymouth or at another establishment.

LIST OF PUBLICATIONS AND CONFERENCE PRESENTATIONS

Publications of the work

This systematic review has been published in the following article:

Hambridge, K., Nichols, A., Endacott, R. (2016) 'The impact of sharps injuries on student nurses: a systematic review', *British Journal of Nursing*, 25(19), pp. 1064-71.

Presentations of the work

This study has been presented as a poster presentation at the following conference:

The International Clinical Skills Conference (Florence) in May 2015: The type, extent and impact of sharps injuries within a nursing student population: a systematic review (poster presentation)

An article was published on the topic before the commencement of the thesis:

Hambridge, K. (2011) 'Needlestick and sharps injuries in the nursing student population', *Nursing Standard*, 25(27), pp. 38-45.

Word count of main body of thesis: 76,536

Signed

November 2019

ABSTRACT

An exploration of sharps injuries within a nursing student population in the UK.

Percutaneous injuries, such as sharps injuries, can transmit up to 60 different types of pathogen (Tarantola et al., 2006) to the injured party. Whilst up to 100% of some nursing student populations sustain sharps injuries (Trivedi et al., 2013), a dearth of research studies investigating the topic worldwide exist. It is unknown within the UK the devices contributing to sharps injuries, the incidence rates and the locations where they occur.

The aims of this study were to identify the characteristics of sharps injuries within a nursing student population within the UK; to explore the experience of sharps injuries, concentrating on the potential psychological effects and to examine factors that influence nursing student behaviour in relation to sharps usage.

Following a systematic review, a multi-phase mixed methods design was used. In Phase One a two-site survey was conducted with nursing students (n=1015) to explore the incidence and impact of sharps injuries. For Phase Two a Twitter Chat was orchestrated to investigate the experiences and effects of sharps injuries with nursing students and Registered Nurses (n=71). Phase Three comprised an audit of sharps injuries sustained in Clinical Skills Simulation Wards (n=3). For Phase Four, interviews were conducted with nursing students who had sustained a sharps injury (n=12) to discover their experiences and the impact of the injury. Findings were synthesised and examined in the context of Learning Theory.

Findings showed that sharps injuries were most likely to occur with glass ampoules (34.9%), when students were preparing injections (65%) and in the second year of the programme (44.54%). Many contributing factors of the sharps injury were identified, with inexperience being the primary cause. Some nursing students reported various psychological impacts after sustaining the SI, which affected both professional and personal life. The qualitative findings were synthesised into 8 themes. The study identified that there were many factors which influence nursing student sharps usage behaviour, both in the educational institution and when in clinical placement.

The thesis concluded that sharps injuries are common within nursing students, and can have many psychological impacts on the individual. Many factors were identified which influence student nurse behaviour in relation to how they learn about sharps usage. These factors have been amalgamated into a theoretical framework model, which may be useful to guide future education, practice and research.

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GLOSSARY OF TERMS

Acquired Immune Deficiency Syndrome (AIDS): a set of symptoms caused by the HIV virus, and as advanced HIV infection or late-stage HIV.

Anxiety: “an emotion categorised by feelings of tension, worried thoughts and physical changes like increased blood pressure. People with anxiety disorders usually have recurring intrusive thoughts or concerns. They may avoid certain situations out of worry. They may also have physical symptoms such as sweating, trembling, dizziness or a rapid heartbeat.” (American Psychological Association, 2019).

Audit: an initiative which seeks to improve the quality and outcome of care through the examination of practice (Taylor, 2014).

Audit trail: “the systematic documentation of material that allows an independent auditor of a qualitative study to draw conclusions about trustworthiness” (Polit and Beck, 2010 p. 547).

Case study: “a research design that focuses on specific groups or populations, often one, and collects data using a variety of methods” (Moule and Goodman, 2014 p. 454).

Chi-squared test: “a statistical test used to assess group differences on proportions” (Polit and Beck, 2010 p. 549).

Coding: the process of transforming raw qualitative data into standardised form for data processing and analysis (Polit and Beck, 2010).

Convenience sample: “the selection of the most readily available persons as participants in a study” (Polit and Beck, 2010 p. 550).

Depression: “a common mental disorder and one of the main causes of disability worldwide. Globally, an estimated 300 million people are affected by depression. More women are affected than men. Depression is characterized by sadness, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, tiredness, and poor concentration. Sufferers may also have multiple physical complaints with no apparent physical cause. Depression can be long-lasting or recurrent, substantially impairing people’s ability to function at work or school and to cope with daily life. At its’ most severe, depression can lead to suicide” (WHO, 2018a)

Directive: an official instruction given by someone in authority (Collins, 2018c).

Facebook: is a social networking website where users can post comments, share photographs and post links to news and other interesting content on the web (Nations, 2019).

Fisher's Exact Test: "a statistical procedure used to test the significance of the difference in proportions. It is used when the sample size is small" (Polit and Beck, 2010 p. 555).

Hepatitis B (Hep B or HBV): "a viral infection that attacks the liver and can cause both acute and chronic disease. The virus can be transmitted through contact with the blood or other body fluids of an infected person. Hepatitis B is an important occupational hazard for health workers. Hepatitis B is a potentially life-threatening liver infection caused by the HBV" (WHO, 2014).

Hepatitis C (Hep C or HCV): "a virus that is carried in the blood and body fluids which infects and damages the liver. The Hepatitis C virus infects the cells in the liver, causing inflammation (swelling and tenderness) and fibrosis. In people with chronic (long-term) Hepatitis C infection, inflammation and fibrosis continue to spread. Over time, usually many years, this can lead to cirrhosis of the liver" (British Liver Trust, 2019)

Human Immunodeficiency Virus: "infects cells of the immune system, destroying or impairing their function and that infection with the virus results in progressive deterioration of the immune system, leading to immune deficiency" (WHO, 2018b).

Incidence: "the rate of new cases with a specific condition occurring within a period of time" (Polit and Beck, 2010 p. 556).

Interview: "a data collection technique that includes gathering information through verbal communication" (Moule and Goodman, 2014 p. 459).

Interview schedule: "the formal instrument that specifies the wording of all questions to be asked of respondents in structured self-reporting studies" (Polit and Beck, 2010 p. 557).

Learning style: is the way each learner begins to concentrate on, process and retain new information (Dunn et al, 1994).

Learning theory: a theory to explain how individuals gain, organise and deploy skills and knowledge (Shulman and Quinlan, 1996).

Legislation: a law or laws implemented by government (Collins, 2018a).

Percutaneous injury: an injury which penetrates the skin, caused by needles, blades (such as scalpels) and other medical instruments that are necessary for carrying out healthcare work (HSE, 2018).

Pilot study: "a small-scale or trial run of the proposed study using a small sample of participants who are representative of the study population" (Moule and Goodman, 2014 p. 461).

Post-exposure prophylaxis: a treatment administered following exposure to a harmful agent which attempts to block or reduce injury or infection (Shiel, 2018a).

Post-traumatic stress disorder (PTSD): “a serious potentially debilitating condition that can occur in people who have experienced or witnessed a natural disaster, serious accident, terrorist incident, sudden death of a loved one, war, violent personal assault such as rape, or other life-threatening events”. (Anxiety and Depression Association of America, 2018).

Prevalence: “is the proportion of a population who have a specific characteristic in a given time period” (National Institute of Mental Health, 2017).

Qualitative research: “a research approach that aims to explore phenomena from people’s perspectives through the use of inductive, interactive and flexible methods” (Parahoo, 2014 p. 412).

Quantitative research: “the investigation of phenomena that lends themselves to precise measurement and quantification, often involving a rigorous and controlled design” (Polit and Beck, 2010 p. 565).

Quasi-experiment: “an experiment in which the rules of a randomised control trial (a true experiment) are not always followed” (Taylor, 2014 p. 306).

Questionnaire: “a tool for the collection of data that can be delivered verbally, in writing, and / or electronically which asks a series of questions relating to the research study” (Taylor, 2014 p. 306).

Regulations: a rule or principle (Collins, 2018b).

Reliability: “whether the data collection tool consistently measures what it has set out to measure” (Taylor, 2014 p. 307).

Sampling bias: “distortions that arise when a sample is not representative of the population from which it was drawn” (Polit and Beck, 2010 p. 567).

Semi-structured interview: “this type of interview respondents are all asked the questions from a predetermined list, but there is flexibility in the phrasing and sequence of the questions” (Parahoo, 2014 p. 413).

Seroconversion: the detection of detectable antibodies that are directed against an infectious agent. Following seroconversion a person tests positive for the antibody when given tests that are based on the presence of antibodies (Shiel, 2018b).

Snowball sampling: “in this type of sampling, the first respondent refers someone they know to the study, who in turn refers someone they know, until the researcher has an adequate sample” (Parahoo, 2014 p. 413).

Survey research: “non-experimental research in which information about people’s activities, beliefs, preferences and attitudes is obtained via direct questioning” (Polit and Beck, 2010 p. 567).

Systematic error: is consistent, repeatable error associated with a flawed experiment design (Statistics How To, 2019).

Systematic review: “a form of literature review in which all of the available research studies on a particular topic are identified, analysed and synthesised” (Parahoo, 2014 p. 414).

Thematic analysis: “the process of identifying, analysing and reporting patterns (themes) within data” (Taylor, 2014 p. 308).

Twitter: is an online news and social networking site where people communicate in short messages called tweets (Gil, 2019).

Twitter Chat: is a public Twitter conversation around a unique hashtag. This hashtag allows individuals to follow and participate in a discussion (Smarty, 2012).

Type II error: “an error created by accepting the null hypothesis when it is false i.e. the researcher concludes that no relationship exists when in fact it does” (Polit and Beck, 2010 p. 570).

Validity: “refers to the degree or extent to which a questionnaire, interview or observation schedule and other methods of data collection study or measure the phenomenon under investigation” (Parahoo, 2014 p. 415)

Volunteer sampling: “a sample of convenience over which the researcher has little control but is instead dependent on the sample volunteering to take part” (Parahoo, 2014 p. 415).

List of abbreviations

AIDS: Acquired Immune Deficiency Syndrome

ANA: American Nurses Association

BBV: blood-borne virus

BDI: Beck Depression Inventory

CASP: Critical Appraisal Skills Programme

CDC: Centers for Disease Control and Prevention

CI: confidence interval

cOR: corrected odds ratio

CSSW: clinical skills simulation ward

CV: content validity

CVI: content validity index

EAGAAGH: Expert Advisory Group on AIDs and the Advisory Group on Hepatitis

EBN: European Biosafety Network

FET: Fisher's exact test

FTE: full time equivalent

HAM-A: Hamilton Anxiety Scale

HASSIH: The Health and Safety (Sharps Instruments in Healthcare Regulations)

HBV: Hepatitis B virus

HCA: health care assistant

HCV: Hepatitis C virus

HCW: health care worker

HIV: Human Immunodeficiency Virus

HoCF: Hierarchy of Controls Framework

HPA: Health Protection Agency

HSWA: The Health and Safety at Work Act

HSE: Health and Safety Executive

ICD-10: International Classification of Diseases and Related Health Problems

I-CVI: content validity of individual items

IES-R: Impact of Event Scale-revised

IPC: infection prevention and control

MHSAWR: The Management of Health and Safety at Work Regulations

MMR: mixed methods research

NHS: National Health Service

NIOSH: National Institute for Occupational Safety and Health

NMC: Nursing and Midwifery Council

PCL: Posttraumatic Stress Disorder Checklist

PC-PTSD Screen: Primary Care PTSD Screen

PEOT: Population, Exposure / Issue, Outcomes, Types of study

PEP: post-exposure prophylaxis

PHE: Public Health England

PICO: Population, Intervention, Comparison, Outcome

PPE: personal protective equipment

PRISMA: Preferred Reporting Items for systematic Reviews and Meta-Analyses

PSS: Perceived Stress Scale

PTSD: post-traumatic stress disorder

RCN: Royal College of Nursing

RIDDOR: The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations

S-CVI: content validity of overall scale

SI: sharps injury

SPSS: Statistical Package for the Social Sciences

SSI: semi-structured interview

UK: United Kingdom

USA: United States of America

WHO: World Health Organisation

Chapter One: Introduction

1.1 Introduction

This chapter introduces the reader to this mixed-methods study exploring the incidence and experiences of sharps injuries (SIs) within pre-registration nursing students. The context of the study is introduced, definitions of key terms are provided and the theoretical context is outlined. The significance of the study is presented, followed by study aims, research questions and objectives. In the last section of the chapter the structure of the thesis is explained.

1.2 The context of the study

Occupational accidents, predominantly those encompassing cutting and piercing instruments among healthcare workers (HCWs), have been a cause of growing concern due to the prevalence of diseases and infections caused by the Human Immunodeficiency Virus (HIV), Hepatitis B virus (HBV) and the Hepatitis C virus (HCV) (Tonarelli, 2016). Patients with these infections may occasionally be asymptomatic and unaware of their condition or choose to ignore their symptoms, thus the prospect of contamination has increased (Reis et al., 2004). Globally, these are the three most common blood borne infections usually associated with transmission via percutaneous injuries to HCWs (Elseviers et al., 2014). The risk of transmission during an incident depends on a number of factors, including the worker's natural immune system, the depth of the injury, the type of injury, the viral load of the source patient, the type of sharp used, where the sharp entered the body and risk reduction strategies implemented in the healthcare setting. The risks of transmission of HBV (when positive for HB e antigen), HVC, and HIV through SIs are often quoted as 1:3, 1:30, and 1:300, respectively (Expert Advisory Group on AIDS

and the Advisory Group on Hepatitis (EAGAAGH), 1998; Department of Health, 2008).

Although an imperative and essential clinical skill for all nursing students, how many SIs occur, what impact these injuries have on the individual and how students learn about sharps usage remain under-explored within the United Kingdom (UK). Many studies have been conducted which investigate SIs within Registered Nurses and other HCWs in the UK, but an exploration into nursing students within the UK remains elusive. This exploration will be within the UK healthcare system which has been described as 'enigmatic, infuriating and complex' (Abbasi, 2018, p. 2163), with pressurized HCWs striving to provide quality care (de Longh and Erdmann, 2018).

Through 15 years working as a nurse in surgical environments, I commonly encountered nurses and other HCWs sustaining SIs within their practice and work. There were times when this caused stress and anxiety for the individual, but on other occasions the practitioner saw it as an occupational hazard and carried on regardless. Surprisingly the advent of safety needles and devices initially caused an increase in SIs within the environment where I practiced. After 10 years of working as a nurse lecturer within a university and seeing nursing students sustaining SIs within the clinical skills simulation ward (CSSW), I decided to investigate the topic concerning SIs and nursing students. This was mainly stimulated by two episodes. One involved a nursing student I encountered in the CSSW who had managed to drive a needle through one finger, out of the other side and into the next finger, causing blood loss and upset. The second episode involved observing a registered nurse in practice with her hand inside a sharps bin trying to retrieve a sharp. These episodes raised my awareness that nursing students were at risk of SIs, but also that registered nurses may not always comply with legislation, directives, guidelines and

recommendations, even though they may be teachers and role models for the student. Preliminary reading around the topic revealed that research had been conducted only minimally in various parts of the world, but none seems to have been completed within the UK.

This thesis has given me an opportunity to explore this under-researched topic in order to gain a better understanding of the scope of the potential problem, and the experience of the nursing student following the injury. It has also allowed the identification of factors which may influence student nurse behaviour in relation to how sharps usage is learnt.

1.3 A definition of sharps and sharps injuries

Definitions of sharps within healthcare are wide and varied (Hersey and Martin, 1994). The following is not designed to be an exhaustive list, but an outline of items, defined as 'sharps', that have been reported to have caused SIs to HCWs:

- blood collection needles (Muralidhar et al., 2010; Royal College of Nursing (RCN), 2013a)
- bone fragments or teeth (RCN, 2013a; Riddell and Tong, 2015)
- broken glass (Hersey and Martin, 1994; Health and Safety Executive (HSE), 1995; World Health Organisation (WHO), 2003), including test tubes (RCN, 2013a)
- emergency services' cutting equipment (HSE, 1995)
- instruments used in invasive operations, surgery (Hersey and Martin, 1994), dentistry and acupuncture (HSE, 1995)
- intravenous (IV) cannulas, or needles used to connect parts of IV delivery systems (Muralidhar et al., 2010; RCN, 2013a)
- jagged metal (HSE, 1995)
- lancets (Hersey and Martin, 1994; WHO, 2003; Bandolier, 2003)
- needles such as hypodermic (Muralidhar et al., 2010) and hollow bore (Hersey and Martin, 1994; HSE, 1995; WHO, 2003; Bandolier, 2003)

- razors (RCN, 2013a)
- scalpels (WHO, 2003; Bandolier, 2003)
- scissors (RCN, 2013a)
- winged steel needles, known as butterfly needles (RCN, 2013a)
- other medical instruments that are necessary for carrying out healthcare work (HSE, 2016)

Sharps injuries can be defined as

“...skin penetrating stab wounds caused by a sharp instrument and accidents in a medical setting.” (Centers for Disease Control and Prevention(CDC), 2008)

This is the definition which will be applied within the thesis. As well as being labelled penetrating stab wounds, SIs have also been described as lacerations or puncture wounds (HSE, 1995); piercings of the skin (Hersey and Martin, 1994) and cuts and pricks (RCN, 2013a). Within medical and nursing literature it is also defined as a percutaneous injury (HSE, 2016).

1.4 Nursing students

In the UK, a pre-registration adult branch nursing student is defined by the Nursing and Midwifery Council (NMC) (2010) as a student aged 18 or over, studying at degree level, undertaking a three year programme (or 4600 hours). The programme is structured to include 50% theory and 50% practice. Students must complete competencies set by the NMC (2018) within practice in diverse placements encompassing the National Health Service (NHS) and the independent and voluntary sector. The rationale for selecting this branch of nursing is because this is the branch who I have worked with, mentored and taught throughout my nursing and academic career.

1.5 Theoretical context of the thesis

This study will explore the primary learning theories that are useful to situate the behaviour of nursing students in relation to sharps usage. A learning theory is a,

“coherent framework of integrated constructs and principles that describe, explain, or predict how people learn.” (Braungart and Braungart, 2016, p. 52)

There are numerous learning theorists who have posited many learning theories over the past century. Understanding and applying learning theories is imperative in education in order to provide an arena for learning (Joyce et al., 2009). Nursing is no different to this. Having an appreciation of learning theories employed when nursing students are learning how to use sharps may aid the development of new strategies and viewpoints. Learning theories related to experiential learning and social learning have provided particular insights. Learning theories are critiqued in Chapter Three and used to underpin the discussion in Chapter Six.

1.6 Significance of the thesis

This thesis intends to explore SIs within pre-registration nursing students due to a scarcity of evidence available on the topic. The importance of this exploration will be to offer significant contributions to the body of knowledge in relation to the incidence of SIs, the types of equipment involved, potential causes of SIs and how SIs can affect individuals. An improved understanding of the phenomena will aid the learning and teaching of sharps usage and potentially aid the prevention of such injuries. Understanding the impact which SIs have on the individual will aid the development of support for the individual.

The incidence and experience of SIs within pre-registration nursing students has been explored because authors have argued that there is a dearth of evidence and published studies related to this subject (Elliott et al., 2005; Blackwell et al., 2007; Petrucci et al., 2009; Karadag, 2010; Hambridge, 2011). Much of this previous research has tended to focus exclusively on the incidence rates of SIs occurring in hospital settings, while this research study reaches beyond those narrow aspects of enquiry. Whilst there is a very limited number of studies investigating SIs in nursing and midwifery students, Karadag (2010) states that there are comparatively large numbers of studies investigating this phenomenon within medical students (deVries and Cossart, 1994; Patterson et al., 2003; Schmid et al., 2007; Varsou et al., 2009). This study will attempt to address that imbalance.

The same can be argued for Registered Nurses. Despite the mounting body of information regarding SIs in practicing nurses, there has been little research focusing on SIs within the nursing student population (Blackwell et al., 2007). Evidence relating to nursing students is relatively lacking worldwide (Elliott et al., 2005), especially with regard to the possible factors associated with it (Petrucci et al., 2009). A previous literature review (Hambridge, 2011), established that there was a dearth of published information and completed research into SIs within the pre-registration adult branch student nurse population, especially within the UK. The literature review highlighted that limited data did exist within Asia, USA, Canada, Australia and other European countries with regards to incidence rates, reasons for not reporting, the location, potential causes and the prevention of SIs. This lack of research exploring SIs affecting nursing students limits the understanding of the scope of the issue. This thesis has thus filled a gap which appears to exist by investigating the various facets

of the issue by not only exploring the aforementioned points, but additionally the type of SIs, and the experience and effect which SIs have on the individual.

Knowing more about SIs involving nursing students will be significant to know because identifying how, why, where and when occurrence happens can increase understanding of the risks of injury in both theory and practice settings. This will be supplemented by the identification of factors which influence student behaviour and how learning occurs regarding sharps usage in this population. This could have an impact upon the teaching and learning of sharps usage and thus the potential prevention of injury. Having a greater understanding of the effects of SIs on nursing students would help to identify the type of psychological harm which can be sustained, how severe this harm may be, the support which is currently received and the support systems which nursing students may additionally require.

The study aims to contribute to conversations within nursing and healthcare by offering a comprehensive exploration of SIs within a nursing student population in the UK. This will be culminated with: 1) a theoretical framework showing the factors that influence nursing student behaviour in relation to sharps usage and 2) a framework showing the psychological support which may benefit the nursing student who sustains a SI.

1.7 Aims, Research Questions and Design

The aim of this study is to explore SIs within a nursing student population in the UK.

The research questions are:

- What is the incidence of SIs within a nursing student population in the UK?
- What type of SIs do nursing students in the UK sustain?
- What is the experience of a SI on a nursing student within the UK?
- What factors influence nursing student behaviour in relation to sharps usage?

The following objectives which were addressed are:

- To identify the incidence and characteristics of SIs sustained by nursing students in the UK
- To ascertain whether SIs are reported by nursing students
- To investigate the device and procedure involved in SIs involving nursing students
- To detect whether the sharps involved were used or clean
- To investigate the psychological impact a SI on a nursing student in the UK
- To determine how many SIs were sustained in Clinical Skills Simulation Wards (CSSWs) compared to other Allied Health Professional students

The research design incorporated four phases. In Phase One a two-site survey was conducted to explore the incidence and impact of SIs. For Phase Two, a Twitter Chat was orchestrated to investigate the experiences and effects of SIs with nursing students and Registered Nurses. Phase Three comprised an audit of SIs sustained in three CSSWs, while in Phase Four, interviews were conducted with nursing students who has sustained a SI to discover their experiences and the impact of the injury.

1.8 Structure and content of the thesis

A systematic review was conducted to examine the quality and quantity of evidence related to the question: “What is the incidence and impact of SIs in the pre-registration nursing student population?” This is presented in Chapter Two, followed by a comprehensive review of wider literature relating to sharps usage and SIs involving HCWs (Chapter Three). Chapter Four provides an overview and critique of the multiphase mixed methods research process, including methodology, methods and the application of the research study. The study was conducted in four phases;

the results and findings are presented in two chapters. The quantitative results from the study (survey and audit) are presented in Chapter Five, followed by Chapter Six which presents the synthesised qualitative findings (Twitter Chat and interviews), analysed using thematic analysis. Chapter Seven is a critical discussion of the synthesised quantitative and qualitative findings in the context of Learning Theory. This is followed by Chapter Eight which considers concluding points and provides answers to the research questions and recommendations.

Chapter Two: Systematic Review

2.1 Introduction

A systematic review was conducted to identify current literature, together with its limitations, quality and potential. The review was also intended to inform decisions about design and methods for the empirical data collection in Phases One to Four of the study (Piper, 2013). The systematic review set out to answer the question: “What is the incidence and impact of SIs in the pre-registration nursing student population?” The systematic review sought to locate and present the best available evidence regarding how many SIs are occurring in the chosen population, what type of injuries were happening and what impact these injuries had on the individual. As of 2013, an extensive search of the literature found no systematic review on this topic had been conducted. The criteria of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement (PRISMA, 2009) were used as a foundation for the conduct and reporting of the systematic review (see Appendix A). Findings from audits did not meet the inclusions criteria for the review but are included in the Discussion (section 2.3) where appropriate.

2.2 The stages of the systematic review

The review was conducted in six stages:

- 1) Development of the search strategy
- 2) Conducting the search
- 3) Article screening
- 4) Critical appraisal of studies meeting the review criteria
- 5) Data extraction
- 6) Aggregation of the data

2.2.1 Development of the search strategy

Inclusion criteria

The inclusion criteria were related to pre-registration nursing students who had acquired a SI. The systematic review included all studies relating to SIs caused by needles, scalpels and blades, suture and stitch cutters, blood lancets, glass, scissors, and razors. These are the sharps which were identified within a previous literature review (Hambridge, 2011) and through personal experience. Articles published worldwide from 1980 to 2014 were included. This is because Acquired Immune Deficiency Syndrome (AIDS) was first recognised as a disease in 1981 (CDC, 1981) and there is a relationship between AIDS and HIV and SIs (Heptonstall et al., 1993).

Both quantitative and qualitative studies were examined for inclusion. The quantitative component of the review considered experimental study designs including randomised controlled trials, non-randomised controlled trials, quasi-experimental, before and after studies, prospective and retrospective cohort studies, case control studies, analytical cross sectional studies, epidemiological study designs including case series, individual case reports, and descriptive cross sectional studies. The qualitative component of the review considered studies that focus on qualitative data including phenomenology, grounded theory, ethnography and action research. Original articles and review articles, including systematic and narrative reviews were considered.

Exclusion criteria

The exclusion criteria were:

- articles not published in English
- articles with a focus on self-harm or the effect of an injury on a patient

- articles reporting an audit or quality improvement project.

Exclusion of non-English studies could lead to language bias (Grégoire et al., 1995; Moher et al., 1996). However, a systematic review found no evidence of systematic bias from the use of language restrictions within systematic reviews in relation to medicine (Morrison et al., 2012).

Formulation of key words

Initial keywords were chosen to aid the retrieval of pertinent articles. Suitable keywords are described as the ‘cornerstone of an effective search’ (Timmins, 2005, p. 44) hence these were chosen with care. As the ‘Population, Intervention, Comparison and Outcome’ (PICO) system is intended primarily for questions relating to therapeutic interventions, the ‘Population, Exposure / Issue, Outcomes, Types of study’ (PEOT) proforma (Bettany-Saltikov, 2010) was used (see Table 2.1).

Table 2.1: The key words used in searching the literature within the systematic review

	Key words
Population	adult student nurse; pre-registration; student of nursing; student nurse
Exposure/Issue	sharp injury; sharps; sharp injuries; needle stick; needle prick; needlestick injury; needlestick injuries; accidents; incidents; occupational injury; occupational injuries; biological exposure incident; percutaneous exposure; blood borne infection; incidence; inoculation; prevalence.
Outcomes	harm; psychological harm; experiences; impact; under-reporting; non-reporting.
Type of study	RCT; survey; case study; ethnography; action research; phenomenology; qualitative; experimental design (pre-post); mixed methods designs.

2.2.2 Conducting the search

The initial search was conducted between 1st August 2013 and 24th December 2013. A second search was conducted in April 2014. The rationale for this second search will be explained within Section 2.2.3.

Databases searched

A comprehensive search of nursing, health and psychology databases was undertaken, which included: BMJ Journals collection; Business Source Complete (EBSCO); CINAHL Plus with Full Text (EBSCO); BMJ Clinical Evidence; the Cochrane Library (Wiley); Internurse; Medline (EBSCO); PubMed; PsycArticles; PsycINFO; ScienceDirect; SwetsWise; Trip (Turning research into practice); and UK PubMed Central. Relevant studies were also identified by searching the following grey literature databases: The National Research Register, Clinicaltrials.gov; Google Scholar; Sigle; theses and dissertations (UK & worldwide); PQDT (open); and EThOS (British Library Electronic online service). The Intute, Department of Health, NHS, Monitor (regulator for health services in England), Health Protection Agency (HPA), Centres for Disease Control and Prevention and Trove (finding Australian Theses) websites were also searched.

2.2.3. Article screening

The screening process was conducted in three distinct stages:

- 1) based on the title
- 2) based on the abstract
- 3) based upon the full text

The search strategy resulted in 376 articles based on title only. Upon reviewing the articles, 186 were found to be duplicates. The next stage of the process was to filter

the articles based on the abstract. This reduced the articles from 190 down to 133 as 57 articles were dismissed based on not fitting the criteria. These 133 articles were then screened based on full text. A further 91 articles were excluded for the following reasons: not full text (n=35); not in English (n=11); wrong study type (n=5); wrong topic (n=17); mixed health student data (n=6); and duplications (n=17).

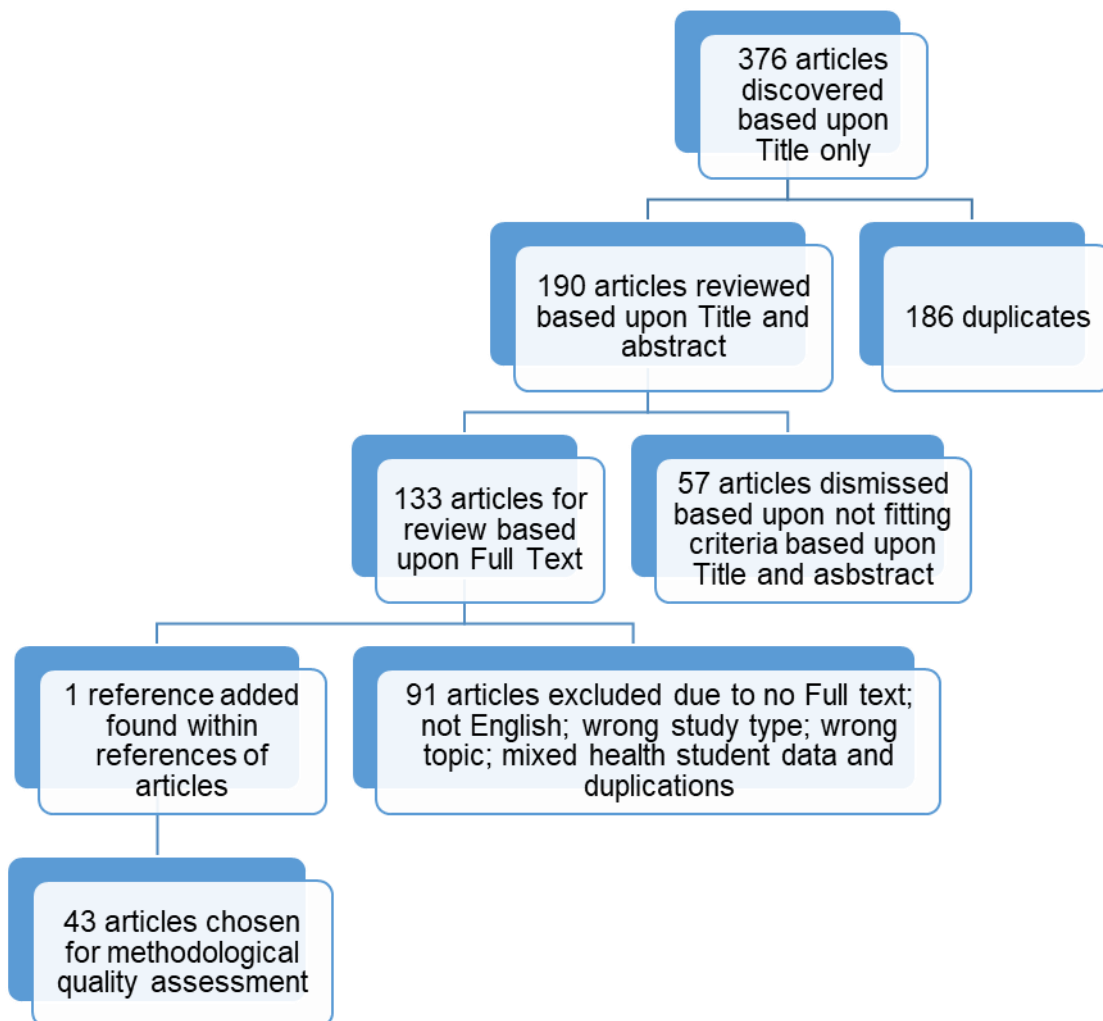
The screening process only included full-text articles due to the complexity and unfeasibility of accessing non full-text articles. Ideally, researchers should detect all studies that meet the criteria, but in the real world this is seldom possible (Borenstein et al., 2009). This exclusion of articles could lead to issues of publication bias which can affect the validity of a systematic review by the researcher synthesising an incomplete set of evidence (Ahmed and Riley, 2012). Of note, it is suggested that only positive results from trials are published, leading to an over-optimistic review of the evidence (Booth et al., 2009).

It is acknowledged that this review may not reflect the entire evidence base, as 91 articles were not considered. Alternatively labelled availability bias (Borenstein et al., 2009), this selective inclusion of studies that are easily accessible may have meant that the results of utilised studies may have been systematically different from the discarded ones (Song et al., 2013). The risk of publication bias through searching for only full-text articles was reduced by the rigorous searching of grey literature within this systematic review (Dalton et al., 2016) and by a serious effort to find the difficult to find studies (Borenstein et al., 2009). Additionally, the declaration of the non-inclusion of the 91 articles is viewed as good practice, as this process adheres to criteria six of the PRISMA (2009) statement (Moher et al., 2009).

Three studies mixed the results from student nurses and student midwives so a decision was made to include the articles as there were commonalities within these health professionals and their training. The NMC (2018) state that both nursing and midwifery students spend 50% of their programme in practice, study for three years and gain an academic and professional qualification. Hence, it was decided to repeat the article search to find additional articles which included student nurses and student midwives. The search in April 2014 found no new articles or studies searching via GoogleScholar using the following keywords: 'midwifery', 'student', 'needlestick', 'needle stick', 'sharp', 'sharps', 'injury', 'inoculation', 'biological exposure', 'percutaneous' and 'blood borne'. GoogleScholar was solely utilised for this purpose rather than a search of the original databases because: 1) up to 100 million records of academic and grey literature can be searched (Haddaway et al., 2015) and 2) the benefits included resource efficiency, cost efficiency, rapidity and the downloading capability function (Haddaway, 2015).

Additionally one article was found within the reference lists of the articles. This three stage process produced a total of 43 articles for methodological quality assessment. The process is shown in Figure 2.1.

Figure 2.1: The process of article selection



2.2.4 Critical appraisal of studies meeting the review criteria

It was imperative to appraise the quality and relevance of the articles in order to decide whether the findings could be included in the systematic review. After studies of an acceptable design were selected, an in-depth assessment for the risk of various biases was conducted. Critical and quality appraisal of the potential studies was conducted using tools appropriate to the study method.

Critical appraisal instruments

When the protocol for the review was developed, CASP tools continued to be used for appraising randomised control trials, systematic reviews, qualitative studies, case

studies and cohort studies (Toye et al., 2013; Nadelson and Nadelson, 2014). The CASP tools were reported to have many redeeming features. The tools were described as being comprehensive checklists which allow the reviewer to assess the methodological quality of a paper by permitting the rigour and applicability of the research to be assessed (Cameron et al., 2011). The CASP tools were also reported as being succinct and able to effectively cover the areas needed for critical appraisal of evidence (Nadelson and Nadelson, 2014).

However, a more recent review of qualitative appraisal tools (Majid and Vanstone, 2018) highlighted the negative aspects of the CASP tool and the advantage of utilising others. Some of the adverse features of the CASP tool identified by Majid and Vanstone (2018) included issues with evaluating the methodological quality of studies compared to other appraisal tools and the tool being time-consuming. The review highlighted the positive aspects of other tools such as the JBI tool (Lockwood et al., 2015) and the QF tool (Spenser et al., 2003). The JBI tool was praised for being short and easy to use, especially by less experienced researchers (Majid and Vanstone, 2018) and its quality of producing a better assessment of study details than other tools (Hannes et al., 2010). The QF tool was applauded for being comprehensive (Dixon-Woods et al., 2007).

Navigating through over 100 appraisal tools is a cumbersome procedure, particularly when faced with assorted methodologies, philosophical perspectives and purposes (Santiago-Delefosse et al., 2016). This amount and range of available quality appraisal tools makes selection problematic (Majid and Vanstone, 2018). Added to this is the argument that tools are difficult to identify which are specific to health research requirements (Katrak et al., 2004).

One systematic review identified was appraised using the '10 questions to help you make sense of a review' critical appraisal tool (Critical Appraisal Skills Programme (CASP), 2013). Evidence for the tool's effectiveness is scarce, but it has been recommended by the National Institute for Health and Care Excellence (2014). Thirty-six identified articles employing a survey were assessed using the Crombie framework (Crombie, 1996), a checklist suitable for appraising descriptive surveys (Holly, 2010). One qualitative article was assessed using the CASP (2006) tool which has been widely used as it allows rapid evaluation and is suitable for different types of qualitative design (Ricci-Cabello et al., 2012). One case study was critically appraised using the Critical Appraisal of a Case Study tool (Centre for Evidence-Based Management, 2013). Evidence for its effectiveness is scarce, although its use has been promoted by the Centre for Evidence Based Medicine (2014). The Support Unit for Research Evidence tool for critically appraising intervention / experimental and controlled observation studies' was used to appraise the four quasi-experiments identified (Cardiff University, 2012).

Cut-off points used in the scoring of the methodological quality assessments

An issue identified was the 'cut-off points' to be used to filter out studies not worthy of inclusion in the final stage of the systematic review based upon the methodological quality assessment. This proved a difficult procedure as there appeared to be a dearth of published evidence on the exact use of 'cut-off points' to use for the appraisal tools utilised during the methodological review. Pope et al (2007) supports this observation by stating that there is an absence of agreement about how cut-off points should be applied. A decision was made regarding the 'cut-off points' by the author, primarily for the surveys. This was based upon the deviation

and range of scores produced by the methodological quality assessments which created a natural cut-off point of 13/20.

The systematic review article was excluded due to a score of 2/10. Of the 36 surveys, two were excluded due to scoring <13/20. The qualitative study was included with a score of 8/10, as was the case study with a score of 9/10. All of the quasi-experiments were included with scores of 9-11/14. The scores for the studies included within the systematic review can be found in Appendix B.

Rigour of the methodological quality assessment process

To ensure the quality of the process, six randomly chosen articles were reviewed blindly by one of the supervisors, with at least one article from each research method. This was achieved by allowing the supervisor to randomly select chosen articles from each of the research methods. This aided triangulation of the quality process. The process showed generally good consensus of methodological quality assessment and there was hence no need for a third assessor to further review the articles.

2.2.5 Data extraction

Quantitative data were extracted from papers using the MASTARI data extraction instrument, while qualitative data was extracted using the JBI QARI data extraction form for interpretive and critical research (Briggs, 2014). Following this process, 40 articles were eligible for inclusion in the systematic review: 34 surveys; one quasi-experiments; one case study and one qualitative study (Appendix B).

Conflicts of interest

My experience as a surgical nurse could be seen as a potential conflict of interest. This is because I may bring along personal and professional experiences of sharps usage and injuries to the systematic review process. The view of Bero and Grundy (2016) applies to this situation, as I endeavoured to detach my personal and professional interest in the subject from the process, and implemented objectivity and rectitude into the procedure. This was aided by 1) having a clear question for the systematic review to answer; 2) adhering rigidly to the PRISMA (2009) criteria and 3) having six articles randomly appraised by a supervisor. This interest in the topic should be seen as distinct from a financial conflict of interest. There was no financial or commercial sponsorship by drug or device companies involved in the completion of this systematic review, which may influence the effect size estimate or conclusions (Cochrane Community, 2017).

2.2.6 Aggregation of the data

The data was aggregated into quantitative (incidence rates, types of SI, and prevalence rates during an injection procedure) and qualitative (the impact).

2.2.7 Overall incidence and prevalence

The sample size, methods used (incidence and prevalence) and the reported incidence and prevalence of SI is wide-ranging. Blackwell et al (2007) reported an incidence rate of 9.4% (n=9), whilst Trivedi et al (2013) found an incidence rate to be 100% (n=100). In a study by Cheung et al (2012) a prevalence rate of 5.9% (n=52) was found, whereas a prevalence figure of 94.2% (n=40) was reported by Sharma et al (2010). Sample sizes ranged from 50 (Reis et al., 2004) to 2776 (Albertoni et al., 1992). There was no pattern of incidence or prevalence according to sample size;

low incidence and prevalence was evident in small and large studies and vice versa. The timeframe for reporting ranged from the previous week (Kermode et al., 2005) to the entire academic training period (three or four years) (Small et al., 2011).

Low incidence and prevalence

Researchers reported incidence and prevalence rates of under 20 percent. Blackwell et al (2007) reported an incidence of 9.4% (n=9), whilst an incidence of 10.5% (n=52) was found by Vandijck et al (2008) and a similar rate of 10.29% (n=228) was reported by Petrucci et al (2009). McCarthy and Britton (2000) reported an incidence rate of 14% (n=9), Zungu et al (2008) described how 15.6% (n=15) of nursing students had a SI and Kermode et al (2005) found an incidence rate of 18.8% (n=16) of nursing students who had sustained a percutaneous exposure.

A prevalence of 13.9% (n=38) was found by Smith and Leggat (2005) and Irmak and Baybuga (2011) reported a prevalence rate of 19.4% (n=60).

Medium incidence and prevalence

Researchers have found incidence and prevalence rates of between 20-50 percent. Small et al (2011) described an incidence rate of 25% (n=49) of nursing students and an identical proportion was reported by Tetali and Choudhury (2006) who found that 25% (n=16) of nursing students had sustained a SI. Lachowicz and Matthews (2009) found a higher incidence of 28.26% (n=13) and an incidence rate of 40% (n=50) was reported by Reis et al (2004). An incidence of 46% (n=23) being discovered by Wang et al (2003), and a similar rate was reported by Kermode et al (2005) of 48.1% (n=42) of student nurses reporting a percutaneous injury. Talas (2009) reported an incidence rate of 49% (n=230).

Regarding prevalence rates, Ozer and Bektas (2012) found an overall prevalence rate of 33% (n=94).

High incidence and prevalence

Researchers have reported incidence and prevalence of between 50-100 percent. Yang et al (2007) described an incidence rate of 50.1% (n=264) amongst nursing students, with a similar figure of 52.5% (n=74) found by Unver et al (2012). Hussain et al (2012) found a rate of 76.4% (n=68), whilst an incidence rate of 78% (n=78) was reported by Lukianskyte et al (2011). An incidence rate of 85.3% (n=64) was described by Muralidhar et al (2010).

A prevalence rate of 61.5% (n=352) was described by Shiao et al (2002) and a higher prevalence rate of 94.2% (n=40) was reported by Sharma et al (2010).

2.2.8. Incidence and prevalence based on academic year

In eight studies, researchers reported the incidence and prevalence rates by academic year (see Table 2.2).

Table 2.2: Incidence and prevalence rate reported in the literature based on academic year

Author, country and sample size	1 st year	2 nd year	3 rd year	4 th year
Albertoni et al (1992) Italy n=2776 Incidence	9.5% (n=111)	26% (n=419) of 2 nd and 3 rd year (p<.001)	-	-
Small et al (2011) Namibia n=198 Incidence	14.4% (n=12)	23% (n=7)	19% (n=9)	15.7% (n=6)
Ozer and Bektas (2012) Turkey n=285 Prevalence	31.4% (n=27)	44.4% (n=28)	39.4% (n=28)	18.6% (n=13)

Petrucci et al (2009) Italy n=2215 Incidence	12.8% (n=90)	10.45% (n=79)	7.79% (n=59)	-
Smith and Leggat (2005) Australia n=274 Prevalence	4.3% (n=5)	11.4% (n=12)	40.4% (n=21)	-
Talas (2009) Turkey n=473 Incidence	-	29.3% (n=68)	36.1% (n=84)	34.3% (n=80)
Unver (2012) Turkey n=218 Incidence	-	56.5% (n=13)	53.1% (n=17)	51.2% (n=44)
Mitra et al (2010) India n=190 Incidence		98.4% (n=187)	-	-

Incidence rates ranged from 7.79% (Petrucci et al., 2009) to 98.4% (Mitra et al., 2010), whereas prevalence rates ranged from 4.3% (Smith and Leggat, 2005) to 44.4% (Ozer and Bektas, 2012). Researchers used different time frames for data collection, with Mitra et al (2010) solely reporting the second academic year, Albertoni et al (1992) reporting years one to three and Small et al (2011) reporting academic years one to four. The sample sizes in the studies range from 190 (Mitra et al., 2010) to 2776 students (Albertoni et al., 1992). Findings from these studies suggest that the second year of study is the stage in which the incidence rates for SIs is highest within the nursing student population.

2.2.9 Types of sharps injuries

Data was extracted relating to the type of device involved in the SI (see Appendix C). Sample sizes for these studies ranged from 100 (Unver et al, 2012) to 2215 (Petrucci et al., 2009). The type of device involved in SIs with the highest incidence was

intravenous needles at 86% (n=86) (Trivedi et al., 2013). This device was reported in eight studies. This was followed by needles (insulin, hypodermic, hollow-bore) with 80.8% (n=55) (Hussain et al., 2012). Needles were reported in 15 studies. Glass items (bottle of patient secretion, blood collection tube, broken ampoule) were reported in 12 studies with the highest incidence being 66% (n=33) (Karadag, 2010).

2.2.10 Incidence and prevalence during the stages of injection administration

Data was extracted relating to the most frequent time to have a SI during the administration of an injection (see Appendix D). Sample sizes within these studies ranged from 50 (Reis et al., 2004) to 878 (Cheung et al., 2012). The stage with the highest incidence of a SI is 'when re-capping the needle' with 62.5% (n=40) (Muralidhar et al., 2010). This issue was reported in sixteen studies. This is followed by 'after administration but before disposal of the needle' which was reported in five studies with the highest incidence being 61% (n=39) (Muralidhar et al., 2010).

2.2.11 The impact of sharps injuries

Only one study explored the experiences of nursing students who had sustained SIs. Naidoo (2010) used a qualitative phenomenological approach with a sample of eight nursing students in South Africa. From the study, four themes were reported: traumatic incident; reaction to the traumatic incident; intervening factors and the need for support. Findings reported below are from this single study.

Traumatic incident

Nursing students gave an 'account of the incident' and provided rich detail even though the incident may have happened up to a year previously. The respondents knew the precise date and time of the SI and described how the injury transpired by 'setting the scene'.

Reaction to the traumatic incident

The respondents spoke of their 'physiological reaction' to the SI including being 'shocked' and 'crying'. There were reports of the 'emotional reaction of the student and family' including being 'fearful of becoming HIV positive', having an 'out of body experience' and feeling 'anxiety' and 'depression' and 'numb'. The respondents reported a 'lack of care from the staff in the service setting', with some staff being 'very unsympathetic'. The incident was defined as being 'nerve wracking', with associated 'blame from family'. Respondents reported the 'reaction to treatment', including the side effects of the post-exposure prophylactic drugs, such as sickness, dizziness and nausea, which affected their attendance at university and practice placement. At least three of the eight students within the study stopped their medication without notifying anyone of their decision. Respondents spoke of the 'reaction to nursing practice' whereby they felt distressed when re-entering the practice placement as they felt they were 're-living the injury', with one respondent stating that they would have considered suicide if seroconversion had occurred.

Intervening factors

A lack of awareness about SI reporting among respondents was described and poor knowledge of registered nurses concerning treatment and counselling after a SI. This caused a delay in treatment and a lack of counselling support for some students.

Need for support

Respondents generally spoke of having understanding family and friends, who were described as 'sympathetic' and 'supportive'. Some respondents felt that some of the nursing staff in the practice setting were not supportive. However, the clinical

supervisors from the higher education institute were 'excellent' and directed the respondents to counselling services offered by the university.

Further qualitative data

One other study provided qualitative data on the consequences of the SI on nursing students. Reis et al (2004) described how they reported negative feelings of 'anger', 'insecurity', 'concern', 'fear', 'low self-esteem', 'frustration', 'incapacity', 'incompetence' and 'fear of infection e.g. HIV' following a SI.

None of the studies used a validated instrument (e.g. anxiety or depression measure) to examine the impact of having a SI.

This research study will aim to explore the experience and impact of SIs within a nursing student population in the UK. To expand on the work of Naidoo (2010), this research study will aim to achieve a deeper understanding of the topic by utilising not only qualitative interviews, but also a national Twitter Chat of nursing students nationwide. This will mean that data will be collected locally and nationally, compared to the data from Naidoo (2010) which was obtained in a localised area. This will be supplemented with the employment of quantitative methods of investigation such as a survey and an audit. This will endeavour to gain a greater comprehension of the incidence, type and causes of a SI among nursing student. The subsequent synthesis of collected data will thus offer a broader comprehension of the topic under investigation.

2.3 Discussion

2.3.1 The incidence and prevalence of SIs

The incidence and prevalence rates for SIs reported in the 40 studies is wide. The incidence rate ranges between of 9.4 -100%, whereas the prevalence rate of ranges from 5.9 - 94.2 percent. The data presented suggests that the least frequent time for student nurses to have a needle stick injury is during the first year of training, whilst the most frequent time is during the second year of training. This echoes an audit conducted by Cheung et al (2010) who reported that most SIs within nursing students happened in the second year (45.1% n=23). A potential explanation for the wide variation in the incidence and prevalence rates could be the disparity in pre-registration nurse education worldwide. This is supported by WHO (2009) who stated that the great dissimilarity in the levels of teaching for professional nurses and midwives around the world can no longer be ignored. Hence there may be many variables related to the potential causes of high incidence and prevalence rates.

2.3.2 The type of SIs

Intravenous needles were the most common device involved in sharps incidents, which mirrors an audit by Tarantola et al (2003), where it was established that 37.3% of SIs happened during IV sampling. This was closely followed by needles which links with the audit of Cheung et al (2010) who found that injection needles were the most common device involved in a SI among nursing students (86% n=37) whereas Tarantola et al (2003) found that 28.9% of SIs happened when using an injection pen and 23.1% with a subcutaneous needle. Glass items were the next most frequent item contributing towards SIs and this echoes the audit conducted by Cheung et al (2010) who found that broken glass from opening ampoules was responsible for 62.5% (n=5) of SIs.

2.3.3 The impact of sharps injuries

The single qualitative study investigating the experiences of nursing students who had sustained SIs (Naidoo, 2010) highlighted the feelings of 'fear [and] anxiety' experienced by nursing students who had sustained a SI in South Africa. This is echoed by Lee et al (2005a) who found in a review of prospective studies that HCWs experience significant fear, anxiety and emotional distress following a SI involving a needle, sometimes resulting in occupational and behaviour changes. Sustaining a SI is stressful, and the higher rates of anxiety in these practitioners could put them at higher risk of future SIs (Sohn et al., 2006). Meanwhile, Zhang and Yu (2013) reported that 15.2% of HCWs recounted manifestations of emotional distress, such as anxiety, worry, frustration, panic, and even extremity numbness after experiencing a SI.

In a study of trainee doctors, SIs were associated with human costs in terms of stress and anxiety, and persistent symptoms could meet the diagnosis criteria for post-traumatic stress disorder (PTSD) (Naghavi et al., 2013). They also found that 12% of doctors who had experienced at least one SI involving a needle during their training reported symptoms consistent with PTSD. Worthington et al (2006) reported within a case study symptoms of PTSD in two doctors after a SI from a HIV-positive patient.

Occupational exposure to blood borne pathogens can be a frightening experience; HCWs may be scared and a few might develop long-term psychiatric consequences (Gerberding, 2003). Nursing students talked of 'depression' and feeling like a 'huge cloud over my head' after a SI; as mentioned above, one had considered suicide if seroconversion occurred (Naidoo, 2010).

Nursing students' fear of becoming HIV positive (Reis et al., 2004; Naidoo, 2010) is mirrored by Zhang and Yu (2013) who reported that 93.9% of HCWs indicated that the major factor inducing negative psychological changes was the fear of HIV infection.

Respondents in the study by Naidoo (2010) spoke of their 'need for support', with many praising their supportive family, friends and clinical supervisors but saying that nursing staff were not as sympathetic and there appeared to be a 'lack of counselling support'. Zhang and Yu (2013) concluded that discovering the ideal type, content, and timing of psychological interventions is crucial to lessen anxiety in HCWs who suffer a SI.

Wicker et al (2014) state that understanding of the psychological impact of SI involving needles is limited because published studies are scarce, whilst Zhang and Yu (2013) contend that published research into the psychological impact of SIs is limited, compared to studies into the incidence, situations when it happens, risk factors and economic costs. Great efforts are made to prevent SIs, but the psychological aspects of these injuries have received little attention (Sohn et al., 2006).

It appears there are potentially huge psychological issues for practitioners following a SI, but only one qualitative study was found that explored the potential impact on nursing students. This is therefore an under-researched area which requires further investigation.

2.4 Summary

This systematic review identified 40 articles and revealed that within the pre-registration nursing student population SIs are extensive and range in type, based

upon the various devices involved. The incidence rate ranges between of 9.4 -100%, whereas the prevalence rate of ranges from 5.9 - 94.2 percent.

The most common devices identified were Intravenous needles, needles and glass items, with recapping being the most common cause during the administration of an injection by the nursing student.

Findings from a single study also emphasise the psychological issues relating to SIs, the impact they can have on individuals and the support and counselling that nursing students require after a SI. There appears to be a dearth of study into this particular aspect of SIs. This systematic review has identified gaps in understanding and shows that further research is needed. Within the UK, no research was identified which has investigated the incidence and experience of SIs within a nursing student population or factors which influence nursing students behaviour regarding sharps usage.

The appraisal of the surveys within the systematic review aided the development of the questionnaire formulated for the purpose of the study conducted within this thesis. This relates to the content (e.g. type and extent) and the construction. Evidence gained from the qualitative study (e.g. psychological impact) supported the development of not only the questionnaire but also the interview schedule. The evidence extracted was utilised during the analysis and discussion stages of the study.

Chapter Three: Literature Review

3.1 Introduction

The previous chapter provided outcomes from the systematic review investigating the incidence, prevalence and impact of SIs, specifically affecting nursing students. This chapter presents a further review and critical discussion of the literature to give a broader view of the significance of SIs involving HCWs.

The literature review was conducted post-hoc to provide new insights and also to offer alternative ways of the understanding study findings (Polit and Beck, 2010; Moule and Goodman, 2014; Parahoo, 2014). For these reasons, the purpose of the literature review in this study was to inform the discussion phase (Chapter Seven), rather than to inform the methodological decisions stated in Chapter Four.

No date limits were set, all HCWs were included and grey literature in the form of policy and legislative documents were included.

3.2 Search strategy

Databases

The search of the literature was conducted by searching the following databases: AMED, BMJ Journals collection, CINAHL Plus with Full Text (EBSCO), Clinical Evidence, Cochrane Library (Wiley), Internurse, Medline (EBSCO), NICE Evidence, PubMed, PubMed Central, PsycArticles, PsycINFO, and ScienceDirect. Finally, Google Scholar was targeted to search for grey literature.

The search was limited to publications in the English language only and there was no time limit set. This was to ensure a historical context was achieved. The search included quantitative and qualitative study designs such as survey, experiment, RCT, case study, literature review, systematic review, Acts of law, directives and

guidelines but excluded opinion pieces and commentaries. This was due to the requirement to obtain a broad range of evidence-based articles relevant to the topic areas. The process for the literature review followed four stages: 1) using search terms to search relevant databases; 2) in the results list produced, the titles and abstracts were screened. Those deemed relevant were saved as a file; 3) the full texts of the relevant articles were retrieved, read and relevant data extracted; and 4) relevant papers found within bibliographies were also identified. Articles without an abstract or full text were excluded.

Key words

Search terms included the keywords: sharps, needlestick, injury, inoculation, percutaneous, experience, impact, psychological, psychiatric, mental, nurse, audit, nursing, student, healthcare worker, policy, guideline, directive law, legislation, learning, theory, teaching style, PTSD, anxiety, depression and seroconversion. These keywords were used in combination to narrow the searches.

3.3 Findings

The literature focused on the microbiological risks associated with SIs; policy context relating to sharps usage and SI prevention; the volume of SIs affecting HCWs; audit results of SIs affecting nursing students; the psychological impact of SIs within HCW populations; the financial cost of SIs, and finally a review of SIs through the lens of learning theory.

3.3.1 Microbiological risks associated with sharps injuries

More than 20 different blood-borne pathogens can be transmitted through percutaneous injuries (Collins and Kennedy, 1987; Morgan, 2000) and this estimation has been increased to at least 60 different blood-borne pathogens

(Tarantola et al., 2006). These infections, some listed in Table 3.1, have rarely been reported as pathogens associated with SIs.

Table 3.1: Pathogens rarely associated with sharps injuries

Cytomegalovirus (CMV)
Epstein-Barr virus (EBV)
Haemorrhagic Fever viruses, such as Ebola virus
Hepatitis D virus (HDV or delta agent, which is activated in the presence of HBV)
Hepatitis G virus (GB virus or GBV-C)
Human T cell leukaemia viruses (types I and II)
Human t lymphotropic retroviruses (HTLV I & II)
Malaria
Parvovirus B19
Prion agents such as those associated with transmissible spongiform encephalopathies (TSE)
Transfusion Transmitted virus (TTV)
West Nile virus (WNV)

(Tarantola et al., 2005; Menna-Barreto, 2006; Günther et al., 2011; NHS Employers, 2015)

Sharps related HBV exposures

It has been widely reported that HBV is a significant, infectious, occupational threat for HCWs exposed to human blood (Mengal et al., 2008), and has been recognized as such since the late 1940s (Leibowitz et al., 1949). Within the UK, the HPA (2012) stated that between 2009 and 2011, 190 HBV exposures were reported (including those involving a source patient co-infected with HCV and / or HIV) of which, 71% (77/109) involved a previously known HBV positive source patient. Percutaneous exposures were found to account for 67% (123/184) of HBV exposures.

Subsequently, Public Health England (PHE) (2014) reported that between 2004 and 2013, 590 HCWs were exposed to HBV following a SI. In spite of HBV being highly infectious, the report also stated that there had been no seroconversions to HBV. This presumably relates to the high percentage of HCWs who are immunised against HBV within the UK (PHE, 2014).

Sharps related HCV exposures

Within the UK, the HPA (2012) stated that between 2008 and 2011, there were three patient-to-HCW HCV transmissions following significant occupational exposures. This brought the total number of HCV seroconversions in HCWs reported to 17. All the HCWs seroconverted following percutaneous exposures involving hollow bore needles contaminated with fresh blood. The 2014 'Eye of the Needle' report stated that between 2004 and 2013, 2566 HCWs were exposed to HCV following a SI. The report stated that there had been nine seroconversions to HCV during this time frame. Available evidence states that since 1997, a total of 21 HCV seroconversions in HCWs have been reported in the UK (PHE, 2014).

Sharps related HIV exposures

Acquired Immune Deficiency Syndrome is a set of symptoms and illnesses that develop as a consequence of progressive HIV infection (AVERT, 2018). It was only with the beginning of what would later be classed as the AIDS epidemic in 1981 that the occupational exposure to biological fluids became a serious matter (McCray, 1986). Human Immunodeficiency Virus infections of HCWs have been reported following occupational exposure to the blood of patients or being injured by a needle that has been contaminated with HIV. The first case of HIV transmission from a patient to a HCW was reported in 1986 in America (Stricof and Morse, 1986).

Between 1997 and 2001 in the UK, available evidence states that there was one documented case of HIV seroconversion in a HCW after an occupational exposure and 38 HCWs with probable occupational acquisition of HIV (Hawkins et al., 2001). These cases were categorised as “probable” rather than “documented” occupational seroconversions because, although these HCWs had no risk factors other than an occupational exposure, they did not have a baseline HIV negative test at the stage of exposure. All but one of these HCWs had formerly worked in healthcare settings in countries of high HIV incidence and were presumed to have become infected outside of the UK. On investigation, the remaining HCWs had no other risk factors to explicate their infection and had never lived in a country of high HIV incidence or worked as a HCW outside the UK.

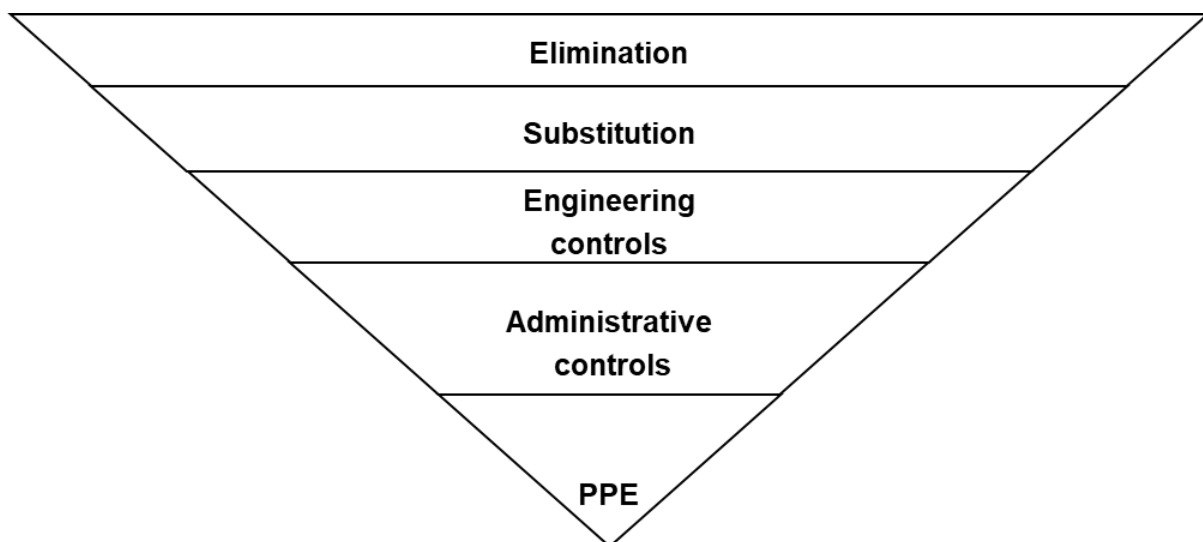
The HPA (2012) stated that 1336 HCWs were reported as having been exposed to HIV positive source patients between 2002 and 2011. Between 2004 and 2013, PHE (2014) reported that 1,478 HCWs were exposed to HIV following a SI but there had been no seroconversions to HIV. Available evidence states that the overall number of HIV cases in the UK diagnosed in HCWs since 1984 following occupational exposure is five documented cases (Anon, 1984; Heptonstall et al., 1993; Hawkins et al., 2001) and 47 probable cases. Of these 47, nine were diagnosed prior to 1997. The NHS European Office (2013) meanwhile state that at least four UK HCWs are known to have died following occupationally-acquired HIV infection.

3.3.2 Policy context relating to sharps usage and sharps injury prevention

The policy context for sharps usage and the prevention of SIs includes legislation, regulations and directives, alongside professional guidance and recommendations. An abundance of legislation exists relating to sharps usage within the UK (Appendix E); four EU Council Directives relevant to sharps usage (Appendix F); key HSE

guidance publications (Appendix G); guidance from a range of sources relating to sharps usage (Appendix H); and WHO approved recommendations and guidance relevant to sharps usage (Appendix I). The policy context for sharps usage and prevention of SIs will be reviewed within the Hierarchy of Controls Framework (HoCF) (National Institute for Occupational Safety and Health (NIOSH), 2015). The HoCF is displayed in Figure 3.1.

Figure 3.1: The Hierarchy of Controls Framework (NIOSH, 2015).



Hierarchy of controls

The HoCF grades risk controls according to the supposed mark of effectiveness in decreasing risk, aiming to advise optimal choice of safety enhancement approaches. In the safety literature, the concept of a hierarchy of risk controls has gained in popularity within healthcare (Card et al., 2012). Within the system, ‘Elimination’ relates to the removal of the hazard and is seen as the most effective measure. ‘Substitution’ involves replacing the hazard, whilst ‘Engineering controls’ relate to isolating people from the hazard. ‘Administrative controls’ involves changing the way

that people work, whereas 'PPE' is protecting the worker with Personal Protective Equipment (PPE). This is seen as the least effective measure.

Elimination

Total elimination of a sharp from the workplace is the most effective way of eliminating the hazard of a SI. There have been proposals for the avoidance of the superfluous use of sharps (NIOSH, 1999; COSHH, 2002; American Nurses Association (ANA), 2002; Hutin et al., 2003; The Health and Safety (Sharp Instruments in Healthcare) Regulations (HASSIH), 2013), with the EU Council Directive 2010/32/EU recommending a reduction in the use of unnecessary sharps.

The EAGAAGH (1998); NHS Employers (2013a) and UNISON (2014) have advised employers and employees over a long period of time to identify and eradicate the superfluous use of sharps during certain procedures. This includes the identification of alternative ways of administering medications which do not involve the use of a sharp. Additionally, sharps free devices should be made available, such as needleless IV systems.

Substitution

Substitution involves replacing the device or process with a less hazardous one. Since the 1990s the use of safer needle devices has been recommended if available (HSE, 1995; NIOSH, 1999; ANA, 2002; Hutin et al., 2003) as a replacement for needles and syringes (The Personal Protective Equipment at Work Regulations, 1992; The Provision and Use of Work Equipment Regulations, 1998; The Health and Social Care Act, 2008; HASSIH, 2013).

Engineering controls

Engineering controls relate to the isolation or removal of a hazard such as a sharp, before it comes into contact with the worker. For decades, there have been regulations and guidelines regarding the safe disposal of sharps using safety equipment such as puncture resistant sharps bins that meet BS and UN standards (The Personal Protective Equipment at Work Regulations, 1992; The Provision and Use of Work Equipment Regulations, 1998; EAGAAGH, 1998; The Health and Social Care Act, 2008; HASSIH, 2013; UNISON, 2014). Since the 1990s, information has been provided for employees relating to safe working practices such as the safe disposal procedures by using sharps bins correctly (HSE, 1995), and this has been reiterated by the EU Council Directive 2010/32/EU recommendation for the provision of secure containers with accompanying guidelines of safe usage.

Administrative controls

Administrative controls relate to the identification and implementation of procedures to allow workers to work safely. This includes policies and procedures to limit exposure to sharps. Employer responsibilities in relation to sharps usage within healthcare settings are to ensure a safe working environment and safe working practices by the implementation of safe systems. The Health and Safety at Work Act (HSAWA) (1974) made employers responsible for the health, safety and welfare of its employees and the creation of a safe working environment. This was reiterated by the HSE which gave advice to employers regarding health and safety law relating to the provision of a safe working environment and safe practice for employees (HSE, 2003). This should be achieved through consultation between Trade Union representatives and employers regarding safety measures for employees with the provision of relevant health and safety documentation and policies (The Safety

Representatives and Safety Committee Regulations, 1977; Health and Safety (Consultations with Employees) Regulations, 1996). It is imperative that the employer assesses the various risks to health and safety in relation to the use of sharps and this has been highlighted by guidance (HSE, 1995; HSE, 2011; NHS Employers, 2013a; UNISON, 2014), regulations (The Management of Health and Safety at Work Regulations (MHSWR), 1999; The Control of Substances Hazardous to Health Regulations, 2002) and within directives (EU Council Directive 89/391/EEC introduced in 1989 (European Agency for Safety and Health at Work 2018 and the EU Council Directive 2010/32/EU introduced in 2010 (European Agency for Safety and Health at Work, 2018c).

A common example of administrative controls is the provision of information and training in the safe usage of equipment, the risks from injuries and prevention of injuries (HSAWA, 1974; MHSWR, 1999). This training has been occurring for decades and was an issue included within all of the EU Council Directives targeted at employees working with biological agents.

The information and training relates to safe workplace practices in relation to sharps and includes not re-capping needles (HSE, 1995; EAGAAGH, 1998; COSHH, 2002; HSE, 2011; HASSIH, 2013; NHS Employers, 2013a; UNISON, 2014) which has been advocated for decades. The one-handed scoop method of re-sheathing has been promoted to reduce the risk of recapping related injuries though (NIOSH, 1999; ANA, 2002; Hutin et al., 2003). Linked to this is also an avoidance of the manual separation of the syringe and needle (HSE, 1995; HSE, 2011) and an avoidance of passing a sharp from one hand to the other (EAGAAGH, 1998; NHS Employers, 2013a; UNISON, 2014). Sharps training should also relate to sharps protection

systems (The European Biosafety Network (EBN), 2011; HPA, 2012; NHS Employers, 2013a; UNISON, 2014).

As well as the safe use of sharps, the training of employees in the safe disposal of sharps in sharps bins has been a common administrative control (HSE, 1995; EAGAAGH, 1998; COSHH, 2002; EBN, 2011; HSE, 2011; HPA, 2012; NHS Employers, 2013a; HASSIH, 2013; UNISON, 2014). The training includes the safe positioning of the bin, which should be of adequate depth and capacity for the activities planned. There should be plentiful bins made available, should never be overfilled and should be within the HCW's arm's length. The sharps should be disposed of promptly in a sharps bin positioned at eye level (NIOSH, 1999; ANA, 2002; Hutin et al., 2003). Training may also relate to the use of sharps bins transportable safely in community settings in cars as well as in hospital settings, by the correct use of a closed, secure lid (Department of Health and Social Care, 2013). This is due to sharps having been identified within cars used by HCWs.

Training may also relate to the safe use of glass ampoules (Hutin et al., 2003), which is only very minimally mentioned within the administrative controls data. Pop-open ampoules were recommended, or a clean barrier such as a piece of gauze, rather than ampoules which required a metal file to open.

Further administrative controls are that employers should limit the amount of employees who handle sharps within their organisation (EAGAAGH, 1998; NHS Employers, 2013a; UNISON, 2014) and also awareness training on the risk of exposure (EBN, 2011; HPA, 2012; NHS Employers, 2013; UNISON, 2014).

Establishing a Needlestick Prevention Committee was viewed as a way of tackling the issue (ANA, 2002) by identifying ways of limiting exposure to sharps. Although

also mentioned briefly as an administrative control by the RCN (2013), there is limited data worldwide regarding Needlestick Prevention Committees.

Employers must correctly manage incidents involving sharps and procedures creating exposure to blood-borne viruses (BBVs) if they do occur within the workplace (COSHH, 2002; HASSIH, 2013; NHS Employers, 2013a; UNISON, 2014).

The employer is responsible for immediate first aid provision, support, counselling and the necessary follow-up post-exposure, including blood tests and prophylaxis provision (The Health and Safety (First Aid) Regulations, 1981; HSE, 2005; HSE, 2011; HASSIH, 2013; European Agency for Safety and Health at Work, 2018b). The employer should additionally give instruction and information regarding the measures that should be followed in the event of an injury (MHSAWR, 1999) and offer immunisations against HBV (UNISON, 2014).

Having a robust reporting system is also an imperative administrative control (HSE, 2005; HSE, 2011). A reporting system of exposures to HBV, HCV and HIV should be in place (The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR), 1995; RIDDOR, 2013) and a record kept of all incidents and accidents. These records aid the evaluation of the effectiveness of implemented safety measures and should help to identify issues in order to prevent the re-occurrence of SIs (EBN, 2011; HASSIH, 2013; NHS Employers, 2013a; UNISON, 2014).

Personal Protective Equipment

Personal protective equipment provides a barrier between the HCW and the hazard, namely the sharp. This is seen as the least effective control as although the PPE can act as a barrier to blood, it will not prevent a SI from occurring. There is a

requirement for the employer to provide PPE such as gloves, aprons, masks and goggles (HASWA,1974; The Personal Protective Equipment at Work Regulations, 1992; The Provision and Use of Work Equipment Regulations, 1998; EAGAAGH, 1998; ANA, 2002; The Health and Social Care Act, 2008; HASSIH, 2013; NHS Employers, 2013a; UNISON, 2014), which should be free of charge and conform to the necessary design and manufacture regulations (European Agency for Safety and Health at Work, 2018a).

The distribution of legislation, directives, guidance and recommendations regarding sharps within the Hierarchy of Controls Framework

It appears that the majority of legislation, directives, guidance and recommendations in relation to sharps usage fall within the administrative controls section of the HoCF inverted pyramid. This links in with the views of Mills et al (2008) who state that healthcare administrative controls are ranked as the weakest, but remain the most commonly proposed solutions to hazards. Further to this, HoCF characteristically classify administrative systems (such as training or re-wording of policies) as weak because they are thought to address only the symptoms of more institutionally engrained problems rather than the true causes (Liberati et al., 2018). There is a minimal amount of policy regarding sharps safety within the elimination, substitution and PPE sections of the HoCF. This finding links with the findings of Card et al (2012) who identified within a systematic review that within healthcare, 3.3% of risk controls were classified as elimination measures, whilst 78% were administrative in nature.

An evaluation of the effectiveness of legislation, directives, guidance and recommendations relating to sharps usage

These legislation, directives, guidance and recommendations offer a comprehensive view of information published over many decades regarding the optimum use of sharps, the implementation of safe working practices and the creation of safe working environments within healthcare settings. The HSE has produced reports following inspections of sharps usage within health and social care settings within the UK.

The HSE issued five prosecutions between 1998 and 2007 to Acute and Community Trusts regarding incidents involving sharps (HSE, 2015). Four of these incidents involved children handling sharps when accessing sharps bins in clinical settings. The HSE also issued 20 improvement notices between 2001 and 2014 to 11 Hospital Trusts, 1 Council, 1 Health Boards and 1 Private Care Homes. The reason for the improvement notices included the need for COSHH assessments, policy drafting and implementation regarding sharps usage and BBVs; the need for staff information, instruction and training regarding sharps; the need for measures to prevent the exposure of employees to BBVs; failure to control risks from SIs; not ensuring staff are aware of procedures to follow in the event of a SI; insufficient assessment of risks of use and disposal of sharps; inadequate application of protective measures for employees and the inadequate monitoring and review. Seven of the improvement notices were after the introduction of the HASSIH (2013) regulations which appears to show a disregard for the aforementioned regulations. A HSE (2016) report of inspections regarding compliance with sharps legislation in 40 NHS organisations made grave reading. Health and safety breaches were

identified in 90% of organisations, 83% failed to fully comply with the sharps regulations and improvement notices were issued to 45% of the organisations visited. Types of failing reported included the use and disposal of medical equipment, where there were failures to use safer sharps where reasonably practicable or the inconsistent use of safer sharps. There were examples given of sharps bins being in reach of children and not being located at the point of sharps use. Hence, used needles were left on trolleys that should have been disposed of in a sharps bin. There were failures to assess the risks of exposure to BBVs from SIs, especially in potentially high risk areas such as the Emergency Department. Information and training in some organisations were not seen as relevant to the sharps activities conducted. An example given was a lack of training in areas such as using a patient's own insulin. It was reported that investigations and reviews were lacking and that in some organisations there was an absence of robust systems to investigate SIs. Hence, from exploring the two HSE reports, there appears to be a dearth of strategies to prevent re-occurrence, supplemented by the use of out of date policies in certain organisations. Finally, there were instances stated within the two reports of poor recording and reporting of instances under RIDDOR legislation which means that the true incidence rates may be much higher than reported. Reporting of Injuries, Diseases and Dangerous Occurrences Regulations is UK health and safety legislation which required the correct documentation and reporting of certain injuries and incidences within the workplace (RIDDOR, 2013). Even though there are a multitude of legislation, directives, guidance and recommendations regarding sharps use and sharps safety, SIs still continue to occur.

3.3.3 The volume of sharps injuries affecting HCWs

Sharps injuries are one of the leading categories of accident sustained by HCWs and have been described as an “important public health concern” (Pathak et al., 2012 p.639).

UK data

The National Audit Office (2003) report claimed that SIs accounted for 17% of accidents to NHS staff and were the second most common cause of injury, behind moving and handling at 18 percent. Elder and Paterson (2006) conducted a literature review of reported SI rates in the UK. The exact figures were difficult to gauge due to differences in the types of reporting systems used, retrospective estimates and the issue of the non-reporting of injuries. The rates given varied between 0.78-5.15 per 100 person-years, or the equivalent of 11-14 injuries per 100 hospital beds per annum. This does compare in part to figures given in the United States of America (USA) at the time of 5.5 injuries per 100 person-years (Dement et al., 2004) and 18-26 per 100 hospital beds per annum (Perry et al., 2003). Elder and Paterson stated that due to the issues with under-reporting, the figures could be 10-fold what was reported. NHS Employers (2013b) estimated that there were 80,000 SIs within the NHS annually (with 40,000 being reported and an equivalent amount remaining unreported). The ‘Eye of the Needle’ report (PHE, 2014) highlighted that between 2004 and 2013, there were 4,830 occupational exposures to blood or other high-risk body fluids. Of these exposures, 3,396 were due to a SI. Nurses and healthcare assistants (HCAs) accounted for 42% of all reports, while doctors and dental professions accounted for 41% and 5% respectively. Disturbingly, ancillary HCWs devoid of direct patient contact were also injured by incorrect disposal of sharps (PHE, 2014).

Worldwide data

Cooke and Stephens (2017) reported rates for SIs involving needles from various countries worldwide, including Australia, Brazil, China, Egypt, France, Italy and The Netherlands. In Australia, Queensland Health (2012) reported SI rates of 2.86 percutaneous exposures per 100 full time equivalent staff within 20 hospitals between 2004-2011, whilst in Brazil there were reported rates of 386 exposures to biological material recorded among 1736 nursing staff within a teaching hospital between 2003-2009 (Marziale et al., 2013). In China 64.9% of nurses experienced a SI within the past year (Zhang et al., 2015), and within Egypt 69.1% of HCWs reported at least one SI in their lifetime (Talaat et al., 2013). Furthermore, 35.6% reported an injury during the previous 3 months with an estimated 4.9 SI involving needles per HCW per annum. In France, 6.3 blood and body fluid exposures per 100 beds were reported with the most frequent exposure being SIs (Floret et al., 2015). Reports from Italy showed that 53% of nurses and nursing students reported having had at least one injury during their career (Stefanati et al., 2015), whilst in the Netherlands the rate of SI was reported as being 0.5 SI / day and a total of 1053 in eight years in a hospital between 2003-2010 (Frijstein et al., 2010). As can be seen from these figures, SIs within the UK and countries around the world are still being reported, and under reported at unacceptable levels. The following section will concentrate upon data of incidents affecting nursing students.

3.3.4 Audit results of sharps injuries affecting nursing students

The systematic review reported in Chapter Two identified the rates of SIs affecting nursing students from surveys and quasi-experiments. Two audits have also been conducted in various parts of the world to investigate SIs within HCWs. Within these audits, the number of nursing students acquiring SIs were also reported.

Puro et al (2001) conducted an audit of 18 Italian urban acute-care hospitals between January 1994 to December 1998, in order to analyse the rate of occupational exposure to blood and body fluids among HCWs. A total of 14,349 exposures to blood and body fluids were reported, with percutaneous exposures accounting for 10,988 incidents. Regarding percutaneous injuries, the highest rates were observed within nurses, whilst 7.9% involved nursing students. The exposure risk was found to be related to job tasks, and the type and complexity of care within different care settings. The rates of exposure were thus linked to the number of injections given.

Jayanth et al (2009) conducted an audit between July 2006 and June 2007 in a 2234-bedded tertiary hospital in India, in order to determine the risk factors and the population at risk of SIs involving needles. Information was collected from a SI register. During this time 296 HCWs sustained SIs, of which 28.4% were nurses and 9.1% (n=27) were nursing students. Approximately half of the staff sustaining a SI (49.7%) had less than one years' experience. The researchers reported that the projected amount of SI for a hospital that size was 594 when comparisons were made to similar sized hospitals, hence there were less SIs than expected possibly due to reporting issues. There appears to be a dearth of audits investigating SIs within nursing students and hence there is limited information available.

3.3.5 The psychological impact of sharps injuries within HCWs

Every SI has potentially severe consequences for the injured staff member, with, at the very least, distress and physical damage (Watterson, 2004) being reported by the injured. Taking a fatalistic viewpoint, each percutaneous injury where contamination with a patient's blood occurs, can be a source of an acute and / or chronic disease, which may lead to disability or death of HCWs, and the risk of

further transmission to others (Lachowicz and Matthews, 2009). Added to this is the potential anxiety whilst waiting for results and the potential litigation against individuals and organisations.

These types of injuries can have a huge psychological impact on the recipient and their families (RCN, 2009). A major factor of the psychological impact of SIs is the 'silent nature' of many infections as the injured may not know if they have been infected until they endure further tests (Symon, 2009). As some infections can have a relatively long incubation period of three to six months, the psychological impact and associated anxiety of potential infection during the follow-up period should not be underestimated (Naghavi et al., 2013). Even when potentially life threatening infections such as HIV are not acquired and SI victims do not seroconvert, SIs can cause unnecessary stress, fear and suffering to HCWs and their families because infections can take months to be diagnosed. This also includes bacterial infections. An example of which is the acquisition of Group A streptococcus following a SI by a doctor in the USA. This led to Necrotizing Fasciitis of the SI site and 17 days of hospital treatment (Hagberg et al., 1997). Healthcare workers can often endure weeks and months of anxiety while undergoing blood tests and the unpleasant and debilitating side effects of anti-viral drugs (RCN, 2013a). Unsurprisingly, in a survey of 232 medical staff and students in Germany, more than 80% of the respondents were concerned about the consequences of SIs (Wicker et al., 2014).

There are many psychological effects which SIs, with its associated risk of seroconversion of BBVs, can have on HCWs. Post-traumatic stress disorder, stress and anxiety, depression, and other psycho-social issues affecting the individual and their family will now be explored.

Post-traumatic stress disorder

Post-traumatic stress disorder has been reported as a direct result of SIs and occurs in response to exposure to a very stressful or traumatic event or an exceptionally shocking, threatening or catastrophic situation (Mental Health Foundation, 2018).

The Royal College of Psychiatrists (2018) state that PTSD can occur following an experience which is devastating, startling and seen as beyond the individual's control.

Believed to be the first case of a HCW acquiring PTSD following a SI, Howsepian (1998) describes an individual traumatised following possible seroconversion with a suspected HIV-Positive patient. This event occurred when the HCW was performing venepuncture. Howsepian outlined the initial emotions of the HCW as being 'frightened', 'tremulous', going into a 'rage' and having a 'sick feeling.' After a week post-SI the reactions were documented as being 'constant feelings of fear', 'victimization', 'impending doom' and having 'visual flashbacks' up to eight times per day. The HCW also described having 'hallucinations of sharp pain'. When the HCW recommenced venepuncture following the event, emotions stated included experiencing 'intense fear', having 'tachycardia', being 'tachypnoeic', being 'diaphoretic', feeling 'anger', having 'insomnia' and 'autonomic flashback.' One year following the SI event, the HCW was still having emotions that were consistent with PTSD. This longevity of emotions was also observed by Worthington et al (2006) who reported a case study where two HCWs developed disabling, chronic PTSD after SI exposures to blood from a patient infected with HIV. Their PTSD continued for more than 22 months after exposure, even though both HCWs continued to test negative for the HIV antibody.

A survey (n=147) conducted by Naghavi et al (2013) identified PTSD within trainee doctors in the UK. The study found that 12% (9 of 77) of doctors who had

experienced at least one SI during their training reported symptoms consistent with PTSD on The Impact of Event Scale-revised (IES-R). A higher incidence of PTSD was identified by Green and Griffiths (2013) of 24% (n=4) in HCWs who met the guidelines for PTSD on the tenth revision of the International Classification of Diseases and Related Health Problems (ICD-10) scale following a SI involving a needle. These were noted to be within a smaller participant study group.

Anxiety

A survey (n=65) of HCWs (29% of which were nurses and 39% were house/medical staff) in the USA enrolled on a post-exposure blood borne pathogen management program (78% n=49 of which were caused by SI) identified reports of anxiety following SIs (Gershon et al., 2000). It was reported that 53% experienced feelings of anxiety. A survey to evaluate the mental health status of 307 HCWs in South Korea with experiences of SIs (Sohn et al., 2006) also reported instances of anxiety. The psychological symptoms before injury and current status were measured using the Hamilton Anxiety Scale (HAM-A) and Perceived Stress Scale (PSS). The proportions of HCWs with and without SIs were 71.1% (n=263) and 28.9% (n=107) respectively. The HAM-A scores were significantly higher among HCWs with injury experiences ($p<0.01$) and hence the conclusion was that HCWs with injury experiences exhibited higher PSS scores after the injury and higher levels of anxiety. The HAM-A has shown sufficient validity and concurrent reliability, although internal validity was shown to be insufficient (Maier et al., 1988). Meanwhile, the PSS requires further evaluation of its test-retest reliability, criterion validity and known-group validity (Lee, 2012).

More specifically, SIs can affect individual professions, with McDowell (2012) stating that many surgeons experience significant anxiety and fear following a SI. In China a

cross-sectional study of 361 nurses and doctors (186 nurses / 175 doctors) discovered that 15.2% of respondents reported manifestations of emotional distress such as anxiety, worry, frustrations, panic, and even extremity numbness after experiencing a SI (Zang and Yu, 2013). The study identified that women, nurses and individuals aged 20-30 were more susceptible to psychological anxiety and frustrations after SI ($p < .05$). The first SI case series involving needles from a psychiatric trauma clinic in the UK compared the severity of illness among these SI patients with a control group of non-SI psychiatric patients (Green and Griffiths, 2013). Tests were conducted to determine whether SI psychiatric disorders had similar duration and severity to non-SI psychiatric disorders and whether the length of psychiatric illness was related to time waited for negative serology results. There were 17 post SI participants (five nurses or paramedics; police, porters, cleaners and other workers). In total 24% ($n=4$) described an initial period of up to two days of acute anxiety, disbelief, tremor, and profound sleeplessness consistent with an acute stress reaction. NHS Employees (2015) state that SIs can have a significant impact on an injured employee, by creating anxiety with regards to the side effects of post-exposure prophylaxis (PEP).

Depression

Depression has been identified in HCWs following a SI. In the aforementioned survey conducted by Sohn et al (2006), the psychological symptoms of HCWs with experiences of SIs were evaluated before injury and current status were measured using the Beck Depression Inventory (BDI). The BDI scores were significantly higher among HCWs with injury experiences ($p < 0.01$). This evidences that HCWs with injury experiences exhibited higher BDI scores after the injury and higher levels of depression. The BDI has been proved to show high internal consistency, high

content validity (CV), validity in differentiating between depressed and non-depressed subjects and sensitivity to change (Richter et al., 1998).

A survey of 107 medical residents conducted in Japan identified depression following SI involving needles (Wada et al., 2007). For medical residents without depressive symptoms at the baseline survey, SI events were associated with depressive symptoms at the follow-up survey (corrected odds ratio [cOR] = 2.98; 95% confidence interval [CI], 1.16–3.70). As it was not possible to conclude when the medical residents developed depressive symptoms, it was not possible to determine causality between SI and depressive symptoms. These findings are though suggestive that there was an association between SI and depression. Linking to the medical profession, McDowell (2012) concluded that many surgeons experience significant depression following a SI. Varying incidences of depression post-exposure have been given for HCWs. Gershon et al (2000) found that 13% of HCWs experienced depression post-exposure, whilst Green and Griffiths (2013) identified that 77% (n=13) of HCWs showed moderately severe depressive symptoms following a SI involving a needle.

Other types of psychological impact linked to depression were also reported. Within the study conducted by Gershon et al (2000), symptoms experienced by HCWs included insomnia, a loss of appetite, sleeplessness and frequently crying especially when thinking about the incident.

The duration of the psychological reactions

Regarding the duration of psychological emotions following SIs it was established within the Green and Griffiths (2013) study that psychiatric disorders following SI were similar to other trauma-related psychiatric illness in its severity. The duration

recorded was 9.3 months (-/+ 6.1 months) and the effects had major impacts on work attendance, family relationships and sexual health.

Qualitative data relating to the psychological impact of sharps injuries within HCWs

Two qualitative studies were identified within the literature search, the findings of which will now be explored.

The first study containing qualitative data was within the Gershon et al (2000) survey. Here HCWs (nurses, nursing assistants, doctors, technicians and unspecified trainees) stated via open-ended questions that they thought that there had never been adequate closure to the incident. Some physicians though had access to the patient's medical records, and found that seeing the final test result on the source patient helped them feel that 'it was finally over'. This though raises concerns about confidentiality and data protection. Conversely, for some HCWs, knowledge that the source patient was negative was not enough, especially in one situation where the client was an intravenous drug user.

Some HCWs within the Gershon et al (2000) study believed the event would 'never be over,' because the exposure incident haunted their thoughts. The exposure was dwelling on the participants' minds and many wished that the event had not happened, with some wanting re-testing and more counselling. There was also a fear that the participant may become positive up to a year after the event as the patient was HIV and HVB positive.

Others thought that the experience made them more careful. This sentiment was echoed by others who found that the experience made them 'learn', be more 'aware' and more 'cautious'. Self-blame was a common emotion though, with HCWs labelling themselves as '*stupid*'.

Some HCWs within the Gerson et al (2000) study described anger on occasion about the incident because they felt that they had not received 'enough training'. Some HCWs were angry and upset for many months, even as long as a year later. This anger was sometimes directed at the '*careless co-worker*', especially if they failed to apologise for the incident. Some HCWs expressed upset when the source patient refused to be tested. If this happened, the participant felt 'abandoned' and thought that their requirements and concerns were not important to the institution. Some were saddened by the lack of follow-up or coordination with their facility.

The incident caused several HCWs to seriously rethink their careers, with one surgeon considering whether this career was for them given the risk and a nurse stated that they wished they did not have patient contact.

Some qualitative findings also related to the impact on the family of the individual. Within the study by Gershon et al (2000) most HCWs who were married or who had a partner felt able to tell them about the experience, but unmarried HCWs were inclined not to tell their families about their exposure incident. One nurse declared that she did not tell her family because of a fear that they would not be supportive. Another nurse said she was ashamed to tell her family, because she did not want to upset them. This was exacerbated by the fact that they felt they might potentially become infected because of the perception of being a '*sloppy co-worker*.'

Although the majority of the spouses and partners were supportive of the exposed HCWs, many were naturally '*worried*,' '*anxious*,' '*concerned*,' or 'feeling stunned.' One nurse described how their spouse was so upset, that they had to calm them down.

Most exposed HCWs changed their sexual practices after the exposure and either refrained from sexual activity or practiced “safe sex.” One nurse reported that she was afraid to have sex with her spouse following the exposure and this led to a marriage break-up. One physician stated that they refused to have sex for four months after the exposure, and then only performed ‘safe sex’ for six months. It was a difficult situation because the couple wanted to start a family (Gershon et al, 2000).

Similarly, Lee et al (2005a) stated that individuals commonly report feeling shame and fear when disclosing the injury to their partners, and the possibility of exposure to their family members. Quantitatively, Zang and Yu (2013) found that 93.9% of the respondents indicated that the major factor inducing negative psychological changes was the fear of infection of themselves or family members.

A phenomenological study conducted in Taiwan involving in-depth interviews explored the psychosocial impacts on unspecified HCWs (n=17) who were exposed to a contaminated SI involving a needle or blood and body fluid at work (Wu et al., 2014). Five main themes emerged from the data: ‘Emotional loading’ included the shock caused to the HCWs and the fear of seroconverting to infectious diseases. HCWs also spoke of the worry about family members and the perceived damage the SI had had on their professional image; ‘Disappointment on the working environment’ included the lack of manpower support, and the feeling of being isolated and helpless; ‘Disapproving eyes’ as a theme was where HCWs described the invasion of their privacy following the SI and the fear of being labelled as a consequence and the ‘Impact on life’ theme describes how HCWs feelings of the exposure being life-threatening, the physical discomfort experienced and the impact the SI had had on professional ambitions. The final theme was ‘Self-adjustment’ where the HCWs made efforts to recover from the SI. Wu et al (2014) concluded that

SIs involving needles could have a great psychosocial impact upon what they described as 'victims', and that follow-up interventions should include psychosocial support.

A SI not only causes a risk of infection, it also has a great psychosocial impact on the victims and their family. NHS European Office (2013) stated that significant stress and psychological trauma can result from SIs involving needles, even where no infection is ultimately acquired, due to long periods of uncertainty regarding the outcome of the injury, as well as changes in lifestyle, working restrictions and, where indicated, extended and debilitating treatments. Despite an exhaustive and iterative search of the literature there appears to be a dearth of evidence relating to the impact of SI within the HCW population.

3.3.6 The financial cost of sharps injuries

The direct and indirect costs

The CDC (2008) defined the direct and indirect costs for healthcare organisations when a SI involving a needle occurs. Direct costs related to baseline and follow-up laboratory testing; PEP and the potential PEP side-effect management and workers compensation. Indirect costs related to time and wages diverted to receiving or providing exposure-related care; lost productivity associated with reporting and receiving initial and follow-up treatment; healthcare provider time to evaluate and treat an individual; healthcare provider time to evaluate and test the source and staff absence. Additional indirect costs could also include disability of the individual concerned (Sharma et al., 2010) and the potential economic impact on the individual (Trueman, 2008). Lee (2005a) reported the humanistic impact and psychological effects of SI involving needles on lost productivity in a study of 110 US nurses who had suffered a SI. Seventy-seven days were missed, 10 due to seeking and

receiving medical attention, and six due to the side effects of HIV prophylaxis treatment. Sixty-one days were lost due to the emotional distress and anxiety created. A study of nurses in 13 European countries and Russia (n=634) showed that following a SI involving needles, 12.3% changed their working habits or department and 2.4% stopped working (Costigliola et al., 2012).

The monetary cost

Mannocci et al (2016) conducted a systematic review to explore the cost of an individual SI which appears to give the most up-to-date data. Fourteen relevant studies were identified from eight countries across the world, namely USA, Spain, France, Sweden, Chile, Belgium, Korea and Italy. Based upon modelling and data divulged within individual studies, the aggregate direct and indirect cost of a SI was calculated as being between \$650-750. This figure though did not take into account litigation or compensation.

Various figures have been attributed to the cost of SI within many countries. In the USA, O'Malley et al (2007) analysed the cost of the management of occupational exposures to infection in four healthcare facilities. The mean cost following exposure to HIV infected source patients was \$2456, whilst exposure to source patients with unknown or uninfected patients was \$376. The management of personnel exposed to source patients infected with HCV cost \$650. The range of costs was calculated to be from \$71-\$4838. Similarly in the USA, Leigh et al (2007) investigated the cost of SIs involving needles and found the average cost to be \$596 (\$339 direct medical costs and \$257 lost work productivity costs).

In Europe, Solano et al (2005) conducted a cost analysis of HBV, HCV and HIV follow-ups in HCWs accidentally exposed to blood and body fluids in Spain. The cost

was calculated to be €1502 for incidents involving source positive for HCV and HIV and €172 for instances of source negative for all three viruses. In cases of HBV the mean cost was €388, with the main cost of the follow-up being serological tests and PEP. Wittman et al (2007) found the cost of a SI involving needles in Germany to be €490, whilst Trueman et al (2008) investigated the cost of SIs involving insulin needles in the UK and found the direct cost to be £362 per injury. In Sweden, Glengård and Perrson (2009) found the direct costs of SIs to be €272. Hanmore et al (2013) estimated the direct cost of SIs in Belgium to be between €210-950 and the indirect costs to be between €63-844.

In South Korea Oh et al (2008) analysed the costs of SIs within HCWs by exploring data produced by 34 hospitals. The costs involved included pharmacy (\$129); laboratory tests (\$70); medical services (\$28) and medical treatment (\$10). The mean cost of each SI was estimated to be \$125.

The total cost of SIs per annum have been estimated within certain countries worldwide. Leigh et al (2007) found the cost of SIs involving needles in the USA to be \$188.5 million per annum within the range of \$118–\$591 million in the USA proposed by Saia et al (2010). Trueman et al (2008) found the cost to the NHS in the UK to be approximately £600,000 related to SI involving insulin administration needles alone. Meanwhile the RCN (2008) estimated the annual cost of SIs involving needles to the NHS in the UK to be £500,000 per Trust. The estimated annual costs for tests and treatments for SIs involving needles was estimated to be \$6.1 million in France (Saia et al., 2010), whilst Glengård and Perrson (2009) found the total cost of SIs to be €1.8 million per year in Sweden. In South Korea, Oh et al (2008) estimated the cost to be \$884,385 per year based upon an estimation of 7057 SIs occurring nationwide.

Costs though are challenging to enumerate because of the emotional cost related with fear and anxiety from worrying about the potential consequences of an exposure; the direct and indirect costs associated with drug toxicities and time absent from work, and the societal cost associated with an HIV, HBV or HCV seroconversion. This includes the likely loss of a worker's services in patient care, the cost of medical care, and the charge for any litigation. Taking this into account, it can be seen that the financial cost of SIs within the UK and worldwide is vast and potentially underestimated. An identification of the reasons why this may be occurring, especially in the next generation of nurses may help to reduce these unnecessary costs.

3.3.7 Sharps injuries through the lens of learning theory

The systematic review conducted for this study identified that SIs involving nursing students continue to exist worldwide. Further to this, nurses and other HCWs continue to sustain SIs irrespective of the abundance of legislation, directives, regulations, guidance and recommendations previously mentioned within this literature review. The contribution of learning theory to understanding the actions taken by nursing students before and after a SI will now be considered.

The purpose of nurse education

The development of autonomous learners and the integration of theory and practice skills are important features of nurse education (Falk et al., 2016). This is attained by nursing students experiencing a variety of learning environments during the programme of study, such as theory, simulation and practice components. Through this process nursing students can experience effective learning experiences which are understood, notable and result in a fresh or heightened way of thinking or practicing (Anderson, 2016). This echoes the thoughts of Kolb and Kolb (2005) who

stated that knowledge is created through the transformation of experience. With every new experience learners possess the ability to learn something new and to increase their knowledge base (Cavanagh et al., 1995). There is no reason to assume that learning about sharps and sharps safety would be any different.

The contrast between classroom and practice learning

The theory component of nursing student learning in the UK accounts for 50% of the programme, with the remaining 50% of the programme undertaken in the practice environment (NMC, 2018). Within the theory component of the UK programme, nursing students may have some clinical skills learning within the classroom through lectures and seminars, some online learning, as well as learning within a simulation environment. These varied learning environments offer nursing students numerous chances to combine cognitive, psychomotor, affective skills and problem-solving abilities.

Learning within these classroom, online and simulation settings are planned and structured (Chan, 2004). This is in contrast to nursing students in clinical placement who are experiencing more complex, intense and demanding learning environments which is causing learning to be affected (Newton et al., 2010). This is because healthcare systems are constantly evolving and becoming more multidimensional.

Evidence would suggest that planned theoretical and practice learning within the University setting can be in contrast to unplanned learning which may occur within practice placements. Experiencing placements within hospital and community settings means that the characteristics and nature of learning environments for nursing students are multifaceted (Vinales, 2015a). The diversity of experiences nursing students have during practice placements may create opportunistic,

uncontrolled, inadvertent conditions for learning (Jokelainen et al., 2011). These situations may make it difficult to construct principles for teaching nursing to students, and for students to learn about nursing. There are also additional challenges for mentors and educators within practice settings. Resources are required, such as experienced practitioners and mentors who are confident and prepared for the role. Evidence suggests that this situation is affected by insufficient funding, the volume of nursing and allied health professional students, understaffing, mentors who see students as a burden and the time allowed for effective mentoring (Vinales, 2015a). Thus a dichotomy may exist between the planned, organised learning within university and the potentially unpredictable circumstances for learning within some practice areas.

The different learning styles of nursing students

Humans learn in different ways from one another and often choose to use what is believed to be an individual preferred learning style (Pritchard, 2009). There are more than 70 diverse models of learning style that focus on the different dimensions and features of learning (Boström and Hallin, 2013), although Reid (2005) stated that there were more than 100. Understanding an individual's personal learning style and the factors that influence it can be used by teacher or mentor and nursing student to enhance learning, self-awareness and cognition (Anderson, 2016).

A literature review conducted by Rassool and Rawaf (2007) found that the predominant learning style preference amongst nursing students is Kolb's 'concrete experience'. These 'concrete experiences' are where nursing students immerse themselves in new experiences and cultures. This echoes the preferred learning style of nurses who Kolb and Kolb (2005) stated tend to have predominantly

'concrete' and 'reflective' styles. This aligns with a 'diverging style' in which information is processed through observation and feelings, and evidence is gathered to reach conclusions and plan actions. This may be particularly useful in nursing, which closely aligns theory and practice and where evidence based practice is crucial. This links well with the findings of a large study conducted by D'Amore et al (2012) of first year undergraduate nursing and midwifery students incorporating Kolb's Learning Styles Inventory (Kolb and Kolb, 2005). The most common learning style identified was 'Divergers' (29.5% n=84), followed closely by 'Assimilators' (28.8% n=82). Most students tended to veer towards the 'Reflector' but there was no strong preference overall. Similar results were found within a survey by Rassool and Rawaf (2007) of nursing students (n=136). Although there were cautions with the results due to type of student and reliability with the questionnaire, they found that 'Reflector' (44% n=48) was the dominant style. The findings from this group of studies equates to the 'accomodation-diverger' or 'activist-reflector' learning style within the Honey and Mumford (1986) model. A small longitudinal survey conducted by Fleming et al (2011) of learning styles among nursing students (n=58) from three academic years in one University in Ireland, using the Honey and Mumford (1986) model found similar findings. The most common style identified was 'reflector' but overall there was not a strong preference indicating an 'all round' capability as learners.

The limitations of learning styles

The findings and conclusions of these previously mentioned studies appear to have another factor in common. The studies identified that although individual nursing students sometimes had a preferred learning style, this style was not a strong preference. This suggests an 'all round' capability of nursing students as learners, as

commonly within the findings of the studies there was a high level of dual-learning styles identified.

Added to this is the notion that in a diverse group of undergraduate nursing and midwifery students the learning styles are just as diverse (D'Amore et al., 2012). This was also identified by Abdollahimohammad and Ja'afar (2014) who conducted a moderately sized study of nursing students (n=156) in Iran and Malaysia. Although generalisability is limited due to the sample characteristics, the findings showed that learning styles of nursing students were also different between student groups in the different countries.

Learning style models have been criticised for many years. These criticisms relate to reliability issues (Reid, 2005) and the fact that they originated in schools and hence faced critique from a neuroscience (Greenfield, 2005) and education-theory perspective (Stahl, 2002). There is also the issue that learning styles can be affected by numerous factors which nursing students may face. These include: culture, age, experience, environment and the fact that students can use different learning styles over time (Anderson, 2016). Demographics and age differences were found to affect the learning styles of nursing students especially in the first year of the Programme (Aina-Popoola and Hendricks, 2014). There is thus a viewpoint that learning styles are on a continuum and are not fixed but based upon the setting and the circumstance (Pritchard, 2009; Hatami, 2013). Learning styles should be seen as a preference and a guide which is not fixed and not a label for the individual learner (Felder and Spurlin, 2005). Highlighting this issue, Alkhasawneh (2013) speculated that the learning styles of nursing students can change over the time during the programme of study. Additional to these criticisms are the fact that even when

education has been tailored directly to individual learning styles this does not affect student outcomes (Stahl, 1999; Willingham, 2005).

Hence, there should be an avoidance of grouping people into one specific learning style as there is not one approach that will produce optimal learning circumstances for all learners (Brown, 2009).

The teaching styles of the lecturer and the mentor

It is acknowledged that students learn in various individualised ways. This can be through auditory and a preference to listening; visually by preferring images and written information; tactilely by preferring writing and practical hands-on working; and kinaesthetic by preferring activities such as simulations and case scenarios (Beischel, 2011). Linked to this theme is the fact that 'teachers' who the nursing student may come into contact with may utilise preferred teaching styles and different methods to aid the student to learn. These teachers could include lecturers, mentors in placement, patients, and fellow students, each with their individually preferred teaching style (Anderson, 2016).

Within the theory component, there is a requirement for nurse educators to communicate information to nursing students in a way that makes it explicit that what they are learning is meaningful and practical knowledge that links directly to nursing practice (Rush et al., 2010). Seven separate teaching approaches or techniques utilised in nurse education exist within the evidence, which teachers may show a preference for. These are technology and online activities (Sharoff, 2011); clinical simulation (Rush et al., 2010); gaming (Graham and Richardson, 2008); art (Brand and McMurray, 2009); narratives and story-telling (Walsh, 2011); reflection (Binding et al., 2010) and problem-based learning (Ramjan, 2011). Hence, there are a range

of teaching techniques and strategies which the nurse educator has at their disposal to impart knowledge.

The role of mentor in the practice setting should not be underestimated as their influence can play a crucial role in the development of student nurses (Vinales, 2015b). This includes the teaching of clinical skills within the practice setting. Nursing students rely on nurses to teach and support them during their clinical placements so that they can become safe practitioners (Anderson et al., 2018). Although this facilitating of learning in busy learning environments has proved challenging for mentors (Warren, 2010). This has meant that sometimes nursing students do not have good learning experiences during their clinical placement (Morrell and Ridgway, 2014).

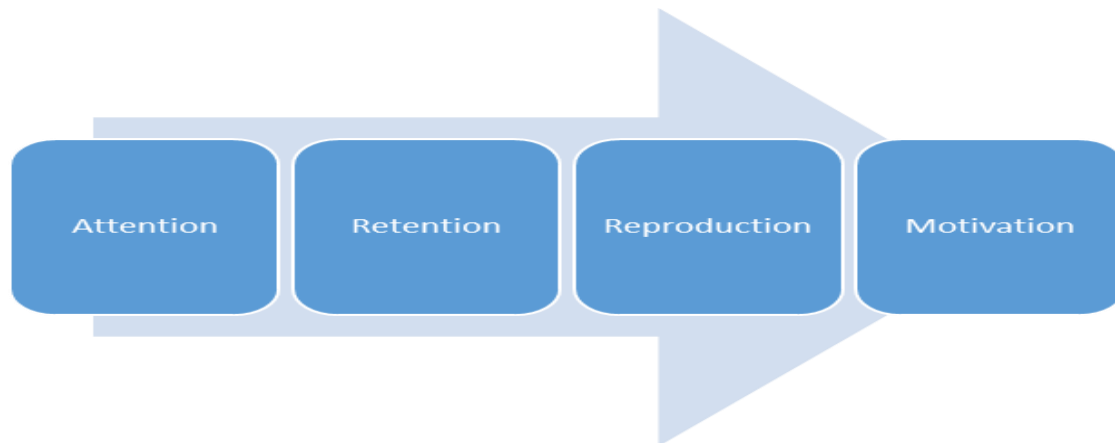
These aforementioned preferred teaching styles may be based upon various learning theories which have been devised. Learning theories have attempted to provide explanations about learning and their application. Educational psychologists and researchers have proposed various theories to explain how individuals gain, organize and deploy skills and knowledge (Shulman and Quinlan, 1996). An appreciation of learning theories aids an increased understanding of how learning happens and may influence teaching styles. A selection of learning theories will now be outlined. These have been selected as the main learning theories employed within nurse education (Aliakbari et al., 2015). The relevance of the learning theories in relation to sharps behaviour is revisited and discussed in Chapter Seven.

Social learning theory

The central principle of Bandura's Theory of Social Learning is the social context of learning. The thought is that individuals gain knowledge from interaction with their

environment (Bandura, 1977a). Learning regarding sharps usage can take place simply by being with others and watching them. In short, people learn from one another via observation and modelling. This process can be seen in Bandura's four step modeling process which can be seen in Figure 3.2.

Figure 3.2: Bandura's four Step Modeling Process



Attentional processes

This stage of the process involves absorbing sensory information and self-directed exploration (Bandura, 1986). It is claimed that in environments nursing students observe and model the attitudes and behaviours and cognition of nurses, lecturers and HCWs. In these circumstances, a nursing student's self-efficacy belief is crucial to one's ability and willingness to learn and to change (Bandura, 1977b). This modeling is claimed to be powerful in its ability to enhance learning at many levels (Bandura, 2007), especially within nurse education because its roots are steeped in practice (Perry, 2009). This modelling of nursing behaviours is based upon the notion that experienced nurses can share their knowledge in the context of a clinical situation and include the tacit knowledge that could be missed in the classroom setting (Perry, 2009). It is argued that novice nursing students often lack confidence and have difficulty imagining that they can perform certain tasks. Therefore, the

student's self-efficacy belief may be low and interfere with their competency (Monagle and Doherty, 2014). Individual self-efficacy and collective efficiency may then be enhanced by observational learning, especially modelling (Zimmerman, 1997).

Retention processes

Observational learning is greatly influenced by retention of knowledge (Bandura, 1977a), which is linked to verbal cues, and reinforced by rehearsal and repeated exposure. Retention can be aided by the learner through metacognitive processes, such as reflective diaries, which can aid organising, monitoring and regulating of thinking processes (Bandura, 1977b).

Motor Reproduction processes

This stage relies on converting symbolic representations into actions. This production stage is linked to individuals performance skills, so that guided practice is required if complex behaviours are to be created (Bandura, 1986). A system of 'scaffolding of learning' (Wood et al., 1976) can be utilised at this stage by hierarchically organising the components of the behaviour. Thus, as simpler components are mastered, then more complex ones can be introduced. In this context nursing students rely on feedback from the mentor, so that self-corrective adjustments can be performed (Bandura, 1977a).

Motivational processes

Incentives to perform is provided by three sources. External motivation relates to rewards and when modelled behaviour is met with valued outcomes. Vicarious reinforcement is the result of learning by observing others successes and failures. Self-produced motivation is self-reward or punishment based upon their own

standards of behaviour. If success is attributed to a person's own ability and effort, it results in a sense of pride (Bandura, 1977a). Hence, whether the individual performs observed behaviour or not will rely heavily on the probable consequences of the modelled course of action (Bandura, 1986).

Application to student nurses sharps usage

In clinical practice or in the CSSW, the nursing student may observe the nurse / lecturer / HCW and see the outcomes of that person's behaviour as positive and try to copy their behaviour, skills, and attitudes. If that nurse then gives the nursing student positive reinforcement through praise, the skills and attitudes are likely to be consolidated and reinforced. Thus the nurse is in a powerful position here as a role model.

However, students can also learn undesirable behaviours and attitudes in this way, hence this may account for some of the SIs reported. This is because some practitioners may not exemplify appropriate nursing behaviours to students (Monagle and Doherty, 2014). This was also highlighted by Bandura (1977a) who stated that prohibited activities performed without adverse effects may have an uninhibited effect on the observer, which displays the powerful influence of social and peer acceptability. These prohibited activities, such as re-sheathing a needle, can result in nursing students carrying out unsafe acts.

Behaviourism

Teaching based on the learning theory of Behaviourism (Skinner, 1938) is concerned with observable behaviour, as opposed to internal processes such as thinking (Chambers et al., 2013). Competency-based training such as nursing programmes are based upon this theory of learning, as it is useful in learning repetitive tasks that

require a great deal of practice. Each step of a clinical skill is learnt before moving onto the next step and then the whole process is finally rehearsed, either through simulation or in real-life situations. From a behaviourist viewpoint, if students repeatedly practice the skill correctly, it should result in task competence (McKenna, 1995a).

Cognitivism

Teaching based upon the learning theory of Cognitivism would consider the thought process behind the behaviour of the learner. The key to learning and adapting is the nursing student's cognition i.e. their perception, thoughts, memory and ways of processing and structuring information (Braungart et al., 2016). This learning is potentially banked in the nursing student's long term memory as it has been learnt, examined, digested, reprocessed and understood. Through cognitivism, the learner could have an appreciation of the whole of a process rather than just discrete steps. Thus the student creates relationships from relevant information from past experiences (and / or classroom based knowledge) to understand the whole clinical situation (McKenna, 1995b).

Constructivism

Teaching based upon the learning theory of Constructivism would assume that meaning is a function of how an individual creates meaning from experiences (Fensham, 1992). This learning theory focuses on preparing the learner to problem solve in ambiguous situations. New information is linked to prior knowledge, previous ideas or experience. Learners are viewed as active creators of knowledge with learning aided by on-the-job training (Wenger, 1998).

Adult Learning theory

Teaching based upon the learning theory of Adult Learning (Knowles, 1990) is based upon the premise that adults prefer to be active participants in all phases of the learning process. Knowles believed adults prefer autonomy and view themselves as responsible grown up learners. The prior experiences of the learner are seen as a useful resource in learning, but only if the learner understands why learning is taking place.

Experiential learning theory

Teaching based upon Experiential learning theory, proposed by Kolb and Kolb (2005), has a strong emphasis on reflective practice which is required to turn an incident into a concrete experience. This helps to identify any gaps and learning needs for the individual. Kolb found that people learn in four ways with the likelihood of developing one mode of learning more than another. These are through 'concrete experience' where nursing students immerse themselves in new experiences and cultures; through 'observation and reflection' where nursing students observe practices and skills from role models and make sense of what has been observed from the concrete experiences; through 'abstract conceptualisation' where nursing student learners create ideas and integrate their observations into logical theories by the utilisation of evidence to support their ideas or decisions; and through 'active experimentation' where nursing students apply new theories for problem solving and decision making. Hence this theory appears to be relevant in how some nursing students may learn sharps utilisation, based upon the individual nursing student concerned.

3.4 Summary

Legislation introduced in the UK since 1974, supplemented by EU Directives, HSE guidelines, WHO-approved publications and other guidelines have consistently highlighted the responsibilities of employers and employees in relation to the safe working environments and the safe use of sharps within healthcare. Yet evidence suggests that there are still health and safety breaches regarding sharps within many healthcare settings and non-compliance with sharps regulations. An area which is still under-explored within the UK, is how many SIs affect nursing students.

Available evidence suggests that there have been many percutaneous exposures to HBV, HCV and HIV within HCWs populations in the UK, although proportionally the number of seroconversions recorded is small in number. Regardless, many studies worldwide have shown the psychological effects of SIs for HCWs. This can include PTSD, anxiety and depression, which can affect a HCW's working life and personal life for long periods of time. Little is known from the literature of the psychological effect of SIs on nursing students within the UK. Not only are there potentially psychological effects, but SIs can also have a financial cost, namely millions of pounds per country per year. Lack of knowledge and skills may be implicated as a cause of SI's.

Evidence suggests that there is a contrast between the classroom and practice learning for nursing students. This is exacerbated by the various learning styles utilised by individual nursing students. Although there are limitations to the theories of learning styles adopted, added to the issue of learning is the various teaching strategies employed by nurse teachers. Evidence suggests that there are many variables which can also affect the learning about sharps safety in any environment. This means that although evidence-based practice such as not re-capping a needle

is taught and presumably learnt, it is still occurring. Where, when and how are nursing students learning such unsafe behaviours? Linked to this question is why nursing students may value this knowledge greater than the safe practices learnt during the educational component of the programme. This links with the aim of the study which explores the factors which influence nursing student's behaviour in relation to sharps usage. Evidence identified within this literature search was utilised during the discussion phase of the study in Chapter Seven.

Chapter Four: The Research Process

4.1 Introduction

This chapter describes the methodology and theoretical underpinnings of the four phases of this study. A description of the mixed-methods approach and a choice for the design will be presented. The chapter will critique the methods used, including the development and administration of the quantitative instruments, and how the qualitative elements were conducted. The chapter also provides details of the recruitment of participants and how the data were analysed. Finally the ethical considerations will be discussed.

4.2 The aims and objectives of the study

The aim of this study was to explore the incidence, type and experience of SIs within a nursing student population within the UK. The research questions were:

- What is the extent of SIs within a nursing student population in the UK?
- What type of SIs do nursing students in the UK sustain?
- What is the experience of a SI for nursing students in the UK?
- What factors influence nursing student behaviour in relation to sharps usage?

The first and second questions intend to discover the extent and type of SIs affecting nursing students in the UK. This is essential to identify because this information is unknown and an examination of the scope of the problem could aid education and learning, further research, and policy and procedure development. The third question aims to explore the experience of a SI on a nursing student. This is imperative to discover because there is only one previous solely qualitative study worldwide which has explored this phenomenon and hence there is little known. Exploring this topic further would help to identify the type of psychological harm sustained, how severe

the harm is, the support received and the support systems which nursing students may additionally require. The fourth question investigates what may affect the behaviour of nursing students before and after a SI has occurred. The following objectives were addressed:

- To identify the incidence and characteristics of SIs sustained by nursing students in the UK
- To ascertain whether SIs are reported by nursing students
- To investigate the device and procedure involved in SIs involving nursing students
- To detect whether the sharps involved were used or clean
- To investigate the psychological impact a SI on a nursing student in the UK
- To determine how many SIs were sustained in Clinical Skills Simulation Wards (CSSWs) compared to other Allied Health Professional students

4.3 Research philosophy

For the research questions to be answered, there is a requirement to choose and apply a research philosophy which best suits the research. Having an understanding of philosophical perspectives is important to inform decisions about research design, how it was planned and how the findings were interpreted.

Types of research philosophies

There are various research philosophical that can be employed, with two of the most popular being positivism and interpretivism. Each of these philosophies involve various assumptions concerning the research's ontology, epistemology and methodology. Ontological and epistemological perspectives are the foundation of research and have an influence on how research is designed, how it is performed, and how it is interpreted.

The ontological perspective of the study

Ontology is the nature of reality and within the social sciences encompasses,

'claims about what exists, what it looks like, what units make it up and how these units interact with each other' (Blaikie, 1993, p.3).

Ontological conventions are concerned with what establishes reality and ontological theories are inclined to fall into one of two reciprocally contrasting and exclusive types 'that lock horns' (Burr, 2003, p.22), namely 'objectivism' and 'subjectivism'.

Objectivism is based upon the notion that the objective reality is out there, and that research is about ascertaining this truth, whilst ignoring one's own feelings and values. It depicts the locus that social entities occur in reality external to social actors.

Ratner (2008) defined objectivism as the concept that an impartial truth exists, and this truth can be acknowledged through the gathering of more and more data.

Subjectivism is based upon the principle that social phenomena are fashioned from the perceptions and resultant actions of social actors. Indeed, subjectivism is based upon real world phenomena and thus the world does not occur autonomously from our knowledge of it (Grix, 2004). Subjectivism asserts that reality is subjective and thus varies from individual to individual (Guba and Lincoln, 1994). This study will incorporate the ontological perspectives of objectivism and subjectivism in order to give a broader understanding of the phenomenon under investigation.

The epistemological perspective of the study

Epistemology is concerned with the theoretical study of knowledge, with Hughes and Sharrock (1997) asking if it is feasible to gain knowledge of the world. Indeed, Crotty (1998) posited that an interrelationship existed between the theoretical standpoint assumed by the researcher, the methodology and the methods used, and the

researcher's interpretation of epistemology. Epistemology concerns the nature and systems of knowledge (Cohen et al., 2007) with epistemological assumptions being concerned with how knowledge can be fashioned, attained and conversed. In other words, what it means to know. Two dominant strands of epistemology are positivism and interpretivism.

Positivism was developed by the 19th century thinker Auguste Comte, and has considerably swayed professional healthcare practice via the medical model in its emphasis upon the '*objective facts of disease, aetiology, diagnosis, treatments, and prognosis*' (Taylor, 2014, p.130). Positivism drives the quantitative approach with the assumption that a '*truth exists*' (Lavelle et al., 2013, p.272). The positivist approach produces a singular and objective view of the world, by predicting and testing relationships (Cooper et al., 2010). This perspective argues that reality occurs externally to the researcher and must be examined through a rigorous method of scientific investigation (Gray, 2004). Positivism asserts that there is a clear division between science and personal experience by looking for objectivity by utilising cogent and logical methods of research to discover a single and impartial reality (Carson et al., 2001). This measured and organized approach of positivism thus aids in the identification of a clear research subject and the construction of suitable hypotheses to be tested (Churchill, 1996). By remaining disconnected from the participants by generating a distance, researchers within positivism stay emotionally impartial in order to make clear distinctions between reason and feeling (Carson et al., 2001). Thus positivist researchers go into the world impartially, discovering absolute knowledge about an objective reality.

Positivism has been described as '*one of the heroic failures of modern philosophy*' (Williams and May, 1996, p.27), because one instance that refutes the theory would demonstrate it as false (Popper, 1968).

The interpretivist paradigm identifies that the objective, positivist method cannot be the only means of acquiring an understanding of human beings, due to the multiplicity of people's lives (Taylor, 2014). Thus, an interpretive approach explores and generates meaning (Cooper et al., 2010). Interpretivism posits that there is no direct, one to one, association between subjects and the world (Gray, 2004) and that reality is in fact various and relative (Hudson and Ozanne, 1988).

Interpretivism evades inflexible structural frameworks and utilises a more personal and malleable research structure (Carson et al., 2001), with the researcher and participant being symbiotic and jointly collaborative (Hudson and Ozanne, 1988).

The principle of interpretivism is to comprehend and deduce the meanings in human behaviour, as oppose to generalising and predicting causes and effects (Neumann, 2000).

A combination of epistemological perspective will be utilised within the study.

Positivist elements of the study will aid the investigation of objective facts regarding SIs, whilst interpretivist components will help to discover the meanings of SIs within the chosen population. This will have an effect upon the philosophical assumptions of the study.

The philosophical bases of the research process

The study is based jointly upon the philosophical assumptions of both positivism and interpretivism. The research questions relating to the type and extent of SIs are embedded within 'objectivism' by the employment of a deductive approach to test a

theory and by looking for causality. The inclination within this approach to measure and accumulate data about what can actually be detected, is seen when collecting data relative to the type and the extent of the SIs within the nursing student population.

The qualitative element to the study investigating the impact of SIs is embedded within interpretivism by the utilisation of an inductive approach to generate new theories and patterns which emerge from the collected data. A qualitative process of gathering data aims to establish patterns, consistencies and meanings, and these observations may lead to the production of relationships and theories (Gray, 2004). This may be seen when gathering data regarding the experience and impact of the SI.

This merging of positivist and interpretivist philosophies links to the notion of pragmatism. Pragmatism can be traced back to the nineteenth century (Maxcy, 2003), and this stance rejects the idea that researchers have to choose a position that is exclusively positivist or interpretivist (Morgan, 2007). Pragmatism avoids the contentious matters of truth and reality by accepting philosophically that there are both singular (positivist) and multiple (interpretivist) realities out there that are open to empirical enquiry (Rorty, 1999; Feilzer, 2010). This combination of philosophical positions within a solitary research study aids the tackling of research questions (Dudovskiy, 2019).

Pragmatism is seen as the philosophical underpinning of the mixed methods research (MMR) paradigm, as it concentrates its attention on a specific situation and uses pluralistic methods to derive knowledge about that state (Cresswell, 2009;

Bergman, 2011). This enables the achievement of results that are meaningful (Cresswell and Plano Clark, 2007).

Pragmatism recognises that there are copious different approaches to understanding the world, with no lone point of view ever giving the complete picture (Saunders et al., 2012). Taking pragmatism as the paradigmatic stance permits the use of numerous diverse methods to address knowledge claims, as it takes the research question, or the problem, as the most imperative factor of the research design (Giddings and Grant, 2007).

Johnson and Onwuegbuzie (2004) advocate pragmatism as the philosophical partner to MMR as it rejects the traditional dichotomy of subjectivism and objectivism and acknowledges that different, even conflicting, theories and perspectives can be valuable in comprehending the world. This acknowledgement means that pragmatism recognises the presence and significance of the natural, physical, sociological and psychological world. Denscombe (2008) also identified multiple facets of the way in which pragmatism underlies the practice of MMR. The provision of a fusion of approaches challenges dualisms as being sterile and unproductive and pragmatism thus looks for a level of compatibility between them. Denscombe (2008) viewed pragmatism as a third alternative approach in cases where researchers decide that neither quantitative and qualitative methods alone will deliver sufficient findings and that some types of research will almost unavoidably need both quantitative and qualitative methods and data to provide an adequate answer.

The combination of qualitative and quantitative lines of enquiry through a pragmatist paradigm permits a more comprehensive approach to a research question which is based upon the complexity of healthcare practice (Shaw et al., 2010). Hence, this

pragmatist approach will help to address the research questions within this study which do not sit easily within an exclusively quantitative or qualitative approach (Darlington and Scott, 2002).

4.4 The mixed methods approach

A mixed methods research approach employs different data collection methods within one study (Moule and Goodman, 2014) in order to address the research questions and objectives (Taylor, 2014). Mixed methods research involves accumulating, scrutinizing, and understanding quantitative and qualitative data in a single study that investigate the same fundamental phenomenon (Leech and Onwuegbuzie, 2008). It is not a new approach to research design as, although the idea of combining qualitative and quantitative methods into one methodology was professed as a way to extend the repertoire of social science in the 1990s (Giddings, 2006), methods were often combined in the 1950s to explore issues and problems when little was known (Campbell and Stanley, 1966). Mixed methods research focuses on research questions that call for real-life contextual understandings, multi-level perspectives and cultural influences. This is achieved by employing rigorous quantitative research assessing magnitude and frequency of constructs and rigorous qualitative research exploring the meaning and understanding of constructs. By the intentional use of integrated multiple methods the strengths of each can be employed (Creswell et al., 2011). Mixed methods researchers thus can make explicit diverse philosophical positions (Greene, 2007).

The rationale for a MMR approach

There are multiple reasons for the employment of a MMR approach in this study, based primarily upon the thoughts of Greene et al (1989) and supplemented by

various authors (Bazeley, 1999; Easterby-Smith et al., 2002; Gray, 2004; Creswell et al., 2011; Bryman, 2012).

Greene et al (1989) outlined the five key purposes of a MMR approach, namely Triangulation, Complementarity, Initiation, Expansion and Development. The aim of 'Triangulation' is to converge results in order to increase their validity and minimise bias. Mixed methods research offers validity by seeking corroborative findings (Gray, 2004) with the results of the study being able to be compared, validated and hence triangulated (Creswell et al., 2011). Data triangulation is possible as information is collected from different sources, and methodological triangulation is possible as a combination of methods can be employed (Easterby-Smith et al., 2002). This links to this study as two quantitative and two qualitative methods were employed to gather and analyse the data. This increases the ability of a MMR approach to be holistic which is seen as a positive. Bazeley's (1999) viewpoint that the incorporation of many approaches to a problem means that there is more confidence in the outcomes was seen as advantageous, and this was a reason for its employment within this study. 'Incrementality' is also possible within a MMR study as some of the quantitative findings may need elucidation through in-depth qualitative investigation. This was evident within this study due to the qualitative phases occurring after a quantitative phase. Polit and Beck (2010) additionally felt that a MMR approach allowed for 'enhanced validity' as the researcher can be more assured about the interpretations and the validity of the results when using various or complementary categories of data.

The importance of 'Complementarity' is to boost the strengths and lessen the weaknesses of individual methods of enquiry. This can be achieved by the counterbalancing of the flaws of a solitary methodology (Gray, 2004). Mixed methods

research also has the benefit of what Polit and Beck (2010, p. 285) described as 'complementarity' through the utilisation of words and numbers which helps to potentially avoid the confines of a single approach. Hence both quantitative and qualitative phases were employed within this study.

'Initiation' relates to the examination of likenesses, inconsistencies and new perspectives to permit analysis from diverse perspectives. This study aimed to view problems from multiple perspectives in order to enhance the meaning, and allowing a more complete understanding of the problems associated with SIs.

The importance of 'Expansion' is that MMR adds breadth and scope to the study. This increased the range and scope of enquiry within this study and allowed the discovery of new dimensions that may emerge (Greene et al., 1989). 'Development' relates to the utilisation of various diverse methods to complement one another, such as the survey and the Twitter Chat which informed the development of the interview schedule. Thus MMR had the potential within the study to develop research instruments and also the chance to deal with unforeseen results (Bryman, 2012).

Bryman (2006), an eminent Professor within social research, conducted an extensive review of rationales for combining quantitative and qualitative research. This involved reviewing Greene et al's (1989) categories and the creation of six rationales for the utilisation of a MMR approach, these being 'Credibility', 'Context', 'Illustration', 'Utility', 'Confirm and discover' and 'Diversity of views'. Table 4.1 gives a rationale for how it has been employed within this study

Table 4.1: A rationale of how Bryman’s (2006) review of mixed methods research categories have been employed in this study

Category	Rationale for utilisation in this study
Credibility	Employing quantitative and qualitative approaches enhances the integrity of the findings
Context	The qualitative research provides contextual understanding coupled with either generalizable, externally valid findings or broad relationships among variables uncovered through a survey
Illustration	The qualitative data can illustrate quantitative findings
Utility	Combining the two approaches will be more useful to practitioners and others
Confirm and discover	Using qualitative data to generate hypotheses and using quantitative research to test them with a single project
Diversity of views	The combination of researchers and participants perspectives through quantitative and qualitative research and the uncovering of relationships between variables through quantitative research while also revealing meanings among research participants through qualitative research

Muncey (2006, p. 231) described a MMR approach as a *‘bridge over troubled waters’* as the subsequent data sets produce a superior understanding of the phenomena under investigation (Cooper et al., 2010).

The limitations of a MMR approach

Johnson and Onwuegbuzie (2004) outlined the potential limitations of the MMR approach which needed to be taken into consideration for this research study. Mixed methods research was acknowledged to be a time consuming and expensive way of enquiry. This is supported by Creswell et al (2011) who found this approach to be resource intensive as extensive time and resources were required to carry out the multiple steps involved such as the various methods of data collection and data analysis. This is also because the researcher has to learn multiple methods, be able to know how to mix each method effectively, be able to interpret conflicting results and know how to analyse quantitative and qualitative data. The study was expensive in terms of time, but inexpensive in relation to resources due to the use of technology.

Johnson and Onwuegbuzie (2004) also stated that it was difficult to find a researcher with skill in both qualitative and quantitative research, whilst methodological purists believe that a researcher should either choose the qualitative or quantitative paradigm, but not both. The researcher has experience of both quantitative and qualitative research projects from previous academic study and research projects. Additionally, Giddings (2006) postulated that MMR approaches tend to dwell within Positivism and seldom reflects a constructionist or subjectivist view of the world. Thus, concerns have been raised regarding how MMR approaches actually use qualitative methods. This study dealt with this issue by utilising two quantitative phases and two qualitative phases. A potential issue with MMR is that ideally the different data sets would be supportive and convergent allowing confidence in triangulation. A problem might arise if the evidence in the different data sets is divergent and does not comfortably triangulate. This was not the case in this study as the data obtained from the four phases complemented each other.

Mixed methods research typology applied by this study

Cresswell et al (2003) described six classic types of MMR design strategies, namely 1) Sequential Explanatory; 2) Sequential Exploratory; 3) Sequential Transformative; 4) Concurrent Triangulation; 5) Concurrent Nested and 6) Concurrent Transformative. These are outlined in Appendix J.

Due to the data collection processes within this study not being exclusively sequential (e.g. quantitative followed by qualitative) or truly concurrent, an alternative MMR design was sought. Creswell and Plano Clark (2011) and Morse & Niehaus (2009) outlined another form of MMR design, namely 'Multiphase'. A multiphase design arises from numerous projects conducted over a time period related by a common purpose and frequently involve convergent and sequential features. A form

of 'Multiphase' MMR design has been employed within this study. This is because multiphase designs have more than two phases and combine sequential and concurrent strands over a period of time (Schoonenboom and Johnson, 2017). Four phases of investigation (survey; Twitter Chat; audit and interview) have been used within this study in a consecutive and synchronised way. A multiphase design fits this approach as there was a necessity to consider numerous dimensions of a topic (e.g. type and impact of a SI), and because different samples were utilised for different phases of the study (Almedia, 2018). Additionally, Almeida (2018) stated that multiphase designs aid the building of each phase of the study of what was learned previously, which this study has elements of. This is due to some preliminary findings from the survey being incorporated into the subsequent Twitter Chat and interviews. These preliminary findings then influenced the type of data which was sought through the use of an audit of CSSWs.

4.5 The study sites

There were two study sites used for data collection, one local and one national.

Local

The local study location was a two-site University in England, anonymised and identified as University X. There are over 1000 nursing students studying within the BSc (Hons) Adult Nursing programme on two sites over 50 miles apart.

National

The study location nationally was the UK, consisting of England, Wales, Scotland and Northern Ireland. Within the UK there are 72 Universities which deliver the BSc (Hons) Adult Nursing programme (Complete University Guide, 2014). In 2014 / 2015

there were approximately 19,700 nursing students on university courses within the UK (RCN, 2017).

Data collection at the two sites is outlined at Table 4.2.

Table 4.2: Data collection on the two sites

Data collection method	Site 1 (single University)	Site 2 (national student nursing population)
Survey	X	X
Twitter Chat	X	X
Audit	X	
Interviews	X	

4.6 Methods

This section will outline the methods used within the study. This will include rationales and critiques for the four methods of data collection used, namely a self-completed survey; a Twitter Chat; an audit and qualitative interviews. The sampling strategies employed within each data collection method will also be discussed.

4.6.1 Self-completed survey

The first phase of the research study consisted of two online surveys.

The strengths of a survey

Surveys have been used widely within research, as they have the benefits of collecting information from participants about their beliefs, attitudes, motivations, ideas, feelings and behaviour (Fink, 2003). Individuals or groups can be targeted, and large samples can be obtained very quickly (Ponto, 2015). As well as being an

economic way of gathering data, surveys have the benefit of having a broad scope and application to different populations (Coates, 2004).

The limitations of a survey

Surveys have been criticised for numerous reasons. Moule and Goodman (2014) contend that survey respondents themselves have a variety of characteristics such as their knowledge of the issue, memory, experience, personality, and their motivation for completing the survey. How are 'true responses' thus identified by surveys. This was a potential issue within this study because nursing students had a variety of experiences, personalities and motivations and also were recalling the SI which may have occurred almost a year ago. Respondents may give answers that show them in their best light or how the respondent feels the researcher wants them to. This was also a potential issue within this study as presumably nursing students may not wish to declare unsafe practice for fear of repercussions. There are also the issues of representativeness and low response rates. The issue of low response rate was tackled by the employment of techniques to boost the return of surveys. Saks and Allsop (2013) argued that surveys are sometimes inept at capturing the connotations and insights of respondents and the setting in which action is taking place. This was addressed by meticulously validating the questionnaire and testing its reliability. Additionally, surveys are concomitant with measurement and not all social spectacles are quantifiable. This was addressed by allowing comments to be entered by the participant on the questionnaire to elaborate on some points. A further critique of internet surveys is that historically they are much less likely to achieve response rates as high as surveys administered on paper, on average 33% vs. 56% (Nulty, 2008). Higher response rates have been found with internet surveys

vs. paper versions (Suh, 2013) especially in the younger generation who may be more adept with technology (Hohwü et al., 2017).

Rationale for using a survey in this study

Although possessing limitations, a survey was chosen as a method to collect data within the study. This was because data could be collected efficiently by this method to achieve the aim of exploring the type and extent of SIs within the chosen population.

Sampling and access to participants for the surveys

The population for Survey One (local) was all adult branch pre-registration nursing students studying the BSc (Hons) Adult Nursing programme within the study setting at University X. The population for Survey Two (national) was all adult branch pre-registration nursing students studying the BSc (Hons) Adult Nursing programme within the UK (excluding the local study setting).

Sampling criteria for the surveys

For the purposes of Survey One (local), the inclusion criteria for the sample was all first, second and third year pre-registration nursing students studying the BSc (Hons) Adult Nursing programme at either of the two campuses of University X. For the purposes of Survey Two (national), the inclusion criteria for the sample was all first, second or third year pre-registration nursing students studying the BSc (Hons) Adult Nursing programme at any University within the UK. No exclusion criteria were applied for either survey. Adult branch nursing students were chosen as this is the branch which the researcher has a working knowledge of (academically and clinically) and because this branch use sharps as an integral part of their roles.

Types of sampling for the surveys

For Survey One (local) a non-probability convenience sample was used. This entailed the selection of the most freely obtainable persons as participants in a study (Polit and Beck, 2010), namely BSc (Hons) Adult Nursing students studying at University X. For Survey Two (national) a combination of convenience and snowball sampling were used. Snowball sampling was an especially useful method as the population nationally was not readily accessible. The survey was shared by participants to fellow nursing students via social media sites.

These types of sampling have fundamental criticisms with the risks of sampling bias and systematic error. This means that the sample may not be representative of the population and hence the findings may not be generalizable. Although snowball sampling has customarily been a technique of enlisting participants who may be challenging to reach by other methods (Faugier and Sargeant, 1997).

Access to participants for the surveys

For Survey One (local), the researcher gained access to the university database of the email addresses of all first, second and third year pre-registration nursing students studying the BSc (Hons) Adult Nursing programme at University X. The survey link was distributed via email by the researcher. Full ethical approval (see section 4.11) was obtained and the principle of confidentiality was adhered to meticulously in order to protect the identity and privacy of personal data which was accessed.

For Survey Two (national), following ethical approval (see section 4.11), the participants were accessed via social media. The social media sites Twitter and Facebook were utilised. Tweets were sent via Twitter. The tweets were made

interesting and prompted people to act in the manner which was required, namely to complete the survey. Each tweet contained the Survey Monkey link to the national survey and was short, simple and avoided abbreviations (Batey, 2018). The tweets were either generic messages on the researchers Twitter homepage or direct messages to selected individuals or groups within the UK publicising the survey. These individuals and groups included nursing students, Nurse Lecturers, nurses, universities which ran the BSc (Hons) Adult Nursing programme, university faculties of health, university schools of nursing and groups or associations involved within healthcare or nursing. The hashtags #studentnurse, #sharps, #sharpsinjury and #survey were used within the tweets to target the intended audience. Some participants were gained via retweets of the survey. Researchers often expand samples to include users who interact with the original set of participants (Kelley et al., 2013).

The survey link and explanation of the survey was also posted on selected Facebook pages. Specific sites were chosen after searching for 'student nurse' and 'nursing student' on the Facebook homepage. Evidence has shown that researchers can contact the Facebook group page fashioned for a precise interest or health issue and then post a message to recruit participants directly from the group page (Walton, 2009). These Facebook group pages are listed in Table 4.3.

Table 4.3: Facebook group pages

Nursing Students
RCN Students NI
RCN
RCN Students
Student nurse

Student nurses
Student Nursing Times
University (anonymised) of RCN student nurses

Discussions were also commenced on the topic of SIs within nursing student group Facebook pages. The discussions were around questions such as “Have you ever had a sharps injury?” and “Why do you think that nursing students have sharps injuries?” Care was taken to not have in-depth discussions which could possibly change the viewpoint of the potential participant. The questions and any subsequent discussion was purely in order to capture the attention and interest of eligible individuals (Arigo et al., 2018) and not to change opinions. At the end of the questions and discussion, the survey link was shared. Private messages were also sent to participants via Facebook messenger (Amerson, 2011), which has been found to be a worthwhile exercise.

The use of social media within research recruitment

Although seen as a new phenomenon, Twitter has been successfully utilised to recruit participants for research studies. O’Connor et al (2014) conducted a health survey using Twitter to aid recruitment. Twitter was found to be a cost-effective method of recruitment, and a way of targeting difficult-to-reach participants. The use of Twitter was found to be an accessible way to participate in health research and aided transparency. Additionally, this medium was successful in gathering data from a specific online population. Recruitment was aided by the fact that participants on Twitter were able to easily share the study details with thousands of followers using real-time technology. This snowballing action of retweeting from follower to follower meant that a tweet can be seen by an extraordinary number of potential participants

(O'Connor et al., 2014). The anonymity of potential participants was achieved as the tweets sent by the researcher could have been seen by any Twitter user who accessed the unique hashtag utilised, and because the subsequent retweets could be seen by multiple unknown Twitter users. Thus there was no process of identifying participants who accessed the survey via a tweet.

Twitter has been found to be quick, cheap and efficient at reaching an abundance of research participants (Batey, 2018). People can tweet anytime from a computer, phone or tablet (Mollett et al., 2011). Twitter has been successfully utilised by other nursing researchers as a means to distribute data associated with research (Booth and Oudshoorn, 2014). Indeed, Godino et al (2012) recruited 12.2% of their sample using social media network websites.

There are some limitations of using Twitter in research. One of those can be that the participants represented can consist only of those who use Twitter (Child et al., 2014). Conversely Twitter allowed the researcher to gain access to nursing students which may not have otherwise been possible, or would have been a time-consuming process. Additionally, using Twitter in research can mean not knowing the demographics of participants, which limits the researcher's capability to generalise the data to explicit populations (Scanfeld et al., 2010). This was not an issue within the survey because Twitter was used solely to direct potential participants to the survey where the demographic data would be collected. A final limitation is that active user usage of twitter ebbs and flows, so short studies are unlikely to capture consistent patterns as many users tweet rarely and with irregular frequency (Abel et al., 2011). Twitter though appears to be going through a resurgence and its usage has been proven to increase during a nursing programme (Price et al., 2018).

Facebook has many advantages within the research arena. Social networks have the potential to provide new opportunities for discovering prospective research participants (Walton, 2009) and sustaining contact with them during the research process (Amerson, 2011). Facebook allows the researcher to provide anonymity when studying topics that may be sensitive, reduces the barrier to reaching large groups of people, and can be used to engage hard-to-reach or stigmatised participants (Ahern, 2005; Cantrell and Lupinacci, 2007; Farmer et al., 2009; Jones et al., 2012a; Ramo and Prochaska, 2012). The anonymity of participants recruited via Facebook was achieved because no record was kept of the participants in the Facebook discussion pages. Additionally, as the link to the survey was posted on the Facebook pages, there was no way of knowing who actually completed the survey.

Facebook also had the advantage of providing participants with instantaneous contact with the researcher to discuss the study (Child et al., 2014). Another benefit is the low cost in using Facebook as a research method (Ahern, 2005; Cantrell and Lupinacci, 2007; Jones et al., 2012b; Ramo and Prochaska, 2012). Large numbers of potential participants can be contacted in a short period of time (Thornton et al., 2016) with the bonus of a fast response time (Tan, 2010). The popularity of social media sites and the ease at which its data is available means these platforms are increasingly becoming primary sources for social research (Ahmed, 2015).

There are some limitations of the utilisation of Facebook within research recruitment. Only participants who have access to the Internet and have a Facebook account may have taken part in the study. These participants were ones who specifically logged onto their Facebook account during the study period. Hence the sampling frame can be questioned (Tan, 2010). This may mean that there can be concerns with the representativeness of participants recruited via Facebook (Thornton et al.,

2016). Although latest data shows that in the UK Facebook has 38 million users and that number is increasing every year (Statista, 2018). Added to this is the issue of not being able to guarantee that the Facebook user recruited is the person completing the survey. This matter is an issue for any survey.

4.6.2 Twitter Chat

The second phase of the research process was a national Twitter Chat. A Twitter Chat is a public Twitter conversation around one unique hashtag. This hashtag allows individuals to follow and participate in a discussion. Twitter Chats are usually about specific topics to connect people with these interests (Smarty, 2012). The NurChat Twitter page (NurChat, 2015) was used as the vehicle for the Twitter Chat. This online discussion site for healthcare professionals is supported and coordinated by Newcross Healthcare. This site was chosen as it had been utilised successfully by nursing students and academic personnel at University X for online discussions relating to various issues within nursing and healthcare.

Strengths of using a Twitter Chat

An advantage of using Twitter for research purposes are that the researcher has access to an abundance of people (Mollett et al., 2011) in relevant professional fields (Adolphous, 2018). This means that the researcher is able to access large amounts of current data to examine behaviours and attitudes of rare events or small groups. It enables the examination of collective experiences, which can be achieved on a limited research budget (McCormick et al., 2017). An added benefit is that Twitter creates an automatic database of information in real time (Adolphous, 2018), which means that as it archived, it will become a unique source of historical information for the researcher to utilise.

The limitations of a Twitter Chat

There are though some limitations of using Twitter within research projects. Active users engagement of Twitter ebbs and flows, so short studies are unlikely to capture consistent patterns as many users tweet rarely and with irregular patterns (Abel, 2011).

Rationale for the use of a Twitter Chat

A Twitter Chat was conducted in order to: 1) collect qualitative data regarding the nursing students experience of SIs 2) collect qualitative data regarding the impact of a SI within nursing students 3) collect qualitative data to aid the development of the interview schedule.

An appraisal of the Twitter Chat

There were positive aspects of conducting the Twitter Chat. It ran smoothly and there were no issues to note. The negative aspects of the Twitter Chat were that it was difficult to coordinate as the tweets did not appear on the timeline in any particular order. This meant that the various discussions were occasionally hard to follow. Many participants forgot to add the #nurchat hashtag and had to be reminded. This also made conversations difficult to follow in real time. Some conversations were also happening within tweets which were not obvious straight away but were identified during the analysis stage. Additionally, some of the participants of the Twitter Chat remain unidentified, and there are no demographic information about the participants except for their position. On reflection, the use of a Twitter Chat within this study was a positive experience which served its purpose of gaining an abundance of valuable qualitative data, although the coordination of the discussion was challenging at times.

The population of the Twitter Chat

The population for the Twitter Chat was the population of the world with access to the internet and a Twitter account.

Types of sampling used within the Twitter Chat

The type of sampling for the Twitter Chat was convenience sampling and a version of snowball sampling as some participants may have introduced other participants to join (Kelley et al., 2013).

Access to the participants of the Twitter Chat

Access to the participants was achieved via the NurChat Twitter homepage.

4.6.3 Audit

The third phase of the study was an audit of SIs that had been reported on Accident and Incident Report forms involving nursing students within the three CSSWs utilised by University X.

Strengths of using an audit

Used widely within healthcare settings, audits have many positive aspects. Audits are useful tools for the collection and analysis of data in regards to compliance and performance within aspects of practice. It aids the comparison of findings and helps to identify improvements (NHS England, 2018). Many of these strengths are transferable to this research project.

Limitations of using an audit

Not only can audits be criticised due to the cost involved and the time-consuming nature of the process, but the quality of an audit is only as good as the documentation used to collect the data (Holmboe, 2009). This was not an issue

within this study as: 1) it was cheap to conduct; 2) each audit only took approximately half an hour and 3) the documentation accurately extracted the data which was required for the purpose of the audit / study. One criticism though was that only the three CSSWs utilised by University X were accessed and not the CSSWs of universities across the UK. This was due to the fact that the three CSSWs locally are on different campuses, and are used by a multitude of healthcare students. Thus it was felt that they were fairly representative of CSSWs nationwide.

Rationale for using an audit

The purpose of this phase was to collect reported data to: 1) have an indication of the number of SIs involving nursing students that occurred in the CSSWs, and 2) compare the number of SIs involving nursing students and other users of the facility.

Sampling and access to participants for the audit

The researcher accessed the Accident and Incident Report forms held at the three University CSSWs.

4.6.4 Qualitative Interviews

Semi-structured interviews (SSIs) were employed in Phase Four of the study.

Strengths of using SSIs

Corbin and Morse (2003) outlined the many advantages of conducting interviews using a semi-structured approach. They were found to be beneficial when investigating research areas that are multifaceted or about which little is known.

Semi structured interviews can tackle 'how' and 'why' questions from the viewpoint of the participant's personal experience, and aids exploration of the insights of individuals and how they give significance to, or construe, their experiences. There is

the scope to gain new understandings of particular phenomena by the flexibility of pursuing emerging themes and following the lead of the interviewee. Morse and Field (1996) highlighted how SSIs were beneficial where the researcher knows the majority of the questions but not all of the answers.

Limitations of the use of semi-structured interviews

Although a semi-structured approach proved beneficial as it was exploring a multi-faceted and under-researched topic (Corbin and Morse, 2003), there were some limitations in its usage. These limitations included the fact that powerful data can be collected which can affect the interviewee personally (Moule and Goodman, 2014). This was addressed by support being offered to participants following the interview. This is outlined in section 4.11. Nunkoosing (2005) highlighted the potential power issues with the researcher-interviewee relationship, by stating that power is always going to exist within interviews, lying in the hands of the interviewer. Within this process the researcher was a lecturer and the participants were nursing students at the same university. Hence there was the potential for the researcher to control the interview, constrain viewpoints and enforce one's will on the interviewee (Wang, 2006). Within these interviews the researcher deliberately attempted to take on a less powerful role (Hoffman, 2007) and boost rapport to build up a compassionate connection with the interviewee in order to gain a sense of reciprocated trust (Karnieli-Miller et al., 2009). As discussed in section 4.9, in the pre-interview period an environment was created to make the participant feel relaxed and non-threatened. It was also evident within the interviews that the ownership and control of the data was in the hands of the participant as they decided the quality and quantity of divulged information, and ultimately could terminate the interview at any stage (Karnieli-Miller et al., 2009).

Rationale for using interviews

The rationale for the utilisation of interviews was linked to the objective of investigating the psychological impact of a SI on a nursing student in the UK. Interviews would aid the identification of views, opinions, perceptions and individual accounts in order to enhance understanding of this phenomenon.

4.6.4.1 Sampling and access to participants for the interviews

In the following sections, the criteria of sampling, the recruitment process, and the individual characteristics of the sample will be reported.

Sampling criteria for the interviews

Volunteer sampling was used to recruit for the qualitative interviews. The inclusion criteria for the interviews was being a pre-registration nursing student studying the BSc (Hons) Adult Nursing programme at the local University X site who had sustained a SI. Exclusion criteria was being a pre-registration nursing student studying the BSc (Hons) Adult Nursing programme at the local University X who had not sustained a SI.

The recruitment process for the interviews

When the participant for Survey One (local) completed the questionnaire, if they had suffered a SI there was a final question inviting the participant to volunteer for the qualitative interview part of the study exploring the impact of the SI. The recruitment process began in July 2015 and was completed in March 2017. The volunteering participant made contact with the researcher via email and a time and date convenient to the participant was arranged for the interview.

Sample size for the interviews

The sample size for the qualitative interviews was determined when saturation of data had occurred (Polit and Beck, 2010) and no new knowledge or information was obtained. To enable this, initial analysis of interview transcripts was undertaken whilst data collection was underway. Data saturation occurred when 12 participants had been interviewed.

4.7 Instruments

This section will outline the development of instruments used within the four data collection methods. These are a questionnaire, a Twitter Chat schedule, an audit form and an interview schedule.

4.7.1 The questionnaire

Rationale for using a questionnaire

Questionnaires have many advantages including 1) giving participants time to complete the questionnaire when it best suits them; 2) saving time and money; 3) a lack of interview bias; 4) allowing anonymity for the participant and 5) less pressure for an immediate response (Gillham, 2000).

The development of the questionnaire

Based upon the findings of the systematic review a questionnaire was formulated to measure the type, extent and impact of SIs within a nursing student population. The development of the questionnaire consisted of three major stages. The first stage was to create a questionnaire. The second stage was to test and revise the questionnaire. The third stage was to finalise the final two questionnaires to be used in Survey One (local) and Survey Two (national).

Formulating the initial questionnaire

Taking into account the findings of the systematic review, and in accordance with the study research questions a questionnaire was developed. Designing suitable questions is imperative in order to acquire data relevant to the study (Harvard University, 2017). The questions within the questionnaire were diligently designed and the type of questions utilised were primarily closed questions.

Scope of the questions

The systematic review showed the many gaps in knowledge relating to SIs involving nursing students within the UK. This included the overall incidence rate; the year of training when SIs occurred; reporting of SIs; the device involved; the procedure being performed; the stage of an injection when a SI occurred; the time of day; the type of shift; the potential causes or contributing factors; whether the nursing student was being observed when the SI occurred; if the sharp was used or unused; the exact location and specialty where the injury occurred; part of body affected and the impact of the SI on the individual. These areas formed the basis of the questionnaire.

An initial review of existing questionnaires

During the systematic review, two survey papers (Reis et al., 2004; Unver et al., 2012) provided an example of the questionnaires used within the research study. The first stage of questionnaire development was to review the reliability and validity of these existing questionnaires and to review the types of questions utilised. The results and an appraisal of these searched for questionnaires can be seen in Appendix K. Attempts were then made to contact all of the remaining researchers (n=32) who conducted surveys identified within the systematic review. This was to acquire copies of the questionnaires. Five researchers responded and provided examples of their questionnaires for review (Kermode et al., 2005; Petrucci et al.,

2009; Mengal et al., 2008; Karadag, 2010; Small et al., 2011). The next stage of questionnaire development was to review the reliability and validity of these five existing questionnaires and to review the questions. The results of this search can be seen in Appendix L. As the existing questionnaires provided did not comprehensively match the purpose of this study, and on occasion there was a question about the validity and reliability of the questionnaire, a new questionnaire was developed for the purposes of this study.

Composing questions for the questionnaire

In the first part of the questionnaire there were seven questions designed to collect demographic information (see Table 4.4).

Table 4.4: Questions and response options regarding demographic data within the questionnaire

Question	Response option
Gender	Male Female
Please state your age	
Please indicate the University where you are studying your BSc Adult Nursing Programme:	University X (Y campus)..... University X (Z campus)..... Other (please state).....
Have you had any previous experience working within healthcare before starting the BSc Adult Nursing Programme?	Yes..... No.....
If yes, please state what healthcare experience you have had:	Health Care Assistant..... St John Ambulance Volunteer..... First Responder..... Other (please state)..... Not applicable.....
Before commencing the BSc Adult Nursing course, how many years of healthcare experience did you complete?	
What is your current Academic year:	1 st year; 2 nd year; 3 rd year

The wording of the remaining questions

The wording for the questionnaire was based upon the key principles of questionnaire development outlined by Blaxter et al (1999) and Boynton and Greenhalgh (2004). Ambiguous or imprecise questions, or any which assume specialist knowledge, were avoided. Questions were created which were short, to the point, and approximately 12 words in length. Questions were drafted which allowed for a broad range of possible responses, and avoided presumptions of a particular answer, or which lead the respondent on. There was an avoidance of hypothetical questions which may attract less accurate responses, and any questions which may offend the respondent. Sensitive questions were devised and placed at the end of the questionnaire where they were unlikely to affect the overall response rate. Open-ended questions were avoided, except where the respondents were given an opportunity to add a few words.

Eighteen questions were then composed based upon the identified gaps in data. To determine the impact of a SI, including PTSD, four questions were created. The Primary Care PTSD Screen (PC-PTSD Screen) (US Department of Veteran Affairs, 2013) was utilised for this purpose. The PC-PTSD Screen assesses PTSD. This tool was chosen as it out performed the Posttraumatic Stress Disorder Checklist (PCL) which is a self-report rating scale for assessing PTSD (Weathers et al., 1993) in terms of overall quality, sensitivity, specificity, efficiency and quality of efficiency (Prins et al., 2003). Bliese et al (2008) indicated that the PC-PTSD had both reasonable sensitivity and specificity when the individual endorses either two or three items. The assessment tool is available to mental health professionals and researchers from the US Department of Veteran Affairs website (2013) and permission was gained to utilise the screen within the survey (Appendix M).

The PC-PTSD screen has four items following this initial statement: In your life, have you ever had any experience that was so frightening, horrible, or upsetting, that in the past month, you:

1. Have had nightmares about it or thought about it when you did not want to?
2. Tried hard not to think about it or went out of your way to avoid situations that reminded you of it?
3. Were constantly on guard, watchful, or easily startled?
4. Felt numb or detached from others, activities, or your surroundings?

Current research suggests that the results of the PC-PTSD should be considered “positive” if a person answers “Yes” to any three items. Care was taken not to change the questions at all, but these were altered slightly to put them into context for the participants within the study. The initial statement was altered to: ‘In the month following the sharps injury (injuries)’, and the possible responses were altered to:

1. Did you have nightmares about it or think about it when you did not want to?
2. Did you try hard not to think about it or went out of your way to avoid situations that reminded you of it?
3. Were you constantly on guard, watchful or easily startled?
4. Did you feel numb or detached from others, activities or your surroundings?

The layout of the questionnaire

Survey Monkey (2015) was utilised to construct the questionnaire. The questionnaire layout and presentation was based upon the principles of Blaxter et al (1999). The questionnaire was typed clearly and was pleasingly laid out, using a type face size which was legible for the participant. It was reinforced that the survey was confidential. It was stated that this was voluntary and the email address of the researcher was given for the participants to use if they so wished.

Clear instructions were given to the respondent regarding what is expected regarding the completion of the questionnaire. The kind of response expected was kept constant throughout the whole questionnaire, except where the student was able to supply extra information in the 'comments' section. A definition of a sharp was given within the instructions. It was reiterated that only SIs sustained within the role of a nursing student should be reported. Additionally, the instructions stated that if the nursing student had had numerous SIs then all the injuries should be reported.

The length of the questionnaire was kept within reasonable limits to gain adequate depth of data, but not too long as to cause boredom and lack of completion. The questions were developed so that they followed a logical order and were numbered accordingly. At the end of the questionnaire the participants were thanked for completing the questionnaire and if the respondent had indicated that they had had a SI, they were invited to take part in an interview to discuss the impact of the SI(s). The questionnaire was drafted and redrafted 10 times until a final version was devised. The questionnaire went through a rigorous validity and reliability process which can be seen in Section 4.8.

The completion of the two questionnaires

Two questionnaires were created: Survey One (local) and Survey Two (national) (Appendix N). For the Survey Two (national) questionnaire, two of the questions gathering demographic data were altered slightly. One additional question enquired which branch of nursing was being studied, namely Adult, Child, Mental Health and Learning Disability. This was to identify nursing students from a branch other than the Adult branch who completed the survey. Additionally, for the response option for the question relating to the University at which the nursing student was completing

the Programme, there were no options given other than stating the name of the University.

4.7.2 Twitter Chat questions

Based upon the qualitative findings from the systematic review and the findings from the surveys, some preliminary questions were composed. These are included in Table 4.5.

Table 4.5: Preliminary questions for the Twitter Chat

“What should you do when you have a sharps injury?”
“How do sharps injuries impact on patient care?”
“Have you had a sharps injury?” “What happened?”
“How were you feeling at the time?”
“Were you offered post exposure support?”
“Did the sharps injury impact on your working and personal life?”

Because of the fluid nature of the discussion within a Twitter Chat, the researcher also decided to create questions in real-time during the Twitter Chat. The Twitter Chat was thus semi-structured.

4.7.3 Audit data collection tool

An audit tool was created for the purposes of the audit. The audit tool was designed in order to collect only anonymised data that was relevant to the objectives of the study. Information criteria for collection within the audit tool has been listed in Table 4.6.

Table 4.6: Information criteria for collection within the audit tool

The year of the injury / accident	The role of the person involved in the injury / accident
The site location where the injury / accident occurred	The type of injury / accident.

4.7.4 The Interview Schedule

Only one qualitative study exploring the topic of the experience of SIs affecting nursing students was identified within the systematic review (Naidoo, 2010).

Naidoo's study did not utilise an interview schedule, as an unstructured, in-depth interview technique was used. To ensure the interviews within this study addressed the objectives of the study, but at the same time were flexible, a SSI schedule was devised.

Development of the interview schedule

The production of questions for the interview schedule were based upon the principles devised by Neuman (2000). This included paying attention to the style of the questions by ensuring that open-ended questions were utilised. This was in order to obtain lengthy and descriptive responses from the participants. There was an avoidance of bias within the schedule by the avoidance of leading questions.

Questions contained terms which the participant would be able to understand and were concise, short and specific. This was because the potential applicants could be from all stages of the adult nursing programme. Probes were incorporated into the schedule in order to explore some topics in more depth.

The schedule listed the main questions to be asked to ensure the interview remained focussed, with an effort made to ensure that all of the questions were relevant. The questions were created so that it was easy to move back and forth between questions or topic areas if the interviewee naturally moved onto another subject during the interview.

At the beginning of the schedule a statement was made greeting the applicant and thanking them for participating in the study. A sequence to the questions was devised by grouping them in themes:

- 'The injury'
- 'Following the injury'
- 'The impact of the sharps injury'
- 'Other themes'

Within each theme there was a question or a set of questions. The first theme, 'The injury', related to the participant's experience of having a SI and related to questions utilised within the questionnaire. The second theme, 'Following the injury', related to the experience of the participant once the injury had occurred. For the third theme of 'The impact of the sharps injury', four questions adapted from the PC-PTSD Screen (US Department of Veterans Affairs, 2015) used in the survey were employed.

Finally, three questions were created to ensure the participant had the opportunity to divulge their full experience of the SI and state any potential impact it may have had. At the end of the schedule, there was a statement prompting the researcher to thank the participant for being a volunteer in the interview. The schedule can be seen in Appendix O.

4.8 Reliability and validity

Establishing rigour in the questionnaire

A number of processes were undertaken to establish validity and reliability for the questions within the questionnaire: face validity, CV, test-retest reliability and internal consistency.

Face validity

Face validity refers to whether the questionnaire appears to investigate what it is intended to. This was judged via a review of the questions by a colleague and identification of issues such as questions that do not make sense or those that might be difficult to interpret and answer (Moule and Goodman, 2014). A stage of the questionnaire development was to distribute it on 9 separate occasions to a Professor of Health Informatics and several Nurse Lecturers within the School of Nursing and Midwifery at University X to judge whether the questions were unambiguous. It was judged not imperative to give the questionnaire to an expert on the topic, but to someone who could evaluate whether the questions address the phenomenon being studied (Parahoo, 2014). Following recommendations of word and grammar changes, by version 10 of the questionnaire it was agreed that the questions were stated in a suitable language for the potential participant to understand (Saks and Allsop, 2013).

Content Validity

Content validity is the degree to which a tool, such as a multi-item scale or questions in a questionnaire, covers all the pertinent notions about the phenomena under investigation (Polit and Beck, 2004; Moule and Goodman, 2014). Content validity was partly enhanced within the study by the completion of a systematic review and by reviewing other instruments for relevant items within previously used questionnaires to be included (Parahoo, 2014). Another way this was achieved was for experts in the field to review the questions within the questionnaire and comment on whether the questions epitomized the variety of questions that might be asked in relation to the topic under exploration. Polit and Beck (2006) described this as the evaluation of the significance of the scale's essence through expert assessment.

Content validity within this study was assessed with the employment of a Content Validity Index (CVI) which was devised by Martuza (1977). There are some criticisms of the CVI method. These include the CVI not adjusting for chance agreement; the disposal of data by the collapsing of experts multipoint ordinal ratings into two groupings ('relevant' and 'not relevant') and the CVI concentrating on item relevance of the items studied but not capturing whether the scale comprises a complete set of items to sufficiently quantify the construct of interest (Wynd et al., 2003). The rationale for its usage in this study was that the CVI focussed on consensus rather than consistency estimates and it has ease of computation providing both item diagnostic information and scale validity information (Polit et al., 2007). Although researchers can compute two types of CVI (Lynn, 1986) namely the CV of 'individual items' (I-CVI) and the 'overall scale' (S-CVI), it was decided to complete an I-CVI. CV was sought by asking a panel of content experts to rate each scale item in terms of its relevance to the underlying construct by utilising the four point scale (Davis, 1992) seen in Table 4.7.

Table 4.7: The Content Validity Index rating scale

Score	Criteria
1	Not relevant
2	Somewhat relevant
3	Quite relevant
4	Very relevant

With this CVI, scores of one and two were seen as 'content invalid' and scores of three and four were seen as 'content valid' (Waltz and Bausell, 1983; Lynn, 1986; Waltz et al., 1991). The final draft of the questionnaire was sent for CVI assessment to a Professor of Health Informatics, Nurse Lecturers within the School of Nursing

and Midwifery at University X, an Infection Control Nurse in the local hospital Trust and nurses in various clinical practices. Lynn (1986) advises a minimum of three to ten experts would suffice and in July 2015, 10 CVI scores were completed which can be seen in Appendix P. It showed that 100% (n=10) of the reviewers rated each item as three to four (Quite relevant / Very relevant) which gave an I-CVI of 1.0 (with the acceptable level being $>.78$ allowing for the numbers of reviewers (Lynn, 1986).

Test-Retest Reliability

Test-Retest reliability involves administering the same measure to the same group under the same conditions on two different occasions and correlating the scores (McIntire and Miller, 1999). This measures the repeatability and consistency of the tool (Moule and Goodman, 2014). As unreliability can derive from poorly worded or ambiguous questions, the questionnaire was administered to the same sample of nursing students on two separate occasions. There should be no differences identified unless something significant has happened to the participant in the intervening timeframe. Respondents were asked to give a name such as a pet's name to each questionnaire response so that responses could be compared and to ensure the anonymity of the respondents. The Test-Retest formed part of the Pilot study which will be discussed further in Section 4.8.

The Test questionnaire was distributed in early July 2015 to third year (n=9), 12 second year (n=12) and first year (n=8) nursing students and the response rate was 62% (n=18). The Re-Test questionnaire was distributed to the same nursing students two weeks later in mid-July 2015. The response rate was 75.86% (n=22). The results can be seen in Appendix Q. From the table it can be seen that 15 respondents completed the Test-Retest, and 132/135 questions were answered

identically. This gives a result of 97.8% accuracy. Unfortunately only the demographic data from the questionnaire was completed as 14 of the nursing students had not sustained a SI. The respondents who had sustained a SI only completed the questionnaire once.

As only one respondent had completed the Test-Retest, participants who volunteered for the interviews in March 2016 were asked to complete the questionnaire on two occasions. The questionnaire was sent out to the 16 interview participants with a 10 day gap. A reminder was sent at the end of March and early April 2016 to complete both questionnaires. By mid-April 2016 a total of 11 participants completed the Test and 8 respondents completed the Retest with six respondents having completed the full Test-Retest. The results of the Test-Retest can be found in Appendix R. From the Test-Retest, 170/180 questions were answered identically, with a 94.4% level of accuracy. A limitation of the Test-Retest process was that it was finalised after Survey One (local) and Survey Two (national) had been completed. This was because of the timeframe and the window of opportunity to start the surveys when the nursing students were at the end of their academic year.

Internal Consistency Reliability

Internal consistency reliability is how well the items in the questionnaire reflecting the same construct yield similar results. This was assessed by repeating a question within the questionnaire. The question involved whether the participant had reported the SI. The results showed that 56.1% (n=74) of SIs were reported. A further question within the questionnaire asked who the nursing student had reported the SI to. The responses showed that 60% of respondents (n=81) had reported the injury

accordingly. Thus, there was a high level of similarity between the responses to the two questions from the participants, suggesting good internal consistency reliability.

The pilot study of the survey questionnaire

A pilot study is a trial run of the planned study using a small sample of participants who are characteristic of the study population (Moule and Goodman, 2014). The aim was to test if the constituents of the main study will be successful and so the pilot study was performed in conjunction with the reliability testing.

As previously stated the Test questionnaire was distributed in early July 2015 to 29 nursing students of which 18 responded. The Retest questionnaire was distributed to the same nursing students two weeks later in mid-July 2015 when there were 22 responses. The nursing students were part of the population which would be subsequently utilised for the full study. The nursing students were asked to report any ambiguous questions, wording or spelling errors. Based upon the feedback, some minor changes to wording were made following the pilot study i.e. specifying years and months of previous experience. There were many other benefits of completing the pilot study. The pilot study aided the testing of the reliability and validity of the questionnaire, which Burns and Grove (2009) saw as an advantageous process. This was particularly important as the questionnaire in this study had been created rather than the utilising a previously validated questionnaire.

The pilot study also tested the sampling technique and recruitment methods, the distribution technique of the questionnaire via email and the Survey Monkey system and thus the practicability of a full study (Van Tiejlingen and Hundley, 2001). The pilot study confirmed that the respondents understood the instructions, the questions

and the relevance of the questions. Additionally the format of the questionnaire and the length of the questionnaire were tested (Parahoo, 2014).

Establishing rigour and trustworthiness in the qualitative phases

Qualitative research is habitually disparaged for lacking scientific rigour with poor defence of the methods employed, an absence of transparency in the analytical techniques and the findings being simply an assemblage of personal thoughts subject to research bias (Sandelowski, 1993; Rolfe, 2006). This questioning by positivists is due to their concepts of validity and reliability not being addressed in the same way within a naturalistic approach. Naturalistic researchers favour different terminology to validity and reliability to create distance from the positivist paradigm.

Lincoln and Guba (1985) developed criteria for establishing the rigour and trustworthiness of qualitative research. Trustworthiness within qualitative research is related to what Taylor (2014) describes as the quality of the data collection and analysis, and their elucidation and arrangement by the researcher. It means how much trust can be given that the researcher did everything to ensure that data was appropriately and ethically collected, analysed and reported (Carlson, 2010). The criteria aim to allow the researcher to demonstrate how interpretations presented in the data, and conclusions drawn, reflect participant's experiences. The criteria described by Lincoln and Guba (1985) relates to: 1) Credibility 2) Dependability 3) Transferability and 4) Confirmability.

Credibility

Credibility within qualitative research refers to the confidence in the truth, believability and value of the data and the explanations provided (Dreher, 1994). Commentators highlight the benefits of member checking (Maxwell, 1992; Taylor,

2014) to scrutinize for accuracy and the correct interpretations of the qualitative data. Although this method has its advantages, member checking was not conducted within this research project for the following reasons based upon the critique of this process by Sandelowski (1993), Morse (1994) and Angen (2000). Member checking assumes a fixed truth of reality, whereas the nature of qualitative research is that there is subjectivity. There may be scope for the member to change their mind about narratives or to be confused about what was said a while ago. There may be issues of understanding abstract synthesis for nursing students early on their academic journey and a notion of pleasing the researcher by validating incorrect information due to the power relationship. Hence member checking was not completed and instead various forms of triangulation were employed to test credibility. Denzin (1978) and Patton (1999) described four methods of triangulation within qualitative research, namely 'methods triangulation'; 'triangulation of sources'; 'analyst triangulation' and 'theory / perspective triangulation'. Three of these methods were employed within this study.

The employment of quantitative and qualitative data collection methods (methods triangulation) to illuminate various aspects of the phenomenon of SIs within nursing students was seen as advantageous as it aided a deeper understanding (McMillan, 2004). If the various data sets can be substantiated by each other, the interpretations and conclusions drawn are likely to be trustworthy (Carlson, 2010). Having two types of qualitative data collection (the Twitter Chat and the interviews) aided the consistency of the data (triangulation of sources), especially as they were at different points of time.

To ensure a rich, robust and comprehensive account of the participant's experiences and the impact of the SI, analyst triangulation was employed within the analysis

process of the Twitter Chat and within the analysis of the qualitative interviews. The Twitter Chat transcript was given to a fellow PhD student (MC) who conducted thematic analysis on 10% of the tweets and coded the qualitative data. A high level of agreement was made with regards to coding and themes.

Anonymised interview scripts five and eight and the anonymised digital audio tapes were given to a fellow PhD student (MC) to assess for the accuracy of the interview transcribing. It was verified as an accurate account. Anonymised interview transcripts four and six and the anonymised digital audio tapes were given to another fellow PhD student (ST) to judge the accuracy of the capturing of the interviews. It was verified as an accurate account of not only the spoken words but the emotions expressed by the interviewees. Fellow PhD student ST was also asked to judge the similarity of the interview questioning between the two transcribed interviews. It was verified that the questions asked in the interviews were similar in both interviews and where there was a difference it related to the variation in the stories i.e. if the incident involved a used or unused sharp. Fellow PhD student ST was also asked to blindly code the two interview transcripts to ensure similarity and parity within the coding process with the researcher. There was a very high level of parity between the coding. Fellow PhD student ST and the researcher then had an in-depth discussion to compare the coding of the two interviews which had been done separately and independently. Where there was a slight disparity the researcher revisited the interview scripts to re-code one small point raised.

Credibility was also enhanced by prolonged engagement which was demonstrated within the qualitative part of the research process by spending sufficient time to learn and understand the phenomenon of SIs within nursing students. This was achieved via years of supervising nursing students previous to the research, and engaging

with nursing students when teaching clinical skills through simulation, especially injection technique. This persistent observation and involvement within the culture assisted in the development of considerations during the data collection process.

Peer debriefing is another recognised test of credibility. There was an exploration of aspects of the qualitative inquiry with fellow academic peers and nurses in practice during the data collection and analysis stages. Negative case analysis was also considered within the qualitative data analysis process when exploring cases of SIs involving clean unused equipment as opposed to used, contaminated sharps.

Dependability

Dependability refers to procedural methods where an audit trail is outlined in order to check the paths for decision creation at each phase of the research development (Taylor, 2014). This shows that the findings are trustworthy and could be repeated. Audit trails were first described by Lincoln and Guba (1985), based upon the earlier work of Halpern (1983). It gives the reader the opportunity to decide whether a piece of research is credible by being able to observe signposts of decision making throughout the qualitative research process (Koch, 2004). This was achieved within this study by stating clearly the qualitative research data collection and analysis procedures. This careful documentation of all components of the study revealed within the research report allows the reader to determine the credibility of the qualitative component of the project. This thick and rich description includes detailed descriptions of settings, participants, data collection, and analysis procedures. This ensures the account is credible, diligence has been demonstrated and the research has been conducted in a respectable manner (Anfara et al., 2002). The absence of an audit trail does not automatically challenge the credibility of qualitative findings

however (Cutliffe and McKenna, 2004), because auditing all of the actions and decisions of qualitative researcher is a difficult task (Parahoo, 2014).

Transferability

Transferability has been described as being comparable to generalisability and relates to the degree to which qualitative findings can be transferred to, or have applicability in, further locations or groups (Polit and Beck, 2010). This can be judged within this study when the researcher offers a thick description of the qualitative research, as well as identifying sampling and design details. Having a true account of the experiences of participants and by the utilisation of the participant's words as quotes to define their experiences has aided the scope for the transferability of the qualitative findings. This thick description also draws the reader into the story more effectively to increase lucidity and a connection with the participants.

Confirmability

Confirmability relates to the extent to which the qualitative findings of the study are shaped by the respondents and not by researcher motivation, bias, or interest. A concurrent confirmability audit was performed whereby the PhD supervisors externally audited the qualitative process and the products of the research. As mentioned earlier in the chapter, an audit trail is visible within the research project which demonstrates instrument development, data collection techniques, data reduction processes, and data reconstruction and synthesis methods. Methods of triangulation have also been mentioned previously in the chapter which have aided confirmability of the findings. A reflexive diary was utilised throughout the research project in order to record methodological decisions, rationales for choices and to reflect upon what occurred during the qualitative research process.

The interview pilot study

An interview pilot study was held in May 2016 to test not only the interview schedule, but the researcher's interview technique, the recording equipment and the location. Following the pilot study interview, the participant was asked for any improvements which could have been made to the interview, and any different questions which could have been asked to stimulate information about the impact of a SI.

As the participant had had a SI with an unused, clean sharp, a suggested additional question was:

- "How do you think you would feel if the sharp involved in the injury had been used?"

This question was viewed as useful to ask in order to gain more data about the potential impact for those participants who also had had a SI with an unused, clean sharp. This question was added into the interview schedule. It was decided that, after listening and transcribing the interview pilot study that it would be prudent for the researcher to probe more into the issues and areas which were raised by the participant. Thus probes for each question were added onto the interview schedule. There were no issues identified with the recording equipment, the timing or the location of the interviews. Data from the pilot study interview was analysed as part of the interview process and used within the qualitative findings.

4.9 The data collection process

Phase One: Survey One and Two

For Survey One (local) an email was sent by the researcher to all 864 pre-registration nursing students studying the BSc (Hons) Adult Nursing programme at University X on the two campuses in mid-July 2015. The email to the potential respondents introduced the survey, explained the rationale for the survey, reiterated

the issue of confidentiality and anonymity, and gave the web link to the survey via Survey Monkey. Survey One (local) was closed in mid-September 2015 as this was the point when the third year nursing students completed the programme and the first and second year nursing students were about to commence the next academic year. In order to increase the response rate for Survey One (local) an email containing the link to the survey was distributed to the Feb 15 cohort of 90 students in the autumn of 2015.

The principles of Zúñiga (2004) were followed to improve the response rate in an on-line survey involving students. Firstly there was initial push of the survey by providing a Uniform Resource Locator within an email to the potential respondent. Three email reminders were sent at weekly episodes whilst being careful not to annoy the prospective population (Cook et al., 2000). The email reminder contained information phrased to convince respondents that their responses would be appreciated. It was not possible to make the survey available for as long as possible to improve recruitment as this was hampered by the tight timeframe for survey completion. Survey distribution was at a time which was most likely to elicit responses as at the time the students were not under pressure to complete assignments and were at the end of their practice placement.

For Survey Two (national), 1534 tweets were sent via Twitter between early August and mid-September 2015 publicising the survey and distributing the survey link. Additionally during that timeframe, there were also 265 retweets of the researcher's tweets broadcasting the survey. Numerous discussions were also completed on relevant Facebook pages to publicise the survey to potential participants. Survey Two (national) was held at this time as this was a common period when third year

pre-registration nursing students had finished the programme and first and second nursing students were in the process of commencing the next academic year.

Phase 2: A Twitter Chat

This section will explain how the Twitter Chat was conducted. The Twitter Chat was devised utilising the guidance provided by Smarty (2012) who explains five steps to an effective Twitter Chat. These five steps are: understand how a Twitter Chat works; form an action plan; announce and promote the Twitter Chat; conduct the Twitter Chat and then finally summarise, store and analyse the data.

Pre-Twitter Chat enlightenment

The first step was having an understanding of exactly how Twitter Chats work. The researcher benefitted by following and participating in numerous Twitter Chats held nationally and within University X to gain an improved understanding of the method.

Planning the Twitter Chat

The second step was to form an action plan. This was regarding the necessary hashtag, the arrangement of a date and time, the identification and recruitment of moderators and the writing of guidelines. The researcher contacted the organisers of the NurChat Twitter site who hold regular Twitter Chats. The study was explained in detail and a request was made to facilitate a Twitter Chat entitled “What are the impacts of a sharps injury?”

Promotion of the Twitter Chat

Thirdly, it was important to announce and promote the Twitter Chat to potential participants to gain interest. In the weeks leading up to the Twitter Chat, it was advertised and promoted on the NurChat Twitter page. Additionally the Twitter Chat was promoted by numerous tweets on Twitter to followers from nursing and health

related arenas. It was stated on the NurChat Twitter page that the Twitter Chat was being used as a vehicle to gather data relating to this study, namely the extent, type and impact of SIs within nursing students. It was explained that this study had gained quantitative data from two surveys and other aspects required further investigation, namely the impact that SIs have on an individual.

Information was also given regarding the ethical clearance for the use of the Twitter Chat to gather data for use in this study. This will be discussed within Section 4.11. Instructions were also given relating to how to participate in the Twitter Chat.

Conducting the Twitter Chat

The fourth step was to conduct the Twitter Chat. This was held in October 2015. It started at 2000 with a welcoming introduction and the allowance of a few minutes to let the participants introduce themselves and begin tweeting. The two organisers of the Twitter Chat from NurChat aided the process and helped the researcher to welcome participants. The participants were reminded to add the hashtag #nurchat so that all the participants could see each tweet.

Some preliminary questions and statements were created to encourage discussion and participation. Examples of these questions and statements are presented in Table 4.8.

Table 4.8: Preliminary questions in the Twitter Chat

“hi firstly what type of sharps injuries have you been aware of ?”

“people always think of needles but there are other sharps that nurses come into contact with”

“in fact with student nurses it seems like glass is the most common sharp where sharps injuries are involved”

“anyone heard of any sharps injuries with 'unusual' sharps i.e. not needles, scalpels, glass??”

“what are the common procedures you have been involved in when sharps injuries occur?”

“from my research with student nurses 1st = glass 2nd = sc [subcutaneous] injection 3rd = im [intramuscular] injection 4th = blood glucose lancet 5th = scalpel”

“why do you think that student nurses have sharps injuries - the incidence and prevalence rates are up to 100% in some populations?”

“almost 50% of sharps injuries in student nurses happens in the skills lab”

At least five minutes was given for the participants to share their thoughts and for the researcher (and the two organisers from NurChat) to retweet significant tweets which would emphasise an important point or aid further discussion. The most significant points made during the Twitter Chat were reviewed and some additional questions were asked at various points to encourage ongoing discussion, whilst simultaneously summarizing and retweeting the top responses.

The researcher answered questions posed by the participants at intervals to create discussion. This stimulated the tweeting of further statements and questions by the

researcher to stimulate further discussion and debate. These can be found in Table 4.9.

Table 4.9: Further statements and questions used within the Twitter Chat

“People always think of needles but there are other sharps that nurses come into contact with”

“In fact with student nurses it seems like glass is the most common sharp where sharps injuries are involved”

“Almost 50% of sharps injuries in student nurses happens in the simulation clinical skills lab - what are your thoughts?”

“Students in surveys have said that nerves and being anxious was a cause”

“Medical students have reported post-traumatic stress disorder following sharps injuries - anyone seen this in nurses / st [student] nurses”

“In a case study in South Africa student nurses reported having suicidal feelings”.

There was scope within the Twitter Chat to share and retweet some tools, equipment and links related to SIs. When the time allowance for the Twitter Chat started to run out, the researcher announced the imminent conclusion of the Twitter Chat and thanked the participants for their participation. The conclusion chats were then retweeted. The Twitter Chat finished at 2100.

Summarise, store and analyse

Following the Twitter Chat it was imperative to précis, store and analyse the data which was produced. The NurChat site automatically transcribed and stored the whole transcription of the Twitter Chat. This was then printed for the purposes of qualitative analysis. In total there were 548 tweets during the Twitter Chat transcript. The analysis process is explained in Section 4.10.

Phase Three: the audit

Following ethics committee approval, the researcher visited the three CSSWs utilised by University X during March 2016. The information was extracted from the Accident and Incident Report forms and inputted onto a Statistical Package for the Social Sciences (SPSS) version 22 spreadsheet under the relevant information criteria categories.

Phase Four: The interviews

To aid the quality and reliability of the interviews, the interview location, timing, and procedure was prudently deliberated.

The location and timing of the interview

All of the interviews were conducted by the researcher face-to-face with the participant. As the location can have a major effect on the interview and the interviewee (Gagnon et al., 2014), this was carefully considered. All of the interviews occurred on the University X campus, in a quiet room free from disturbance. The interviewee was able to choose a convenient time for the interview.

The pre-interview procedure

The following steps were taken before each of the interviews to ensure the process was undertaken uniformly. The interviewee was welcomed into the interview room and given a Participant Information Sheet (Appendix S). This sheet contained the following information for the participant:

- The aims of the study
- The interview
- Confidentiality and anonymity
- Storage, retention and security of data
- Voluntary participation and the right to withdraw

- Counselling and Occupational Health Services
- Ethics of the study
- Any questions and concerns
- The contact details of the researcher and the PhD supervisor.

The interviewee was given time to read and digest the information and then any points or questions raised were answered. If the participant was willing to participate in the interview, they were given a consent form (Appendix T) to complete and sign. The mobile phones and devices of the researcher and the interviewee were turned off and a 'do not disturb' sign was placed on the outside of the location door to reduce any interruptions.

The interview

For each interview the researcher positioned themselves in a non-threatening, relaxed manner opposite the participant. Each interview was recorded on a small digital recorder. This was chosen instead of making notes during the interview because digital recordings can be replayed an unlimited amount of times, whilst field notes cannot be replayed, are often incomplete and thus may prove to be biased accounts (Tessier, 2012). The interviews in this study lasted between 12 and 34 minutes.

To aid the quality of the interview, the following two approaches by Roulston (2016) were employed. These were the interviewer talking less and listening more and also the creation of an asymmetrical conversation allowing the interviewee to speak most. Thus attempts were made to make the interview into a conversation, with the participant allowed to speak freely and jump back and forth to different topics. The researcher made efforts to avoid introducing bias and opinion into the interview and to let the participant speak freely. By listening intently, certain points mentioned by

the interviewee were revisited for further clarification and explanation. The interview schedule was used as a guide and questions were asked in various orders dependent of the flow of the interview conversations.

This SSI schedule allowed some flexibility in the order of the questions to extract rich data from the participant. The researcher followed the principles outlined by Taylor (2014). The researcher utilised a list of vital themes, subjects and questions to be covered and used discretion concerning the sequence of the questions depending on the individual interviewee. This flexibility within the interview allowed for probing questions to explore and investigate the topic. At the conclusion of the interview the participant was thanked for their participation and the issue of confidentiality and anonymity was reinforced.

4.10 Data analysis

Analysis of the surveys

The completed questionnaires were obtained via Survey Monkey. The data was converted and then analysed utilising the software SPSS version 22 for Windows.

For each questionnaire descriptive statistics were performed in order to summarise the data, including frequency, mean and standard deviation. This is presented in a variety of tables. Chi-square was then employed in order to determine a significant difference between the expected frequencies and the observed frequencies in various categories. This choice of statistical test was dependent upon the sample size, sampling method, and the level of measurement. This will aid the generalisation of the findings to equivalent populations (Parahoo, 2014).

Analysis of the Twitter Chat

There is a dearth of evidence relating to how qualitative data derived from a Twitter Chat should be analysed. It was decided to utilise thematic analysis. Thematic analysis is a qualitative method for detecting, investigating and presenting patterns or themes, through the conversion of qualitative information by developing codes, words or phrases that serve as labels for sections of data (Boyatzis, 1998). Braun and Clarke (2006) argue that thematic analysis should be a foundational method for qualitative analysis, as it produces essential skills for conducting numerous other methods of qualitative analysis. Contrary to this point is a lack of substantial published literature on thematic analysis in comparison to grounded theory, ethnography and phenomenology which may cause novice researchers to feel unsure of the processes (Nowell et al., 2017).

Thematic analysis is though suited for use with a large data set (King, 2004; Guest et al., 2012) and thus can address a large variety of research questions and topics (Vaismoradi et al., 2013). Thematic analysis is not tied to a specific theoretical perspective (Maguire and Delahunt, 2017), with the advantage of its utilisation across a range of epistemologies and research questions (Nowell et al., 2017). It has been characterised as having a highly flexible approach, which can be modified for the needs of the study, providing a rich detailed, and complex account of data (King, 2004). A disadvantage though is that this flexibility can lead to discrepancies and an absence of coherence when producing themes derived from the data (Holloway and Todres, 2003).

The well-structured approach of thematic analysis aids the creation of a clear and organised final report (King, 2004) with trustworthy and insightful findings (Braun and Clarke, 2006). Although a further disadvantage is that compared to other methods it

does not allow the researcher to make claims about language use (Braun and Clarke, 2006). Described as being easily grasped and quick to learn, thematic analysis can examine the perspectives of different research participants, highlighting similarities and differences, whilst also generating unanticipated insights (King, 2004).

Although historically there has been a lack of clear boundaries between thematic analysis and other qualitative analysis methods in the literature (Sandelowski and Barroso, 2003), the six steps of conducting thematic analysis which consolidates and defines the data set in rich detail have been clearly outlined (Braun and Clarke, 2006). These steps can be found in Table 4.10.

Table 4.10: The 6 stages of Thematic Analysis (Braun and Clarke, 2006)

Stages of Thematic Analysis
Becoming familiar with the data
Generating initial codes
Searching for themes
Reviewing themes
Defining and naming themes
Producing the report

Braun and Clarke’s (2006) six phases of conducting thematic analysis were meticulously followed to analyse the 548 tweets generated in the Twitter Chat. Familiarity with the data was achieved by researcher immersion within the Twitter Chat data set. This involved reading and re-reading the transcript. Initial codes were then generated which were collated together to produce initial themes and sub-themes. The number of tweets (significant statements) in total at this stage was 331 and there were a total of 13 themes or sub-themes identified. The themes and sub-

themes were reviewed and refined and the statements were re-read numerous times to identify any duplication. The total number of statements for the final analysis was reduced to 314. This review also re-defined the number of themes and aided the selection of quotations which would be used to illuminate the final report. As mentioned in Section 4.8 the Twitter Chat transcript was given to a fellow PhD student (MC) who conducted thematic analysis on 10% of the tweets and coded the qualitative data. There was a high level of agreement with the codes and themes identified. Additionally the 15 steps of 'good' thematic analysis (Braun and Clarke, 2006) were used as a template for thorough analysis of the qualitative data. This process produced 4 themes. These are presented in section 6.2.

Analysis of the audit

Similarly to the quantitative results gained from the surveys, the data obtained from the audit was analysed using SPSS version 22.

Analysis of the interviews

The qualitative interview data was analysed using thematic analysis. It was decided to utilise thematic analysis to ensure consistency of qualitative data analysis throughout the study. The six steps of conducting thematic analysis described by Braun and Clarke (2006) were followed during the data analysis which consolidates and defines the data set in rich detail. The first stage was to become familiar with the interview data. The researcher immersed himself in the data which had been audio-taped. Listening repetitively to the audiotapes allowed comprehensive engagement with the data. The researcher transcribed the 12 interviews verbatim, which was laborious, but the process enabled absorption into the data by the listening, reading and re-reading of the interview transcripts. The second stage was generating the

initial codes. Coding is an imperative process within qualitative data analysis. Data was manually coded by the researcher. Coding can be performed using three approaches: 1) theory-driven codes derived from the researcher's or other existing theories; 2) inductive codes derived bottom-up from the researcher's reading of the data and 3) prior-research driven codes (Boyatzis, 1998). In this qualitative data analysis the process of coding was primarily 'inductive' coding, but with some 'prior-research driven' coding based upon the systematic review and the literature review. Highlighter pens and coloured pens were employed to aid this. All of the 12 interview transcripts were treated in the same way, by meticulously creating as many potential codes and themes as possible. All coded data was then collated to form one mind map per interview. This systematic method was utilised rather than systems such as NVIVO due to it being very successful in previous qualitative studies conducted by the researcher. The third stage involved searching for themes. A long list of different codes was created from the mind-maps. These were then allocated into initial themes. A mind map of all the amalgamated themes was then produced. Two identified codes were classed as outliers which are data that differs considerably from themes identified within the data collection process (McPherson et al, 2006). Although there is a viewpoint of the importance of incorporating outliers into the analysis stage of research in order to improve knowledge of a topic (Phoenix, 2016), it was decided to remove these from the process. This was due to the standpoint that by being different from other data, outliers may exert disparate influence on the conclusions (Aguinis et al., 2013). From the final amalgamated mind map a new list of 15 themes was devised. These are shown in section 6.2. The fourth stage involved reviewing and refining the themes. All of the data extracts that fitted into each theme were re-read to ensure the data formed a coherent pattern. Each theme

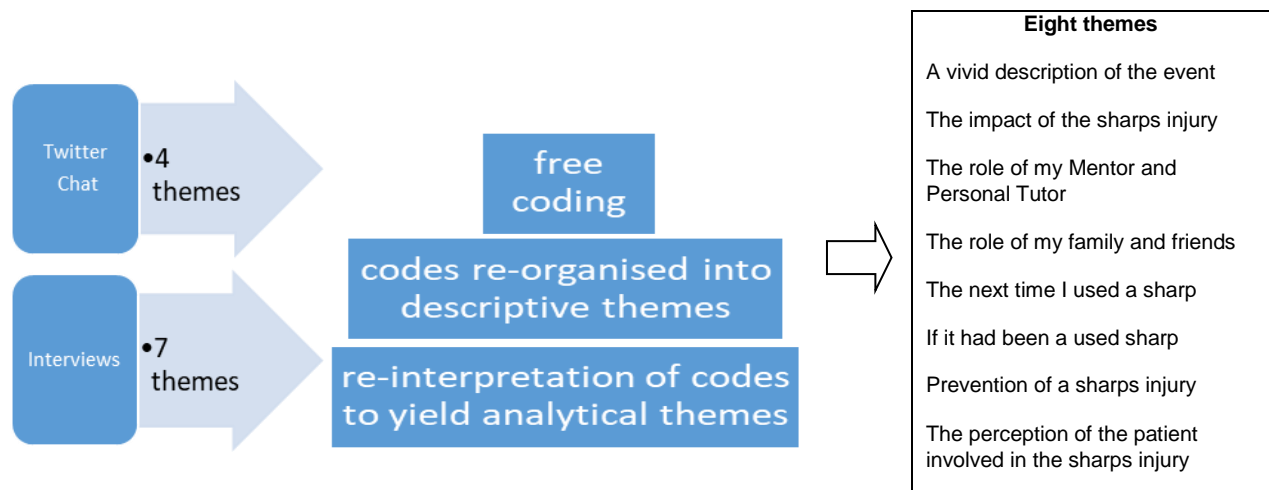
was then considered in relation to the whole data. This resulted in seven themes. The fifth stage was defining, naming and capturing the essence of the themes. An overall narrative was created with the data. Some of the themes were renamed in order to achieve greater clarity, to be concise and to give the reader an immediate sense of what the theme concerned. Seven themes were eventually produced which are displayed in section 6.2.

The final stage was producing the report. The report was written with the aim to be thought-provoking, by the utilisation of vivid examples from the data. Quotations were given which were labelled to the individual participant to give context to the rich data. The writing up process also aided further discussion and interpretation of the quotes. The above has described the data collection and data analysis process separately but in reality these two stages overlapped. The process of transcribing and analysis commenced following the pilot study. An example of the analysis of the interviews is shown in Appendix U.

Synthesis of the qualitative findings

The analysis of the Twitter Chat resulted in four themes and the analysis of the interviews resulted in seven themes. There followed a process of qualitative synthesis to review the eleven themes created from the two data sources. This was conducted based upon 'Thematic synthesis' devised by Thomas and Harden (2008) and presented by Barnett-Page and Thomas (2009) as part of a systematic review exploring methods of synthesising qualitative data. The findings of the Twitter Chat and interviews were revisited and free coding undertaken. The codes were re-organised into 'descriptive themes'. These themes were then further interpreted to yield 'analytical themes'. This synthesis process created eight themes with associated sub-themes. This process can be seen in Figure 4.1.

Figure 4.1: The process of Thematic Synthesis



4.11 Ethical considerations

In the following sections the ethical approval, valid consent, confidentiality and anonymity, and the protection from harm within the research study will be reported.

Ethics approval

Ethical approval for the study was obtained through the University Ethics Panel in early July 2015 (Appendix V). The ethical issues considered in the design and conduct of the study included: how the participants would be approached, their rights, how data would be gained and the risks to the individuals.

Valid consent

The principles of consent originate from the Nuremberg Code of 1947 (US Department of Health and Human Services, 2016) and the Helsinki Declaration (1964). Consent was seen as being freely agreed by participants without pressure, intimidations or coaxing, with the participants in research were properly informed. Further to this the Economic and Social Research Council (2018) stated that research subjects should be informed of not only the purpose, but the methods, intended use and risks of the research.

Valid consent for the survey

Prior to agreeing to participate in Survey One (local), nursing students studying at University X received information within an email explaining thoroughly the purpose of the study and requesting their participation. This also formed the first part of the questionnaire to encompass participants in Survey Two (national).

The correct amount, level and extent of information was given to potential participants to enable them make an informed choice (Taylor, 2014). To aid openness and honesty, the contact details of the researcher were given in case the potential participant wanted to ask any questions which they may have about the study at any stage. The information also explained that the completion of the survey would mean that the participant was giving their consent to be part of the study. The participants were informed that participation was entirely voluntary and that they had the right to withdraw from the study at any time before the survey was completed. Students from University X were informed that participation within the study, or refusal to take part, would have no bearing at all on their progress within the nursing programme which they were studying. There was no coercion or duress placed upon the participants in the light of the lecturer – student relationship which remained professional at all times.

The information stated that responses were totally confidential and anonymous, and that the survey was not a test of knowledge but the researcher was interested in the honest views and opinions of the participant. It was stated that this study had been approved by the Ethics Committee at University X. The information also stated that summarised results from the research would be published in professional journals, but no individual person or practice placement would be identifiable. Finally, potential

respondents were informed that if they had any questions or concerns about the project, contact details of the researcher were provided.

Valid consent for the Twitter Chat

As mentioned in Section 4.6.2, information was posted on the NurChat Twitter site regarding the ethical approval for the utilisation of the Twitter Chat to gather information for purposes of this study. Participants were asked to read a statement stating the researcher's name, job role, the title of the PhD study, and permission to use qualitative information gained from the Twitter Chat for the purposes of the PhD project. The statement was clear that all information and comments gained would be anonymised and that confidentiality would be maintained. It was also stated that University X had granted ethical permission to gather the data. It was made clear that if a participant did not want their comments to be used within the study they should inform the researcher via an email address provided. Because there was a delay between gathering and analysing the Twitter Chat qualitative data, if a participant decided to withdraw from the research, tweets could systematically be identified and removed from the transcript. As the conversations within the Twitter Chat were not exclusively chronological, removing individual tweets would not necessarily affect its comprehension.

Valid consent for the audit

Valid consent was not required or gained for the purpose of collecting anonymised data for the audit.

Valid consent for the interview

Participants volunteered for the interview following completion of Survey One (local) via a postscript at the end of the questionnaire (Appendix N). As mentioned in

Section 4.9, information concerning the study was given to participants via the Participant Information Sheet (Appendix S) when the participant arrived for the interview. The interviewee was given unlimited time to read and digest the information before giving consent. The Participant Information Sheet gave details of: 1) the name of the study, 2) the aims of the study, 3) the interview process, 4) confidentiality and anonymity, 5) the storage, retention and security of data, 6) the right to withdraw, 7) counselling services that were available if required and 8) ethical considerations. It specified also that if there were any questions or comments about the research study, these could be made before participation in the study. The participant then was asked to read and sign the consent form (Appendix T) to state that they were content to participate in the interview. The participants were informed that participation in the study was voluntary and that they could withdraw within one month of the interview date. It was imperative to indicate a point at which the participant could withdraw, because after one month data may have been anonymised and amalgamated, and hence a participant's data could not be excluded (Economic and Social Research Council, 2019). Each participant was allocated a unique code number for the purpose of the study which could be used to highlight which participant wished to withdraw from the study.

Confidentiality and anonymity for all four phases

The maintenance of complete confidentiality is imperative for all research participants as this: 1) protects subjects from harm; 2) protects privacy; 3) helps to build a trust and a rapport; 4) maintains ethical standards and 5) upholds integrity within the research process (Baez, 2002).

All data gained was anonymised with confidentiality being maintained. This was preserved by not using the names and addresses of the participants within any part of the study. The only exception to this was where, following the survey stage, the participant volunteered themselves for an interview. Following the identification of the participant to organise the interview, the identity of the participant was immediately anonymised again. Additionally, it was stated to participants that if interviewees revealed evidence of practice that needed reporting to the NMC or the law, then confidentiality would need to be broken.

Each participant of the two surveys, the Twitter Chat and the interviews were assigned a unique study number or code, as close as possible to when the data was collected. A list of unique study number or codes and individual names was kept separately and secured electronically and not referred to unless there was a specific reason i.e. safety. Data in paper form, audio-tape or digital-tape, and portable data was stored correctly, safely and securely within locked fireproof cupboards. Portable data was stored with password-protected information on a computer or memory stick with a firewall, virus and spyware protection.

Each participant was informed of the use of the research data and who would have access to the information. Additionally, participant's data was not discussed beyond the needs of the study. If confidentiality or anonymity could not be guaranteed, participants were informed that they would be told in advance e.g. if issues of misconduct or safety were mentioned. In this instance, some action would have to be taken i.e. offering a counsellor. Information will be retained for a timeframe of 10 years to facilitate realistic completion of the research, dissemination and any further analysis of the data. Participants were informed that once transcripts of audio-tape

or digital-tape were made, the original copies would be shredded and destroyed. For the audit stage of data collection, no identifiable information was collected.

Protection from harm

Due to the delicate nature of the study, counselling within University X was offered if the participants locally mentioned that they had been harmed in relation to SIs.

Those students would be directed to the University X Student Counselling Service, the University X Occupational Health Department or their GP. The University X Student Counselling Service and University X Occupational Health Department were made aware of the study in preparation for any self-referrals. There was an opportunity for a debriefing session for participants after the interview stage of the study in order to discuss any issues raised within the study. This was achieved in a face-to-face interaction following the interview.

4.12 Summary

This chapter has described how the study combined the ontological perspectives of Objectivism and Subjectivism in order to gain a broader understanding of the phenomenon under investigation. This will involve the employment of Positivist elements to investigate objective facts regarding SIs, whilst interpretivist components will discover the meanings of SIs within the chosen population, encompassing a pragmatic stance. A form of 'Multiphase' MMR design has been employed within this study to explore the topic at two study sites, one local and one national. Online surveys utilising convenience and snowballing sampling aided by use of social media were utilised to gain data, following the development of questionnaires and testing of reliability and validity. A national Twitter Chat to explore SIs and nursing students was conducted, followed by an audit of three CSSWs to identify the types of injuries occurring in CSSWs and which healthcare student sustained these injuries. An

interview schedule was developed and validated prior to their employment in semi-structures interviews conducted at the local site to explore the experience and impact of the SIs. Quantitative data analysis was aided by the use of SPSS and thematic analysis was employed to analyse the qualitative data compiled. There followed a process to synthesise the qualitative data in themes. Finally, the ethical considerations of this study have been stated, with consideration given to consent and confidentiality within the study.

Chapter Five: Quantitative findings - surveys and audit

5.1 Introduction

This chapter presents the quantitative findings generated from the two surveys and the audit. The aim was to explore the incidence and experience of SIs within a nursing student population. The results pertaining to the student's demographics information are also presented, showing the whole respondent set (n=811) and the sub-set that had sustained an injury (n=119). This is followed by the survey results from the nursing students that had sustained an injury given in research question sequence, namely the extent, the type and impact of the SI. Some results will be presented by injury (n=135) and some by respondent who has sustained a SI (n=119). The figures given have been rounded up by SPSS version 22. Moreover, all results for the statistical analysis of the questionnaire items are presented. The association between survey findings and the sample characteristics were measured using a chi-square test (X^2) using the significance level of $p=0.05$ (5%). When cells had frequencies of <5 , the Fisher's Exact Test (FET) was utilised. Finally, the results of the audit of the Accident and Incident Report forms of the three CSSWs utilised by University X are provided. The chapter begins with a description of the sample, followed by the quantitative results.

5.2 Sample demographic information from the two surveys

Survey response rates

The local questionnaire was distributed to 954 nursing students in July 2015 at University X, of which n=544 completed the questionnaire, which gave a response rate 57.02%. All of the respondents were from the Adult branch except one who was identified as a mental health student. This person was excluded (n=543). Another respondent was excluded because they gave no data except for the branch which

they were studying (n=542). An additional five respondents were excluded as there was a lack of data given and the question "Have you had a SI" was not answered. In total there were 537 responses to analyse.

The national questionnaire was distributed between early August and mid-September 2015, of which n=471 completed the questionnaire. Of the 471 respondents nationally, 40 were from University X and were deleted from the data as Survey One (local) was in progress. A further 76 respondents were deleted due to incomplete demographic data, being a Lecturer, being from another European country, being an ODP, being a student midwife and not answering the question "Have you had a SI in the current Academic year". This reduced the total to 355 respondents. Then 31 Child, 43 Mental Health, four Learning disability, two Adult / Child, one Adult MH were removed to include only Adult branch nursing students. The final total of respondents for analysis was 274. The rationale for selecting adult nursing students is because this is the branch who I have worked with, mentored and taught throughout my nursing and academic career. Table 5.1 shows the descriptive statistics for the demographic characteristics of the samples.

Participant's age, gender and previous experience

There were a similar number of respondents from each of the three years of academic study in Survey One (local). The mean age of the respondents was 28.44 years old and ranged in age from 18-54 years old. The vast majority of the respondents were female (92.4% n=496) having had previous experience of working within healthcare before starting the Programme (63.7% n=342). Being a HCA or equivalent was the most common occupation (84.9% n=288).

There were more respondents in the second year of their academic study (40.5% n=111) and the mean age of the respondents was 27.88 years old in Survey Two (national). The ages ranged from 19-51 years old. The vast majority of the respondents were female (89.1% n=244) having had previous experience of working within healthcare before starting the Programme (59.1% n=162). Being a HCA or equivalent was the most common occupation 87.6% (n=151). This information is presented in Table 5.1.

Table 5.1: Respondent demographic characteristics for the two surveys

	Survey 1 (local): (n, %)	Survey 2 (national): (n, %)
Current Academic Year	(n=537)	(n=274)
1 st year	163 (30.4%)	67 (24.5%)
2 nd year	197 (36.7%)	111 (40.5%)
3 rd year	177 (33.0%)	95 (34.7%)
Did not state		1 (0.4%)
Age	(n=533)	(n=272)
Range	18-54	19-51
Mean (SD)	28.44 (8.281)	27.88 (7.7670)
Gender	(n=537)	(n=274)
Male	41 (7.6%)	30 (10.9%)
Female	496 (92.4%)	244 (89.1%)
Previous healthcare experience	(n=537)	(n=274)
Yes	342 (63.7%)	162 (59.1%)
No	195 (36.3%)	112 (40.9%)
Previous experience type	(n=342)	(n=274)
HCA or equivalent	288 (84.9%)	151 (87.6%)
Previous experience months	(n=332)	(n=161)
Range	3-357 months	1-300 months
Mean (SD)	61.64 (60.326) %	55.86 (58.687) %
Right or left handed	(n=535)	(n=274)
Right	465 (86.6%)	243 (88.7%)
Left	69 (12.8%)	30 (10.9%)
Ambidextrous	1 (0.2%)	1 (0.4%)

Note: Denominators vary according to missing data; bold figures show the denominators for each variable

The demographic characteristics of the respondents from Survey One (local) and Survey Two (national) who had sustained a SI

Demographic data of the respondents from Survey One (local) (n=56) and Survey Two (national) (n=63) who had sustained a SI showed that most were in the second year of academic study (44.5% n=53). The vast majority of respondents were female (90.8% n=108) and had experience in healthcare before starting the BSc (Hons) Adult Nursing Programme (55.5% n=66), the most common type being a HCA or equivalent (88.1% n=59). The age range was from 19-51 years old with the mean age being 28.28 years old. The vast majority of respondents being right handed (88.2% n=105). The table in Appendix W shows the demographics from the respondents from Survey One (local) and Survey Two (national) who had sustained a SI.

Due to the parity and similarity of the respondents nationally and locally, the respondents who had sustained a SI were amalgamated together for the purpose of analysis (n=119). This data can be seen in the table in Appendix Y.

5.3 Presentation of the findings

Data for SIs were analysed in two ways:

- i) By injury (n=135) e.g. in relation to the type of device involved
- ii) By respondent who has sustained a SI (n=119) e.g. in relation to PTSD

Hence the findings will be presented either in relation to injury or by respondent who has sustained a SI.

5.3.1 The extent of sharps injuries

This section will present the results relating to the extent of SIs, namely the incidence; the most frequent academic year when SIs were sustained; the number sustained individually per year; when and where the SIs were sustained; if supervision was present and likely causes.

The incidence of the sharps injuries

The results from Survey One (local) showed that the incidence of SIs within the last academic year was 10.4% (n=56). The results from Survey Two (national) showed that the incidence was 23% (n=63). By amalgamating the data from the two surveys, the incidence rate of the whole sample was 14.7% (n=119). This data was seen in Appendix Y.

The academic year when the SI was sustained

The most frequent academic year when a SI occurred was in the second year of academic study (44.54% n=53), followed by the third year and then the first year. This data can be seen in Table 5.2.

Table 5.2: The academic year when the sharps injury was sustained

Academic Year in which the SI was sustained	Frequency N=119	Percentage
1 st year	n=23	19.3%
2 nd year	n=53	44.5%
3 rd year	n=43	36.1%

The number of SIs sustained by respondents within the current academic year

The vast majority of respondents who had sustained a SI had had one SI within their current academic year (89.66% n=104), whilst 8.62% (n=10) had sustained two. This data can be seen in Table 5.3.

Table 5.3: The number of sharps injuries sustained by respondents in the current academic year

Number of SIs	Frequency (N=116)	Percentage
1	n=104	89.7%
2	n=10	8.6%
3	n=1	0.9%
More than 5	n=1	0.9%

Note: Denominators vary according to missing data; bold figures show the denominators for each variable

There was no statistically significant association between the number of SIs sustained and gender ($p=0.227$, *FET*); academic year ($p=0.711$, *FET*); previous experience ($p=0.847$, *FET*) or being right or left handed ($p=0.545$, *FET*).

The time when the SI occurred

When analysing the individual injuries (n=135), the most common time that SIs occurred was between 1200-1459 hrs (31.5% n=35), followed by 0900-1159 (27% n=30) and 1500-1759 (20.7% n=23). This data can be seen in Table 5.4.

Table 5.4: The time when the sharps injuries occurred

Time zone of sharps injury	Frequency N=111	Percentage
1200-1459	n=35	31.5%
0900-1159	n=30	27.%
1500-1759	n=23	20.7%
1800-2059	n=15	13.5%
2100-2359	n=4	3.6%
0600-0859	n=2	1.8%
0000-0259	n=2	1.8%

Note: Denominators vary according to missing data; bold figures show the denominators for each variable

There was no statistically significant association between the time zone when the SI occurred and gender ($p=0.457$, *FET*); academic year ($p=0.564$, *FET*); previous experience ($p=0.786$, *FET*) or being right or left handed ($p=0.589$, *FET*).

The type of shift when SIs occurred

When analysing the individual injuries ($n=135$), the most common shift when SIs occurred was on a 'long day' (65% $n=76$), followed by an 'early shift' (25.6% $n=30$).

This data can be seen in Table 5.5.

Table 5.5: The type of shift when sharps injuries occurred

Type of shift	Frequency N=117	Percentage
Long day (e.g. starting at 7-8am and finishing at 7-9pm)	n=76	65%
Early shift	n=30	25.6%
Night shift	n=8	6.8%
Late shift	n=3	2.6%

Note: Denominators vary according to missing data; bold figures show the denominators for each variable

There was a statistically significant association between the type of shift and academic year ($p=0.017$, *FET*). There was no statistically significant association between the type of shift when the SI occurred and gender ($p=0.650$, *FET*); previous experience ($p=0.279$, *FET*) or being right or left handed ($p=0.266$, *FET*).

The exact geographical location of the SI

The most common location for a SI to occur was in the ‘treatment room’ (44.4% $n=52$), followed by the ‘patient’s bedside’ (29.1% $n=34$), and the ‘patient’s own home’ (8.5% $n=10$). In total there were 10 different locations where SIs were reported. This data can be seen in Table 5.6.

Table 5.6: The exact geographical location of the sharps injury

Location	Frequency N=117	Percentage
Treatment room	$n=52$	44.4%
Patient’s bedside	$n=34$	29.1%
Patient’s own home	$n=10$	8.5%
Operating theatre	$n=9$	7.7%
Clinical skills simulation ward	$n=6$	5.1%
Office	$n=2$	1.7%
Sluice	$n=1$	0.9%
Ward pharmacy room	$n=1$	0.9%
Drug room	$n=1$	0.9%
Care home	$n=1$	0.9%

Note: Denominators vary according to missing data; bold figures show the denominators for each variable

There was no statistically significant association between gender ($p=0.059$, *FET*); academic year ($p=0.787$, *FET*); previous experience ($p=0.276$, *FET*) or being right or left handed ($p=0.995$) and the location of the SI.

The specialty where the SI occurred

The most common speciality where a SI occurred was in a 'Medical' environment (26.3% $n=30$), followed by 'Surgical' (18.4% $n=21$) and 'District Nursing' (15.8% $n=18$). In total there were 15 specialties reported where SIs occurred. This data is presented in Table 5.7.

Table 5.7: The specialty where the sharps injury occurred

Specialty	Frequency N=114	Percentage
Medical	n=30	26.3%
Surgical	n=21	18.4%
District nursing	n=18	15.8%
University Clinical skills Ward	n=6	5.3%
Theatres (including recovery)	n=6	5.3%
GP surgery	n=5	4.4%
Nursing home	n=5	4.4%
Oncology	n=4	3.5%
Intensive care unit	n=4	3.5%
Out patients department (including GU clinic)	n=4	3.5%
Community hospital	n=3	2.6%
Palliative Care Unit and Hospice	n=3	2.6%
Emergency Department	n=2	1.8%
Gynaecology	n=2	1.8%
Endoscopy unit	n=1	0.9%

There was no statistically significant association between the specialty where the SI occurred and gender ($p=0.966$, *FET*); academic year ($p=0.639$, *FET*); previous experience ($p=0.392$, *FET*) and being right or left handed ($p=0.520$, *FET*).

Whether the nursing student was being directly observed when the SI occurred

In total, 78.6% (n=92) of SIs occurred when the student was being observed by their Mentor. This data is presented in Table 5.8.

Table 5.8: Whether the nursing student was being observed when the sharps injury occurred

Was the nursing student being observed?	Frequency	Percentage
	N=117	
Yes	n=92	78.6%
No	n=25	21.4%

Note: Denominators vary according to missing data; bold figures show the denominators for each variable

There was a statistically significant association between gender and whether the nursing student was being observed ($X^2(2) = 10.381, p=0.006$). There was no statistically significant association between whether the nursing student was being observed and academic year ($X^2(4) = 2.230, p=0.694$); previous experience ($X^2(2) = 1.541, p=0.463$) and being right or left handed ($X^2(4) = 0.987, p=0.912$).

The potential causes of the SI

When looking at the individual SIs (n=135), 116 responses were made regarding the potential cause. The most commonly mentioned possible cause was 'inexperience', followed by 'lack of familiarity' and 'the equipment'. In total there were 16 potential causes mentioned. This data is presented in Table 5.9.

Table 5.9: The potential causes of the sharps injury

Cause	Frequency of reporting
Inexperience	54
Lack of familiarity	35
Equipment	35
Stress	18
Haste	15
Lack of sleep	11
Lack of protective devices	11
Inattention	11
Carelessness	11
Supervision	5
Heavy workload	5
Carelessness of a colleague	2
Faulty equipment	1
Patient movement	1
Patient's skin integrity	1
Lack of light	1

The part of body affected by the SI

Most of the SIs occurred to the hand (98.2% n=109). One injury occurred to the arm (0.9%) and one to the thigh (0.9%).

Was the SI reported by the nursing student

When looking at the individual SIs, 56.1% (n=74) were reported. There was a statistically significant association between reporting the SI and being right or left handed ($X^2(2) = 8.936$, $p=0.011$) and academic year ($X^2(2) = 10.821$, $p=0.004$).

There was no statistically significant association between reporting the SI and gender ($X^2(1) = 3.222$, $p=0.073$) and previous experience ($X^2(1) = 1.960$, $p=0.161$).

Reasons why the nursing student did not report the SI

There were responses from respondents regarding why 80/135 SIs were not reported. Respondents could give more than one response. The most common reason was because the sharp was 'unused or clean', followed by it being a 'minor injury', being 'embarrassed' and because the 'patient was not infected'. In total there were 11 reasons given for non-reporting. This data is presented in Table 5.10.

Table 5.10: Reasons why the nursing student did not report the sharps injury

Reasons why the nursing student did not report the SI	Frequency of responses
Unused or clean	61
Minor injury	44
Embarrassed	25
Patient not infected	11
Did not know how to report	9
Afraid	6
Too shy	5
Worried it would affect assessment	5
Lack of time	3
Mentor / other advised not to report	2
Too complicated	1

5.3.2 The type of sharps injuries

This section will present the results relating to the type of SIs within a nursing student population, namely the devices involved in the SIs; the procedure; the stage of the injection process and whether the sharp was used or clean.

The device involved in the individual SIs

When analysing the individual injuries (n=135), the most common device involved with SI was glass (34.9% n=44), followed by subcutaneous injection needle (29.4% n=37) and intramuscular injection needle (13.5% n=17). In total, there were 12 different types of sharps devices reported. This data is presented in Table 5.11.

Table 5.11: The device involved in the individual sharps injuries

Device	Frequency N=126	Percentage
Glass	n=44	34.9%
Subcutaneous injection needle	n=37	29.4%
Intramuscular injection needle	n=17	13.5%
Blood glucose lancet	n=7	5.6%
Intravenous injection needle	n=6	4.8%
Scalpel or stitch cutter	n=4	3.2%
Scissors	n=3	2.4%
Filter needle	n=3	2.4%
Tablet cutter	n=2	1.6%
Intradermal injection needle	n=1	0.8%
Cap of urine bottle	n=1	0.8%
Sewing needle	n=1	0.8%

Note: Denominators vary according to missing data; bold figures show the denominators for each variable

There was no statistically significant association found between the type of device involved in the SI and gender ($p=0.486$, *FET*), academic year ($p=0.172$, *FET*), previous experience ($p=0.456$, *FET*) and being right or left handed ($p=0.846$, *FET*).

The procedure involved when the individual SIs occurred

When analysing the individual injuries (n=135), the most common procedure being performed when the SIs occurred was ‘preparation of an injection’ (65% n=80), followed by ‘administration of an injection’ with 12.2% (n=15), and ‘when cleaning or clearing’ (8.9% n=11). In total there were 11 different procedures being performed when the SIs occurred. This data is presented in Table 5.12.

Table 5.12: The procedure involved when the individual sharps injuries occurred

The procedure	Frequency N=123	Percentage
Preparation of an injection	n=80	65%
Administration of an injection	n=15	12.2%
When cleaning or clearing	n=11	8.9%
When assisting a surgical procedure	n=3	2.4%
Accidentally injured by a colleague	n=3	2.4%
Taking a blood glucose sample	n=3	2.4%
Removing a suture	n=2	1.6%
Performing an aseptic technique	n=2	1.6%
Handling or transferring a sample	n=2	1.6%
Processing or cleaning equipment	n=1	0.8%
Washing a patient	n=1	0.8%
n=123		

Note: Denominators vary according to missing data; bold figures show the denominators for each variable

There was no statistically significant association between the procedure involved when the individual SI occurred and gender ($p=0.842$, *FET*), academic year ($p=0.129$,

FET), previous experience ($p=0.675$, *FET*) and being right or left handed ($p=0.751$, *FET*).

The stage of the injection process when an individual SI occurred

When analysing the individual injuries ($n=135$), when SIs occurred during the injection process the most common stages were ‘when drawing up the drug’ (27.7% $n=26$); ‘when assembling the syringe and needle’ (23.4% $n=22$), and ‘when opening the ampoule’ (18.1% $n=17$). This data can be seen in Table 5.13.

Table 5.13: The stage of the injection process when a sharps injury occurred

Stage of injection process	Frequency	Percentage
	N=94	
Drawing up the drug	$n=26$	27.7%
Assembling the syringe and needle	$n=22$	23.4%
When opening the ampoule	$n=17$	18.1%
When disposing of syringe and needle	$n=8$	8.5%
When re-capping the needle	$n=6$	6.4%
When administering the drug	$n=5$	5.3%
When unsheathing the needle	$n=4$	4.3%
When closing a safety device	$n=3$	3.2%
When disposing of a glass ampoule	$n=1$	1.1%
When pulling the rubber cap off a drug ampoule	$n=1$	1.1%
When injecting into a bag of fluid	$n=1$	1.1%

There was no statistically significant association between the stages of the injection process when the SI occurred and gender ($p=0.484$, *FET*), academic year ($p=0.997$, *FET*), previous experience ($p=0.911$, *FET*) and whether right or left handed ($p=0.701$, *FET*).

Whether the sharp was used or clean

In total 82.5% ($n=94$) of SIs occurred with unused (clean) sharps. There was a statistically significant association between whether the sharp was used or clean and gender ($X^2(2) = 9.592$, $p=0.008$). There was no statistically significant association

between whether the sharp was used or clean and academic year ($X^2(4) = 1.194$, $p=0.879$), previous experience ($X^2(2) = 0.881$, $p=0.644$) or being right or left handed ($X^2(4) = 1.314$, $p=0.859$)

5.3.3 The impact of SIs

This section will present the results relating to the impact of SIs within a nursing student population, namely rate of PTSD.

PTSD incidence

The survey asked four questions which tested for the incidence of PTSD following a SI. In total, 5.9% ($n=6$) of respondents who had sustained a SI answered three or more of the four PTSD questions positively. This suggests that these respondents showed signs of PTSD. In total 37.3% ($n=38$) respondents answered 'yes' to at least one PTSD question. This data can be seen in Table 5.14

Table 5.14: The incidence of post-traumatic stress disorder following a sharps injury

PTSD Question	Number of responses / 119 and %	Yes response frequency	Yes response percentage
Question 1	102/119 (85.7%)	n=19	18.6%
Question 2	102/119 (85.7%)	n=24	23.5%
Question 3	101/119 (84.9%)	n=17	16.8%
Question 4	102/119 (85.7%)	n=2	2%
0 questions answered 'yes'		n=64	62.7%
1 question answered 'yes'		n=21	20.6%
2 questions answered 'yes'		n=11	10.8%
3 questions answered 'yes'		n=5	4.9%
4 questions answered 'yes'		n=1	1%
Participants who answered 'yes' to 3 or more of the 4 questions		n=6	5.9%

There was no statistically significant association between sustaining PTSD and gender ($p=0.434$, *FET*), academic year ($p=0.183$, *FET*), previous experience ($p=0.681$, *FET*) and being right or left handed ($p=0.598$, *FET*).

5.3.4 The results from the audit

An audit was undertaken of the available Accident and Incident Report forms held within the three CSSWs utilised by University X. This detailed accidents and

incidents that had occurred between 2008 and March 2016. The results of this audit are presented below.

The amount of recorded accidents identified

The audit showed that there were 46 recorded accidents over eight years.

Personnel who had sustained the recorded accidents

Nursing students were involved in 56.5% (n=26) of recorded accidents, followed by medical students (19.6% n=9). In total 10 different personnel recorded an accident during this time. This is presented in Table 5.15.

Table 5.15: Personnel who had sustained the recorded accidents within the audit

Personnel who had sustained the recorded accidents	Frequency	Percentage
	N=46	
Nursing student	n=26	56.5%
Medical student	n=9	19.6%
Technician	n=3	6.5%
Dental student	n=2	4.3%
Paramedic student	n=2	4.3%
Cleaner	n=1	2.2%
Work experience	n=1	2.2%
Student midwife	n=1	2.2%
Nurse	n=1	2.2%

The types of recorded accident

Regarding the type of injury, 69.6% (n=32) of recorded accidents were classed as SIs, whilst 19.6% (n=9) were classified as faints. There were six types of accident recorded. These are presented in Table 5.16.

Table 5.16: The types of recorded accident within the audit

The types of recorded accident	Frequency	Percentage
Sharps injury	n=32	69.6%
Faint	n=9	19.6%
Back injury	n=2	4.3%
Facial injury	n=1	2.2%
Slipped	n=1	2.2%
Splash to eye	n=1	2.2%

Who had sustained the recorded SIs

Of the 32 recorded SIs, nursing students were involved in 59.375% of them (n=19), whilst medical students were involved in 15.625% (n=5). In total there were eight different personnel who recorded a SI. This data is presented in Table 5.17.

Table 5.17: Who had sustained the recorded sharps injuries within the audit

Who had sustained the recorded sharps injuries	Frequency	Percentage
Nursing students	n=19	59.4%
Medical student	n=5	15.6%
Technician	n=2	6.25%
Dental student	n=2	6.25%
Paramedicine student	n=1	3.13%
Cleaner	n=1	3.13%
Work experience	n=1	3.13%
Midwifery Student	n=1	3.13%

5.4 Summary

Regarding the extent of SIs involving nursing students, the results from the survey show the incidence rate being 14.7%. This confirms that nursing students in the UK do suffer from SIs, with the second year of study on the Programme being the most

frequent time for this to occur. The results also show that when nursing students do have SIs, the most frequent amount is one per year.

In relation to the types of SIs sustained by nursing students, these results show a variety. The most common device which caused a SI was glass, followed by subcutaneous needles. The most common procedure involved was when the nursing student was preparing an injection. When the SI occurred during an injection procedure, the most common stages were highlighted as when the drug was being drawn up and when assembling the equipment.

Regarding the impact of the SI on the nursing student, it was identified that 5.9% (n=6/119) of the nursing students who had sustained a SI reported PTSD. This was based upon their responses to specific questions within the survey which were based upon a validated PTSD scale. Approximately a third of the respondents who had sustained a SI did report at least one of the four signs of PTSD based upon the criteria utilised.

Additional data gained from the survey related to the objectives of the study. It was identified that the most frequent time frame when SIs occur involving nursing students is between 0900-1500. This coincided with the most frequent shift when SIs occur as being a long day. Although this timeframe may include other shifts worked at that time e.g. 0700-1500 shift. The vast majority of injuries affected the nursing student's hand and can occur in many various geographical locations. The locations reported included hospital departments, community settings and within the University X CSSWs. The most frequent location was identified as the treatment room, which coincided with the most common procedure occurring when SIs happen. There were many specialities where nursing students were on placement when the SI was

sustained. The most common specialities identified were medicine and surgical settings, with district nursing placements also featuring. The results from the audit identified that nursing students account for most reported accidents with the University X CSSWs, and the most frequent injury there is a SI. The audit highlighted that nursing students accounted for the most common group to suffer SIs within the University X CSSWs. This may have been related to the fact that nursing students are the most frequent users of these facilities.

Most sharps causing the injuries were clean, unused devices. Many potential causes of the injury were reported. These included 'inexperience', 'lack of familiarity' and 'the equipment'. The surveys showed that most SIs involving nursing students were reported, but a large amount were not. There were many reasons given for this non-reporting. The most common reasons included the device being unused and clean, the injury being described as minor and the nursing student being embarrassed. The surveys also identified that approximately a fifth of SIs occurred when the nursing student was not being observed by their mentor, a lecturer or another healthcare professional.

Chapter Six: Qualitative findings - Twitter Chat and interviews

6.1 Introduction

In this chapter the findings of the Twitter Chat (n=71 participants) and the interviews (n=12 participants) are presented. The outcomes of the thematic analysis and subsequent synthesis of each data source are summarised and then each theme and sub-theme is then presented using illustrative data excerpts.

6.2 Themes

The analysis of the Twitter Chat resulted in four themes that emerged from the data. These can be seen in Table 6.1.

Table 6.1: The four themes emerging from the Twitter Chat

The injury	After the injury
Prevention of the injury	The impact of the sharps injury

The analysis of the interviews initially produced 15 themes which are presented in Table 6.2.

Table 6.2: The 15 themes emerging from the interviews

Vivid description	Communication	Thinking about it
Causes	Flashbacks	Perception of the patient
Mentor	Follow-up	Dwelt on it
Immediately afterwards	Feelings	Other student nurses
Next time / different techniques	If it was a dirty needle	How I dealt with it

As outlined in section 4.10, these themes were reviewed and refined to produce seven emergent themes. These themes and the amount of extracted significant statements per theme can be seen in Table 6.3.

Table 6.3: The seven themes emerging from the interviews

Theme	Number of extracted significant statements
The impact of the sharps injury	142
A vivid description of the event	76
Next time I use a sharp	74
The role of my mentor	60
If it was a dirty needle	46
The role of my family and friends	43
The perception of the patient involved in the sharps injury	25

There followed a process of qualitative synthesis to review the eleven themes from the two data sources. This synthesis process created a final eight themes, with associated sub-themes. The full list of themes and sub-themes from each data source is presented in Table 6.4.

The eight themes were as follows:

The first theme '*A vivid description of the event*' illustrates the level of detail provided by the participants. The second theme '*The impact of the sharps injury*' reflects how the SI had affected the participants and the impact which it had on their professional and private lives. The third theme '*The role of my Mentor and Personal Tutor*' exemplifies the important role of supervisors during and after the SI. The fourth theme '*The role of my family and friends*' comprises information about what part kin

and peers played in the nursing student's life following the SI. The fifth theme '*The next time I used a sharp*' illuminates how practice had changed and the emotions felt when the nursing student was faced with performing a task involving a sharp in the future. The sixth theme '*If it had been a used sharp*' illustrates the hypothetical emotions and experiences which the participant may have had if seroconversion or exposure to bacterial infections had potentially happened. The seventh theme '*Prevention of the sharps injury*' suggests the various ways in which SIs involving nursing students can be prevented from occurring. The eighth theme '*The perception of the patient involved in the sharps injury*' demonstrates how the opinion of the patient had an influence on the apparent severity of the SI for the participant. The themes and sub-themes are provided in Table 6.1.

Table 6.4: The themes and sub-themes of the qualitative data

<p>Theme One. A vivid description of the event (section 6.4.1)</p> <p>Subthemes:</p> <ul style="list-style-type: none"> The type and extent of injury The procedure being performed and the type of equipment being used The exact location of the SI The potential causes of the SI The first aid which was performed Having to have blood tests taken and receiving an inoculation after the SI Hiding the SI Talking to the patient after the incident
<p>Theme Two. The impact of the sharps injury (section 6.4.2)</p> <p>Subthemes:</p> <ul style="list-style-type: none"> The emotions experienced Feeling upset for the patient Having flashbacks about the SI The SI did not affect me The SI stopped me from doing something

Theme Three. The role of my Mentor and Personal Tutor (section 6.4.3)

Sub-themes

The supportive attitude of my Mentor
The competence of my Mentor
The relationship with my Mentor following the SI
The use of humour by my Mentor (and other nursing personnel)
My Mentor shared their experience of having a SI
An educational opportunity
My Personal Tutor
Prompted to reflect

Theme Four. The role of my family and friends (section 6.4.4)

Sub-themes

Telling nursing student colleagues
Telling family members
Telling non-nursing friends
I did not tell anybody about the SI

Theme Five. The next time I used a sharp (section 6.4.5)

Sub-themes

Improved sharps safety
My improved nursing practice
Emotions
Avoidance of sharps following the injury
Get the next injection over with

Theme Six. If it had been a used sharp (section 6.4.6)

Sub-themes

Hypothetical feelings and emotions
Telling others
Avoidance of situations and experiences
Questioning my competency
The relationship with my Mentor

Theme Seven. Prevention of a sharps injury (section 6.4.7)

Sub-themes

Sharps bins
Best practices
Disposal of sharps
Education
Not re-sheathing
Simulation
Safety devices
Respect for sharps
Good leadership
Good preparation

Theme Eight. The perception of the patient involved in the sharps injury (section 6.4.8)

6.3 Participant Demographics

6.3.1 The Twitter Chat

The majority of the Twitter Chat participants were nursing students (n=46). The participants are presented in Table 6.5.

Table 6.5: Participants of the Twitter Chat

Participant role	Number
Student nurse	46
Nurses	17
Other	8
Total	71

6.3.2 The interviews

Semi-structured interviews were conducted with 12 nursing students, mostly female (n=11), with ages ranging from 21-46 years. Full demographic details of participants are provided at Table 6.6.

Table 6.6: Biographical details for individual participants for the interviews

Participant	Gender	Year of student when interviewed	Year of student when injury occurred	Age of student when interviewed	Interview date	Equipment
P1	Male	2nd	1st	46	03/05/16	Glass vial
P2	Female	3rd	1 st & 2 nd	22	03/05/16	Clean IV needle & Glass vial
P3	Female	3rd	3 rd	21	05/05/16	Clean needle
P4	Female	2nd	1st	33	17/05/16	Used needle
P5	Female	2nd	2nd	22	17/05/16	Clean IV needle
P6	Female	3rd	2nd	39	24/05/16	Glass vial
P7	Female	3rd	2nd	21	09/06/16	Clean IV needle
P8	Female	3rd	1st	26	05/07/16	Glass vial

P9	Female	3rd	1st	41	07/07/16	Used needle
P10	Female	2nd	2nd	24	13/10/16	Used needle
P11	Female	1st	1st	23	26/10/16	Glass vial
P12	Female	2nd	2nd	20	23/3/17	Used needle

Eleven out of the twelve participants were in the first or second year of undergraduate training when the injury occurred and four participants out of the twelve sustained an injury from a used needle.

6.4 Presentation of findings

In order to preserve the anonymity of participants who took part in the Twitter Chat, each participant was given a code (NS = nursing student; TC = Twitter Chat) and a number, e.g. NS TC1. Participants within the interviews were given a code (NS = nursing student; Int = Interview) and a number e.g. NS Int1. Quotes from the Twitter Chat and interviews are presented to support the findings. Each quote used is followed by the participant's pseudonym. When quoting the participant's account, *italics* are used to identify the voice of the participant.

6.4.1 Theme One - 'A vivid description of the event'

Participants provided detailed accounts of either the whole, or a component of, a SI episode. Six nursing students recalled accurately the time of day when the SI occurred. One participant recalled accurately the precise day, the time and which appointment of the day was taking place when the SI occurred (NS Int3). Similarly, another participant was able to remember the specific time of day ('*two o'clock time*') (NS Int2).

The type and extent of the injury

Nursing students vividly described the type of injury which had occurred to their fingers or thumbs and these ranged in severity from ‘*a scratch...a break to the skin*’ (NS Int12) to ‘*a small cut*’ (NS Int1; NS Int6) to ‘*a piercing puncture wound*’ (NS Int5) to ‘*a stab wound*’ (NS Int7) and ‘*slicing to skin*’ (NS Int8; NS Int11). A nurse within the Twitter Chat mentioned that they still had the wound from an historic SI:

“I still have a scar from a vial I broke whilst a student” (N TC8)

The amount of blood present following the SI was vividly described by some participants. Sometimes there was subjectively ‘*copious amounts of blood loss*’ (NS Int1; NS Int6) and occasionally ‘*the bleeding would not stop*’ (NS Int5). This was because the participant perceived that they had only just missed hitting a bone in their finger and hence the injury was deep. Occasionally, the loss of blood was described as ‘*only a small amount*’ (NS Int7).

The procedure and equipment

Some nursing students described how SIs did not always occur with needle sticks but also with broken glass when glass vials of medication sometimes do not snap correctly (NS Int1; NS Int6; NS Int8). Similarly some nurses tweeted that glass has been found to be a cause of SIs in practice. The type of glass mentioned was universally glass vials containing medication. The issue was the shattering of the glass ampoule rather than a clean break when opening:

“when opening the glass vile of medication it has shattered instead of break cleanly” (NS TC3)

It was felt that a SI from broken glass was less of a biological hazard than a used needle, although it did depend of what medication was in the vial.

SIs had been sustained by nursing students when drawing up an intra-venous antibiotic (NS Int2; NS Int7) and when preparing injections such as vaccinations (NS Int3); an anti-emetic drug (NS Int5); a steroid drug (NS Int11) and an anti-coagulant injection (NS Int12). There was a sense that a high percentage of SIs occurred while the nursing student was assembling or disassembling the equipment.

SIs occurring when administering insulin with insulin pens and needles appeared to be common (NS Int4; NS Int9; NS Int10). These injuries arose when removing needles from the pen and with *'diabetic patient's needles left on a night table'* (NS TC16) covered with magazines which were very difficult to identify.

Nursing students and nurses explained how scalpels, sutures and surgical blades were sharps hazards and could have the same impact as used needles. Likewise, razors used by patients were described as a *'hazard'* (NS TC16) and *'perilous'* (NS TC2). Razors were viewed by nursing students as a danger and a cause of harm even though hospital issued razors were not always very sharp. Other medical equipment discussed which could contribute to a SI included scissors, unspecified theatre equipment, arterial blood gas collection devices and blood lancets:

"we all assume that a sharps injury is a needle stick however it involves other sharps equipment as well" (NS TC12)

Location of the sharps injury

All of the nursing students within the interviews explained the exact location of where the SI had been sustained. These were within hospital settings, in the community, and within the CSSWs. The environments included *'on a medical ward'* (NS Int1); *'in a treatment room'* (NS Int2; NS Int3; NS Int8; NS Int11); *'at the patient's bedside'*

(NS Int4; NS Int12); *'on an oncology unit'* (NS Int5); *'on a respiratory ward'* (NS Int6); *'in an Intensive Care Unit'* (NS Int7); *'on a Stroke Unit'* (NS Int8) and *'in an Elderly Care Ward'* (NS Int12). A nurse recollected via a tweet how a SI occurred when they were a nursing student as they were preparing equipment in a Cardiac Cath laboratory. A nurse tweeted that in the 1980s the operating theatre was a hazardous environment for SIs, as sharps were left on trolleys to be cleared following procedures. Another nurse tweeted that when they worked in the Infectious Diseases Unit as a nursing student, they discovered:

"undisposed sharps were like ammunition." (N TC3)

An explanation within the Twitter Chat as to why sharps were more prevalent in certain hospital care settings concluded that in surgical settings there was an abundance of injections and in medical environments there were a large amount of emergencies requiring injections.

SIs were also described within community areas, such as *'in a Residential Home'* (NS Int9) and *'in a Community Hospital'* (NS Int10; NS Int11). The community was considered a prime location for SIs because practitioners may feel out of their comfort zone in unfamiliar surroundings. Not having the appropriate equipment such as sharps bins, and the setting not being a typical, clean environment where equipment is easily accessible were also seen as factors. Being in someone's house was viewed as difficult because of the hidden dangers and hazards created by organisation issues:

"...you are a guest in someone's house, not always an organised place to work #hazards" (N TC7)

Another specific location identified was the CSSW. Many nursing students viewed the anxiety of being observed in that environment as an increased risk, whilst others thought that more care was taken in placement than in the CSSW. Some participants of the Twitter Chat felt that nursing students may not be as cautious in the CSSW as in practice and this may be why SIs occurred there because this environment may be perceived as less dangerous. It was viewed as more beneficial for a SI to happen in the safety of the CSSW as it was less risky and dangerous than in clinical placement, as clean, unused needles were utilised there:

“[the skills ward]...gives us chance to learn from our mistakes for the real world” (NS TC2)

Potential causes

The potential causes of SIs affecting nursing students was vividly discussed by many of the participants in both the Twitter Chat and the interviews. The issue of ‘*inexperience*’ of nursing students was highlighted (NS Int1; NS Int2; NS Int3; NS Int4; NS Int5; NS Int6; NS Int7; NS Int9; NS Int11). This also links to the perceived problems of a ‘*lack of training*’ (NS Int2) and a ‘*lack of knowledge*’ (NS Int1; NS Int11). On occasion the participant had only been in the placement for a very short period of time when the SI occurred and this was thought to be a contributing factor. Sometimes the participant had used a sharp less than 10 times before having the injury. This lack of experience meant that nursing students may incorrectly handle and dispose of sharps as this was potentially a new experience for them. This could occur before going out into clinical placement and whilst out in placement:

“students may have less experience...than others in using and handling sharps so more injuries may occur” (NS TC24)

Being in the second year of study was highlighted as a potential cause of SIs for nursing students. A suggested reason for this may be pressure, especially when being assessed which some saw as scary. Additionally it was mentioned that the second year was seen as being more challenging, where there was the perceived pressure to be more independent in practice:

“I think it is due to the pressure you are under” (NS TC12)

Another reason proposed for the second year of study being a potential factor was more sharps usage happening at that stage and possibly more opportunities to give injections than in the previous year. Available evidence supports this factor (Smith and Leggat, 2005; Ozer and Bektas, 2012). Having too much confidence was highlighted within the qualitative phase of this study as a contributing factor (NS TC3; NS TC28), meaning that some second year nursing students may become complacent due to misplaced confidence in their abilities. Sears et al (2014) reported the expression of over-confidence within novice learners, which links with the confidence not always based upon ability within this study. This view though appears to conflict with predominant available evidence which suggests that there is a decrease in confidence throughout a nursing student’s programme, based upon how they are treated by nursing staff (Porter et al., 2013) and high levels of stress which affects performance (Goff, 2011; Lopez and Lopez, 2011).

Poor sharps technique was also emphasised by student nurses as being a reason. Examples given included the passing of a sharp to another person rather than disposing of the sharp themselves (NS TC6; NS TC8; NS TC12; NS TC30), poor assembly of the sharps equipment (NS TC17) and the unnecessary disassembling the sharps equipment after use (NS TC7). It was felt that an abundance of SIs

happened when the sharps were being disposed of (NS TC6; NS TC11; NS TC12). This was perceived within the qualitative phases to be because nursing students may be too focused on learning the actual task and may forget the importance of disposing of the sharp correctly. Many SIs were seen as avoidable because a break in the correct procedure occurred and were partly due to inadequate preparation (NS TC17; NS TC18). Available evidence suggests that a lack of safety training and preparation increases the risk of SI within nursing students (Zhang et al., 2017).

Re-sheathing of the needle was highlighted as being a danger. Examples were given of observing nurses in practice attempting to put the cap back on the sharp after use. This was described as being very poor injection technique, but something which might be ingrained in practice:

“Some nurses are set in their ways and were taught this therefore think this is best practice” (NS TC3)

A nursing student stated that they had been taught very early in their training never to re-sheath a needle (NS TC40), although another participant mentioned that they were not informed of this poor practice until the second year of their programme (NS TC34). As discussed in section 3.3.2, information and training relating to safe workplace practices in regards to sharps, includes not re-capping needles (HSE, 1995; EAGAAGH, 1998; COSHH, 2002; HSE, 2011; HASSIH, 2013; NHS Employers, 2013a; UNISON, 2014) has been advocated for decades. Available evidence does appear to suggest though that some educational intuitions do not always provide nursing students with adequate safety training in relation to sharps (Talas, 2009; Cheung et al., 2010; Zhang et al., 2017).

On occasions the behaviour and the practice of '*the mentor*' (NS Int8) and other HCWs was seen to increase the risk of a SI involving nursing students. Examples included doctors who had asked participants to dispose of their used sharps. Nurses mentioned within the Twitter Chat that historically it was courteous to clean-up after other professionals, but this was now seen as poor practice which was unacceptable and also counter to published guidelines. As discussed in section 3.3.2, the training of employees in the safe disposal of sharps in sharps bins has been a requirement for decades (HSE, 1995; EAGAAGH, 1998; COSHH, 2002; EBN, 2011; HSE, 2011; HPA, 2012; NHS Employers, 2013a; HASSIH, 2013; UNISON, 2014), including the prompt disposal of a sharp in sharps bin positioned at eye level (NIOSH, 1999; ANA, 2002; Hutin et al., 2003).

It was considered that nursing students should have the confidence to refuse such a request, and if the nursing student was not confident enough, the mentor should be their advocate in these situations. This links in with the expectation of the support and supervision of nursing students provided by registered nurses in the clinical setting (NMC, 2018). Doctors and other HCWs were accused of being careless by leaving sharps such as vials and needles in cardboard trays and on beds instead of disposing of the sharps themselves in a sharps bin immediately after usage. This occasionally happened following emergency situations when HCWs were trying to gain intravenous access. An example given was following the insertion of central lines and chest drains, when sharps had been left on the bed post-procedure. Similar issues were reported by the HSE (2016) in section 3.3.2, whereby HCWs had left needles on trolleys causing a hazard to fellow staff as well as to the public.

Hence, HCWs were seen as putting others, such as nursing students and patients, at risk and potentially breaching their duty of care:

“not all student nurse sharps injuries are from sharps being used by student themselves” (N TC7)

Some examples were given within the Twitter Chat and the interviews of *‘the patient’* being viewed as the cause of the SI (NS Int9; NS Int10; NS Int12). Sometimes patients were described as being thin and occasionally nursing students struggled to identify subcutaneous fat to inject safely into (NS Int12). This brought their technique into question. Some patients were described as being feisty and moved at the time of an injection which increased the risk of a SI (NS Int9; NS Int10). As previously mentioned, patients sometimes left needles around in their own environment which proved difficult for nursing students to see (NS TW16).

Sometimes *‘the needle or equipment’* (NS Int3; NS Int5; NS Int9) was seen as the cause, linked to poor disposal methods. Sharps bins were not always available to the nursing student which posed an increased risk of injury post-injection (NS Int9). Other poor disposal methods included over-full sharps bins and finding needles in rubbish bags (NS TC10). Other examples included seeing large syringes placed in small sharps bins (N TC1) and sharps bin lids which had not been fitted correctly (N TC8). This is despite decades of legislation and guidance regarding the safe use of sharps bins (HSE, 1995; EAGGAAGH, 1998; COSHH, 2002; EBN, 2011; HSE, 2011; HPA, 2012; NHS Employers, 2013a; HASSIH, 2013; UNISON, 2014), and the safe disposal of sharps (NIOSH, 1999; ANA, 2002; Hutin et al., 2003).

Nursing students highlighted that a potential cause could be stress, anxiety and *‘feeling nervous’* (NS Int2), which was especially true when being observed (NS Int2)

by the Mentor in placement and lecturers in the CSSW. A nursing student stated that they were dreading being observed as it could be very off-putting and potentially increase their risk:

“Yes I would say anxiety could play a part” (NS TC27)

Another potential cause was ‘*the location*’ where the nursing student was experiencing their clinical placement (NS Int6). This was for two reasons. Firstly, the placement may use an abundance of sharps which was seen as an increased risk factor and conversely in some practice settings there were no sharps being used, and hence no learning about sharps took place. This issue was identified by Yang et al (2004), who reported that some departments within clinical settings use more sharps than others. This means that nursing students may be more at risk of a SI based upon the clinical setting.

Being distracted was also viewed by three participants as a potential cause due to concentrating on the client rather than themselves and the sharp (NS Int2; NS Int9; NS Int10). Distraction has been reported within the literature as increasing the risk of sustaining a SI (Fisman et al., 2003). Despite the abundance of sharps safety initiatives, it is reported that distracted HCWs continue to suffer from SIs (Palmer, 2017).

A discrepancy between what is taught and learnt within the CSSW and how procedures are conducted in the practice placement was also posited as a cause (NS TW12; NS TW15). Hence a theory-practice gap was claimed to exist in relation to sharps usage. This issue has been documented within the field of nursing over many decades (Henderson, 2002; Ahmad et al., 2015; El Hussein et al., 2017).

Other factors relating to the cause of SIs within nursing students included ‘*haste*’ (NS

Int10), '*feeling tired*' (NS Int7), '*human error*' (NS Int3) '*bad luck*' (NS Int8) '*being clumsy*' (NS Int10), '*ineptitude*' (NS Int1) and '*being too heavy-handed*' (NS Int2).

First aid and follow-up

The administration of first aid performed following the SI was commonly mentioned by the participants. Student nurses explained vividly the first aid which they received. This was sometimes the whole episode from the beginning to the end (NS Int1) and sometimes highlighting pertinent parts of the event such as '*washing the injury under water*' (NS Int2), '*squeezing the injured finger to encourage bleeding*' (NS Int9), '*applying compression to the bleeding finger*' (NS Int5), '*applying a plaster onto the sharps injury*' (NS Int10), and '*organising the necessary follow-up procedure*' (NS Int10), such as blood tests. Discussions highlighted how HCWs should comply with Occupational Health policies and local policies in the health environment where they worked. Being offered a visit to the Emergency Department following the SI was discussed but on occasion declined by nursing students because of the nature and circumstances of the injury i.e. it was not felt to be necessary as the SI was a small cut caused by glass (NS Int11). Some nursing students spoke of how unsure they felt about what occurs when a SI had happened. This participant describes the confusion they felt regarding the procedure which should follow:

"I had an idea of what to do but I wasn't sure sort of how the process went...I didn't know you had to make it bleed immediately...and I didn't know about filling out a Datex form when that had to be done, if I definitely had to go down to the Emergency Department or if it was in some cases or not" (NS Int12)

Participants who had sustained a SI involving a used needle vividly spoke of their experience of having blood samples taken and receiving an inoculation. One nursing student (NS Int9) explained how they had blood samples taken immediately '*in the*

timeframe of about a couple of hours' after the injury occurred. The blood samples were performed in the clinical placement by a phlebotomist and sometimes the participant (NS Int12) had to visit the Emergency Department for an inoculation due to an injury with a used sharp. The same nursing student described feeling awkward when attending the Emergency Department:

"I knew it had to be done which was fine, it just felt a bit strange because I was there as a student nurse and they didn't expect to have to be having bloods taken and then having a Hep B booster but you know, it was quite sore the Hep B afterwards that was quite painful"
(NS Int12)

Hiding the sharps injury

Another issue described vividly by some participants was how they had hid the SI from their mentor. This non-reporting was sometimes because of 'a fear of looking incompetent' (NS Int6) and also embarrassment:

"I was drawing up some antibiotics...and I pushed the needle and it went right through the bag and into my finger...and then I had a bit of blood coming through my glove...and then I stopped the bleeding and then I just started again so I didn't tell anyone about it...because I was a bit embarrassed and I felt a bit silly" (NS Int7)

"Lack of reporting could be from embarrassment" (NS TC28)

There was a sense of being afraid of failure and the reprisals of the SI, such as being marked down in placement competencies, being in trouble or facing the consequences. There was also the perceived fear of getting into trouble and having to admit that a mistake had happened:

"worried that they [the student nurse] would be taken off placement and not be able to carry on with the course" (NS TC2)

Another fear mentioned as to why non-reporting may occur was a dread of looking unprofessional and feeling scared and frightened about the experience. Stress was seen as a factor due to it causing the nursing student to be forgetful. The sheer panic about BBVs meant that some nursing students blocked out the experience and the necessary reporting and follow-up procedures (NS TC40; NS Int4; NS Int7). Not knowing how to report a SI was also discussed as a reason for non-reporting. Some nursing students stated that they did not know where to report the incident, or who to report the injury to, or may think that the injury does not need to be reported (NS TC 20; NS TC24). This was especially true if the participant was in very early stages of the programme. Worryingly a nurse within the Twitter Chat mentioned that they were aware of qualified nurses who did not know the procedure until they had to go through the process (N TC4). Other reasons suggested for non-reporting included the inconvenience of reporting (NS TC5) and being in denial of the situation (NS TC14). Participants seemed surprised that nursing students did not report SIs (N TC14; NS TC6), and felt that work needed to be done to change that mind-set, as all SIs should be reported to protect the individual. This links to legislation and guidance documented over many decades which has highlighted the importance of HCWs reporting SIs (RIDDOR, 1995; HSE, 2005; HSE, 2011; RIDDOR, 2013). Having a robust reporting system not only benefits the individual, but aids the evaluation of safety measures and helps identify issues to aid the prevention of SIs (EBN, 2011; HASSIH, 2013; NHS Employers, 2013a; UNISON, 2014).

Even though the nursing student may be potentially anxious of the consequences, it was discussed that it was imperative that the incident was reported due to the risk of seroconversion. A solution offered to this within the Twitter Chat was anonymous reporting of SIs which would be beneficial as the fear of disciplinary action was

then removed (N TC1). Although it was stated that follow-up treatment or education regarding seroconversion following the incident may prove difficult due to the anonymity aspect (NS TC19).

Communicating with the patient

A final vivid memory which was revealed was how the mentor and the student nurse communicated and reassured the patient following the SI (NS Int10; NS Int12). This was especially important when the patient was asked for consent to have the necessary blood tests taken:

“...my mentor talked to the patient, just to settle her because she was like “Ooh” didn’t really like needles...they [the Mentor] sort of had to go around it very sensitively because she didn’t like needles...so we had to talk her through it, I went in and said ‘Look, this is what happened earlier’”
(NS Int10)

6.4.2 Theme Two - ‘The impact of the sharps injury’

The emotions experienced

The participants stated within the Twitter Chat and the interviews that there was a multitude of emotions displayed when they acquired a SI. Feeling worried, stressed and anxious were common emotions expressed. Nursing students who stated that they were stressed were asked within the interviews how much stress they had suffered based upon a zero to ten scoring system. The stress levels ranged from five to seven out of ten, indicating that generally nursing students within the interviews had suffered a moderate amount of stress following the SI. Some nursing students explained how long the worry and stress had lasted for and this ranged from ‘disappearing quickly’ (NS Int7), to ‘two to three days’ (NS Int5), to ‘quite a while’ (NS Int6) to ‘two years’ (NS Int8).

Waiting for blood test results following a SI with a used needle had an impact on some of the participants. Two nursing students (NS Int4; NS Int12) mentioned the anxiety that they endured during the wait for the blood tests, whilst one of the nursing students (NS Int4) stated the amount of times they had to call the Occupational Health Department to find out the outcome, which resulted in increased anxiety. This was because the nursing student felt that no-one had contacted them to explain clearly what the procedure was. Another nursing student (NS Int10) mentioned that the timeframe of the process of having bloods taken and obtaining the results was long. In their situation the wait was three days for the blood test results and then two weeks for an official letter confirming the results. These are the thoughts and feelings of one nursing student during the three day wait and how they felt about potentially contracting a disease through seroconversion:

“...it was an anxious three days but...I was really anxious, I felt that...this is so dramatic but I thought I was going to die of some horrible disease that I'd given myself...that's the reality of it and it was sleepless nights...I felt sad for my family because I never thought that going into nursing would affect my family's life and already within the first six months of my training I had already put my family's...our little unit in danger I felt...so these were all the things that were going through my mind during those three days” (NS Int4)

The worry occasionally continued until the results of the blood test were known. This was because of the risk of possible seroconversion which caused the nursing students to think about the types of viruses and diseases which could be acquired from a patient via a SI. These included Hepatitis, HIV and other infections:

“HIV is the first thing that it will come in to my mind” (NS TC25)

There was also worry and concern regarding how the University might react and perceived the nursing student once the SI was reported:

“I was worried about...the University...how they might respond”
(NS Int4)

Sometimes the worry felt by the participant was how they felt they would be perceived and viewed by their mentor and other HCWs in practice placement following the SI. This worry and anxiety in practice placement was also related to whether the SI sustained by the participant would affect their grades. There was concern that there was a possibility that competencies would not be signed off for the placement in the Ongoing Achievement Record (OAR) documentation or the injury would affect marks awarded:

“I felt maybe it was gonna affect my performance in terms of grading for when it came to the OARs [Ongoing Achievement Record] being done”
(NS Int5)

One participant explained how they felt worried and anxious for about a year following the SI if they were asked to prepare sharps again, or any new procedures by their mentor. This was due to the concern about making a mistake, and worry about potentially harming the patient. This participant began to question their own competence:

“...worried about having to do it again and kind of would get anxious if I thought like one of my mentor was going to ask me to like prepare any medication again...I think I did worry for a while after that especially on that particular placement about trying anything new...whether I'd...be able to do it properly erm, and also kind of worrying about you know, getting something wrong to the point that it was going to affect like patient safety or something like that erm, I did find myself questioning myself quite a bit...I'd say until I...cos that was I think it was my second placement of my second year, erm, and I would say probably until the second placement that I have had in my third year” (NS Int6)

A nursing student (NS Int4) was very worried about telling their husband that they had sustained a SI, although their husband was very supportive. Another nursing student (NS Int10) stated that they did not feel stress and worry initially following the

SI, but it affected them once they had left the placement. It was only when the nursing student got home, sat down and reflected upon the situation that the worrying started. A nursing student said that they felt worried because of a fear that medication had entered the cut caused by the SI. The nursing student feared that an allergic response to the medication may happen. The worry meant that this participant and their mentor monitored the injury for a period of time:

“I suppose some of the medicine might have got in there so I suppose that was the one thing that me and the nurse...were watching for in case suddenly I had a reaction to something...I just thought “Oh now...we’ll soon find out if I’m allergic to what was in there” (NS Int11)

A nursing student (NS Int12) was worried because of uncertainty and fear of the unknown regarding the procedure of having blood samples taken following a SI. This situation was exacerbated by the fact that the participant did not know when they would receive the results from the blood sample and who to ask about it. A feeling of embarrassment following the SI sometimes lasted for up to a year. The seniority of the mentor was one contributing factor in this embarrassment:

“...she [the Mentor] was a nurse practitioner, so that was probably another thing because she was quite high up...it kind of made it worse erm, maybe if she had just been a practice, like a newly qualified practice nurse or something I wouldn’t have felt quite so embarrassed” (NS Int3)

Embarrassment following the SI had both positive and negative impacts on the actions of some participants. The feeling of extreme embarrassment about the SI stimulated some to reflect upon the scenario. A nursing student then read the reflection to a group of peers at a University reflective session. The main reasons for choosing to talk about the incident was because they *“thought it would help my colleagues’* (NS Int4). Conversely, the SI sometimes had a negative effect on some

participants due to the embarrassment of the mentor potentially viewing the nursing student as less competent:

“I tried to hide it at first because I was really, really embarrassed...and so was really embarrassed really and just didn't want anyone else to know about it” (NS Int6)

The embarrassment of the impending student-mentor relationship was also reported by this nursing student:

“I went in to where my mentor was erm, its very embarrassing...I was a bit embarrassed by my outburst of hysterical crying...I found that I looked a right mess on the day [laughs] but erm, [pause] I felt embarrassed because I was thinking oh my goodness they are never going to trust me again, you know, doing this silly mistake, you know, how am I going to prove myself to you know, my mentor that I am capable of handling a needle” (NS Int5)

Some participants stated how shocked and stunned they felt following the SI. The shock commonly continued for a very short period of time, ‘*maybe for about five seconds*’ (NS Int5) before they felt much calmer. One nursing student scored the amount of shock ‘*probably about a six initially*’ (NS Int7) on a scale between zero to ten because a large blunt needle had caused the SI. The shock was frequently related to the unexpected nature of the injury, the pain that was caused and the amount of blood loss (NS Int7; NS Int11).

Frustration with themselves for various periods of time following the SI was also an expressed emotion, but did not last for very long ‘*half an hour...if that*’ (NS Int2).

There was also frustration experienced when the perceived cause of the SI was the mentor or the patient. These two nursing students described their frustration:

“A little bit frustrated that I was going to pop the top off with erm, a sterile wrapper but my Mentor said no and you just do what your mentor says and I got cut” (NS Int8)

“Probably yes [frustrated] because...I was doing it methodically and just getting into the swing of it, doing it step-by-step it was just a she moved, I moved” (NS Int10)

Letting various people down, letting the University down and feeling like a failure following the SI was also reported. This was through a sense of wanting to perform the sharps procedure to a high standard:

“I didn’t have to go and sit down or anything I was fine...I was like stressed because I wanted to do it well and I failed in my eyes in doing it” (NS Int11)

Panic was also suffered by some participants following the SI. The panic was sometimes due to a concern about what was going to happen subsequent to the SI (NS Int4). Similarly another participant mentioned how they felt panicked for a short period of time as they had wrongly assumed that they would have to attend the Emergency Department to have blood samples taken (NS Int5). The sight of blood was also a cause of panic following the SI and this participant describes:

“I was okay but erm, yeah then it [blood] started coming through my glove and I was like “Oh no” erm, and I did panic a little bit” (NS Int7)

Some participants spoke of how the impact of the SI made them cry. One nursing student (NS Int4) stated that crying occurred when they endured the ‘*awful*’ experience of telling a family member about the incident. Breaking down in front of the mentor ‘*hysterically crying*’ (NS Int5) was also reported which was followed by removing themselves from the situation for a period of time to calm down. One participant described spending time in a kitchen on placement by themselves to maintain their dignity (NS Int5).

A feeling of annoyance was also expressed (NS Int3; NS Int7; NS Int12) following the SI, which on occasion lasted for '*18 months*' (NS Int4). This participant explained how they still felt annoyed with themselves for allowing the SI to happen although a long period of time had passed. The annoyance also stemmed from the fact that the participant felt they should have been able to prevent the SI from happening.

A loss of confidence for various periods of time following the SI was also expressed. This loss of confidence regarding the use of sharps ranged from '*a few days*' (NS Int2) to '*a few months*' (NS Int3). It was primarily related to the use of sharps, drawing up intra-venous medications and administering medications, and stemmed from a fear of repeating the mistake and the gamut of emotions the incident would have created.

Another impact of the SI was the perception of feeling incompetent in practice. One perspective of the perception of incompetence was what the participant's mentor may think of them following the SI and there was a concern that the perceived incompetence would be '*on my record*' (NS Int9). This created worry for the individual concerned, and was a reason why the nursing student was very '*apprehensive about telling*' the Mentor about the SI. Similarly, another nursing student (NS Int6) attempted to hide the SI from their mentor due to the perception that they would be seen as incompetent. Another participant questioned their own competence following the SI because they felt that '*I was the only person that had ever done it*' (NS Int6).

There was also the perception that relatives may view the nursing student as incompetent following the SI. One participant was concerned about how the parents

of a baby might identify them as being ineffectual after they had witnessed the SI occurring when the nursing student was preparing an injection for a baby:

“I just felt...incompetent...I felt like...the parents were kind of...looking at me like ‘who are you?’...why are you measuring up vaccines for our baby?” (NS Int3)

A ‘*disheartened feeling*’ (NS Int11) and a low mood following the SI was also reported. Another nursing student felt very isolated following the SI because they were upset about the injury and because they were in placement a distance away from their home. This meant that they could not return to their family when they wanted to seek condolence (NS Int4). This participant felt very sorry and guilty that the SI had occurred because of the potential impact it may have had on their family. This was regarding the risk of seroconversion and the impact that this may have had on their family unit. Feeling foolish, being an idiot and feeling silly following the SI were also phrases commonly expressed by the participants within the Twitter Chat and the interviews (NS Int1; NS Int2; NS Int7; NS Int8; NS Int9; NS Int12).

Feeling upset for the patient

On the occasions that a used needle was involved in the SI, there was a sense that some nursing students were distressed for the patient. This was due to the harm or pain that the patient then had to endure, such as having blood samples taken. The anguish was related to the harm which they perceived they had caused to the patient due to their own actions. This caused some participants to be upset.

This was occasionally exacerbated by the characteristics of the patient as this participant describes:

“I just had more concerns about the patient because obviously...like I said she was quite an elderly lady, she was frail, and it must have been quite horrible for her to have people coming and taking bloods for something that isn't necessarily relevant to her treatment...it could have been prevented, it was unnecessary” (NS Int12)

There was also the issue of perceived stress in the patient that a participant felt that they had caused following the SI (NS Int10). This student nurse was upset and felt very guilty because the patient involved in the SI had a needle phobia, was confused and potentially would have been upset by having to have blood samples taken caused by the participant's mistake. Another nursing student was also dismayed because the patient involved in the SI was concerned about the welfare of the participant following the injury. This caused guilt for the nursing student (NS Int4).

Concern for fellow HCWs

Not only was one participant very upset for the patient, but also for HCWs who had to take blood samples from the patient (NS Int9). This was because the HCWs already had a very heavy workload and because the patient concerned was described as *'very volatile'* which may have increased the risk of a SI for the HCW. In this instance the participant felt like she had *'let the nurse down'*. The potential impact on other parties and also the cost of the SI was deliberated within the Twitter Chat and the interviews. These impacts included the effect on Occupational Health services as antiviral prophylaxis might have to be administered following a SI involving HIV or Hepatitis, and the *'astronomical costs in terms of treatment and possible compensation'* (N TC3). Additional costs to this could also be blood tests, the time spent incident reporting and conducting a root cause analysis.

The amount of documentation and perceived problems that had been caused by the SI were also reported. The worry was that the mentor and the nursing team would subsequently not let the nursing student perform some clinical skills as the nursing team *'are probably going to be more cautious around me'* (NS Int10). The same nursing student was also concerned about how their perception of how the mentor had dealt with the SI situation would be interpreted (NS Int10). Concern regarding how trustworthy the participants would be perceived by other nurses following the SI was also expressed. This concern about their dependability was stated to be more important than the apprehension about their health, as this nursing student describes:

"I was sat with another nurse taking my blood, she would have known that I'd had a sharps...and they were like 'Oh what have you done?' and I was like, you know, I was making a joke of it but are they going to think that I am you know, not as trustworthy because of this has happened? And so yes, I think there was that more of that worry than a health concern...I wasn't worried about infection or anything for me it was more sort of their opinion of me" (NS Int10)

The blood tests

Some participants dwelt upon the wait for the blood results. One nursing student spoke of how they continually thought about the potential results of the blood test, with it being permanently *'on my mind'* (NS Int9). Being informed of a negative blood result created relief for some of the participants and they spoke about how this felt. One nursing student used words such as *'a relief...elated...very happy'* (NS Int4). Another participant spoke of how *'pretty reassured'* (NS Int10) and relieved they felt because they had prior access to some of the patient's blood results before the official blood results were issued. This created a feeling of comfort that the outcome of the blood results would be favourable. One participant mentioned how they

perceived that they would feel if they had to tell their family and friends bad news following the blood sample tests:

“I was thinking sort of what would happen next so I was forward thinking like I’d have to tell my Mum, I’d have to tell like my boyfriend, I’d have to tell my friends, erm, I felt like if the result had come back with something bad, I would have been a lot more distressed and a lot more upset and been affected by it a lot more than I was” (NS Int12)

Having flashbacks about the SI

Having flashbacks about the incident for periods of time was another impact of the SI. Following the SI some nursing students suffered flashbacks for a short period of time from ‘*probably a couple of days*’ to ‘*up to a week*’ (NS Int4; NS Int7), whilst another participant suffered flashbacks for ‘*a good two or three months*’ (NS Int6). These flashbacks were described as not necessarily nightmares, but episodes of lying in bed at night thinking about the incident, how they felt at the time, the pain which was created and how incompetent they perceived themselves to be. Sometimes the accounts of the flashbacks were very vivid concerning the feeling when the sharp had originally penetrated the skin, as this nursing student describes:

“...however sometimes just when I’m drifting off to go to sleep...[whispers] I can’t believe I’m going to tell you this...I...I feel the...sharp...the needle going into my finger so that’s the only thing personally...maybe...[almost crying] just still in my mind somewhere...sorry...but obviously there’s something there because if I’m...just when I’m drifting off to sleep, you know, and never want it to happen again...I don’t have nightmares about it but I do just as I’m drifting off...I’m just drifting off to sleep sometimes but I wouldn’t say I’m having nightmares about it and worried about it or...I would say five or six times that’s happened” (NS Int4)

Another participant stated how they would quickly try to stop the flashback when it occurred and how they would ‘*try to squash it by doing something else to get my mind off it*’ (NS Int5). This was because for a couple of times a day, lasting for two to

three days following the SI, the nursing student would be reminded of it when they did not want to be.

The pain

Another impact of the SI was the pain and discomfort caused to the fingertips or the thumb. The pain experienced was sometimes minimal and was described as '*just a little bit of pain at the time*' (NS Int1) and '*a little bit sore for the rest of the day*' (NS Int2). Occasionally the pain was more severe because the sharp involved was a blunt drawing up needle, and then it was described as being '*very, very sore*' (NS Int5). The pain was experienced for various periods of time, lasting for '*three hours maybe...if that*' (NS Int2), '*probably about two or three days*' (NS Int3), to '*maybe about a week and a half afterwards*' (NS Int5).

The SI stopped me from doing something

A further impact of the SI was that the event did stop a participant from doing an activity. In this case the participant explained how the SI had prevented them from donating blood for a period of time:

"I went to give blood...and I had to fill in a form and go through everything and obviously it said...'Have you received a needle stick injury?' and I was talking to the nurse about it and she said 'Well you can't give blood today because of the needle stick injury...so it was a bit of a shame not being able to do that'" (NS Int12)

No impact

Occasionally participants stated that the SI did not affect them personally. This was because they may have sustained '*loads of cuts over my lifetime*' (NS Int1) and so they were not unduly concerned. Additionally there was sometimes the feeling that

unless there was something to worry about, in this case the risk of seroconversion, the incident did not cause concern (NS Int9).

6.4.3 Theme Three - '*The role of my Mentor and Personal Tutor following the injury*'

A supportive mentor

The supportive attitude of the mentor was articulated by participants. There was a sense that the mentor (and the nursing team) were '*really supportive and understanding*' (NS Int2) following the SI. The supportive behaviours of the mentor (and the nursing team) were also expressed such as '*checking on me*' (NS Int11) which was appreciated as it made the participant feel cared for and not forgotten. The enquiry of the participant's emotional state following the event was welcomed and imperative to aid the nursing student overcome the emotions that were felt (NS Int10). This was particularly welcomed in the instance when a student nurse was found crying by the mentor. Calming reassuring words spoken by the mentor, such as '*oh don't worry that happens*' (NS Int3) was also a support to the participant following the SI. Another participant stated that the mentor had a calming influence on them following the SI with words such as '*Okay, calm down it's fine*' (NS Int9). This was because the participant was in a distressed state, felt anxious and was confused about what to do following the SI. There was also a sense that the mentor's behaviour towards the nursing student did not change subsequently which was felt to be very important. In fact the behaviour was described as '*encouraging*' (NS Int11). The normalisation of the event by the mentor (and the nursing team) by not making a commotion about the SI was applauded, with terms such as '*don't worry it was an accident*' (NS Int9) being used.

By not making the participants feel uncomfortable and by not reprimanding, the nursing students felt reassured:

“I felt grateful that she [the Mentor] was so supportive because she didn’t make a huge palaver of it she just went through the steps, talked me through it...it felt like it was normal to her it wasn’t like “Oh my God I’ve got to go through these steps with her” she was very reassuring so I felt fine and really supported” (NS Int10)

The supportive conversations also commonly incorporated the mentor encouraging the participant to use sharps again when they may have felt disinclined to do so. Not only did this improve the participant’s confidence levels but it helped the nursing student not avoid an essential part of their learning, as described here:

“...she [the Mentor] just reassured me and if anything she pushed me to do the IVs because I think she could sense there was hidden reluctance to do it but then...her pushing me slightly to just get on I think it helped because had I not had that and I think had I allowed my reluctance to continue then I think I would have developed not so much a fear but dislike for doing future IVs and needle prep and things like that” (NS Int5)

The support and comfort from the mentor also continued if the nursing student had to have tests following the SI. Sometimes the mentor took the necessary blood samples and also thoroughly explained to the participant what the process entailed. The support that was given was appreciated by the participants and it was felt that this aided good teamwork in the placement, by not making them feel uncomfortable following the SI (NS Int2; NS Int4; NS Int5; NS Int10).

Competence of the Mentor

Not only was the mentor seen as being supportive, but also competent in their role following the event. The nursing students praised the mentor regarding how competent, proficient and knowledgeable they were. The competence ranged from

instigating first aid for the injured participant with common phrases such as '*she took over and administered first aid immediately*' (NS Int1) being mentioned. The mentors were also described as being proficient regarding the correct documentation which had to be completed following a SI and the completion of a thorough assessment of the circumstances of injury:

'She [the mentor] asked about the situation...she asked me what did I do and I told her. She said 'has the needle gone in to any fluids or patients' (NS Int5)

Not only did the mentors thoroughly assess the nature of the SI but they also re-assessed the situation and offered further advice regarding the injury. This involved checking the blood loss, suggesting dressings to apply, completing further documentation and suggesting visiting the Emergency Department if required.

The relationship with the mentor

The perceived relationship with the mentor following the SI was also discussed. It was felt that some relationships stayed the same or improved, some changed slightly, but sometimes the relationship was perceived as being worse. Initially following the SI the relationship was sometimes alleged to be different because the participant did not know the mentor very well at that stage of the practice placement. This made this nursing student worry that the mentor may initially see them as being '*a bit of a handful*' (NS Int3) and the relationship felt different for a short period of time. A participant felt that the relationship between the mentor and themselves was stronger following the SI. This was due to the competent way in which the mentor dealt with the situation and the nursing student then '*probably appreciated her a bit more*' (NS Int10).

Generally the relationship between the participants and the mentor was perceived to be the same following the SI:

“...it didn’t change how we worked together or anything it was still, I feel like we still had the same relationship, I still got on with her really well”
(NS Int11)

Although the relationship did not change, one participant (NS Int4) stated how they were concerned about returning to the practice placement and how she would be perceived by the mentor and the nursing team. The nursing student was worried that all of the staff would have been made aware that the SI had occurred. This created worry for the participant because there was a feeling that ‘*everybody would know*’ and they might be treated differently. Another nursing student did feel that the relationship between them and their mentor was worse after the SI. This was because they were afraid to approach the mentor for fear of being seen as inept:

“I felt like I couldn’t really approach him really with questions because...well [pause] any questions that I thought were going to be make him doubt my competency” (NS Int6)

The use of humour

The use of humour by the mentor (and the nursing team) was conveyed as a common occurrence following the SI. The participants interpreted the use of humour in many different ways. Some saw the use of humour by their mentor as a way of helping them calm down following the SI because the participant was agitated and saw the humour as a ‘*bit light-hearted*’ and ‘*nothing malicious*’ (NS Int1). Another participant mentioned how an appropriate level of humour was used to make them feel better about the SI as the mentor ‘*made a bit of a joke about it*’ (NS Int12) in an appropriate way that did not cause any offence to the participant. This humour was used as the participant perceived that the mentor knew her well enough not to take

umbrage. As well as using humour initially after the incident, another nursing student described how her mentor used humour about the incident at a later stage in order to put her at ease:

"...we would have a little bit of a joke about it really...if we went to somewhere else...she was like 'Are you sure you want to do another injection? You are not going to stab yourself again are you?' [laughs] do you know what I mean?" (NS Int9)

Although one participant (NS Int6) did not appreciate the mentor using humour following the SI because of how they felt following the injury and because of their inexperience at the time:

"I was really, really embarrassed and upset about it and he kind of was dealing with that with humour which I maybe wasn't ready to deal with it in that way at that point so...he handled it jokey which I think he was doing to...make me feel better but it didn't really come across that way" (NS Int6)

The sharing of experiences

When the mentor (and the nursing team) shared their experience of having a SI, there was a feeling that this was beneficial to the participant. This helped to reassure the nursing student as they then realised that it was a much more common occurrence than they had imagined and they did not feel like it had only ever happened to them:

"one of the nurses on the ward erm, she cut her finger a couple of weeks ago, erm, so that made me think, oh, you know, I'm obviously not the only person who has ever done it" (NS Int6)

Other nursing personnel apart from the mentor, such as HCAs, also disclosed to the nursing student their experience of personally having a SI. This was perceived as a way of trying to normalise the situation by using phrases such as *'don't worry, we've*

done it loads' and *'it's a normal thing'* (NS Int10). This helped to reassure the participant and was seen as a coping mechanism. The SIs were often put into a context, being described as being like an occupational injury which can happen within any organisation:

"they said it's just like if someone stubbed their toe in an office...it's just our version of like, occupational hazard it's just that it is very stigmatising I guess because it is a needle, but there are people with hammers and saws in other places" (NS Int10)

A chance for education

The mentor sometimes seized the chance to inform and educate the nursing student following the SI. Some of these occasions involved an outline of the process, policies and procedures which should be followed a SI involving a used sharp (NS Int2). This helped the nursing student understand the procedure in a time when they were having problems comprehending:

"...she [the mentor] showed me the little flow chart and possibilities...the process was broken down really well...and I went home with it so that was quite good, the visual aid to the process was very useful...they can talk at you about what's going on but you kind of, your head's over here somewhere isn't it so actually having that piece of paper with the breakdown of who to contact and what happens next, that was probably the most useful part apart from being well supported"
(NS Int10)

Some mentors offered the participant tips on how to avoid a similar circumstance from happening again, by giving them advice on different techniques to minimise the risks (NS Int2). One nursing student described attending an injection technique training day organised by the mentor following the SI with a used sharp.

This helped to improve practice and to reduce their anxiety, as the nursing student describes:

“I went and had the training with the diabetic team which was really helpful...we practiced on teddy bears so that really made the next experience much easier” (NS Int4)

One participant though felt that the mentor missed an opportunity to educate about different techniques which could be used in the future by the nursing student to reduce the risks of a SI reoccurring (NS Int6).

The Personal Tutor at University

Some nursing students declared that they had contacted their Personal Tutor to inform them of the SI and had received reassurance, support and guidance as to what had to happen next (NS Int9; NS Int10; NS Int12):

“She was good as gold she just said ‘Have you done this, have you done that?’ and I said ‘Yes it’s all been done’ it had all been done by the time I spoke to her and she said ‘Okay well you know if you need anybody to talk to or anything else you know, I’m here just let me know” (NS Int9)

The communication with the Personal Tutor commonly involved them asking the participant pertinent questions, advising them to complete the necessary documentation and if applicable referring them to the Occupational Health service. This was in line with the responsibilities of the employer based upon decades of legislation and guidance on follow-up support (The Health and Safety (First Aid) Regulations, 1981; HSE, 2005; HSE, 2011; HASSIH, 2013; European Agency for Safety and Health at Work, 2018b).

One nursing student explained her reluctance to contact their Personal Tutor because of the fear of the incident being documented on their record, being seen as incompetent and a fear that staff at the University would know about the SI. When she did tell her Personal Tutor, the participant declared *'I'm so sorry you'll never believe what I have done'* (NS Int9). The apprehension about disclosing the information about the incident was unfounded though as the Personal Tutor was seen to be very supportive. Participants spoke of the various reasons why they did not tell their Personal Tutor about their SI. These were fearing the Personal tutor would think she was *'a fool probably'* (NS Int6), being *'really embarrassed'* (NS Int4) and a feeling that *'it wasn't deemed necessary'* (NS Int2) because of the nature and circumstances of the SI.

6.4.4 Theme Four - *'The role of my family and friends'*

Informing nursing student colleagues

Telling nursing student colleagues about the SI conjured up many emotions for the participants. Feeling apprehensive of the reaction from their peers was frequently mentioned. Other emotions experienced when reciting the SI experience were being *'embarrassed'* (NS Int4) and feeling *'silly'* (NS Int1). On the occasion when a participant was on clinical placement away from home and their nursing peers, they found it difficult to disclose the SI and felt a sense of isolation:

"when you are on placement you are all alone unless you have got another student there and you are already close to them so because I was on my own on that placement like I have been for other placements it can be really isolating and having no one to really talk to and try and make light of the situation is hard" (NS Int5)

The experience of telling nursing peers about the SI was sometimes viewed as a learning experience as their nursing student colleagues learnt about what had

happened during the injury and what had to happen following the injury. It occasionally gave participants an opportunity to 'educate other students' (NS Int11) which gave them a feeling that they had helped others. Some of the peers who a participant disclosed their experience to were nursing students from another University. Hence there was a sharing of information between students from different educational establishments, as this nursing student explains:

“there were two other students on placement with me at the same time... there was a first year first placement and a third year management student and they were from [name] Uni and...so it was kind of sharing experiences between the Unis and between placements and settings I guess”
(NS Int10)

Nursing student colleagues commonly assumed that the SI had occurred with a needle. Hence it was felt that sometimes learning took place concerning SI caused by glass (NS Int11). Talking to nursing student colleagues about the SI also helped peers to develop prevention strategies as a way of avoiding SIs happening to them (NS Int4). The discussions with other nursing students meant that they were more informed about being careful and being more wary in the presence of sharps (NS Int3). In essence it was thought to be beneficial to talk to nursing student colleagues for their own personal benefit, but also for the benefit of others (NS Int9).

The reaction from the nursing student peers towards the participant was regularly one of humour. Some participants spoke of how their colleagues laughed and made light of the situation when they told the story of the SI:

“I did tell my friends and they just laughed at me which was fine...it didn't affect me though...everyone made a joke out of it”
(NS Int2)

This laughing about the SI was seen as a *'coping mechanism'* (NS Int9) and also a sense of *'camaraderie'* (NS Int10) between the participant and their peers. Another participant stated that they had been called names by their nursing student colleagues when they had told them their story, but this was in a jovial manner:

"I got called all sorts of names [laughs] not very nice ones but that's fine [laughs]...yes we've got a really good relationship anyway so it's, you know, you're called an idiot" (NS Int9)

There were many reactions following the disclosure of the SI. Nursing student colleagues were very supportive after they had been told them about the SI. This included *'messages on Facebook and text messages'* (NS Int4) with thanks for the sharing of the information. Reassurance was also given by justifying the injury by claiming that *'everyone makes mistakes'* and *'it's just human error'* (NS Int7).

Further benefits of telling nursing student colleagues of the SI included a feeling of *'getting it off my chest'*, primarily because it sometimes felt that there were *'only so many people you can talk to about a situation like this'* (NS Int5). This was because being a nursing student meant that you could potentially understand the situation more effectively. This was unfortunately not always the case because one participant (NS Int7) felt that other student nurses did not fully understand the concept of having a SI because they had not experienced one personally:

"I've mentioned it to my friend...but she hasn't had a sharps injury so she didn't understand like the feelings behind it" (NS Int7)

A further benefit identified was that participants felt that by telling their nursing student colleagues about the SI, they realised that they were not alone. This was because some of their peers had also had a SI meaning that *'I was quite glad that I wasn't the only one'* (NS Int8).

Informing non-nursing friends

There were a few reasons stated why some participants did not tell their non-nursing student friends about the SI. There was a feeling that friends would not be able to comprehend the SI because they were not directly involved within healthcare and because the participants may have felt *'foolish and stupid'* (NS Int9). On the occasions that some participants (NS Int12) did tell their non-nursing friends about their experience, they stated that they had to sometimes reassure them as they took the news very seriously.

One participant (NS Int6) to this day has not told anybody except the researcher of this study about their SI because of feeling embarrassed, thinking that they were the only one and because of a perceived assessment of their competence as a nursing student. Another participant stated that they had not told anybody initially about the SI, because they felt embarrassed and a failure. At a later stage though, the participant did tell their nursing student colleagues:

"I didn't actually tell anybody...I was just erm, [long pause] [voice wobbly and participant was almost crying] I almost felt like, definitely a failure as a student and I didn't really want my fellow students to know that I had done such a thing because you want to do...complete your nursing career and never have one, so for me to have one within four weeks of starting placement I was really embarrassed about...[pause] sorry keep wobbling"
(NS Int4)

Informing family members

Telling family members about the SI created various emotions for the participants. When the SI was caused by a used needle, telling family members was occasionally a very traumatic experience and the worst part of the whole episode. It was described as *'awful'* (NS Int4) and involved feeling very anxious and crying profusely. There was a sense of feeling foolish when recounting the episode and also feeling

silly. Although not always upsetting, participants did state that they felt sad and 'disappointed' (NS Int9) with themselves. One nursing student talked about the perils of being on placement far away from home in the aftermath of the SI. This made the incident much more difficult for them because they felt isolated with no-one to discuss the situation with:

"...you can't really sort of tell family and when you are on placement you are all alone...it can be really isolating and having no one to really talk to and try and make light of the situation is hard" (NS Int5)

The reactions from the family following the revelation were also sometimes varied. Some participants spoke of how supportive their family was following the disclosure. This was by the family being loving and reassuring to the participant and was helped by the fact that the family were impartial and not involved in the episode. Participants stated that it was beneficial to talk to someone who was not going to bombard them with information and someone who they actually knew very well. This was because occasionally the mentor had only known the participant for a short period of time before the injury. Nursing students talked of reciting the story of their SI to their parents, and then their family member reiterating how 'clumsy' (NS Int11) the participant had been throughout their lives. This had been brought up in conversation by their family to help to normalise the SI that had occurred. There were also discussions about various injuries that other family members had had, as a way of normalising the situation, as one nursing student describes:

"my Mum...she was like Dad had chopped part of his finger off at work before so [laughs] it's just a sharps thing [laughs] she was like he's come home falling off roofs and spraining bits so she's like "all pieces still attached? Yes, you are fine" (NS Int10)

One participant mentioned how worried certain members of their family were and wanted to know more information about the situation '*my Mum just had a lot of questions*', whilst others were ambivalent to the situation '*my Dad was just kind of irrelevant to the whole situation*' or mocked the student nurse '*my brother made a few jokes*' (NS Int12). Another participant said how their family had said they had been foolish acquiring the SI. They were called '*an idiot*' (NS Int12) at the time.

6.4.5 Theme Five - '*The next time I used a sharp following the injury*'

Perceived improved practice

Following the SI there was a sense that the participant's practice and performance had improved primarily in relation to the use of sharps, but also in other aspects of nursing care. A participant spoke of how their sharps safety had improved following the injury in relation to the use of sharps bins to dispose of the sharp more effectively than they previously may have done. This meant that the participant kept '*the sharps bin as close*' (NS Int9) as possible in order to avoid an injury when disposing of the sharp. Three participants spoke of how more meticulous they were with sharps following their injury, and how they now took their time when handling sharps. This meant that they had learnt to be more '*conscientious about where it's going*', paid it more attention and gave the sharp their '*110% focus*' (NS Int5). It was expressed that the participants would check and double-check the sharp during the procedure to reduce the risk of possible injury. Another nursing student (NS Int2) spoke of how they now use gloves and a tissue when dealing with sharps to reduce the risk of having an injury, whilst another participant (NS Int8) explained how they now used the wrapper from the syringe they were using to open the glass ampoule to avoid cutting themselves on the glass ampoule containing the drug.

On occasion the participant had been taught a new technique which they said they would employ next time they were performing that skill, in this case introducing a drug into a bag of intravenous fluids:

“...so I’ve been shown different techniques of how to hold the bag so the needle won’t go anywhere but that hole that it needs to go into”
(NS Int5)

The SI had made some participants more conscious of the hazards involved in the procedure and of their surroundings. This meant that sometimes adaptations were made with the technique when using the sharp, such as the ‘*positioning of my hands*’ (NS Int4). This involved being more mindful of their surroundings when performing nursing procedures involving sharps by paying more attention to what they were doing.

A participant (NS Int10) explained how her approach to patient care had improved following the SI, such as making the patient feel more relaxed and by distracting them during potentially painful procedures. This was especially true if the patient had a mentation issue, which was a new phenomenon for the participant. This new approach was directly related to the lessons which had been learnt following the SI. Similarly another nursing student spoke of the assessment they now made to protect themselves and the patient, mainly because they thought of themselves as ‘*really clumsy*’ (NS Int10). The assessment of the situation involved looking at the patient’s psychological state and possible risks involved. One participant (NS Int1) spoke of how they did things differently next time they handled sharps, by taking more precautions, having discussions with their mentor and watching the procedure being

performed competently. In essence, there was a feeling that learning from experience had taken place following the event:

“...it’s just one accident you know, other people have done it you know, I’m not going to be the first and I’m not going to be the last so just take it on the chin and learn from the experience”
(NS Int5)

There was also a sense that the SI had improved some participant’s general nursing practice and skills as well by making them more aware of optimal ways of performing various nursing skills. It was expressed that the participants felt the need to ‘*do things correctly*’ and also importantly to ‘*learn before doing it*’ (NS Int11). It was felt that this helped to enhance the participants practice and made them more aware of exactly what they were doing. Additionally, not being complacent was also an important factor, which meant that following the SI, various new areas of learning happened, not just how to use a sharp correctly.

Emotions

Performing a procedure involving a sharp following the SI conjured up many emotions. These emotions were either felt or anticipated. Feeling anxious, nervous and having trepidation were commonly stated. The anxiety that the participants felt was sometimes through a fear of a SI happening again:

“I was obviously quite nervous doing...injections after that...and never want it to happen again so I’m anxious about that” (NS Int4)

Another participant stated that when they were asked to do their first sharps procedure following their injury they mentioned that ‘*I was a bit shaky*’ (NS Int3). The nervousness of giving an injection subsequently did sometimes last for a long time. One participant (NS Int8) stated that they still felt nervous about using sharps two

years after the SI through fear of cutting themselves again. The nursing student exclaimed how proud they felt following the completion of their next procedure using the type of sharp which was involved in the injury. Another participant (NS Int12) discussed how they initially felt nervous about their next sharps procedure as they did not want to make another mistake and put the patient through the stress and upset of having to have blood tests taken again. Even though the next sharp usage commonly created anxiety, once it had been performed participants felt less anxious:

“...giving the next injection I was a bit [anxious]...but it was fine [laughs] and I did her injection the next day and it was okay” (NS Int10)

Another emotion frequently expressed was the feeling of being cautious when next handling sharps. Participants stated how careful and wary they were when it came to dealing with sharps following the SI, such as when breaking off the top of an ampoule (NS Int1). The cautiousness was commonly overcome by using a different technique when handling the sharp or paying closer attention to the procedure. Feeling ‘*on-guard*’ (NS Int5) when they came into contact with exposed needles following the SI was also mentioned. Even though there was a sense of being very cautious about repeating the procedure, once the procedure had been completed, confidence returned:

“I was a bit cautious about doing it again but then I did get over it and I did...do it again and then I practiced and my confidence grew”
(NS Int7)

Avoidance of sharps

Avoidance of sharps following the injury was expressed by some participants. The circumvention was for various lengths of time, which ranged from ‘*20 minutes to an hour*’ (NS Int10), to ‘*a couple of days*’ (NS Int5) to ‘*four weeks*’ (NS Int8). Avoidance

was achieved by giving excuses, not volunteering or allowing the mentor to perform skills using the sharp, as this nursing student describes:

“kind of would get anxious if I thought...my Mentor was going to ask me to...prepare any medication again so I think I’ve kind of managed to talk my way out of it up until now...I would kind of avoid having to like draw up anything if I could...yeah, just kind of make excuses or say ‘well if you [the Mentor] do that do you want me to do something else instead?’”
(NS Int6)

The avoidance was commonly achieved by allowing the mentor to carry on and perform the sharps procedure. This was occasionally because the participant did not want to risk repeating the SI. Although in some placements there was no way of avoiding using sharps because of the amount of injections that had been prescribed.

Getting back on the horse

Not all of the participants avoided sharps following their SI. There was a feeling that they ‘*need to do another injection*’ (NS Int9). Avoiding it was not an option, as sometimes they were prompted by their mentor to ‘*get back on the horse*’ (NS Int10). There was a sense that some participants would not be frightened when faced with using sharps again, but might ‘*be wary and may do it slightly differently*’ (NS Int1). Indeed, the evidence suggested that some nursing students wanted to get the next sharps procedure over with. There were concerns raised that if the next procedure involving sharps was not completed, it could cause more long-term issues with confidence:

“I wanted to do it, I wanted to sort of just almost get it over with to be honest, it was just get this done” (NS Int9)

There was a sense on occasion that the participants wanted to do the next sharps procedure but wanted to be shown again by their mentor how to do it more safely.

6.4.6 Theme Six - 'If it had been a used sharp'

It would be different

Participants discussed different responses had a used sharp been involved in the SI. There was a sense that the participant's responses would have been different if the sharp had been used before the SI. This was primarily due to the potential contamination risk from the SI, and not knowing what types of disease could be carried within the blood of another person, as this participant explains:

"Well it would be a completely different ball game then of course...if it had been in a patient I'd have no idea whether they're an inoculation risk...to be honest I think it would be much worse situation...had the needle gone into the patient first and then into me" (NS Int5)

Hypothetical emotions

There are many emotions which participants felt that they would putatively experience if the sharp had been a used sharp rather than a clean sharp. One very common emotion expressed was a massive knock of confidence within their nursing practice. This would have involved avoiding people, interacting with patients and certain nursing skills. This feeling of a loss of confidence also led to a feeling that some participants would not be able to help and safeguard their patients if they could not protect themselves:

"I think my confidence would just self-plummet to interact with the patients because if I couldn't protect myself then how would I be able to protect my patients" (NS Int5)

Worry and anxiety was another common emotion articulated. This worry and anxiety was declared it would be worse than the initial worry that some participant's felt during their SI with clean equipment. The worry and concerns would have been about the risks of BBVs and contamination if a used sharp had been the cause of the

SI. This was viewed as being more serious. Dwelling on the issue and constantly thinking about it would also have been a potential issue for many participants:

“I’d probably be a bit more traumatised by it because...it could have potentially been something more sinister, it could have...caused me to become ill or something as a result” (NS Int7)

The worry was not only concerning potentially acquiring an infection and having an illness during their lifetime, but passing that infection onto other people. The hypothetical impact could then be on other family members and the problems and issues that could create. There was a sense that the worry frequently expressed would have continued until the participant received the results of their blood tests. The worry was sometimes related to potentially having another SI if they had injured themselves with a used sharp. There was also a sense of guilt at potentially being absent if treatment was necessary with a hypothetical injury. Added to this was a feeling that they were the only person this had ever happened to:

“I would probably be worried and like if I was the first one to do it and that would all go through my head like am I the only one ever to have done it on this placement” (NS Int11)

An indication of how more worried a participant would have felt if the sharp had been used rather than clean was expressed. The fear of potential seroconversion meant that the worry level would have moved *‘from like two to three... to a good seven, eight I reckon’* (NS Int11) but if the patient was a known HIV positive patient, then *‘it probably would have been max’*. One participant declared that they would have felt *‘paranoid’* (NS Int8) that they had acquired a disease following the SI. The amount of worry that might have potentially been felt had the sharp been used may have affected sleeping patterns, might have made the participant think about the incident unwillingly and may have kept them awake all night:

“it would have just kept me up, I would have had lack of sleep because I would have been up worrying about it just over-thinking it, thinking of the worse possible scenario” (NS Int8)

The hypothetical abundance of worry may even have made one participant (NS Int6) question their own abilities and wonder if nursing was the correct career for them.

Another nursing student stated that they would not have been concerned about having the necessary blood tests and investigations following a SI involving an unclean needle. This was because of the importance of *‘getting checked out’* (NS Int3). Being potentially embarrassed about the episode was also mentioned as there may be a questioning of the participant’s own abilities and competence (NS Int8).

Another nursing student explained how they would have been annoyed with themselves if a used sharp had been involved, because they felt that they knew the correct procedure to dispose of a used sharp (NS Int3).

Shock, panic and feeling scared were other emotions divulged by some participants due to the severe nature of the theoretical situation. This was because irrational thinking and *‘a lot of panic’* (NS Int11) meant that *‘the worst possible scenario’* (NS Int8) was envisaged. Another participant mentioned the *‘meltdown’* they thought they would have had if the sharp had have been used instead of clean. This would have involved potentially feelings such as shock, rage, and frustration:

“I think it would be a much worse situation and had the needle gone into the patient first and then into me...I think I would have gone into a meltdown...meltdown as in shock, anger... I’d be extremely frustrated with that I’d be angry, just really upset” (NS Int5)

“I can only imagine that you would be quite scared” (NS TC13)

One student stated that they would be more cautious and apprehensive about doing an injection procedure if the injury had been with a used sharp, than they would have been using a glass ampoule:

“Erm, I think I’d be constantly worried and...I think I’d be a lot more cautious...but I think I would be a lot more apprehensive with doing needles than I would opening a glass ampoule again” (NS Int11)

The feeling that emotions would be more long-term if the sharp was used than the short period of time which they had endured with a clean sharp, was also discussed. There was a sense that the emotions would only have been for ‘*a few days*’ (NS Int5) if the sharp was clean, but ‘*would probably go on for a much longer period of time*’ if the sharp was used. This was because of the potential serious consequences of the injury. Hence, one participant (NS Int8) mentioned that they would have considered having counselling support if the sharp had been used, to help them to overcome the potential emotions of stress, anxiety, irritability and depression.

To tell others or not

Regarding telling others about the SI, many participants felt that this would be different if the sharp had been used. The story may have been told differently as an injury with a used sharp would not have been seen as a laughing matter:

“...if it was something more substantial then it’s not appropriate to be making a joke about it and things...I would have responded differently” (NS Int2)

Telling the story of their SI may also have made some participants feel ‘*more embarrassed about it*’ (NS Int3), and occasionally less likely to have told other nursing students about the injury, but may have just spoken to close associates instead. There was a sense that the participant may have spoken to people who they

trust because of a fear about their safety and also due to the personal nature of the situation:

“I mean there might have been one or two who I am close to that I might have if I was really, really worried you know, in the first instance like waiting to find out about any infection or anything like that but it wouldn’t be something that I would talk freely about” (NS Int6)

Avoidance of situations

The avoidance of certain situations and experiences if the sharp involved in the SI had been used was also expressed by some participants. Some nursing students felt that they would have ‘*avoided people*’ (NS Int2) and avoided ‘*doing sharps for a lot longer*’ (NS Int8). Some participants also said that they would have avoided placement because of a plummeting in ‘*confidence*’ (NS Int5), ‘*fear of repetition*’ of an injury, possible ‘*treatment*’ (NS Int11) following the injury and the amount of ‘*anxiety*’ (NS Int8) they may suffer as a consequence. Even though it was felt that it is difficult to envisage a situation unless you have personally experienced it, there was a sense that it would be a much worse situation which was likely to be over-analysed, resulting in an increased possibility of being reluctant to go back into placement.

Questioning competence

Questioning of competence was also mentioned as a hypothetical issue raised by some participants if the sharp had have been used. This was associated with ‘*questioning my abilities*’ (NS Int6) to complete nursing skills adeptly. Finally the relationship between the mentor and one participant was visualised as being potentially different had the sharp been used.

The participant felt that the mentor may have viewed and treated them differently:

“I would have worried that they [Mentor] would have thought less of me or not let me do as much because I was a danger, I was clumsy or I couldn’t do it properly” (NS Int11)

6.4.7 Theme Seven - ‘Prevention of the sharps injury’

Sharps bins

The prevention of SIs was commonly mentioned by participants. Sharps bins were highlighted as being essential equipment. Nursing students suggested how SIs could be prevented by the correct use of sharps bins. This included the importance of familiarisation with the placement policies and procedures of sharps bin usage and the signing of the bins when they were first assembled. It was also mentioned by many participants that sharps bins should be kept close by, be easily accessible and be within easy reach during a sharps procedure:

“the sharps bin is your friend – keep it by your side...” (N TC5)

This aided the safe and effective disposal of the sharp by a movement straight from the patient to the sharps bin. It was felt that the correct techniques of disposal should be used, by ensuring that there is no crowding and by being supervised during the procedure:

“people should always have sharp bins accessible when dealing with sharps to ensure safe and effective disposal” (NS TC1)

It was mentioned that it was imperative that there were enough sharps bins of different sizes so that sharps could be disposed of safely and efficiently. It was also viewed as important to check that sharps bins did not get too full, as this could potentially cause a SI. When the sharps bins were full, it was stated by nursing

students that the bins should be signed for and locked and not left for others to complete. Additionally, these used bins should be disposed of correctly and replaced. This is in accordance with decades of legislation and guidance regarding the training and promotion of the safe use of sharps bins (HSE, 1995; EAGAAGH, 1998; COSHH, 2002; EBN, 2011; HSE, 2011; HPA, 2012; NHS Employers, 2013a; HASSIH, 2013; UNISON, 2014). It was also mentioned that those not completing this important final task should be questioned and that staff should take more responsibility with this important aspect. It was revealed that occasionally sharps bins had been seen which not been put together properly, which could potentially cause a SI. This echoes the findings of the HSE (2015; 2016) reports of poor sharps practice within Trusts discussed within section 3.3.2. Examples were given of a lid falling off as it was not firmly attached, and a patient incorrectly assembling the bin in a community setting (N TC1; N TC8).

It was also stated that best practice guidelines should be followed which includes not filling the sharps bin passed the maximum fill line on the bin (N TC1; NS TC17). It was re-iterated that short-cuts should not be taken (N TC14; NS TC3; NS TC18; NS TC26). It was discussed that in parts of the community some patients have sharps bins issued to them for the duration of their treatment which they take to the GP when full, whilst in other areas this was not the case. Hence there was a discrepancy reported in sharps bin procedures between healthcare areas (N TC12; NS TC26).

Safe disposal of sharps

The disposal of sharps was also considered an imperative way of preventing SIs involving nursing students. Participants spoke of good preparation before starting the procedure, so that correct disposal was at the forefront of people's mind:

“make sure that you handle sharps carefully and dispose of them safely into a sharps bin immediately after use” (NS TC1)

Participants felt that sharps should be handled carefully and disposed of instantaneously after usage into a sharps bin. There was consensus that HCWs should always dispose of their own sharps, stating that it should be a matter of urgency. An example was given of a doctor not disposing of sharps following a lumbar puncture:

“if you have used any sharps, clean after yourself, make it a priority” (N TC13)

Again this observed practice mentioned within the qualitative phases of the study appears to be in contravention of decades of legislation and guidance regarding safe disposal of sharps (HSE, 1995; EAGAAGH, 1998; COSHH, 2002; EBN, 2011; HSE, 2011; HPA, 2012; NHS Employers, 2013a; HASSIH, 2013; UNISON, 2014) and echoes the findings of the HSE (2015; 2016) reports of poor sharps practice within Trusts discussed within section 3.3.2.

Education

Education was felt to be an important factor in the prevention of SIs regarding nursing students. Good education, repeated at intervals was viewed as beneficial to enable good practice especially from the start of the programme. This education should involve repetition of the correct procedures in the CSSW as well as the placement of posters highlighting the importance of safety in areas where sharps are kept or used:

“one word - Education...” (NS TC26)

It was felt by participants that learning good practice in the CCSW at the University was a beneficial process as it gave nursing students an opportunity to learn good practice before going out into placement. Simulation is seen as a valuable learning approach within nurse education (WHO, 2018c), with the benefits of aiding proficiency, replicating clinical practice and allowing mistakes within a safe environment (Eyikara and Baykara., 2017). It was felt that his learning should involve following best practice guidelines so as to reduce the risks of a SI and that the topic of sharps safety needed to be given as much attention as it commands (NS TC5; NS TC6; NS TC17; NS TC26; N TC2; N TC14).

It was stated by four nursing students that there should be regular education sessions for all HCWs involved in the use of sharps to update their skills (NS TC4; NS TC17; NS TC26; NS TC15). This was also seen as a method to aid the reporting of bad practice within a no-blame culture (NS TC28). More '*theoretical input before practice*' (NS TC6; N TC7), and having more practical sessions prior to placements throughout the programme was seen as beneficial:

“Education is essential for sharp safety...” (NS TC14)

Although theoretical education was felt to be crucial for sharp safety, it was also mentioned that nursing students should be allowed to learn through practice more.

Do not re-sheath

Not re-sheathing a needle was a considered an imperative part of preventing a SI from occurring. Some participants stated that it was a very dangerous practice:

“Even being a student nurse, I always know to never re-sheath a needle”
(NS TC43)

Nursing students stated that there should be constant reminders in practice about not re-sheathing. It was stated that it was not really mentioned in placement but there were informative posters in the clinical environment. It was felt that if nurses follow the correct procedure of having a sharps bin at their side during a procedure, there should be no need to re-sheath a sharp. It was stated that it was shocking that practitioners were still re-sheathing needles, and it was felt that this had been declared as bad practice for years:

“Why do you need to re-sheath a needle?” (N TC4)

Adhering to policies and procedures

The importance of being aware of the policies and procedures regarding best practice of sharps usage was discussed. It was suggested that sharps policies and procedures should be included in the placement information pack for nursing students. Additionally it was felt that more awareness could be achieved by informing colleagues if procedures involving sharps were being completed incorrectly:

“I thoroughly believe that there needs to be more awareness of sharps in each ward” (NS TC14)

This was mentioned that this could be realised within staff meetings, Twitter Chats, posters and development sessions for staff to learn and develop best practices (NS TC1; NS TC4; NS TC5; NS TC15; NS TC31).

Safety devices were also considered an essential way of preventing SIs. It was stated that many placement areas now have safety needles, including self-sealing needles and safety devices attached to needles, which make them much safer to use, gives reassurance to the user and thus reduces the risk of SIs. These views fit with the fact that since the 1990s the use of safer needle devices has been

recommended (HSE, 1995; NIOSH, 1999; ANA, 2002; Hutin et al., 2003) as a replacement for needles and syringes (The Personal Protective Equipment at Work Regulations, 1992; The Provision and Use of Work Equipment Regulations, 1998; The Health and Social Care Act, 2008; HASSIH, 2013).

Good leadership was considered imperative with SI prevention, by facilitating the adherence to policies and procedures. This involved good leadership at the bedside when sharps were involved to avoid a SI especially in emergency situations (NS TC8; N TC2). It was viewed as a sign of very poor leadership if HCWs were forced to dispose of other people's sharps and taking personal responsibility was considered vital. This taking of responsibility for your own actions was seen as imperative for personal safety and the safety of others, and fits with the Health and Safety at Work Act (HSAWA, 1974) and subsequent legislation and guidance discussed within section 3.3.2.

Respect for sharps

Having respect for sharps was thought to be an essential part of the prevention of SIs:

“Respect them [sharps] proportionately to the amount you fear the idea of a bad incident with them” (NS TC9)

This is because some participants felt that nursing students did not understand how dangerous sharps were and suggested that nursing students should treat sharps with an abundance of respect and caution (NS TC9; NS TC30; N TC7). There was a sense that student nurses needed to learn the importance of their own safety in relation to sharps otherwise they may have problems in placement (NS TC5; NS TC6; NS TC14).

6.4.8 Theme Eight – ‘The perception of the patient involved in the sharps injury’

Crack addict, drug user or prostitute?

The perceived risk of seroconversion following an injury with a used sharp by participants and their mentor was occasionally influenced by their perception of the patient. One nursing student joked about the SI risk involving a used needle. She perceived that she was not at risk because the patient did not fall into a certain category in society who they thought may be at high risk of having an infection, in this case a drug user or a prostitute. In this instance the patient was an older person living in a Residential Home:

“...it was the perception of the patient...I did make a joke of it ‘Well she doesn’t look like a crack addict...I’ll be fine...she doesn’t look like she was ever a prostitute or you know, took crack or anything’ so I’m not massively worried” (NS Int9)

Contrary to this statement, the participant did feel that she needed to know more about the patient and her history regarding the potential for seroconversion. The nursing student did appear anxious about this issue and needed to know more in order to help to reduce her anxiety. The same participant also felt that she was at low risk of seroconversion because of the age of the patient involved. The perception was that because the patient was older, she assumed the risk was low. Hence she did not feel concerned about the SI:

“I mean initially I just thought ‘Oh no’ and, and it makes you realise just how you do judge people because I did look at her and think ‘Oh she’s an old lady’ you know, ‘It won’t be anything bad’ now that’s really bad I know that’s really bad...there was nothing in her blood or anything else and she was an elderly lady erm, I wasn’t particularly worried if I’m honest, perhaps I should have been, but I wasn’t” (NS Int9)

If a '*different patient*' (NS Int9) was involved, then it appears that some participants felt that they would have been more concerned about the injury with a used sharp. The nursing student declared that they were not worried about the infection risk. This was compounded by the fact that commonly the participant '*knew the patient*' (NS Int10) and hence thought '*it could be worse*' (NS Int10) if a perceived higher-risk patient was involved. This participant additionally perceived the risk of seroconversion to be minimal as the correct procedure was followed. By expressing blood following the SI and following the correct procedure, they saw the risk as being minute:

"I would probably have been...more worried about the results, [if it was a different patient in a different context] but then I don't want to assume someone is full of bugs and I probably would have been alright as it was a tiny, teeny, tiny and if you bleed it and stuff it's like the millionth chance isn't it" (NS Int10)

Dying from a horrible disease

Conversely, another participant who had had a SI involving a used sharp did perceive the patient as potentially a source of infection and disease. This made the individual very anxious as they dramatically declared that they '*thought I was going to die of some horrible disease that I'd given myself*' (NS Int4)

A mentor's perception

A mentor also perceived the patient to be low risk as the patient was elderly. Hence the threat of seroconversion was perceived as slight, as the participant involved explained:

"I was quite interested as I didn't know obviously what was going to come back, what the risks are because my Mentor said to me, 'you know, she's an elderly lady erm, so the risks could be minimal, erm, they are most likely to be minimal'" (NS Int12)

6.5 Summary

Nursing students gave a vivid description of the event explaining the various types of injuries which occurred, and the varied procedures which they were involved with when the SI happened. The equipment which caused the SI was also varied. The nursing students suffered SIs in a multitude of environments ranging from the University simulation ward, to within hospital placements and within community settings. A range of various potential causes were deliberated, highlighting the myriad contributing factors involved. The first aid and follow-up care was also described in detail, although on occasion the SI was hidden and not reported.

The SI had an impact on the participants which affected their professional and private lives. Many different emotions were conjured up following the SI and experienced for variable periods of time. Occasionally the emotions would be severe with some nursing students suffering from flashbacks about the SI experience. There was concern and worry regarding not only the injury, but factors such as the risk of seroconversion, blood tests and how the nursing student may be perceived by the University, their mentor and the patient. The SI seemed to occasionally impact on family life which caused upset for individuals. Nursing students were also sometimes worried about the impact of the SI on the patient and fellow HCWs.

The role of the mentor and Personal Tutor was highlighted which exemplifies the important role of supervisors during and after the SI. The supportive nature of the mentor and other HCWs was illuminated, linked to their competence with dealing with the SI situation. The mentors on occasion used humour to help the nursing student deal with the experience, and took opportunities to share their experiences of similar personal episodes. Other mentors used the opportunity to educate the

nursing student and to reflect upon the circumstance. The Personal Tutors of the nursing students at the University were also described as supportive.

Peers and kin played a role in the nursing student's life following the SI. Nursing student friends used humour and were supportive when the nursing student involved in the SI gave an account of their experience. This episode stirred up many emotions but was viewed commonly as a learning experience. Non-nursing friends were generally not informed of the SI due to issues of comprehension. Telling family members was occasionally a traumatic experience which elicited various reactions.

The next time the nursing student used a sharp illuminated how practice had changed and the emotions felt when the nursing student was faced with performing a task involving a sharp in the future. There was a sense that improvement in sharps practice had occurred, with the employment of new, safer techniques. There was also a feeling that improvements had been made in other aspects of nursing care. This situation did conjure up varied emotions, with some nursing students avoiding sharps for variable periods of time. There was a sense though that the nursing student needed to 'get back on the horse' with regards to using sharps again.

If it had been a used sharp various hypothetical emotions would have been expressed which may have been more severe than having a SI with clean equipment. These emotions may also have lasted longer, with the nursing student less likely to talk openly about their experience. If seroconversion or exposure to bacterial infections had potentially happened, some nursing students may have avoided sharps for a period of time due to feelings on incompetence.

Various ways in which SIs involving nursing students can be prevented from occurring were suggested. Emphasis was placed upon education, simulation, good

leadership and the adherence to policies and procedures regarding sharps usage. Good preparation and having respect for sharps was also highlighted as a preventative technique. Practically, nursing students mentioned safe disposal techniques within sharps bins, the use of safety devices and the avoidance of re-sheathing as ways of helping to prevent SIs from happening.

The opinion of the patient had an influence on the apparent severity of the SI for the participant. There was a perception that there was a low risk involved in the SI as the patient was an older person, as opposed to being high risk if the patient was a 'crack addict' or 'prostitute'.

The findings from the quantitative and qualitative phases of this study will now be discussed in the following chapter.

Chapter Seven: Discussion

7.1 Introduction

This chapter will critically engage with, and discuss, the synthesised findings from the four phases of the study in relation to the literature. The quantitative and synthesised qualitative data were collected and analysed separately. The integration of the findings from the surveys, Twitter Chat, audit and interviews will now take place, where the data will be critically discussed in relation to available evidence.

The aim of this mixed methods study was to explore the experience of SIs from the perspective of nursing students within the UK, and to identify the incidence of SIs within that population. The study drew from two surveys, a Twitter Chat, an audit and qualitative interviews. The systematic review concluded that SIs involving nursing students worldwide were extensive, ranged widely in type, and were linked to psychological harm. The literature review highlighted that the types of microbiological risks of SIs involving HCWs are multiple, the policies to protect the individual from harm are not always complied with, the cost of SIs are astronomical and there are many potential psychological harms associated with SIs. Linked to these factors is that there are many learning theories which can influence nursing student's usage of sharps. The systematic review and the literature review highlighted a dearth of studies investigating nursing students involved in SIs.

7.2 Discussion of the findings

The study findings identified the incidence rate of SIs to be 14.7% within nursing students in the UK, Within the systematic review (Chapter Two), an incidence rate of between 9.4 - 100% (Blackwell et al., 2007; Trivedi et al., 2013) and a prevalence rate of between 5.9 - 94.2% (Cheung et al., 2012; Sharma et al., 2010) was identified

within studies conducted worldwide. This low incidence rate compares to similar figures reported within Italy (Petrucci et al., 2009); Belgium (Vandijck et al., 2008); Australia (Smith and Leggat, 2005); Canada (McCarthy and Britton, 2000); South Africa (Zungu et al., 2008); India (Kermode et al., 2005) and Turkey (Irmak and Baybuga., 2011).

This study revealed that SIs mostly occurred within the second year of the programme with an incidence rate of 44.5%. This echoes the findings of the eight studies reported within the systematic review, which identified the second year as the academic year with the most occurrences (Petrucci et al., 2009; Mitra et al., 2010).

Various locations of the SI were identified, with the treatment room (44.4% n=52) and the patient's bedside (29.1% n=34) shown to be the prime sites. Similar findings were identified within the literature (Talas, 2009; Karadag, 2010; Lukianskyte et al., 2011). Within this study medical (26.3% n=30) and surgical (18.4% n=21) environments were reported as the most common specialties, and this echoes the findings reported within the systematic review (Yang et al., 2004; Yao et al., 2010; Irmak and Baybuga, 2011; Cheung et al., 2012; Yao et al., 2013).

This study's findings identified the various devices involved in these SIs, with glass (34.9% n=44) being the most common. Within the systematic review, glass was reported within eight studies (Karadag, 2010; Ozer and Bektas, 2012), with Intravenous needle being the most common device (Trivedi et al., 2013).

Most sharps involved in the SIs were clean and unused, but worryingly 17.5% within this study were classed as used. A similar figure was identified by Smith and Leggat

(2005) of 15.8%, but this is approximately half of the 36.3% of used sharps causing injury to nursing students reported by Zhang et al (2017).

This study has also explored the experience of nursing students who had sustained a SI. It was identified that 21.4% (n=25) of nursing students were not being observed by their mentor at the time of the incident. This is approximately half of the rate of 55% (n=27) reported by Small et al (2011) and 50% reported by Petrucci et al (2009).

There were many varied contributing factors identified, with inexperience (n=54) being seen as the most common cause. A small body of knowledge relating to this issue supports this finding (Shiao et al., 2002; Smith and Leggat, 2005; Khoshnood et al., 2015; Suliman et al., 2018).

The study identified that 5.9% of nursing students who has sustained a SI displayed the characteristics of PTSD, whilst participants within the survey (n=38) and interview (n=7) phases suffered the impact of the SI. There is a dearth of data available within the literature to compare these findings.

Eight themes were reported from the qualitative data which was collected within this study. The only comparative findings identified within the systematic review is from the study conducted by Naidoo (2010).

The theme '*A vivid description of the event*' described within this study has echoes to the theme of '*Traumatic incident*' identified by Naidoo (2010). There are some similarities within this theme, such as the participants providing rich detail, knowing the precise date and time and the setting of the scene. This study though offered additional rich information regarding the type and the extent of the injury; the

procedure and device involved; the location of the SI and the potential causes of the injury.

The theme '*The impact of the sharps injury*' identified within this study links with the theme '*Reaction to the traumatic incident*' described by Naidoo (2010). There were similar findings reported within both studies with regards to some of the emotions expressed such as being shocked, crying, and having anxiety. This study though described more emotions experienced such as embarrassment, frustration, annoyance, having flashbacks, and feeling upset for the patient and fellow HCWs. The Naidoo (2010) study described a lack of support from some staff and family members, whereas within the theme of '*The role of my family and friends*' within this study, HCWs and family were seen as being very supportive. Within the Naidoo (2010) study participants mentioned the side effects of post-exposure prophylaxis drugs, but none of the participants within this study had to commence that type of medication. Additionally, one participant stated that they had considered suicide, but this reaction was not mentioned by participants within this study.

The theme '*The role of my mentor and Personal Tutor*' within this study described the very supportive nature and competence of the participant's mentor and Personal Tutor following the SI. Naidoo (2010) though reports how some nurses were not very supportive of the nursing students and were not always aware of treatment and counselling procedures. Both studies found the Personal Tutor to be reassuring and supportive.

Within this study, the theme '*The next time I used a sharp following the injury*' offered rich data regarding the emotions felt when involved with procedures involving sharps. Naidoo (2010) briefly mentions participants feeling distressed when re-entering

practice, though this study richly describes the perceived improvement of practice, the range of emotions expressed, and occasionally the avoidance of procedures involving sharps.

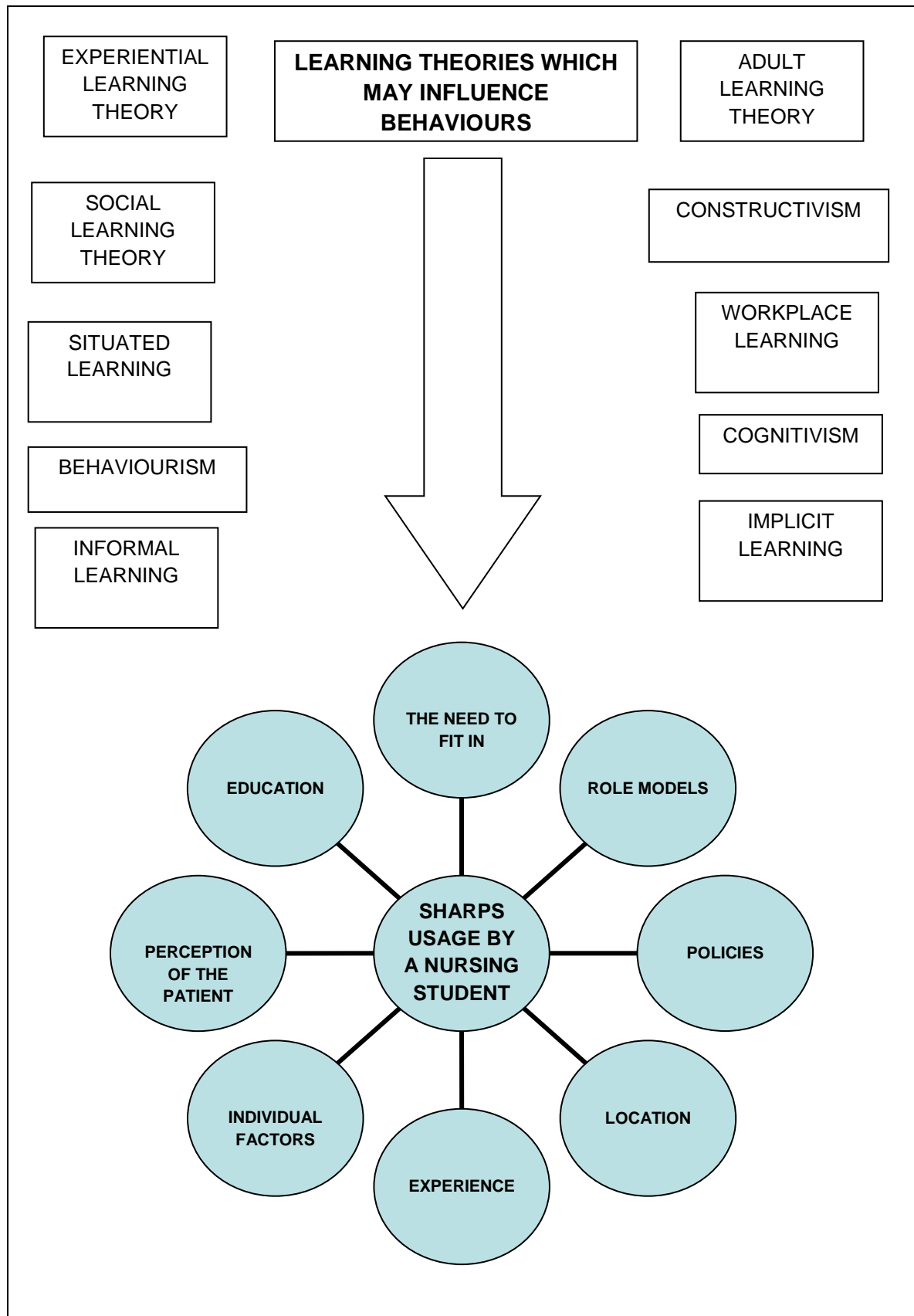
The other themes identified within this study, namely '*If it had been a used sharp*', the '*Prevention of the sharps injury*' and '*The perception of the patient involved in the sharps injury*' appear to be themes used to describe and experience which were not reported within the Naidoo (2010) study.

The study's findings identified two distinct areas warranting further discussion: 1) the factors that influence nursing student behaviour in relation to sharps usage and 2) the potential psychological impacts of the SI on nursing students.

7.3 A theoretical framework showing factors that influence nursing student behaviour in relation to sharps usage

The synthesis of the quantitative and qualitative findings from the study, in conjunction with the available literature, has aided the production of a theoretical framework encompassing the factors that influence nursing student behaviour in relation to sharps usage. This is in relation to how nursing students learn to manage the use of sharps and what they do if an injury occurs. The theoretical framework is shown in Figure 7.1

Figure 7.1: A theoretical framework showing factors that influence nursing student behaviour in relation to sharps usage



These factors will now be discussed and then evaluated in relation to how learning theory may influence the behaviour of the nursing student in relation to learning skills involving sharps.

7.3.1 Education

It was identified that nursing students learn the skills and behaviours of sharps usage in different settings, taught by various teachers. This learning is primarily within the educational institution and whilst in clinical placement. This blend of theory and experience based knowledge then helps to determine an individual's practice (Higgs et al., 2008). This learning is set in the context of: 1) a dichotomy of planned, structured learning within educational institutions (Chan, 2004) and also learning within complex environments in placement (Newton et al., 2010); 2) up to 100 different learning styles (Reid, 2005) influencing learning; and 3) various teaching styles based upon multiple learning theories adopted by teachers.

In the educational institution

Participants in the qualitative phases of this study perceived the university CSSW as a primary location where sharps usage was learnt. Learning sharps safety within the CSSW was seen to be beneficial, especially if the learning was conducted pre-placement. The educational institution being viewed as a major influencer on nursing students clinical practice has been verified by other researchers (Mikkelsen et al., 2008; Wu et al., 2009) with 96.3% (n=340) of nursing students within a survey conducted by Hinkin and Cutter (2014) identifying this.

Learning about sharps within the CCSW can occur in a variety of ways based upon numerous learning theories. These were highlighted within the work of Lavoie et al (2018) and Kaakinen and Arwood (2009). Utilising the lens of Experiential Learning

(Kolb and Kolb 2005) some nursing students may learn within the CSSW when observing demonstrations of the sharps skills, and the subsequent immersion into these new experiences such as handling sharps and giving injections during simulations. Similarly, Social Learning (Bandura, 1977a) may be evident when there is observation and modelling of sharps usage by nursing students following viewing the performance and practice of nurse tutors. This type of learning has echoes of Situated Learning (Lave and Wenger, 1991), with the associated copying of behaviours by nursing students whilst observing nurse tutors simulating sharps usage. This is especially true with new nursing students in the early stages of their learning. Cognitivism considers the thought process behind the behaviour of the learner. In relation to a clinical skill such as injection technique, a nursing student may receive information within the educational institution via sources such as lecturers, seminars, online learning and reading. This information is then processed by repeating the sharps usage through simulation and using the skill in clinical practice. This learning may then be banked in the nursing student's long term memory as it has been learnt, examined, digested, reprocessed and understood. Using the lens of Cognitivism this could be understood as the nursing student having an appreciation of the whole of a process rather than just discrete steps. This means that the student creates relationships from relevant information from past experiences (and / or classroom based knowledge) to understand the whole clinical situation (McKenna, 1995b), such as the safe use of sharps.

It was identified that more than half of nursing students responding to the survey had previous healthcare experience. Additional to this is that nursing students may have some experience of handling sharps during the programme in clinical placements.

Through the lens of Adult Learning Theory (Knowles, 1990), this may be understood

as nursing students linking their sharps learning in the CSSW to prior experiences of learning. Learning clinical skills within the CSSW lends itself to teaching based upon the theory of Behaviourism (Skinner, 1938), whereby a task involving the use of sharps can easily be broken down into stages and then rehearsed as a whole process.

Irrespective of the learning theories involved, participants within the quantitative and qualitative phases of this study sustained SIs within the CSSW. The audit conducted within this study showed that SIs were the most common injury within the CSSW (69.6% n=32) and that nursing students were the most frequent healthcare students sustaining this (59.4% n=19), or indeed any injury (56.5% n=26). The location of the CSSW as a place where nursing students sustain SIs has been identified by other authors. Smith and Leggat (2005) identified this location by reporting that 45% of SIs involving nursing students occurred there. This is substantially higher than the 5.3% of SIs reported within the survey phase of this study. There is a dearth of available evidence exploring why SIs occur within this arena. From the qualitative phase of this study, nursing students suggested that feeling anxious, especially when being observed by teachers and because this location was seen as less dangerous than being in practice and hence less risky, were seen as possible reasons.

Retention of this knowledge attained within the educational institution appears to be a factor which could potentially contribute towards SIs by influencing nursing student's behaviour. Participants within this study identified this issue, which has been reported by Hinkin and Cutter (2014) who stated that theory taught and learnt within the university setting may not always be retained by some nursing students. Linked to the retention of knowledge issue is a perceived lack of knowledge about sharps usage as a potential influence on behaviour. Learning around sharps usage

is a skill competing with many other clinical skills within the CSSW, with learning being dependent upon factors such as student numbers, availability of the CSSW, amount of teachers, variability of teaching methods and the availability of appropriate equipment.

This notion of a lack of knowledge regarding sharps usage has been identified by other researchers. A survey conducted by Vandijck et al (2008) reported that Belgian nursing students' knowledge of some infection prevention and control (IPC) issues varied between adequate and disappointing. Worryingly, only a quarter of the 495 respondents could define a needlestick injury. Recent survey research conducted by Suliman et al (2018) in Jordan found that a substantial risk for SIs involving needles exists because nurse students conduct invasive procedures with minimal knowledge. This study, even though there were issues of generalisability, showed that nursing students appeared unaware that re-capping the needle was a major risk.

This lack of knowledge appears to be related in part to a lack of training regarding sharps usage in nursing students. This was identified within the qualitative phases of this study as a potential contributing factor for a SI. Although there are limited studies conducted in relation to IPC knowledge and practice among nursing students (Hinkin and Cutter, 2014), those that are available reach similar conclusions. Insufficient training was reported as a probable factor responsible for a high proportion of SIs involving nursing and midwifery students in Iran (Khoshnood et al., 2015). This was because nursing students early in their training were 3.4 times more likely to have had a SI than students in the final year of their education. These findings are limited to a small college of nursing students (n=190) which questions the generalisability of the results. Likewise, in Australia, Smith and

Leggat (2005) identified insufficient training as a probable contributing factor for SIs within nursing students. Therefore a situation may exist where nursing students may have a lack of knowledge, a lack of retention of knowledge and a lack of training regarding sharps usage within the educational institution. Added to this is the potential factor of the quality of the training which may influence sharps behaviour. Studies have identified that students consider the quality of their education to be unsatisfactory (Salehi et al., 2001). This includes the view that existing nursing education delivery in the UK is limited in its capability to provide a efficient workforce fit for the 21st century (Taylor et al., 2010), especially with regards to clinical skills (Kermansaravi et al., 2015).

In the clinical environment

Another arena where nursing students within the qualitative phase of this study stated that sharps usage learning occurred was within the clinical placement. This learning primarily occurred when working with the mentor, other nurses and HCWs. Interestingly, within the interview phase, nursing students (n=5) stated that this learning with the mentor commonly occurred post-SI, where the mentor was described as being competent and knowledgeable (n=8).

The clinical placement has also been identified by other researchers as a primarily location where learning occurs. Hinkin and Cutter (2014) conducted research at one university in Wales and found that one of the major influences of learning when nursing students were in clinical placement were the mentor (91.2% n=323), other nurses (89.3% n=316) and doctors (49.4% n=175).

Worryingly, linked to this factor, is the notion that the level of HCWs knowledge and practice in relation to IPC is often classed as unsatisfactory (Cutter and Jordan,

2012; Iliyasu et al., 2016; Osuala and Oluwatosin, 2017). This situation provides opportunity for unsafe sharps practice to be observed and replicated by the nursing student in clinical placement. This may then account for some of the SIs reported by nursing students within this study. This Informal Learning (Seylani et al., 2012) may be a way in which nursing students learn these behaviours by watching, absorbing and repeating the unsafe actions of mentors and other HCWs. Similarly, Situated Learning (Lave and Wenger, 1991) may be taking place where nursing students in clinical placement copy potentially dangerous behaviour when partaking in procedures involving sharps.

Considering that mentors, nurses and HCWs play a major role in influencing sharps behaviour, Rich (2012) identified a lack of awareness of hazards coupled with a lack of training, as a reason why many HCWs had a lack of compliance with standard precautions. This was in addition to factors such as inadequate staffing, the unnecessary use of sharps and a lack of supplies. Rice et al (2015) found that non-compliance with standard infection control precautions for the handling and safe disposal of clinical waste was reported as the main contributing factor for 410 significant SIs involving HCWs between 2002 and 2011 in England, Wales and Northern Ireland. This non-compliance included: 1) HCWs not having a sharps bin at hand during and after procedures; 2) clearing away sharps which had been used by someone else; 3) the unnecessary over-filling of sharps bins; 4) the dangerous habit of the recapping of needles after usage and 5) the unsafe practice of passing sharp instruments from one hand to the other hand. These echo the findings from this study as nursing students reported seeing these types of behaviours in clinical placement. A lack of training regarding sharps may be the issue, although this notion makes the false assumption that learning may have taken place. The issue may be

the enabling of the learning of knowledge that the learner values, sees the usefulness of and uses in practice.

The findings from the qualitative phases suggest that nursing students felt that a contributing factor to SIs may be a perceived discrepancy between theory taught, learnt and practiced at the university within the CSSW, and how procedures are conducted in the practice placement. This theory-practice gap in relation to safe sharps usage reported within this study and within available evidence may be a contributing factor for an unnecessary, preventable amount of SIs affecting not just nursing students, but many HCWs. This may be because there are conflicting factors affecting the behaviour of individuals. This issue is not a new phenomenon with Henderson (2002) proposing that student nurses were desensitised during their professional socialisation and were often faced with discrepancies between values taught within the education environment and those witnessed within practice. It appears that sharps usage within the educational institution and the clinical placement is no different.

There is reason to suggest that the learning influencing nursing students within the CSSW, has echoes to the learning processes which may occur within clinical placements. This may then account for some of the SIs reported within this study, as some practitioners may not always exemplify appropriate nursing behaviours to students (Monagle and Doherty, 2014). This issue was further highlighted by Bandura (1977a), who stated that prohibited activities performed without adverse effects may have an uninhibited effect on the observer. This displays the powerful influence of social and peer acceptability on the individual. These prohibited activities, such as re-sheathing a needle, can result in nursing students learning unsafe acts and then going on to perform them themselves.

The jagged edge of sharps

A noteworthy finding within the survey phase of the research study was that the most common item causing SIs involving nursing students were glass ampoules or vials. More than a third of respondents within the survey (34.9% n=44) stated that this was a cause of the SI, with glass also being described as a contributing factor within the qualitative phases of the research study. This links to a finding within the systematic review which identified glass as a common item involved in SIs involving nursing students (Shiao et al., 2002; Yang et al., 2004; Smith and Leggat, 2005; Irmak and Baybuga, 2011; Ozer and Bektas, 2012; Unver et al., 2012). A survey conducted in Iran by Khoshnood et al (2015) also identified opening glass ampoules as a high risk event for nursing and midwifery students.

Glass ampoules for holding medications and liquids were designed by the French pharmacist Stanislaus Limousin in 1886 and HCWs have been subject to the danger of laceration since their creation. Dangers from splinters of glass when using ampoules were mentioned as early as 1916 (Stoker, 2009). Within the qualitative phases of this study, nursing students emphasised how SIs occurred when glass vials containing medication sometimes did not snap correctly. The issue was the shattering of the glass ampoule rather than there being a clean break when it was opened. Another concern raised during the interview stage of this research study was that even though broken glass was seen as less of a biological hazard than a used needle, there was a fear of an allergic response occurring from exposure to the medication within the broken glass vial. Added to this issue was the belief that some nursing students assumed that SIs only occurred with needles, so there was a lack of awareness that glass could even be a cause of SIs.

Following a thorough systematic review and literature review (reported in Chapters Two and Three), there appears to be a scarcity of understanding as to what informs nursing student's behaviour with regards to glass usage and ampoule opening when preparing medications. Available evidence suggests that it may be a lack of skill (Karadag, 2010), with a contemporary quasi-experimental study conducted in Turkey stating that incorrect technique and a failure to use protective measures may be contributing factors (Arlı and Bakan, 2018). During the interview phase of this study nursing students stated regularly that they were unaware of the various recommended protection devices which could be utilised to open glass ampoules (NS Int2; NS Int6; NS Int11), and 11 SIs were caused by protective devices being unavailable. Nursing students mentioned within this study that they sometimes copied the practices of their mentor regarding ampoule opening (NS Int1; NS Int8). This is where some behaviour was learnt. Using the lens of Social Learning Theory (Bandura, 1977a), this could be comprehended as nursing students learning by copying role model behaviour in how glass ampoules of medication are opened in clinical environments. A survey (n=1903) of nursing students reported that 59% identified the most important role model to be the mentor in practice, with only 14% identifying the nurse teacher (Saarikoski et al., 2013). This appears to be a reason why students may abandon knowledge gained within formal learning within the educational institution, and adopt other behaviours in clinical practice. Learning within the CSSW locally regarding injections and medication occurs with plastic ampoules and not glass ampoules. Local nursing students may not be exposed to the correct and recommended behaviours for the opening of glass ampoules before they enter practice, which can be seen as a criticism of the learning process. This situation occurs presumably because of the expense of glass ampoules vs. plastic

and also to reduce the risk of SIs with glass occurring in the CSSW. This situation may also be occurring in other educational institutions, but there is a dearth of evidence about this situation at present.

A worrying situation exists for nursing students as almost 130 years since its introduction, glass is still contributing towards SIs affecting HCWs, who may be subsequently influencing nursing student sharps practice. A thorough literature search showed that there is very sparse evidence within the UK regarding the types of devices involved when nurses are affected by SIs. Public Health England (2014) reported that 4830 SIs happened between 2004 and 2013 involving HCWs. Needles accounted for 86% of the SIs, whilst glass was presumably classed within the 'other sharps' category with a rate of 14%. Available data from other parts of the world show incidence rates of glass causing the SI to nurses ranged from low figures of 1.4-4.7% in countries such as Australia and Turkey (Smith et al., 2006a; Irmak, 2012) to higher incidence rates identified within nurse populations of between 23-35.2% in Turkey, Japan and Korea (Ayranci and Kosgeroglu, 2004; Ilhan et al., 2006; Smith et al., 2006b; Smith et al., 2006c; Özlü et al., 2016). Thus a situation exists where nursing student's behaviour in relation to glass usage is influenced by nurses and HCWs who may regularly sustain glass injuries.

With regards to nursing students' lack of awareness of protective devices when using glass, a nursing student (NS Int2) within the interview phase of this study exclaimed that next time they dealt with a sharp (glass was the cause of their injury) they would now use gloves and a tissue to reduce the risk of having an injury. This presumably meant that gloves and the correct device was not used when the injury first occurred. Another participant (NS Int8) within the interview stage explained how they now used the wrapper from a syringe to open the glass ampoule to avoid

cutting themselves on the glass ampoule containing the drug. Again, this presumably meant that the SI discussed in the interview (caused by glass) was sustained when the nursing student was not utilising a protection device. It is interesting to note that the improved method of opening a glass ampoule identified by the nursing student has potential risks to the individual as well as the risk of contamination to the medicine. Using the lens of Experiential Learning (Kolb and Kolb, 2005), this could be viewed as nursing students observing the practices of others, or applying new theories to problem solving situations. Employing the lens of Constructivism, this could be understood as the nursing student in these situations creates meaning from experiences (Fensham, 1992). The learner may problem solve in these types of ambiguous situations where nursing students find themselves in circumstances where protective devices are not used or available, and may then have to adopt incorrect and unsafe practices whilst problem-solving how to open a glass ampoule.

Considering that there are products on the market to safely remove the top from a glass ampoule e.g. the SnapIT (P3 Medical Limited, 2012) and the Steritest™ Glass ampoule breaker (Merck, 2016), it appears that nursing students are learning some behaviours from techniques devised by fellow HCWs. There are many reported and recommended techniques devised by HCWs to open glass ampoules. These include scratching the neck of the glass ampoule with a small file or with another ampoule (Cohen et al., 1997); scissors (Koqa and Hirose, 1999) and a cutting knife (Bajwa and Kaur, 2012). It is interesting and worrying to note that these proposed safe ways of opening a glass ampoule proposed by HCWs involves introducing another sharp into the procedure. Two additional materials which have historically been utilised to break a glass ampoule are a paper towel and a piece of gauze (Stoker, 2009). Both materials have the issue of the practitioner not being able to view or manipulate the

glass ampoules, and of disposing of the glass ampoules top safely. The additional risk of using these products are fibres of the material contaminating the medicine or the ampoules during the procedure. These two materials can increase the risk of a SI occurring and risk contamination of the medicine. A perceived safer method described by doctors practicing in the UK involves the utilisation of a 2ml or 5ml syringe with the plunger removed to snap off the top of the glass ampoules (Ismail and Ismail, 2007). Halder et al (2014), doctors practicing in India, stated that this was a simple, inexpensive safe method of opening ampoules. This was recommended by the authors because even though specialized ampoules opening devices exist, these products were not always available. An obvious issue with these proposed techniques is that these products were not designed for this purpose.

Legislation, directives, guidelines and other documentation dating back to 1974, identified within the literature review, highlighted employer responsibilities in relation to sharps usage within healthcare settings to ensure a safe working environment and safe working practices by the implementation of safe systems. These included training in safe sharps usage; PPE and protection device provision; risk assessment; the implementation of preventative strategies and the reporting of SIs. Interestingly, within the documentation, glass is very rarely mentioned and highlighted as a sharp. One of the few mentions is within a WHO recommended document (Hutin et al., 2003). This mention regarded the safe use of glass ampoules with the provision of Pop-open ampoules or the use of a clean barrier such as a piece of gauze, rather than ampoules which required a metal file to open. It appears that legislation, directives, guidelines and other pertinent documentation could have highlighted the hazards of glass ampoules much more effectively. This could have been

supplemented by the more rigorous promotion of protective devices to open glass ampoules more safely for HCWs and the students which they may influence.

Therefore, a situation exists where nursing students learning in placement and in the educational institution are potentially adopting behaviours regarding the safe usage of glass, from nurses and HCWs who: 1) do not always use, or have access to, protective devices; 2) use products to open glass ampoules which are not designed for that purpose; 3) suffer regularly from glass-related injuries; and 4) may not adhere to the multitude of legislation, directives, guidelines and recommendations published over many years to protect themselves from injury and harm. This state of affairs appears to replicate some of the failures outlined within the literature review with regards to poor assessment of risks and an inadequate application of protective measures (HSE, 2015). This situation also highlights the differences between the formal, class-based learning in the CCSW and the informal, practice based learning occurring in placement. This appears to be linked to various learning theories adopted by nursing students and the copying of behaviour of recognised role models in clinical placement.

7.3.2 The need to fit in

The need to 'fit in' appeared to be an influence on behaviour regarding how nursing students learn to handle sharps. There were numerous examples of this behaviour within the qualitative phase of this study.

Copying unsafe practices

Even though it was stated to be an unsafe and unacceptable practice, examples were given within the Twitter Chat where doctors expected used sharps to be cleaned up by others within some clinical environments. This may potentially create

a situation for nursing students to behave in an unsafe way to fit in with the culture of the clinical environment. The re-sheathing of needles, outlawed for decades within policies, directives, guidelines and recommendations, was also observed by nursing students in practice. Nursing students within the qualitative phase of this study viewed this practice as an unsafe and outdated practice, so it was worrying to see then that 6.4% (n=6) of SIs in this study were caused by the re-sheathing of a needle.

The process of nursing students copying unsafe and unacceptable practices links with the views of Hinkin and Cutter (2014) who felt that there was a need for nursing students to fit into the culture of the clinical placement. Therefore some nursing students may follow the practice of clinical staff even if it was judged to be incorrect. This behaviour can be labelled as acquiring acceptance (Becker, 2002; Dingwall, 2014) by assuming occupational identity. This situation is what Gray and Smith (1999) highlighted as a nursing student losing their 'outsider status', by fitting in with ward routines. This issue has been highlighted by other researchers (Kelly, 1998; Levett-Jones and Bourgeois, 2007).

Nursing students within this study may have learnt some sharps practices from their mentors and other HCWs in placement by copying and adopting behaviours which may be safe, but occasionally may unfortunately be unsafe and hazardous. This acclimatising into the environment can thus mean nursing students imitate poor practice, especially if this is the norm (Henderson, 2002). This 'fitting in' creates a sense of belonging which was viewed as a prerequisite for learning. This notion was proposed by Melia (1987) who believed that nursing students needed to adapt to the environment in order to learn. Without this belonging, nursing students may feel alienated and anxious which could affect learning, confidence and progress (Levett-Jones and Lathlean, 2009). This conforming to the norms of the clinical environment

is a role which many nursing students play in order to not be seen as a disruptive influence in the clinical placement (Vinales, 2015b). A factor influencing this situation is the need to pass placement assessments (Levett-Jones and Lanthean, 2009).

Nursing students within the study tried to fit in with the clinical environment in many ways other than through replicating clinical skills. The impact of having a SI made some nursing students state that they were very worried about their relationship with their mentor, whilst others feared being viewed as incompetent by their mentor following their SI. This was also an observation by Levett-Jones and Lathlean (2009) who stated that students sometimes spend more time concentrating on establishing relationships and ensuring they 'fitted in' with clinical teams, rather than concentrating on the type of experiences offered.

Learning by fitting in and conforming with the norms of the clinical environment links to many forms of learning. Using the lens of Social Learning Theory (Bandura, 1977a), in the clinical placement the nursing student may observe the mentor or HCW and see the outcomes of that person's behaviour as being positive and copy the behaviour and skills. This may also involve nursing students learning undesirable activities, which may account for some of the SIs reported within this study. As the desire to obtain social and peer acceptability in practice is so strong, some nursing students may copy unsafe practices in relation to sharps, such as re-sheathing needles which would not have been taught or learnt within the educational institution phase of learning. This copying of behaviour, even though the techniques may be unsafe and dangerous, displays the powerfulness of the role model for the nursing student with outsider status who wishes to fit in. As this way of learning in the clinical placement appears to be so powerful, the improvement of certain skills and the

curtailment of unsafe and unacceptable practices would make this process an effective learning environment for fundamental skills such as sharps safety.

This type of learning by 'fitting in' has elements of Informal Learning, where learning can happen by the practice of merely watching, absorbing and repeating the behaviours of others during educational experiences (Seylani et al., 2012), such as viewing the sharps usage of a mentor. Therefore this type of learning in the clinical environment when copying behaviours to gain acceptance has been described as both deliberate and planned, and also incidental (Eraut, 2004) as the nursing student may be intentionally learning aspects of sharps behaviour or learns sharps skills incidentally, whilst duplicating the norms of the mentor or HCW. Learning sharps usage in this subsidiary manner also has links to Implicit Learning, where the nursing student in the clinical environment may be attaining complex skills without realising what has been learnt (Son, 2008).

This style of learning sharps usage by 'fitting in' can also be described as Workplace Learning (Billet, 2002) where the nursing student acquires skills in a social setting whilst learning from mentors. This workplace, vocational-style learning is commonly seen as a lower form of learning, as it is set within the culture of the workplace environment which may be variable in quality, which may mean that the learning related to sharps usage may be of variable quality. Additionally, the learning can be on an ad hoc basis encompassing role models.

A further type of learning which can be linked to 'fitting in' is Situated Learning (Lave and Wenger, 1991) which was devised in the 1990s but based upon previous work conducted by Dewey and Vygotsky. Nursing students in clinical settings learning the skills of sharps usage by copying the behaviours of mentors and HCWs may be learning through the very process of actively partaking in a learning experience.

Learning theories can be utilised to overcome the need for a nursing student to fit in and potentially watch and copy unsafe sharps practice. Using the lens of Social Learning Theory (Bandura, 1977a), if the HCW training and education discussed within the administrative controls of the HoCF (see section 3.3.2) was more effective, then nursing students may then copy more evidenced-based, safe procedures when handling sharps in placement. This is as opposed to the copying of poor sharps practices outlined within the two HSE (2015; 2016) reports. Utilising the lens of Behaviourism (Skinner, 1938), more frequent step-by-step learning and practices within the CSSW may ingrain task competence in the nursing student (McKenna, 1995a) and potentially lessen the need to copy unsafe practices in order to fit in. Using the lens of Experiential Learning (Kolb and Kolb, 2005), nursing students could be encouraged to utilise reflections upon experiences more effectively, in order for them to apply new theories to circumstances which they are confronted with regarding the use of sharps. This may aid decision making and problem solving skills to negate the need to copy and fit in.

7.3.3 Role models

Comments made within the qualitative stage of the study indicated that nursing students viewed nurses, their mentors and other HCWs in practice as role models who were held in high esteem. This was evident after some nursing students had sustained a SI and commented upon the mentor's level of knowledge and level of competence. A role model can be defined as a person worthy of imitation, as that individual is viewed as a confident example of a member of their profession (Perry, 2009).

The topic of role modelling within nurse education has been given less consideration in the literature when contrasted to other health fields, such as medicine (Baldwin et al., 2014). Limited previous studies suggest that nursing students understand the significance of clinical practice reinforced by theory, and often base good practice on what they have been taught merged with local policy and positive role models (Levett-Jones et al., 2009; Ward, 2010). This suggests that role models may affect the behaviour of nursing students in relation to sharps usage. This is a particularly important factor to determine because many healthcare professionals in clinical practice are often oblivious to the notion that students may view them as role models (Grossman, 2007).

Nursing students value role models and these individuals can have an immense influence on learning which occurs within the clinical environment (Donaldson and Carter, 2005). The main issue in relation to sharps usage is when poor practice happens, which may then be replicated by the nursing student. Available evidence suggests that students who are subjected to unsafe behaviours may mimic such practice (Jack et al., 2017), especially if the poor practice is viewed on a regular basis (Krykjebo and Hage, 2005). Because of their low ranking in the healthcare team, nursing students often take a submissive standpoint when observing poor practice (Rees et al., 2014). This may mean that poor sharps usage may go unchallenged and may be replicated due to the esteem which the role model is viewed by the nursing student.

Role models in placement appear to have a stronger influence than academic teaching staff within the educational institution. Academic staff are not always regarded as role models by students due to their apparent remoteness from clinical nursing practice, although this proposition may be softened when academic staff

teach clinical skills in the university setting (Felstead, 2013). A survey (n=1903) of nursing students reported that 59% identified the most important role model to be the mentor in practice, with only 14% identifying the nurse teacher (Saarikoski et al., 2013). So with evidence to suggest that role models in clinical environment have a powerful influence on the learning of sharps usage by nursing students, there are numerous types of learning which can influence behaviour.

Using the lens of Experiential Learning, this could be understood as learning in relation to the influence of role models. Of the four ways in which Kolb and Kolb (2005) found that people learn (concrete experience; observation and reflection; abstract conceptualisation and active experimentation), it appears that nursing students within this study learnt sharps usage in the clinical environment primarily through 'observation and reflection'. This was when nursing students observed practices and skills from role models and made sense of what has been observed from the concrete experiences. This process of learning then involved the copying of these watched behaviours, such as preparing and administering an injection, opening glass ampoules or disposing of sharps.

Employing the lens of Social Learning Theory (Bandura, 1977a), this could be understood as learning which can happen in relation to the influence of role models. When nursing students observe a role model in clinical practice performing a procedure involving sharps, the sequence of events will be remembered. This information and learning may then be used by the nursing student to guide subsequent behaviours. This means that safe practice as well as unsafe practices may be replicated. Bandura (1977a, p. 22) felt that '*most human behaviour is learnt observationally through modelling*', and sharps usage by nursing students appears to be no exception to that rule.

7.3.4 Policies

This study identified aspects of poor compliance with policies, directives, guidelines and recommendations regarding sharps safety by HCWs within clinical environments. The issue which this situation creates is that it may mean that nursing students are correctly shaping their behaviour based upon policies, but are also on occasions adapting their behaviours when potentially being influenced by poor compliance with these policies by other HCWs. Examples of this poor compliance within this study included: 1) HCWs leaving used sharps in clinical areas; 2) issues with sharps bins; 3) the re-sheathing of needles; and 4) a lack of protective devices.

As discussed in the literature review chapter, policies, directives, guidelines and recommendations regarding sharps safety have been in place for decades to protect the organisation and the individual from injuries involving sharps. Evidence has also proven that even though this has been the situation for a long time, breaches to these policies are still occurring nationwide exposing HCWs and members of the public to SIs and costing organisations large sums of money through prosecutions. It has been determined that an abundance of administrative controls have been implemented to reduce the incidence of SIs, yet these are acknowledged as weak (Liberati et al., 2018), especially if compliance to these controls is viewed as poor.

HCWs leaving used sharps in clinical areas

Within the qualitative phase of this study, doctors and other HCWs were identified as occasionally being careless, and acting in contravention of policies, by leaving used sharps such as vials and needles in cardboard trays and on beds. This is rather than disposing of the sharps themselves in a sharps bin immediately after usage. This was especially evident during emergency situations when sharps had been left on the patient's bed post-procedure, which became a hazard for the nursing student

(NS TC1). These situations replicate the findings of the HSE (2016) report where it is reported that used needles and sharps were found to be left on trolleys for others to dispose of.

Issues with sharps bins

Issues relating to sharps bin usage was also identified within this study. Worryingly, some nursing students within the interview phase of this study mentioned that sharps bins were not always available in community settings (NS TC26; NS Int9). There appeared to be an inconsistency with some patients being issued with sharps bins, whilst others were not (NS TC26). This could then affect the behaviour of the nursing student and nurse post-injection or sharp usage if the correct disposal equipment was not available. Overfull sharps bins were also highlighted as an issue within this study, as well as the dangerous situation of sharps being found in rubbish bags (N TC2; NS TC5). An additional issue was poorly assembled sharps bins, meaning that the lid fell off. The two reports from the HSE (2015; 2016), both highlighted similar issues of poor sharps bin usage by HCWs, which exposes individuals needlessly to SIs.

The re-sheathing of needles

Worryingly within this study, nursing students stated that they had observed nurses incorrectly re-sheathing needles in the clinical area (NS TC13; NS Int5), and six (out of 119) nursing students within the survey caused their SI by re-sheathing.

The re-sheathing or re-capping of needles has been seen as unsafe practice for decades and is mentioned numerous times within the abundance of published policies, directives, guidance and recommendations regarding sharps safety. This

finding has also been identified within other studies within the systematic review (Reis et al., 2004; Talas, 2009; Aslam, 2010; Cheung et al., 2012) where recapping was identified as a contributing factor for SIs within nursing students. A study using a survey of 354 nursing students found that 83.6% (n=296) correctly answered questions relating to reducing the risk of SI by not re-sheathing, bending or breaking the needle and discarding in a designated sharps container (Hinkin and Cutter, 2014). This means though that presumably 16.4% of the sample either were not aware of the risk of this procedure or felt that this unsafe practice was acceptable.

A lack of protective devices

In the survey stage of this study, eleven nursing students (out of 119) reported a lack of protective devices as a contributing factor for a SI. Additionally, three nursing students were closing safety devices when the SI occurred. This factor of a potential lack of protective devices, or poor compliance with these protective devices, could influence the behaviour of nursing students with regards to sharps usage in practice.

A lack of protective devices and measures, and a failure to use these devices and comply with these measures where reasonably practicable, was worrying identified within the HSE reports (2015; 2016) which criticised some Trust practices. This was despite decades of policies which have promoted safe sharps practice, and the use of protective mechanisms. These findings corroborate with Reis et al (2004) who identified a lack of the necessary materials for safe sharps usage to be a contributing factor for SIs in a small survey of nursing students (n=50) in Brazil. Research conducted by Hinkin and Cutter (2014) also identified the availability of facilities and equipment as a contributing factor to poor infection control procedures involving nursing students within the UK . Similarly, in a survey study exploring SIs within nursing students (n=100) in a hospital in Lithuania (Lukianskyte et al., 2011), an

important factor identified relating to causing SIs were a perceived lack of protection measures.

Within the survey and the qualitative phases of this study, protective equipment such as safety-needles were seldom mentioned. This appears remarkable considering how many years these products have been in existence and the amount of years that their usage has been promoted within legislation. This may be as a result of nursing students not being made aware of this equipment when simulating sharps skills within the University CSSW, and / or not practicing with this equipment when in clinical settings. Cost has been stated as a barrier to the implementation of sharps safety devices (Sohn et al., 2004; An et al., 2018), even though evidence suggests that the longer-term gains include reduced amounts of SIs and associated costs (Hanmore, 2013). This has meant that UK healthcare facilities have been slower to adopt these safety devices compared to some other developed countries (MindMetre, 2014). Similarly, the cost of safety devices as opposed to conventional needles for use in hundreds of nursing student simulations of clinical practice annually may cause financial issues for educational establishments. The cost of 100 25g orange needles from a medical supplies company costs £3.36 (Medisave, 2019), compared to a price of £21.01 for 100 safety needles (Care Company Store, 2019).

There appears to be parallels here with the type of learning present with regards to the need to fit in and role modelling, and the type of learning which influences behaviour in regards to adherence to policy compliance. Using the lens of Social Learning Theory, this could be understood as the copying of unsafe behaviours by nursing students in relation to sharps usage. This may mean that policies may be contravened as nursing students try to attain social acceptance within the clinical

environment. Learning types such as Informal and Implicit Learning appears to be evident within this factor, with Situated Learning occurring alongside Workplace Learning.

The HoCF for sharps outlined in the literature review chapter (see section 3.3.2) may have an impact on the behaviour of nursing students regarding sharps usage. A criticism of the current state of affairs is that most of the control in progress relate to administrative controls which are classed as weak in comparison to elimination and substitution. Based upon the stage of the programme, it is difficult to consider that nursing students may affect how sharps can be eliminated within healthcare settings. As stated, within this study protective devices were very sparsely mentioned, except during the survey stage when nursing students stated that they had injured themselves with one, or there was an absence of devices within the clinical setting. Worryingly, as stated, engineering controls such as sharps bin usage and the safe disposal of sharps has been stated as an ongoing problem observed by nursing students in clinical placements. The behaviour of role models in relation to these aspects may influence nursing students in their techniques and practices. Administrative controls appear to be the most abundant form of control, yet again nursing students have reported issues with observing re-capping of needles and the safe use of sharps bins which may be replicated in clinical practice. Although training and information sharing about safe sharps usage occurs in healthcare settings, it raises the question whether the training is having the desired effect. This is because unsafe sharps practices are still widespread and although training has taken place, it may be questioned whether desired learning occurred. The study identified that glass ampoules were the most common SI affecting nursing students, yet this

important factor is barely mentioned within any of the policies outlined in the literature review.

7.3.5 Location

The location where the nursing student is learning whilst studying the programme has the potential to influence the behaviour of the nursing student in various ways. It has been acknowledged that a dichotomy exists between the planned learning sessions held within the University (Chan, 2004) and the potentially chaotic learning which may occur in a multitude of placement settings (Jokelainen et al., 2011). Added to this are the many local factors within placement settings identified within this study which may affect the learning process regarding safe sharps usage. These factors relate to: 1) the specialty; 2) the patient and 3) workload issues.

The specialty

Participants from this study have highlighted the treatment room and the patient's bedside as common locations within placement where nursing students sustain SIs. Similar findings were identified within the literature (Talas, 2009; Karadag, 2010; Lukianskyte et al., 2011). This appears to be related to the most common places where nursing students are likely to be either preparing sharps or using sharps.

Common specialties where SIs occur were reported within this study as being medical and surgical, and also within community settings. Surgical and medical environments have been reported as the most common specialties for SIs involving nursing students (Yang et al., 2004; Yao et al., 2010; Irmak and Baybuga, 2011; Cheung et al., 2012; Yao et al., 2013). Within the qualitative phase of this study, a rationale for these specialties being hotspots for SIs was offered. Nursing students perceived that there were more SIs occurring within these specialties because of the

abundance of injections being administered within these areas of practice due to the type of patients present. Conversely, in some practice settings there were no sharps being used, and hence it was felt by nursing students that no learning regarding sharps took place. Additionally these are common areas where nursing students experience placements. These situations could potentially affect the behaviour of the nursing student, by exposing the nursing student to copious sharps or potentially an absence of learning due to a dearth of sharps usage.

Many specialties identified within this study where SIs occurred have been reported in other studies, but some specialties appear to have not been reported before despite a rigorous systematic review and literature review. These potentially unreported specialties include District Nursing, General Practice, Nursing Homes, Community Hospitals, Palliative Care Unit, Hospices and Endoscopy Units. Additional areas identified within the qualitative phase include 'respiratory', 'Stroke care' and 'Cardiac catheter laboratory. A few studies identified within the systematic review used the term 'other' when reporting locations (Yang et al., 2004; Yao et al., 2010; Yao et al., 2013), so some of these specialties may come under that umbrella. Hence, there may be factors related to these individual specialties which warrants further investigation into how nursing student sharps behaviour may be influenced.

There may be factors relating to learning within the community which may influence the behaviour of nursing students with regards sharps safety. The quantitative and qualitative phases of this study identified that SIs involving nursing students can happen in unfamiliar settings. It can be argued that many of the settings where nursing students experience their placements are unfamiliar based upon their variable previous experience. An unexpected finding within the survey was that the

third most common location for SIs to occur within a nursing student population in the UK was in the patients' own home and the third most common specialty was District Nursing. Within the qualitative stage of the study, SIs were also identified within community areas, such as in a Residential Home and within a Community Hospital. This is a potentially new phenomenon arising from this study regarding SIs being sustained by nursing students outside of hospital settings.

These community settings were considered to be a prime location for SIs within this study because nursing students felt out of their comfort zone in these unfamiliar surroundings. This appeared to be exacerbated by nursing students not always having the appropriate equipment at their disposal, such as sharps bins. The setting was also seen by nursing students as not being the typical, clean environment where equipment was easily accessible. Findings from the Twitter Chat found that being in someone's own house was seen by nursing students as difficult because of the hidden dangers and hazards as it was not always an organised place to work. This may affect the learning behaviour of the nursing student.

Within the UK there have been reported cases of SIs being sustained by HCWs, including nurses, in community settings. Public Health England (2014) reported the locations of 3683 SIs reported between 2004-2013 involving HCWs. The least frequently reported locations were community settings, which included GP surgeries, prisons and ambulances. A possible reason for this was given by the RCN (2008). In a survey of nurses (n=4407) in the UK, the RCN found that slightly less nurses were using sharps in community settings (90-93%) compared to hospitals (98-99%), even though more nurses working in the community had sustained a SI involving a needle (53%) at some point within their career compared to the average (48%). A supposition given by the RCN for this result was the length of service, with the

assumption that community nurses had worked for a longer period of time than hospital based nurses. This supposes that community nurses thus had more opportunity to have sustained an injury during their career. The authors claimed a relationship between longevity and SI incidence, but no evidence was provided to support this assertion, as there may be many other factors and variables involved.

Bennett and Mansell (2004) studied 543 nurses working in a community setting in the UK and identified that 21% (n=79) of them had sustained a SI. This compares to a reported rate of 5.25% in the USA (Brouillette et al., 2017) within a systematic review and meta-analysis. Some causes within the UK community environment were attributed to overfull sharps bins, people and pets. The authors concluded that the issue of SIs occurring in the community links to the unique and unpredictable nature of the various locations. This links to the findings of this study with nursing students highlighting issues with poor sharps bin practice and the hazards of other peoples' behaviour with sharps. Worryingly, 11% (n=40) of nurses within the study by Bennett and Mansell reported re-sheathing needles. There is also a dearth of evidence within the searched literature relating to SIs affecting nursing students and nurses within community settings which is worthy of further investigation.

Using the lens of Experiential Learning, this could be understood as nursing students replicating behaviours of role models within practice areas, and learning in unpredictable, unfamiliar surroundings. This learning occurs during and from experience (Dewey, 1938), especially in this alien setting. Nursing students appear to be learning through doing during hands-on practice (Fry et al., 2015) in the patient's home. Employing the lens of Constructivism (Fensham, 1992), this could also be understood as learning within unfamiliar community environments as the nursing student attempts to problem solve in ambiguous situations. This unfamiliar

setting with used sharps potentially in hidden places within the patient's home environment, means that new information, such as the safe handling of a sharp is linked to prior knowledge, previous ideas or this unfamiliar experience.

The patient

Findings from the qualitative phases of this research study revealed that the patient was occasionally a contributing factor of the SI involving a nursing student. Nursing students commented on the issue of patient movement at the time of a sharps procedure which was felt to increase the risk of a SI occurring or contributed to the SI. The patients were sometimes described as being feisty which was felt to increase the risk of a SI happening. This issue caused a distraction during the sharps procedure. One nursing student mentioned patient movement as a contributing factor for the SI in the survey stage of this study.

This finding supports the minimally available literature (Reis et al., 2004; Aslam, 2010) which identified the non-cooperative patient as a contributing factor for nursing students' SIs. Therefore it appears that only nursing students who have been exposed to potentially lively patients may know to adapt their behaviour in relation to sharps usage to lower the risk of a SI occurring, showing again how Experiential Learning may be an important style of learning in this type of situation. Linked to this is the finding within this study that nursing students were exposed to hidden sharps in the form of used needles from patients with diabetes who left needles under magazines on tables. Only nursing students exposed to these potentially dangerous situations in the patients home setting could be aware to adapt behaviour to lower the risk of a SI occurring. Stringent searches have not identified data relating to this issue with regards to nursing students, yet the patient was identified as a cause of SIs involving nurses in community settings in the USA (Markkanen et al., 2015). This

study reported that unsecured sharps were being encountered by nurses unexpectedly in rubbish, bedding, and on chairs, cushions and tables.

Within the qualitative phases of this study there was also the issue of the patients' skin integrity being highlighted as contributing to the occurrence of a SI. This was because sometimes patients were described as being thin and nursing students sometimes struggled to identify sufficient subcutaneous fat to inject safely into when administering an injection. This issue can be learnt within the theory component of sharps usage learning with pedagogical learning in lectures, seminars and through simulation. It may be very difficult to effectively simulate this scenario accurately so it could only be through Experiential Learning and being exposed to this situation in clinical placement with a real patient that the correct behaviour of sharps usage can be learnt.

Workload

Workload issues could also be a factor which influences nursing students' behaviour in relation to sharps. Nursing students (n=5) within the survey phase of this study described how having a perceived heavy workload was viewed as a potential cause of the SI.

This supports similar findings within other studies (Aslam, 2010; Lukiansyte et al., 2011) which identified workload as an influencing factor for SI acquisition within nursing students. Survey research conducted by Hinkin and Cutter (2014) also confirmed workload as a contributing factor in the infection control practice of 59.9% (n=212) of nursing students. Similarly when exploring HCWs, Rich (2012) concluded within a literature review, that inadequate or short staffing was a contributing factor for SIs within HCWs also. The workload issues may mean that there may be the

aforementioned issue of a lack of supervision of the nursing student by a nurse or mentor in practice. There may additionally be the issue of rushing which may expose the individual to adopt unsafe, short-cutting behaviours and practices, which may contravene policies, directives, guidance and recommendations for safe sharps practice in practice. Workload issues within the University setting may mean that nursing students may not always experience sufficient time to simulate clinical skills such as sharps usage as is required for that individual nursing student to learn.

7.3.6 Experience

Experience may have an effect on a nursing students' behaviour in relation to sharps usage, although the extent of this relationship is unclear. On the one hand inexperience was cited as a very popular cause of SIs within this study, yet this study also identified that more than half of the nursing students who sustained a SI had some previous nursing or healthcare experience.

Inexperience

Inexperience was highlighted as a potential contributing factor for SIs within the survey phase due to a lack of familiarity with the sharps techniques and the equipment involved within procedures. This was due to the fact that some nursing students stated within the interview phase that they had only given a handful of injections (NS Int2; NS Int5; NS Int6; NS Int7) and were only in practice placement for a short period of time when the injury occurred (NS Int4; NS Int8). The small body of knowledge relating to this issue supports this study's findings with inexperience (Shiao et al., 2002; Smith and Leggat, 2005; Khoshnood et al., 2015; Suliman et al., 2018); a lack of practice and a lack of familiarity (Cheung et al., 2012); a lack of technical ability (Reis et al., 2004); and under-developed manual skills (Talas, 2009) being viewed as causes of SIs involving nursing students. The findings of Petrucci et

al (2009) highlighted that more SIs were sustained by first year nursing students than more experienced nursing students, and the audits cited within the literature review which concluded that having less than one years' experience and not having given many injections were seen as contributing factors.

Having experience

Interestingly in the survey phase of this study the most common year when nursing students reported a SI was year two (44.5% n=53), followed by the third year of study (36.1% n=43). Thus, surprisingly nursing students in the first year of the programme had the lowest rate of SI (19.3% n=23), when nursing students were at their least experienced. This seems to conflict with inexperience being an issue, as does the fact that the survey phase of this study showed that 55.5% of the nursing students who sustained a SI had previous nursing or healthcare experience. This may mean that some nursing students had been involved in sharps procedures previously in a different role, which may or may not have influenced behaviour. Another explanation may be that nursing students may spend less time in clinical placement in the early stages of the programme and thus may have less exposure to SI risk.

Learning from mistakes

Within the qualitative phase of this study, an experience of sustaining a SI appeared to have had an effect on subsequent sharps behaviour. Nursing students spoke of how their behaviour regarding sharps usage had changed by adhering more effectively to policies, being more meticulous and being more conscious of the hazards involved. This appeared to be supplemented commonly by the mentor offering advice and education about safer sharps usage.

Utilising the lens of Adult Learning Theory (Knowles, 1990), this could be understood as learning from prior experiences which could be viewed by the individual as a useful resource in learning. In episodes where SIs occur, some nursing students may learn from this mistake in an andragogic manner by encompassing self-directedness and a problem-solving approach to rectify the error. Learning may take place following a SI by the nursing student utilising this event as a learning resource with a desire to solve the problem and apply new knowledge immediately. This process is in direct opposition to the potentially pedagogical, teacher-centred approach to learning a skill involving a sharp which may have taken place within the educational institution. Employing the lens of Experiential Learning (Kolb and Kolb, 2005), this could be comprehended as learning from mistakes where the nursing student comprehends the importance of learning from a SI, reflects upon the experience and then modifies their behaviour accordingly to reduce the risk of future injuries.

This learning attributed to trial and error can be labelled as a form of informal learning. This is where a trigger such as a SI can act as an incentive for individuals to recognise that a problem exists (Marsick et al., 2006). Following a SI, there may be a need for the nursing student to develop a new strategy for handling sharps correctly and realise that this learning has to take place in order to effectively address the issue.

7.3.7 Individual factors

Findings from within the quantitative and qualitative phases of the study highlighted individual factors which may affect a nursing student's behaviour in relation to sharps usage. Proposed personal factors identified within this study included anxiety, feeling

tired and being clumsy during the sharps procedure. This was especially true when the nursing student was being observed by a mentor or a lecturer.

Feeling anxious

Factors related to feeling anxious have also been identified by Reis et al (2004) who discovered that insecurity and nervousness were potential contributing factors for SIs involving nursing students. Similarly, Cheung et al (2012) highlighted stress as a potential cause within nursing students, which was linked to occasionally being hasty or inattentive. Other research studies (Aslam, 2010; Lukianskyte et al., 2011) have also identified quickness, inattention and haste as contributing factors for SIs in this population. It has been acknowledged for decades that anxiety can have a negative impact on task performance (Baumeister, 1984; Beilock and Carr, 2001; Smith et al., 2001) and other studies (Cheung and Au, 2011; Ebrahimi et al., 2016) support this view, declaring that novice nurses who are anxious tend to under-perform. Findings from this study and available evidence suggests that anxiety and similar associated feelings can be a contributing factor which affects the behaviour of a nursing student in relation to sharps usage.

Lack of sleep

There was also the issue identified within phases of this study that a lack of sleep and feeling tired when conducting the sharps procedure cause the SI. Eleven (12.8%) nursing students within the survey mentioned a lack of sleep as a contributing factor to their injury. This notion of tiredness as a causal factor was also recognised by other researchers studying nursing students and SIs (Lukianskyte et al., 2011; Cheung et al., 2012). Zhang et al (2017) reported that a lack of sleep was a contributing factor for SIs involving nursing students in China, especially if three or more night shifts had been completed.

Sleeping problems have been found to cause a worsening in brain function, including memory and continuous attention (Lo et al., 2016) which can escalate the risk of work-related injuries (Uehli et al., 2014). Insomnia can also affect job performance, decision making, concentration, judgement and problem solving (Kuppermann et al., 1995; Roth and Roehrs, 2003; Gaultney and Collins-McNeil, 2009; Fortier-Brochu et al., 2012). These would appear to be imperative attributes of a nursing student during a high risk procedure such as sharps usage. This suggests strongly that a lack of sleep could be a contributing factor in nursing student behaviour in regards to sharps usage. A solution to this was suggested by Bhardwaj (2014) who called for greater reinforcement to HCWs to have sleep and rest on their scheduled days off in order to reduce their risk of SI occurrence.

Being clumsy

Findings from the surveys and the qualitative phases of this research highlighted that nursing students occasionally saw themselves as being careless, clumsy, heavy handed and inept which was felt to contribute to the SI. Research conducted by Cheung et al (2012) also identified carelessness as a causative factor within nursing students, as did Reis et al (2004) who labelled this factor imprudence. There was also the issue in this study of human error and what was viewed by some nursing students as just bad luck. Again, Reis et al (2004) identified this factor and reported that some SIs involving nursing students were unavoidable.

Therefore it would appear that the findings from this study support available evidence that there are some personal, individual factors associated with a nursing student which may affect behaviour in relation to sharps usage. These factors may play a part in the increased risk of sustaining a SI as being anxious, tired and clumsy are factors associated with reduced performance.

7.3.8 The perception of the patient

The students' perception

Although only affecting two nursing students, findings from the interview phase of this study highlighted that the level of perceived risk felt by some nursing students may affect their behaviour in relation to sharps usage. This risk was occasionally influenced by the nursing students' perception of the patient, i.e. whether the patient was a 'crack addict...drug user [or a] prostitute'.

These findings from this study support the very sparse research conducted into the perception of risk by nursing students in relation to infection control and prevention. Hinkin and Cutter (2014) found that the perceived risk of infection influenced 91.5% (n=324) of nursing students infection control practice in placement. This may be related to a lack of knowledge in this particular area of practice or worryingly may mean that a small percentage of nursing students were not influenced by the perceived level of infection when conducting procedures in practice. This small percentage of nursing students with this perception identified within the study could though equate to many more nursing students in clinical practice.

The mentors' perception

A mentor may influence the behaviour of the nursing student based upon their own individual perception of the patient. This was stated within the interview phase of the study by a participant who stated that the mentor perceived the threat of seroconversion as being only very slight based solely upon the age of the patient.

This view supports some available research on the topic. In the UK, the RCN (2008) stated that 90% of SIs involving nurses had been reported. The most common reason given for the non-reporting of 10% of SIs by nurses was that the nurse

believed the injury was associated with a low risk of transmission. The findings from this RCN survey also showed that 66% of respondents said they perceived the level of risk of contracting a BBV to be low, compared to 19% who thought a medium risk was present and 15% who perceived a high risk. In Australia, Kable et al (2011) conducted a survey of nurses (n=7423) and found that of the 71 nurses who had sustained a SI, the perception of almost two-thirds was that they were not at risk of contracting a blood borne disease. Although the risk of seroconverting might be considered to be low based upon knowledge of patient factors and the degree of exposure, these exposures are still associated with a clinically significant risk. This is particularly true in patients whose status may be unknown i.e. 'low risk' does not equal 'no risk'. Regarding other HCWs who nursing students may work with in clinical placement, Rice et al (2015) stated that one of the common reasons why HCWs did not report SIs was that the perceived risk of transmission was seen as low. This factor links to recent research conducted by Bouchoucha and Moore (2018) in a small qualitative exploratory study performed in Australia investigating the attitudes and behaviours of registered nurses around the adoption of standard precautions. It was reported that some nurses made judgements of the use of standard precautions based upon personal judgements of risk. This was felt to be related to a biased perception of risk as described by de Zwart et al (2009) and Weinstein (1984). This suggests that the perception of some nurses and HCWs of the level of risk is associated with the characteristics of a patient. This perception of risk by some nurses and HCWs may then influence the behaviour of nursing students regarding their practice, perceptions and post-SI behaviour. This is unfortunate in an environment where HCWs are legally obliged to take even-handed and feasible protections to safeguard themselves and others within the workplace (Dougherty and

Lister, 2015). Using the lens of Social Learning Theory, this could be understood as some nursing students copying the behaviours of nurses in relation to perceptions of risk, in an environment where they feel they need to fit in to the culture of a clinical environment as previously discussed.

7.4 The psychological impact of a SI on nursing students: Post-traumatic stress disorder

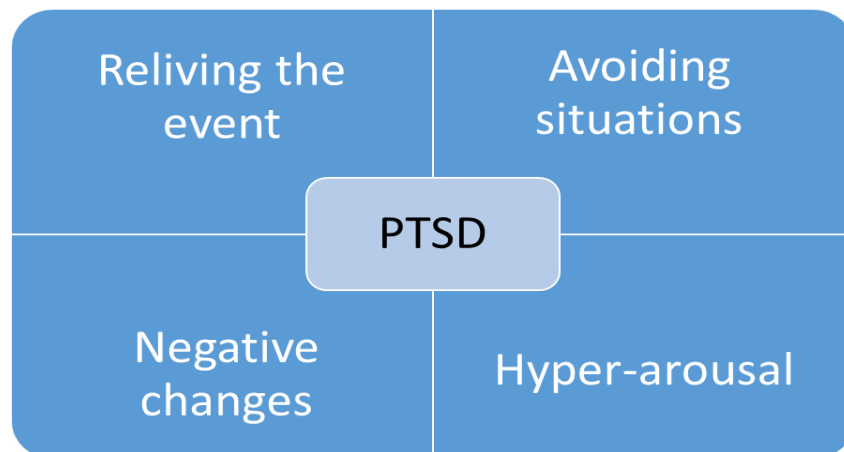
Findings from the quantitative and qualitative phases of this study identified the various psychological effects of sustaining a SI affecting nursing students, including anxiety. These findings add to the limited existing knowledge of the psychological effects identified by Naidoo (2010) in South Africa and Reis et al (2004) in Brazil in relation to nursing students and SIs.

A new phenomenon arising from the survey phase of this study is the identification of PTSD in 5.9% (n=6/119) of nursing students who had sustained a SI. Additionally approximately a third of nursing students in this study who had sustained a SI stated that they had suffered at least one identified symptom of PTSD. This psychological disorder will now be explored in relation to nursing students, nurses and other HCWs.

7.4.1 The characteristics of post-traumatic stress disorder

Mind (2017) define PTSD as a type of anxiety disorder that may manifest following a traumatic event characterised by an initial acute stress reaction that can last between 3 days to 1 month. In most cases symptoms resolve within several weeks of exposure (Forneris et al., 2013). US Department of Veteran Affairs (2015) and Mind (2017) defined four symptoms of PTSD which can be seen in Figure 7.2.

Figure 7.2: The symptoms of post-traumatic stress disorder



Showing some similarities, Bressert (2018) listed the common symptoms of acute stress reaction as being persistently experiencing the event; avoiding reminders of the trauma and hyper-arousal such as difficulty sleeping, irritability and anxiety. Koucky et al (2012) describes two more symptoms, these being fear, helplessness or horror, and the presence of dissociative symptoms such as numbing or detachment. The main difference between the two conditions of PTSD and acute stress reaction appears to be the timeframe when the diagnosis takes place. Hence, PTSD and acute stress reaction will be considered here.

7.4.2. The incidence of post-traumatic stress disorder

The survey phase of this study identified that 5.9% (n=6) of nursing students who sustained a SI met criteria to suggest PTSD. Additionally, 37.3% (n=38) of nursing students stated that they had suffered at least one identified symptom of PTSD. Following an extensive literature review there appears to be no research available describing PTSD affecting nursing students in relation to SIs. There also appears to be no research available describing PTSD affecting nursing students caused within practice placement worldwide. This appears to be a substantial finding within this

study. The only evidence identified which has used terminology in this domain was conducted by Hussain et al (2012) who investigated SIs involving dental, medical and nursing students and discovered that 15% had suffered mental distress as a consequence. Additionally, Naidoo (2010) documents many psychological effects suffered by nursing students which appear to link to PTSD, but did not definitively identify the condition within the participants of the study.

As there are no direct comparisons with other research studies investigating nursing students and PTSD, the only comparisons which can be made relate to trainee doctors. Post-traumatic stress disorder was identified in 12% of trainee doctors who had experienced at least one SI during their training within the UK (Naghavi et al., 2013). This compares to the 5.9% of nursing students in this study who had sustained PTSD following a SI.

Very little research has been conducted which has identified PTSD affecting nurses following SIs. da Cunha Januário et al (2017) conducted a cross-sectional study of nursing staff (n=445) in Brazil investigating exposure to biological material. The validated IES-R tool to monitor signs and symptoms of PTSD was utilised. In total 73 nurses were exposed, of which 61 met the inclusion criteria of the study. The majority (60.7%) of exposures were related to the percutaneous route. The incidence of PTSD was 19.6% (n=12).

There is limited data within the literature regarding reports of nurses suffering from PTSD in non-SI associated arenas. The literature which is published relates primarily to specialties within nursing where PTSD is suffered. Laposa et al (2003) conducted a small survey of 51 Emergency Department workers in Canada (73% of which were nurses and physicians) and identified that 12% of respondents met full criteria for

PTSD on the Post-traumatic Stress Diagnostic Scale. Mealer et al (2007) conducted a large survey of ICU and general nurses (n=351) to determine differences in psychological symptoms of these two types of nursing groups. The results of the survey identified that 24% (n=54) of ICU nurses and 14% (n=17) of general nurses tested positive for symptoms of PTSD. A further study by Mealer et al (2009) of nurses showed similar findings with the incidence of 22% (n=73) having symptoms of PTSD and 18% (n=61) meeting diagnostic criteria for PTSD. Gates et al (2011) studied emergency department nurses in the USA who had experienced violence from patients or visitors within a survey. The survey (n=230) incorporated the Impact of Events Scale-Revised tool (Weiss and Marmar, 1997) which has high internal consistency ratings and strong sensitivity and specificity. Ninety-four percent of nurses (n=209) experienced at least one PTSD symptom after a violent event and 17% had scores elevated enough to be considered probable for diagnosis of PTSD. Responses from nurses regarding issues of intrusion, avoidance and hyper-arousal had links with the findings of this study. Nurses responded highly to questions relating to 'any reminder brought back feelings about it' (82.5%); 'I thought about it when I didn't mean to' (69%); 'pictures about it popped into my mind (67%) and 'I had waves of strong feelings about it' (68%). Regarding avoidance, nurses responded highly to 'I tried not to think about it (57%). Finally with regards to hyper-arousal, nurses responded highly to 'I felt watchful or on guard' (73%); 'I feel irritable and angry' (67%) and 'Other things kept making me think about it '(67%).

Finally, Adriaenssens et al (2012) conducted a multi-site survey study of Emergency Nurses (n=248) in Belgium utilising the Impact of Events Scale (Horowitz et al., 1979) and the validated Dutch version of the Brief Symptom Inventory. Although not sharp related trauma, one in four nurses scored above the sub-clinical cut-off for PTSD

with 8.5% meeting clinical levels for PTSD. When PTSD occurs in the nursing population, there are numerous non-SI related causes. These can be seen in Table 7.1.

Table 7.1: Non-sharps injury related causes of post-traumatic stress disorder in the nursing population

Aggression from patients (Adriaenssens et al., 2012)
Burns (Adriaenssens et al., 2012)
Child abuse / negligence (Adriaenssens et al., 2012)
Death of a patient (Mealer et al., 2009; Adriaenssens et al., 2012)
Massive bleeding (Mealer et al., 2009)
Medication errors (Rassin et al., 2009)
Open surgical wounds (Mealer et al., 2009)
Performing futile care to critically or terminally ill patients (Mealer et al., 2009)
Suicide (Adriaenssens et al., 2012)
Trauma related injuries (Mealer et al., 2009) including road traffic accident victims (Adriaenssens et al., 2012)

In total 5.9% (n=6) of nursing students suffered from PTSD following a SI within this study, with a lower incidence rate than medical student and nurse populations.

7.4.3 The symptoms of post-traumatic stress disorder experienced by nursing students

Having an acknowledgement of the symptoms of PTSD or acute stress disorder that nursing students may exhibit following a SI (or other events which evidence suggests contributes to PTSD within nursing populations) may aid in the identification of the condition and allow for the facilitation of the necessary follow-up care. These will now be explored.

'Reliving the traumatic event'

Persistently reliving the traumatic event of a SI was described by some nursing students within the qualitative phase of this study. Approximately a fifth of participants who had sustained a SI, stated within the survey that they had experienced nightmares about the SI or thought about it when they did not want to. These findings echo some of the reactions of some participants reported within the Naidoo (2010) study involving nursing students in South Africa. Within that study some nursing students who had sustained injuries described how they had re-lived the SI.

Reliving the experience can be described as having a flashbacks, which Mind (2017) defines as vivid experiences when sufferers relive some aspects of a traumatic event, including images, sounds, and physical sensations such as pain and emotions. Some accounts of the flashbacks described by the nursing students in this study were very vivid, sometimes lasting three months and included the feeling of the sharp penetrating the skin. These experiences are very similar episodes to the experiences of the individual involved in the first reported account of a HCW sustaining PTSD post-SI. Similarly in that study, Howsepian (1998) described how the HCW involved in a SI reported having frequent flashbacks and hallucinations of

sharp pain. Limited evidence within this specific area suggests that nursing students can relieve the SI, which may incur nightmares and flashbacks in a small amount of individuals.

'Avoidance of situations'

The avoidance of situations that remind a person of a traumatic event is a recognised symptom of acute stress (Bressert, 2018). This symptom was displayed by some participants within the qualitative stage of this study, where some nursing students recalled how they avoided procedures involving sharps for various lengths of time ranging from 20 minutes (NS Int10) to four weeks (NS Int8). This was echoed within the survey stage of this study, where some participants who had sustained a SI stated that they had tried hard not to think about the SI or went out of their way to avoid situations that reminded themselves of it.

This appears to be a new phenomenon arising from this study showing that nursing students who sustain SIs sometimes avoid procedures involving sharps for various periods of time. This is now a recognised symptom of PTSD involving nursing students who have sustained a SI. This is important to now know, as by recognising this symptom in individuals, nurses and lecturers may be able to consider PTSD as an issue for the individual nursing student, and ensure the individual does not miss out on essential sharps experiences and learning.

'Hyper-arousal'

It was identified that some nursing students within this study did experience symptoms of hyper-arousal, such as difficulty sleeping, irritability and anxiety following the SI. Within the survey stage of this study 17 participants (16.8%) who had sustained a SI stated that they were constantly on guard, watchful or easily

startled. Other feelings reported included being worried, stressed and anxious post-SI. It supports the finding that some nursing students within the Naidoo (2010) study similarly described feelings of fear and anxiety following a SI, as did Reis et al (2004). Regarding nurses, a retrospective study of 400 nurses in the USA (Lee et al., 2005b) discovered that in the two weeks following the SI, 60.1% reported being afraid of needed devices more than before the injury and 41.8% felt anxious, depressed or stressed.

A new finding from this study suggests that some nursing students may have worry and suffer stress post-SI for periods of time ranging from two days to two years. This anxiety continued for some participants within this study until the next procedure involving a sharp had been performed. These findings echo limited evidence available regarding other HCWs. Howsepian (1998) reported that some symptoms of PTSD in a HCW lasted for up to a year. This longevity of emotions was also observed by Worthington et al (2006) who reported a case study where two HCWs developed disabling, chronic PTSD after SI exposures and their PTSD continued for more than 22 months.

This study has identified that 16.8% (n=17) of nursing students suffer symptoms of hyper-arousal post-SI, which can sometimes last for up to two years. Having an awareness of this issue may assist the mentor or lecturer to identify the potential reactions to the SI in the individual nursing student, and may raise awareness of the longevity of these symptoms in some individuals.

'Negative changes'

Negative changes in beliefs and feelings were described as a symptom by all of the nursing participants (n=12) within the interview phase of this study. These negative

changes ranged from anger; annoyance; feeling embarrassment; being shocked; being stunned and panic. On occasion some of these changes lasted for up to 18 months (NS Int4).

These findings contribute to the limited existing knowledge related to negative changes occurring for the nursing students who have sustained a SI. It supports the findings of Reis et al (2004) who highlighted that although 83% of the accidents in the study did not involve exposure to biological material, nursing students reported negative feelings such as anger, insecurity, concern, fear as well as low self-esteem feelings, such as frustration, incapacity and incompetence. Feeling shocked was a reaction identified by Naidoo (2010). This negative change was also reported by Daley (2010) who conducted a phenomenological study investigating the lived experience of eight registered nurses who suffered percutaneous injuries in the USA. One theme identified within the study was 'being shocked', primarily regarding the potential of infection following the SI.

Negative changes post-SI were reported by Howsepian (1998) when a HCW recommenced venepuncture following the SI event, including 'intense fear', feeling 'anger', and having 'insomnia'. These findings match nursing students within this study who expressed the negative emotions when the next sharps procedure was performed following a SI, which included feeling anxious, nervous and having trepidation. The anxiety related to the participant's fear of a SI reoccurring.

Regarding dissociative symptoms within the survey phase of this study, only two participants (2%) who had sustained a SI stated that they felt numb or detached from others, activities or their surroundings. This feeling of being numb was experienced by some nursing students in the Naidoo (2010) study. The confirmation that negative

changes can be experienced post-SI by some nursing students is important to know so awareness can be raised as to the potential symptoms to identify in an individual. There is also the relationship between gender and PTSD, and support availability when nursing students show symptoms of PTSD. These aspects will now be investigated.

7.4.4 Being female and sustaining post-traumatic stress disorder

Despite rigorous searching, there appears to be no available evidence or research conducted relating specifically to the incidence of PTSD affecting nursing students. The findings from this study supports evidence which suggests that females are more prone to PTSD within other HCWs and also within society.

A study conducted by da Cunha Januário et al (2017) investigated nurses' exposure to biological material in Brazil and identified that PTSD was more prevalent in females. Other limited research studies corroborate the opinion that PTSD is more prevalent in females and highlight sex as a risk factor for the development of the disorder. Rybojad et al (2016) investigated PTSD affecting paramedics (n=100) working in Poland using the Impact of Event Scale. The incidence rate was reported as 40%, with females accounting for 64.3% of those suffering PTSD. Within the general population in the USA, evidence suggests that rates of PTSD were higher in females within a study investigating alcohol related conditions (Pietrzak et al., 2011).

A new phenomenon arising from this study is that the majority of nursing students suffering from PTSD following SI are female. This is obviously attributed to the fact that females were the highest proportion of nursing students in this study, and vastly outnumbered males. This finding, linking to available evidence, raises awareness of the potential effect of gender on the incidence of PTSD regarding nursing students

which requires further investigation. This is especially important within cohorts of nursing programmes which are overwhelmingly dominated numerically with females.

7.4.5 Support following the sharps injury

Within this study nursing students who had sustained a SI felt supported by their mentor, personal tutor, peers, family, friends and other HCWs when contact was made. Some of the symptoms of PTSD and acute stress reaction did carry on for up to two years though in certain cases and it is unknown whether this support continued. The support identified within this study is in direct opposition to the majority of the experiences of nursing students from the Naidoo (2010) qualitative study. Nursing students in that study conducted in South Africa reported a lack of care from nursing staff, with the staff being described worryingly as unsympathetic. The family of nursing students were sometimes described as angry and apportioned blame, which is the opposite of the loving way in which the family of the nursing students in this study reacted to the individual. Within both studies the university staff were described as being supportive following the injury.

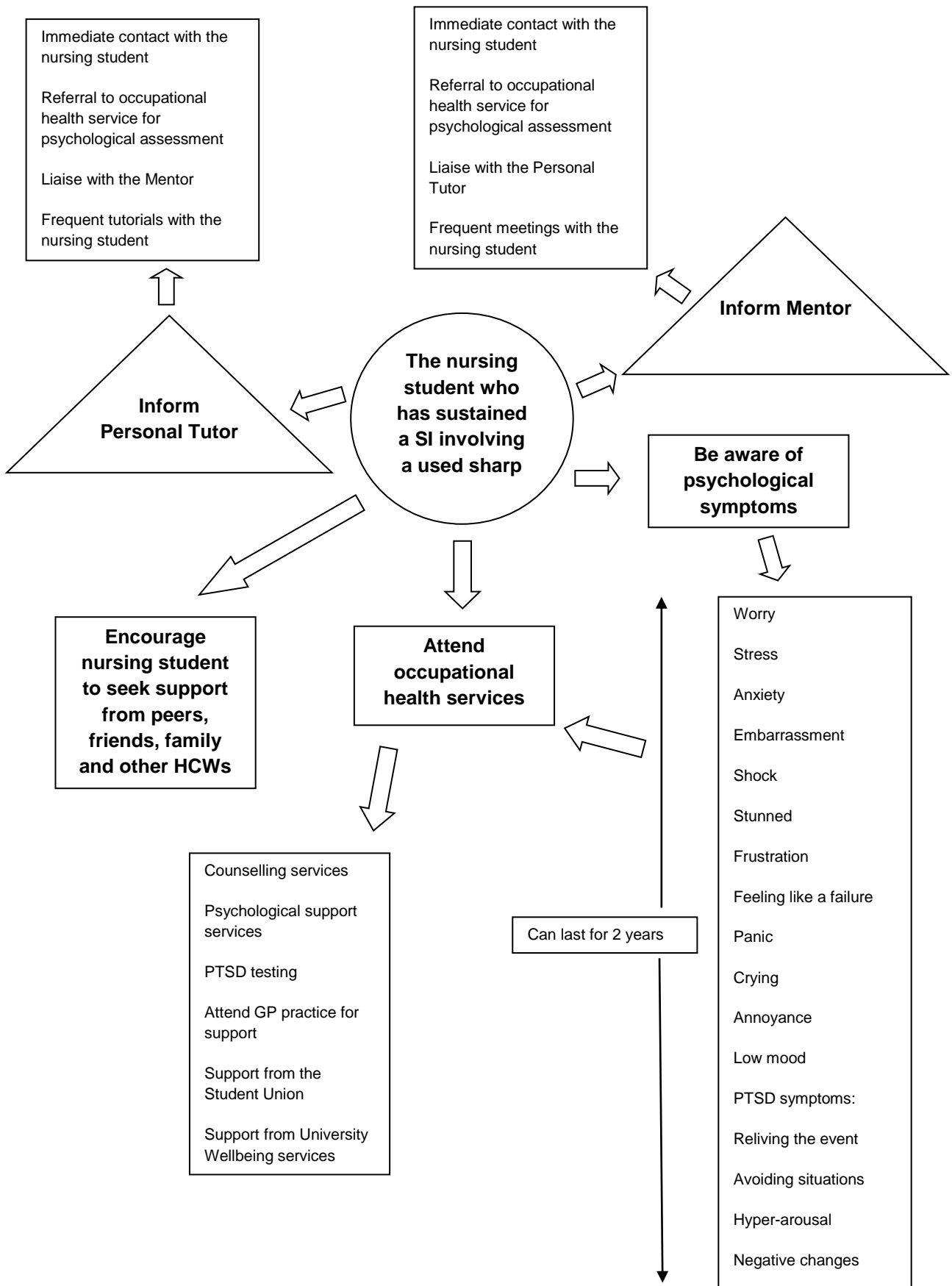
Researchers have claimed that the development of PTSD in nurses following SI is associated with a lack of social support, highlighting the need for a psychiatric service in the occupational environment to attend to HCWs (Carter et al., 2011; Olf, 2012). The experience of a nurse in the USA who suffered a SI involving a needle left by a doctor in the bed of a patient dying of AIDS was described within a report (Shalo, 2007). The PEP for the nurse was addressed, but there appeared to be a neglect of mental health counselling or follow-up for the individual. The nurse subsequently suffered from severe anxiety; panic attacks; disturbed sleep; night terrors and PTSD which affected her work and personal life. In the UK, the RCN (2009) found that following a SI, only 69% of nurses were offered adequate support,

whilst similarly in Australia, 61% of nurses who sustained a SI were offered counselling services (Kable et al., 2011). A similar conclusion of a lack of a follow-up service for care of employees following the exposure was made by da Cunha Januário et al (2017) in Brazil. Evidence therefore exists that nurses are not always receiving the support which they may need following a SI. When support is available, recovery from the incident was more effective. This was emphasised by Alderman (2005) who described the experience of a nurse who had contracted HCV following a SI involving a discarded stylet where the sharps container was not close enough to the nurse during the procedure. The experience involved a change in lifestyle such as using condoms and separating family toothbrushes and having negative thoughts, such as crying, mood swings and sleepless nights. Recovery from the experience was aided by a referral to a psychologist and the support received from colleagues. Qualitative findings from this study suggests that the initial support following SI for nursing students was praised which is in direct opposition to the support offered in other parts of the world involving nursing students and nurses. As some nursing students suffered symptoms for up to two years following the SI, more information is needed regarding what happens after the initial support occurs.

7.4.6 A framework for the psychological support of a nursing student post-sharps injury

Evidence from the study and the subsequent discussion has aided the formulation of a framework for the psychological support of a nursing student post-SI. This can be seen in Figure 7.3.

Figure 7.3: A framework showing the psychological support which may benefit the nursing student post-sharps injury



Informing the mentor and the personal tutor following the SI was seen by nursing students in this study as being a beneficial process in order to seek immediate support. If the SI occurs within clinical practice, the personal tutor should make prudent contact with the nursing student. This appears to fit the policy within the local educational institution. The mentor and / or the personal tutor should then contact the occupational services within their organisation to start the process of psychological support for the individual nursing student. This process links to the many policies, directives and guidelines previously explored.

Additionally to this, frequent meetings / tutorials should be arranged to support the student, and observe and assess the nursing student for a variety of psychological symptoms which may be demonstrated for up to two years following the SI. The student should be encouraged to attend counselling and psychological support services within the organisation or outside of the organisations. The occupational health services should also offer the nursing student a PTSD assessment to help to identify individuals who may be suffering from PTSD. The qualitative stage of this study also suggested the benefit of seeking support from peers, friends, family, and other HCWs, and this should be encouraged by the mentor and the personal tutor.

7.4.7 Summary

There are many factors which can influence the behaviour of nursing students in relation to sharps usage and how these skills are learnt. The educational institution and the clinical placements have a direct influence as do the many HCWs who the nursing student comes into contact with. There is evidence to suggest that knowledge is not always retained by the nursing student, and the skills are on occasion taught by HCWs who sustain SIs in practice. This is sometimes due to the non-adherence of policies which have been in place for decades to promote a safe

working environment in relation to sharps usage. With regards to education, evidence suggests that a theory-practice gap exists with regards to sharps practice.

Sharps practice in relation to glass, which was identified as the most common device causing SIs to nursing students, was related to the poor use or availability of safety devices, copying unsafe practices in placement and through the skill of safely opening a glass ampoule not always being learnt within the CSSW. Hence, either nursing students copied role models or developed unsafe practices causing injury.

There appeared to be a desire to fit in to the clinical placement, which sometimes manifested itself by copying the unsafe practices of HCWs. Evidence suggests that HCWs do not always comply with policies designed to maintain a safe working environment. This may be a reason why some nursing students re-sheath needles and use sharps bins unsafely causing SIs.

Educational programmes are designed to offer nursing students a wide variety of clinical placements to aid their development and competency. This does mean that some nursing student's placements where many sharps are used potentially increases the risk of SI, whilst other environments are almost sharps free meaning that the nursing student may miss out on opportunities to handle sharps. Nursing students sometimes find themselves in unpredictable environments, such as in the community, where hidden sharps can be a contributing factor for SIs.

Many other factors were also identified which influenced sharps behaviour, with inexperience being a common issue associated with SIs. There were also many individual factors such as feeling nervous and having a lack of sleep. A worrying factor was the perception of risk involved with the SI, especially if the person was known to the nursing student and was an older person rather than a perceived high

risk patient. This was sometimes reiterated by the mentor supervising the nursing student.

Learning about sharps usage occurs within the educational organisation and the clinical placements. The learning is variable based upon the experiences of the individual nursing students. The mentors, lecturers and other teachers who the nursing student comes into contact with on their journey means that a variety of teaching methods and styles could occur. Each individual nursing student has their own preferred learning style which influences how learning happens. Linked to this is the variety of learning theories associated with learning about sharps usage. At least five different learning theories have been strongly linked to learning within this study, and based upon the diversity of nursing students and mentors and teachers, presumably many more learning theories are being employed.

Although small in number, an unexpected finding within the study was that nursing students can show signs of PTSD following a SI. Although other psychological effects have been identified in a few previous studies, this appears to be the first time that this issue has been reported. Post-traumatic stress disorder has been identified within nurses, doctors and other HCWs in relation to sharps, so there appears to be no reason why nursing students should not be equally affected. A thorough literature search did not identify the reporting of PTSD affecting nursing students in any context, so this finding appears to be important.

Nursing students reported many disturbing symptoms following a SI, including nightmares, flashbacks, avoiding procedures involving sharps and feelings of stress and anxiety. This study suggests that PTSD affects females nursing students following SI more than males, and this links to previous studies involving not only

nurses, doctors and other HCWs, but other groups within societies. Evidence suggests that the support following a SI worldwide is variable, although in this study the support was described as good. It was identified that the psychological symptoms following a SI involving nursing students can last for up to two years. Hence a framework for the follow-up of nursing students to deal with the potential psychological effects including PTSD was devised. This framework has been designed to improve the follow-up of nursing students who may be suffering the devastating symptoms of PTSD post-SI.

Chapter Eight: Conclusion

8.1 Introduction

This study set out to explore SIs within a nursing student population in the UK. A mixed-methods approach was utilised encompassing surveys, a Twitter Chat, an audit and interviews. This final chapter will summarise the findings and state the strengths and limitations of the study, the contribution to knowledge the study claims to make, along with practice and methodology and recommendations for future research and education.

8.2 Summary of the findings

From the nursing student population in the UK that was studied the incidence rate of SIs was 14.7%. SIs sustained by these nursing students commonly occurred when drawing up medication during the preparation of an injection.

Nursing students within the qualitative phases of the study spoke widely about their experience of sustaining a SI. The findings were synthesised into eight themes. The first theme '*A vivid description of the event*' illustrated the level of detail provided by the participants. The second theme '*The impact of the sharps injury*' reflected how the SI had affected the participants and the impact which it had on their professional and private lives. The third theme '*The role of my Mentor and Personal Tutor*' exemplified the important role of supervisors during and after the SI. The fourth theme '*The role of my family and friends*' comprised information about the part kin and peers played in the nursing student's life following the SI. The fifth theme '*The next time I used a sharp*' illuminated how practice had changed and the emotions felt when the nursing student was faced with performing a task involving a sharp in the future. The sixth theme '*If it had been a used sharp*' illustrated the hypothetical emotions and experiences which the participant may have had if blood-borne virus

seroconversion or exposure to bacterial infections had potentially happened. The seventh theme '*Prevention of the sharps injury*' suggested the various ways in which SIs involving nursing students can be prevented from occurring. Finally, the eighth theme '*The perception of the patient involved in the sharps injury*' demonstrated how the opinion of the patient had an influence on the apparent severity of the SI for the participant.

Many factors were found to influence nursing student behaviour in relation to sharps usage. The discussion of the findings identified many influencing factors involved. Education within both the educational institution and the clinical setting was viewed as an important influencer. As the nursing students appear to have the desire to fit in with the clinical setting and viewed the mentor as their prime role model, informal learning in the clinical setting superseded formal learning within the educational institution. This manifested itself by the copying of the sharps behaviours of role models, even if some of the practices were unsafe. The major learning theories which had aided the understanding of the actions of nursing students in relation to sharps usage appeared to be Social Learning when copying the behaviours of these role models, and Experiential Learning when problem-solving issues which were experienced. There were therefore occasions when nursing students did not comply with legislation, directives and guidelines in relation to the safe use of sharps. The location of the placement appeared to be an important influencing factor, especially if the environment was unfamiliar such as in community settings. The notion of experience appeared to be a double-edged sword, as some students who sustained SIs were inexperienced, whilst others were in the second and third year of the programme and had healthcare experience. Individual factors were also seen as influencers to sharps practice, as on occasions nursing students felt nervous or

viewed themselves as clumsy. The final influencing factor identified was the level of risk which was associated with individual patients. This was on occasion influenced by the mentor.

The quantitative phases of the study identified that SIs occurred most commonly during the afternoon on a long day shift, and the treatment room and the patient's bedside were key locations. Medical and surgical environments were popular specialities where SIs occurred, with the community being a prominent location because of its unfamiliarity to some nursing students. Contributing factors were numerous with inexperience being seen as a major factor. The hand was vastly the most common part of the body affected by SIs, accounting for just over a half of SIs reported. There were many psychological factors identified within the quantitative and qualitative phases of the study. These encompassed anxiety and low mood which on occasion lasted for up to two years. Although small in number, a notable finding within the study was that some nursing students showed signs and symptoms of PTSD following a SI. A larger research study needs to be carried out with regards to the association between SIs and PTSD to reach more conclusive conclusions.

8.3 Strengths of the study

This study has offered insight into the issues of SIs within a nursing student population in the UK. The mixed methods approach generated many new ideas and authentic data which may not have been possible with the employment of a single method of investigation (Cresswell et al., 2011).

The online survey questionnaire was developed with attention to detail, solely for the purpose of this study and went through a rigorous process of validity and reliability

testing. This aided the generation of pertinent data for analysis in order to answer the research questions which had been set (Moule and Goodman, 2014).

The use of social media sites to distribute the survey nationally proved to be a cheap and effective method of targeting 274 nursing students within the UK (O'Connor et al., 2014). Valuable qualitative data was acquired via a Twitter Chat which proved to be an effective method of collecting an abundance of data. As the data in the form of tweets were automatically transcribed as part of the Twitter Chat package, there was no need to transcribe the event (Adolphous, 2018). The rigour within the qualitative phases of this study was aided by having two sources of qualitative data; the use of triangulation; conducting a pilot study and the achievement of data saturation (Parahoo, 2014).

8.4 Limitations of the study

The findings of this study should be interpreted in relation to a number of limitations, which may raise issues related to the validity, generalisability and transferability of the results.

Even though the systematic review was methodically conducted, there was scope for some studies relating to nursing students and SIs to have been missed. The employment of different keywords or other databases, may have potentially identified other studies (Moule and Goodman, 2014). Some key words only became evident when exploring the studies which had been identified within the systematic review. Additional keywords which could have been used to identify other studies include: cutting equipment; lancet; razor; scalpel; scissors; laceration and puncture. The issue of the lack of clarity of the cut-off point for the tools used to assess the articles

for the systematic review means that some rejected articles may have been included if the cut-off point was clearer (Pope et al., 2007).

Survey results can always be questioned due to the size of the sample and whether 'true responses' were actually obtained. This is due to issues relating to memory; motivation of participants to complete the survey; wanting to look favorably and the participant not wanting to appear incompetent (Moule and Goodman, 2014). The small sample size may have resulted in a Type II error, and not finding an association between SIs and variables such as gender, when one actually exists (Polit and Beck, 2010).

The utilisation of convenience and snowball sampling within a quantitative framework risks potential sampling bias to enter the research process (Taylor, 2014). Linked to this was the fact that nationally only nursing students who were regular users of social media sites during the specified timeframes participated within the Twitter Chat and responded to the national survey which questions the representativeness of the sample (Child et al., 2014). Added to this issue is that it was impossible to definitively categorize the participants within the Twitter Chat, so the identification of the participants was subject to error (Scanfeld et al., 2010).

The interviews were only conducted locally and not nationally. Hence, there are issues with the transferability of the findings (Lincoln and Guba, 1985), as all of the participants were from one university in a certain part of the UK. Although the nursing students at University X are probably fairly typical, as students are recruited from all around the UK and beyond. Great efforts were made to ensure potential organizational and interpersonal power issues would not be a concern, issues may have existed within the interviews (Moule and Goodman, 2014). This was due to the

researcher being a lecturer at the university where nursing students were the participants. As mentioned in section 4.6.4, this included creating a compassionate connection and creating a non-threatening environment for the interviews.

Irrespective of this, some participants may have withheld other important aspects about their experience due to issues related to the relationship between the researcher and the nursing student.

Due to the nature and purpose of the study, the researcher devised the data collection instruments, and collected and analysed all of the data. Even though triangulation occurred and others played a role in verifying the instruments, bias could have been introduced within the data collection and analysis stage (Parahoo, 2014). Potential bias may have been negated to a degree, due to other PhD students analysing and verifying a selection of qualitative data during the analysis process.

8.5 Contributions to knowledge

By investigating SIs through the eyes of nursing students, more insight has been gained about not only the incidence, type and experience of SIs, but also factors which influence behaviour in relation to sharps.

It has been established that there are many factors which can influence the behaviour of nursing students in relation to sharps usage and how these skills are learnt. The educational institution and the clinical placements can have a direct influence on the individual nursing student, as do the many HCWs who the nursing student comes into contact with in practice placements. The identification of these factors, has aided the identification of learning theory which influences the individual. There are numerous learning styles employed by nursing students, who learn in a

variety of ways based upon the different teaching styles of teachers who they come into contact with. Social Learning theory appears to be the primary theory employed by nursing students regarding sharps usage who learn partly by copying skills of nurses and HCWs. Although safe practices are learnt in clinical placement, there are also some unsafe practices copied including needle re-capping and unsafe ways of opening glass ampoules of medicine. This issue seems to be influenced by the nursing student attempting to fit in within the culture of the clinical environment where the clinical placement is.

It has been identified that 5.9% (n=6) of nursing students sustaining SIs can be affected by PTSD. This can have devastating effects upon some individuals causing issues such as flashbacks and an avoidance of sharps usage. Support following an injury involving a used needle is imperative for some individuals, with friends, family, peers, mentors, other HCWs and the personal tutor being the main points of contact. These support systems may benefit some nursing students as it has been identified that some symptoms of PTSD can linger for up to two years. Thus a framework has been created for nursing students who sustain a SI identifying the points of contact who may be able to support them and the signs and symptoms which should be observed for up to two years post-SI.

8.6 Contributions to practice

The incidence rate of SIs in a nursing student population in the UK has been identified as being 14.7 percent. Previously this data was known in many countries around the world, but not within the UK itself. Additionally to this it has been identified that the second year of the programme is the most common stage when SIs occur in the UK. It is now known how many nursing students per year sustain a SI. Making mentors of nursing students in practice setting aware of this is imperative,

as it can occur in most placement areas within hospitals and within community areas.

Glass has been established as the most common device involved with SIs involving nursing students, often caused by the incorrect technique employed when opening the glass ampoule. As nurses and other HCWs are viewed as role models by nursing students, in practice the correct technique should be taught and demonstrated to the nursing student with the employment of protective devices which should be made freely available. This also involves working within the legislation, directives and guidelines produced over many decades.

It has been determined that some SIs occur when the nursing student is not being observed by the mentor. This aspect should be addressed until the nursing student has been deemed to be competent in the sharps procedure and complies with the legislation which determines safe practice. The mentor should be aware though that being observed can also contribute to the incidence of SIs by the anxiety this creates in some individuals.

The survey phase of this study identified that all fields of nursing students reported a SI. Nurses, mentors and HCWs in practice should be aware that nursing students studying on Adult, Child, Mental Health and Learning Disability programmes are at risk of SIs by the various sharps related procedures involved within those fields.

Nursing students view nurses and other HCWs as role models whilst in practice placement, so thus it is imperative that these role models avoid the various unsafe sharps practices which have been reported to still occur. Stricter adherence to legislation, directives, guidance and recommendations with regards to safer sharps

practice will reduce SIs, and save large amounts of money as well as preventing a host of psychological effects.

HCWs should be aware that some nursing students who sustain SIs involving used sharps could show signs and symptoms of PTSD or other anxiety related issues. These issues could continue for up to two years. It is imperative that this issue is known so that the required follow-up services and help can be instigated. This should relate to: 1) immediate first aid; 2) referral of the nursing student to local occupational health services; 3) the immediate psychological support in the practice placement by the mentor (and other nurses and HCWs); 4) ensuring the nursing student informs the personal tutor for pastoral support; 5) encouraging the nursing student to talk to friends, family, mentor, nurses, HCWs or personal tutor about the experience; and 6) being aware that the signs and symptoms of PTSD can occur for up to two years.

Evidence identified within the literature (HSE, 2015; 2016) and the findings from this study, appear to show that unsafe sharps practice by HCWs continues. This begs the question whether policies need to be changed or learning needs to occur in a different way. One aspect of policy change could be more emphasis on the hazards involved with SIs occurring with glass ampoules. Glass as a hazard was mentioned very rarely within the identified sharps policies, directives, guidelines and other documentation. Even though the overall physical and emotional impact of an injury caused by glass may be much less than an injury caused by a used needle, these SIs are the most common type affecting nursing students. There could be a more vivid reiteration within policies, directives and guidelines of the safe use of the many protective devices which are on the market to open glass ampoules safely. This

could be linked to the highlighting of unsafe practices when opening glass ampoules with equipment which is not designed for that particular purpose.

A review of how sharps safety is taught and learnt by HCWs needs to occur. This is because SIs continue to occur even though policies, directives, guidelines and other documentation have promoted safe practices for decades within the UK. It appears that the way in which sharps safety is taught is not effective enough to deter HCWs from performing unsafe practices, which can have a severe physical and emotional impact on themselves and their colleagues. This issue is compounded by the notion that nurses and other HCWs are seen as influential role models by nursing students who may copy these unsafe practices.

8.7 Methodological contributions

This study has not only contributed to the knowledge of SIs involving nursing students, it has also contributed to methodology. It has been established that a Twitter Chat can be a useful method for collecting qualitative data to understand the experiences of nursing students and nurses. It is an under-utilised method of capturing pertinent qualitative data on a research topic exploring the experiences of participants. The added advantage of this method is the potential for saving valuable time if the tweets can be printed directly from the Twitter Chat site. This study has also displayed how thematic analysis can be used effectively to analyse tweets in order to gain rigorous qualitative data. Previously the utilisation of Twitter Chats and analysis of tweets have not been discussed widely within the literature.

The second contribution to methodology arising from this study is that social media sites such as Twitter and Facebook can be invaluable mechanisms for distributing survey questionnaires cheaply and effectively to potential participants when

investigating nursing students, and hence nurses and other HCWs. This study has shown that participants over a wide catchment area can be conveniently and successfully contacted and invited to participate in surveys.

8.8 Contributions to theory

It has been identified within this study that there are many influences which help to shape nursing student behaviour in relation to sharps usage. This study has discovered that many learning theories can be utilised to help to understand how nursing students learn procedures which involve sharps. The most pertinent learning theories employed within this study to view learning in these various domains are Social Learning Theory; Experiential Learning Theory; Cognitivism; Adult Learning Theory and Constructivism. These learning theories appear to be most relevant because learning about sharps by nursing students involves the immersion into experiences within simulation in the CSSW and in clinical placement. There are also opportunities within the educational institution and in placement for nursing students to observe and copy role models, whilst fitting into the culture of the environment. Nursing students were found to have created relationships from what they felt was relevant information and experiences in order to help understand the processes involved with using a sharp. These situations also included using past experiences to learn, which aided problem solving when they found themselves in ambiguous situations involving sharps.

These findings from this study can be used to influence teaching and learning in relation to sharps usage by nursing students. As nurses and other HCWs have been identified as being viewed as primary role models and influencers, education regarding sharps usage within clinical practice settings could be improved. This

could entail annual learning in the form of workshops and e-learning to highlight the: 1) incidence of SIs within HCWs; 2) common devices involved with SIs (especially glass ampoules); 3) common procedures where SIs occur; 4) common causes of SIs; 5) unsafe practices employed by some HCWs; 6) correct use of safety devices and 7) safe, evidence-based practice supported by decades of legislation and guidance.

There also needs to be reinforcement within these sessions that nursing student view nurses and HCWs as role models and are likely to copy safe and unsafe behaviours.

Findings from this study can also be utilised to influence teaching and learning within educational institutions. As it has been acknowledged that nursing students learn in a variety of ways, numerous ways of learning about sharps safety needs to be employed. The safe principles of sharps usage should be reinforced through the implementation of lectures, seminar sessions, e-learning and simulation annually within the programme. The starting point should be pre-placement in the first year of the programme, in order to promote safe and evidence-based practice at the start of the nursing student's journey. This learning should then be built upon each academic year, especially within the CSSW where nursing students should be encouraged to practice with sharps safely and comply with legislation and guidelines. This is especially pertinent when simulating the correct and safe way of opening a glass ampoule, which was identified as the primary device causing SIs for nursing students.

8.9 Recommendations

Having completed the study, discussed the findings and considered the contributions to knowledge, practice and methodology, these are recommendations for future research and education.

8.9.1 Recommendations for research

This study is the first study within the UK which has investigated the incidence, type and experience of SIs involving nursing students. It is acknowledged that the sample size was small and one of the qualitative phases was conducted on one site only. Future studies exploring the experience of SIs involving nursing students could be conducted on multiple sites to overcome potential Type II errors to enable the findings to be more generalizable and transferable. This should incorporate not only Adult nursing students but also Child, Mental Health and Learning Disability students.

This study has started the generation of knowledge into SIs and nursing students, but there is a need for the various data collection methods to be reviewed and the knowledge gained from this study to be applied and used to enhance and develop the questionnaire and the interview questions, prior to repeating the study or developing other studies in this topic area. This is especially true of the experience and impact of SIs involving nursing students, as this is potentially only the second study to ever explore this specific topic area.

There is also scope for more research investigating SIs occurring outside of hospital settings. The unfamiliar setting identified within the study means that not only nursing students, but nurses and other HCWs may be at risk of SIs in the hazardous arena of community settings. As it was identified as a unique issue, an investigation into PTSD in nursing students would be advantageous. This should be not only in relation to SIs, but to many other aspects of their experiences on nursing programmes which may trigger this psychological effect.

It was stated within the systematic review (Chapter Two) that a possible reason for the variation in incidence and prevalence rates of SIs worldwide could be the disparity between pre-registration nurse education in different parts of the world. Thus, future research could investigate the level of education in relation to sharps usage at different stages of programmes in various parts of the world.

Further study could also include an exploration of the educational content of sharps teaching within the undergraduate nursing curriculum in the UK and worldwide. This is because there are 72 UK universities and 100s worldwide potentially teaching sharps skills differently.

8.9.2 Recommendations for education

As identified within the Discussion Chapter (Chapter Seven), SIs involving nursing students can occur within the CSSW and can involve glass. A suggestion arising from this study's findings is to ensure that lecturers teaching sharps usage in the CSSW, who are acting as role models for nursing students, prepare the nursing student more effectively for sharps safety. This should be done before the nursing student starts practice placement, and should involve the numerous protective and safety devices available. From the first occasion when the nursing student is exposed to sharps in the CSSW, legislation, directives, guidance and recommendations should be adhered to and the correct protective devices should be demonstrated in techniques such as opening glass ampoules and not plastic ones.

This study identified gaps in the awareness that some nursing students who sustain SIs involving used sharps can develop a host of psychological symptoms, including PTSD. These symptoms can continue for up to two years and thus there is scope for the personal tutor to have immediate and prolonged contact with the nursing student

to make referrals to occupational health services, and to direct the nursing student to support from friends, peers, and family members. Frequent tutorials over the two years post-SI would be an advantageous way of identifying any psychological effect which the SI may have had.

A potential gap in knowledge of some nursing students identified within this study is the perception of the risk of seroconversion from SIs, based upon the perception of the patient involved in the incident. With some nursing students being only concerned about SIs involving very high risk groups of patients such as prostitutes and drug addicts, education relating to the potential risk of seroconversion following a SI involving all patients needs to occur. This is because if the nursing student does not view all patients as potentially carriers of blood-borne virus sero-converting pathogens, the nursing student may potentially not always report the SI or receive the necessary follow-up.

8.10 Personal Reflections

This study set out to explore SIs involving nursing students within the UK. I started this study as a lecturer, primarily teaching clinical skills, and having now completed the study I view myself as a lecturer and a researcher because of the journey which I have been on and now completed.

Designing and completing the study, and the writing up of the thesis has opened up various theoretical concepts and ways of knowing within the field of SIs and nursing students. It made me look in depth at how different lenses of truth exist and the worth of these differences to comprehend a topic more holistically. I have discovered how many nursing students are affected by SIs and the experiences they subsequently have. I have started to develop a greater understanding of the issues

related to SIs, including why they may occur, and how nursing students learn different behaviours involving sharps usage. Through conducting this study, the importance of support for the nursing student post-SI has been established. This is because of the many psychological effects of such an injury.

I feel I have gained confidence in my own ability to autonomously design and implement a research study, and have an appreciation of the many important steps involved in that procedure. The process of researching literature, planning and steering the study, analysing the data and contributing the findings to the contemporary debates within this field has further advanced my skills as a researcher and demonstrated my aptitude to determine and examine various subjects. It has occasionally opened up difficult debates about SIs, but this has helped me to develop my own skills and knowledge.

From my own personal position, this has been a mammoth six year journey for me. The journey has had its ups and downs, and its own pleasures and senses of achievement, despite the many barriers that appeared during the process. Throughout this journey I feel that I have grown as a person, an academic, a nurse and as a researcher.

APPENDICES

Appendix A: The PRISMA statement

Title

1. Title - identify the report as a systematic review, meta-analysis or both

Abstract

2. Structured summary – provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria; participants and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number

Introduction

3. Rationale – describe the rationale for the review in the context of what is already known
4. Objectives – provide an explicit statements of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICO)

Methods

5. Protocol and registration – indicate if a review protocol exists, if and where it can be accessed (e.g. Web address) and, if available, provide registration information including registration number
6. Eligibility criteria – specify study characteristics (e.g. PICO, length of follow up) and report characteristics (e.g. years considered, language, publication status) used as criteria for eligibility
7. Information sources – describe all information sources (e.g. databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched
8. Search – present full electronic search strategy for at least one database, including any limits used, such that it could be repeated
9. Study selection – state the process for selecting studies (i.e. screening, eligibility, included in the systematic review, and, if applicable, included in the meta-analysis)
10. Data collection process – describe method of data extraction from reports (e.g. piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators
11. Data items – list and define all variables for which data were sought (e.g. PICOs, funding sources) and any assumptions and simplifications made
12. Risk of bias in individual studies – describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level) and how this information is to be used in any data synthesis
13. Summary measures – state the principal summary measures (e.g. risk ratio, difference in means)

14. Synthesis of results – describe the methods of handling data and combining results of studies, if done, including measures of consistency for each meta-analysis
15. Risk of bias across studies – specify any assessment of risk of bias that may affect the cumulative evidence (e.g. publication bias, selective reporting within studies)
16. Additional analyses – describe methods of additional analyses (e.g. sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified

Results

17. Study selection – give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram
18. Study characteristics – for each study, present characteristics for which data were extracted (e.g. study size, PICOs, follow-up period) and provide the citations
19. Risk of bias within studies – present data on risk of bias of each study and, if available, any outcome-level assessment (see item 12)
20. Results of individual studies – for all outcomes considered (benefits or harms) present, for each study: (a) simple summary data for each intervention group and (b) effect estimates and CIs, ideally with a forest plot
21. Synthesis of results – present results of each meta-analysis done, including CIs and measures of consistency
22. Risk of bias across studies – present results of any assessment of risk of bias across studies (see item 15)
23. Additional analysis – give results of additional analyses, if done (e.g. sensitivity or subgroup analyses, meta-regression [see item 16])

Discussion

24. Summary of evidence – summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g. health care providers, users, and policy makers)
25. Limitations – discuss limitations at study and outcome level (e.g. risk of bias), and at review level (e.g. incomplete retrieval of identified research, reporting bias)
26. Conclusions – provide a general interpretation of the results in the context of other evidence, and implications for future research

Funding

27. Describe sources of funding for the systematic review and other support (e.g. supply of data); role of funders for the systematic review

Appendix B: The 40 articles which were eligible for inclusion in the systematic review

Reference / country of origin	Aim of the study	Study design	Sample size	Key findings	Score from Critical Appraisal Tool
Albertoni, F et al. (1992). (Italy)	To assess the rate of needlestick injury in hospital personnel in an Italian region. To identify risk factors potentially amenable to correction	Survey	30,226 HCWs (2776 student nurses)	9.5% of 1164 first year students had had a SI involving a needle; 26% of 1612 second & third year student nurses had had a SI involving a needle (p<.001)	16/19
Askarian, M et al (2012) (Iran)	To evaluate the frequency of SIs involving a needle in Iranian dental, nursing and midwifery students and their knowledge, attitude and practices regarding the use of protective strategies against exposure to blood borne pathogens	Survey	208 were nursing / midwifery students	75% did not report their injury; reasons were not knowing the reporting mechanism; did not realise that all SIs involving needles required reporting; did not know to whom to report the injury	16/19
Aslam, M et al (2010) (Pakistan)	To estimate the frequency of needle stick injuries and associated factors among nursing students, nursing professionals and paramedical staff in public sector tertiary care hospitals of Karachi	Survey	417 nurses (and paramedical staff)	45% (n=36) of sample having a SI involving a needle were student nurses in a previous month	16/19

Blackwell, L et al (2007) (USA)	To determine the incidence of needle sticks among nursing students at a small liberal arts University and evaluate the circumstances around the situation	Survey	96 student nurses	<p>9/96 received a needle-stick injury which is a rate of 9.4%</p> <p>Only 4 out of 9 students (44.4%) reported the incident</p> <p>22.2% (2 out of 9) students experiencing needle-stick injuries reported receiving only 3-5 hours of sleep on the night prior to the incident</p> <p>33.3% (n=3) of injuries occurred on a Medical-Surgical unit</p>	16/19
Cheung, K et al (2012) (Hong Kong)	To identify the risk factors for and prevalence of SIs among nursing students in different years of study	Survey	878 Nursing students from the 4 year full-time BSc in Nursing and the 3 year Diploma in Nursing	<p>Prevalence of 5.9% (n=52) of SIs over past 12 months</p> <p>SI location: 53.2% (n=25) on medical wards; 29.8% (n=14) on surgical wards;</p> <p>SI devices: 75% (n=42) injection needles</p> <p>Procedure: 27.8% (n=15) occurred when removing a needle cap</p> <p>Other factors: 62.5% (n=35) blamed 'carelessness'</p> <p>Reporting SIs: 60.7% (n=34) chose not to report the SI</p>	18/19

<p>Hussain, JSA et al (2012) (India)</p>	<p>To assess the occupational exposure to sharp instrument injuries among medical, dental and nursing students in Mahatma Gandhi Mission's Campus, Navi Mumbai, India</p>	<p>Survey</p>	<p>89 nursing students</p>	<p>76.4% (n=68) were the cases of sharp instrument injuries in the past year</p> <p>60.2% (n=41) had had 2 episodes of the injury</p> <p>73.5% (n=50) of the SIs occurred during IM / IV injection</p> <p>80.8% (n=55) occurred with a hollow-bore needle</p>	<p>16/19</p>
<p>Irmak, Z and Baybuga, MS (2011) (Turkey)</p>	<p>To investigate the prevalence of, and other factors associated with SI involving needles among Turkish nursing students</p>	<p>Survey</p>	<p>310 nursing students</p>	<p>19.4% (n=60) said they had injuries from needles</p> <p>The most common device was a syringe needle (54% n=34), followed by glass items (33.3% n=21)</p> <p>60% (n=36) occurred when giving IV / IM injections, followed by from a broken ampoule (25% n=15)</p> <p>The most common area of injury was the finger (81.4%)</p> <p>Location: medical clinics (43.3% n=26) and surgical clinics (56.7% n=34)</p> <p>68.3% (n=41) SIs involving needles were unreported</p>	<p>18/19</p>

Karadag, M (2010) (Turkey)	To identify the frequency of NSSIs in nursing and midwifery students; to determine the activities and devices associated with injuries; to determine the vaccination status against the HBV	Survey	141 nursing and midwifery students of which, 85 were nursing students	35.5% of the students had received a NSSI 66% (n=33) were caused by a broken ampoule or vial while 28% (n=14) were caused by a syringe needle 84% (n=42) did not report the incident	17/19
Kermode, M et al (2005) (India)	To describe the extent of occupational blood exposure and the risk of blood-borne virus infection among a group of HCWs in rural north India	Survey	87 student nurses	48.1% of student nurses had had a percutaneous within the last year	17/19
Kim, KM et al (2001) (Korea)	To examine the level of knowledge and performance of the universal precautions among the nursing and medical students in Korea	Survey	515 student nurses	Student nurses had a good level of knowledge relating to 'avoiding injury from used needles' compared to medical students Student nurses had a poorer level of knowledge relating to 'putting the cap back on the used needle before disposing of it' – although a better level of knowledge than medical students	15/19
Lachowicz, R and Matthews, PA (2009) (South Africa)	To identify procedures, areas of activity, occupational groups and other variables that carry a high risk of transmission of blood borne infections from patients to	Survey	435 HCWs	28.26% (n=13) of student nurses had sustained a SI	17/19

	health care workers at Witbank Hospital				
Li, Y and Scott, C (2008) (China)	To learn more about nursing student's HIV/ AIDS knowledge, attitudes and willingness to provide care for patients with AIDS	Survey	204 nursing students in final clinical year	Six respondents (3%) had experienced needlestick injury	17/19
Lukianskyte, R et al (2011) (Lithuania)	To determine the frequency of needle stick and SIs, to assess and compare the reasons and factors affecting SIs experienced by staff nurses and student nurses and to define how they are informed about notification and prevention of SIs	Survey	196 (96 staff nurses & 100 student nurses)	78% (n=78) of student nurses had suffered a needle-stick injury 59% (n=46) occurred in the procedures room; 15% (n=12) occurred in the patient's room 49% (n=39) occurred during breaking of the ampoule 64% (n=50) was due to inattention / haste 92% (n=72) did not report the incident	18/19
McCarthy, G and Britton, J (2000) (Canada)	To investigate non-sterile occupational injuries and infection control practices reported by final-year dental, medical and nursing undergraduates	Survey	64 final year student nurses	14% (n=9) of 64 student nurses had had a needle-stick injury	17/19
Mengal et al (2008)	To assess the prevalence of, and factors relating to, the acceptance of HBV	Survey	196 second, third and fourth year students	12.8% (n=25) had had 1 needle stick injury ; 9.2% (n=18) had had 2 needle stick injuries; 3.6% (n=7)	16/19

(Pakistan)	vaccination by nursing students in a tertiary hospital in Pakistan			had had more than 2 9.1% (n=5) of those who were exposed to blood and blood products, did not reported the injury	
Mitra, SP et al (2010) (India)	To assess the perception and practice of nursing students about needle stick injury in a tertiary care hospital	Survey	190 second year students	98.4% (n= 187) had had an accidental needle prick Only 18.4% (n=35) reported the injury to the authority	16/19
Muralidhar, S et al (2010) (India)	To determine the occurrence of SI involving needles among various categories of health care workers, and the casual factors, the circumstances under which these occur and to, explore the possibilities of measures to prevent these through improvements in knowledge, attitude and practice	Survey	75 student nurses	85.3% (n=64) had had a needle stick injury in the preceding year	14/19
Naidoo, M (2010) (South Africa)	To explore the lived experiences of student nurses at the UWC, SoN who sustained needle-stick injuries during their placement	Phenomenological study	8 nursing students	4 themes reported: Traumatic incident - including 'account of the incident' and 'setting the scene' Reaction to the traumatic incident - including 'physiological reaction', 'emotional reaction of the student and family', 'reaction	9/10

				<p>to treatment' and 'reaction to nursing practice'</p> <p>Intervening factors – including 'knowledge of student', 'knowledge of professional staff in service setting' and 'preparedness to practice'</p> <p>Need for support – including 'support from family and friends', 'support from staff in service settings' and 'support from staff at the Higher Education Institution (HEI)</p>	
<p>Ozer, ZC and Bektas, HA (2012) (Turkey)</p>	<p>To investigate the prevalence and nature of SI involving needles among Turkish nursing students, to estimate the number of vaccinations administered, to investigate type of needlestick and SIs, and to provide data about circumstances of the SI</p>	<p>Survey</p>	<p>285 nursing students</p>	<p>Overall prevalence rate of 33% (n=94)</p> <p>14.4% (n=41) occurred with a glass item</p> <p>First year</p> <p>SI prevalence was 31.4% (n=27) in the first year</p> <p>Second year</p> <p>SI prevalence was 44.4% (n=28) in the second year</p> <p>Third year</p> <p>SI prevalence was 39.4% (n=28)</p>	<p>17/19</p>

				<p>in the third year</p> <p>Fourth year</p> <p>SI prevalence was 18.6% (n=13) in the fourth year</p> <p>Most commonest cause was: 10% (n=7) occurred with a glass item</p>	
<p>Petrucchi, C (2009)</p> <p>(Italy)</p>	<p>To determine the frequency, distribution, nature and circumstances of percutaneous and mucocutaneous exposure and to identify some possible risk factors associated with percutaneous and mucocutaneous exposure</p>	<p>Survey</p>	<p>2215 nursing students</p>	<p>First year students had a higher probability of skin and percutaneous contamination than their colleagues of the second and third year</p>	<p>16/19</p>
<p>Reis, RK et al (2004)</p> <p>(Brazil)</p>	<p>To identify the types of accidents occurring; to identify the topographic areas affected; to identify the major causes attributed by the people victimized; to evaluate the conduct adopted in view of the accident as well as the reactions generated by the accident</p>	<p>Survey</p>	<p>50 nursing students</p>	<p>40% (n=50) reported to have been victimised by some type of accident with cutting and piercing objects or had contact of biological material with their skin or mucosa</p> <p>51% (n=)of injuries were caused by piercing objects; 44% of injuries were caused by cutting objects</p> <p>The predominant objects causing accidents were needles although among cutting objects (ampoules,</p>	<p>17/19</p>

				<p>scissors, glass vials) medication ampoules were the most common</p> <p>Most frequently affected areas of the body: 90.2% (n=65) occurred on the fingers</p> <p>22.2% (n=16) related to 'lack of attention / distraction; 13.9% (n=10) related to 'inexperience'</p> <p>The students reported negative feelings of 'anger'; 'insecurity'; 'concern'; 'fear'; 'low self-esteem'; 'frustration'; 'incapacity'; 'incompetence'; 'fear of infection e.g. HIV'</p>	
Salelkar, S et al (2010) (India)	To study the problem of needlestick injuries	Survey	662 healthcare works, of which 47 were student nurses	<p>6.4% (n=3) student nurses had had a SI involving a needle in the previous year</p> <p>33% (n=1) of student nurses had reported the SI involving a needle</p>	18/19
Scaggiante, R et al (2013) (Italy)	To describe the first case of acute HCV infection after a needlestick injury in a female nursing student at Padua University Hospital	Case study	1 student nurse	<p>Student nurse injured on the second finger of the right hand when re-capping a 23-gauge needle after taking a blood sample. The source was a 72 year old female patient who was weakly positive for anti-HCV. Three months after the injury, a relevant increase in transaminases with a low viral</p>	9/10

				replication activity was observed in the student, indicating HCV infection. The student nurse was treated with pegylated interferon plus ribavirin for 24 weeks. The patient was 'cured' 6 months later	
Schaffer, S (1997) (USA)	To examine risk factors for percutaneous (needlestick) and mucocutaneous (splash) exposure incidents to blood and body fluids that occurred while they were nursing students	Survey	580 newly qualified nurses	31 incidents of percutaneous exposure	17/19
Schmid, K et al (2007) (Germany)	To obtain data concerning the incidence, reporting and follow-up of occupational exposure to blood or other body fluids	Survey	597 HCWs of which 68 were student nurses	20/68 student nurses consulted the occupational physician as a result of occupational exposure to blood or other body fluids – the vast majority of which were SIs in the whole sample	19/19
Sharma, R et al (2010) (India)	To determine the occurrence of SI involving needles among the health care workers in a tertiary care hospital in Delhi, the various factors responsible for needle stick injuries, the circumstances under which they occur and explores the responses of the health care workers after an injury	Survey	332 HCWs of which 42 were nursing students	94.2% (n=40) of student nurses had had one or more SI involving a needle (the highest compared to other health workers) 25% (n=10) had had a SI in the last month 28.6% (n=12) had a SI whilst re-capping 38.8% (n=16) reported the SI to	15/19

				their supervisor or senior	
Shiao, J et al (2002) (Taiwan)	To describe the prevalence and characteristics of needlestick injuries in student nurses in Taiwan	Survey	572 student nurses	Prevalence rate was 61.5% (n=352) 42.6% (n=150) were caused by syringe needle (hollow bore needle related injury); 21.3% (n=75) were caused by glass item; 14.8% (n=52) was due to re-capping; 19.3% (n=68) happened when opening of ampoule or vial; 86.9% (n=306) needlestick injury were not reported	19/19
Small, L et al (2011) (Namibia)	To determine the incidence of needle-stick injuries in student nurses and to describe the context of their occurrences	Survey	198 first-fourth year student nurses	25% (n=49) had had a needle-stick injury during their academic training; 58.8% (n=20) who had injured themselves, injured themselves only once; 26.5% (n=9) who injured themselves, injured themselves more than once; 45% (n=22) of those students who sustained needle-stick injury never reported it; 27% (n=17) of all injuries occurred in the clinics; 27% (n=17) of all injuries occurred in the medical wards	19/19
Smith, D and Leggat, P (2005)	To investigate the prevalence and nature of SIs involving needles among Australian nursing students	Survey	274 student nurses	13.9% (n=38) reported a SI involving a needle in the previous year Prevalence: 4.3% (first year);	19/19

(Australia)				<p>11.4% (in the second year); 40.4% (in the third year)</p> <p>37% caused by a normal syringe; 22% caused by a glass item; 20% caused by an insulin syringe; 45% of all SI occurrences happened in the skills laboratory</p> <p>Of the 38 students reporting SI in the previous year, 15.8% had had multiple NSIs, numbering between 2-5 events</p> <p>34% of those reporting a SI were injured while opening the cap; 26% of those reporting a SI were injured when opening an ampoule</p> <p>39.5% of SIs were not reported</p>	
Talas, MS (2009) (Turkey)	To identify the frequency of SIs in nursing students during clinical practice; to describe activities and devices associated with injuries; to determine vaccination status against HBV infection and to define nursing students' use of UP for protection against BBPs	Survey	473 second, third and fourth year student nurses	<p>49% (n=230) reported sustaining NSISi</p> <p>Most of the injured students (63.5%) had had 2 or more SIs</p> <p>Most frequent site was the hand (98.7%)</p> <p>29.3% of injuries occurred in the second year; 36.1% occurred in the third year; 34.3% occurred in the fourth year</p> <p>43% (n=168) occurred with</p>	19/19

				<p>medical ampoules and serum bottles; 42% (n=166) occurred with hollow-bore needles; 74% (n=169) happened on wards; 70% (n=160) reported that the cause was 'manual skills were under-developed'; 27% (n=62) reported that the cause was 're-capping a needle'; 56.1% (n=129) of SI were unreported to their clinical instructor or hospital staff</p>	
<p>Tetali, S Coudhury, PL (2006) (India)</p>	<p>To understand health care providers perception of risk of occupational exposure to needles, blood and body fluids, to find out the correlates of exposure and to identify groups of health care providers at high risk of sustaining maximum number of such exposures</p>	<p>Survey</p>	<p>755 HCWs of which 75 were student nurses</p>	<p>Mean number of injuries per person per year was 1.9 (SD 0.7)</p> <p>25% (n=16) nursing students had had a SI in the previous year</p> <p>55% of injuries were caused by re-capping</p> <p>Non-reporting (n=43)</p>	<p>17/19</p>
<p>Trivedi, A et al (2013) (India)</p>	<p>To assess knowledge of the prevention and management of SIs involving needles of nursing students</p>	<p>Quasi-experiment</p>	<p>100 student nurses</p>	<p>Pre-intervention assessment</p> <p>100% had suffered SIs by needles; 55% suffered NSI from blood filled hollow needles; 86% mentioned getting struck by stylet of IV catheter; 31% suffered SI by surgical blade / scalpels</p> <p>Post-intervention</p> <p>There was a significant</p>	<p>9/14</p>

				(p=<0.001) improvement in knowledge of students regarding prevention and management of SI following training	
Unver, V et al (2012) (Turkey)	To determine the number and causes of occupational incidents that occurred in nursing students	Survey	218 second, third and fourth year student nurses	56.5% (n=13) of second year students 53.1% (n=17) of third years 51.2% (n=44) of fourth years 52.5% (n=74) of all years Second years 53.8% (n=7) were caused by injection needles 84.6% (n=11) did not report the SI Third years 52.9% (n=9) when using an injection needle 82.4% (n=14) did not report the SI Fourth years 43.1% (n=19) caused by injection needle 88.6% (n=39) did not report the SI	16/19
Vandijck, DM et	To assess the knowledge and perception of Belgian	Survey	495 student nurses: first year, second year, third	10.5% of students reported at	18/19

al (2008) (Belgium)	undergraduate nursing students about IC policies and procedures and to identify potential areas for improvement		year	least 1 needle stick injury 71.2% of students officially documented the needle stick injury	
Wang, H et al (2003) (China)	To examine the impact of structured training on prevention of occupational exposure to blood-borne pathogens on knowledge, behaviour, and incidence of medical sharp injuries among student nurses in Changsha, China	Quasi-experiment	106 student nurses	Knowledge of Universal Precautions increased in the intervention group but not in the control group 1.42 injuries per student nurse year (95% CI 1.05, 1.87) Injuries occurred most commonly when giving an injection (24%) The most common sources of SIs were intravenous needles (44%), and syringe needles (32%)	11/14
Yang, YH et al (2007) (Taiwan)	To evaluate the changes in frequency of SIs after student participants had been given a training program on prevention of SIs	Quasi-experiment	107 third year nursing students	Pre-test: 1999: 50.1% (n=264) of students reported experience of SI at least once in clinics during the internship training Only 39% of these students reported the events Of the participants 50.5% (n=54) reported a SI pre-test Average frequency of SI was 8.1 /	9/14

				<p>year</p> <p>Post-test:</p> <p>SI decreased significantly to 25.2% (n=27)</p> <p>Average frequency of SI was 2.7 times / year</p> <p>After intervention, report rates increased 1.5 times to 55.6%</p>	
<p>Yang, YH et al (2004)</p> <p>(Taiwan)</p>	<p>To examine frequency and mechanism of SIs among nursing students in Southern Taiwanese vocational schools, to compare the prevalence of SIs among these nursing students with others, and to determine the effect of internship rotation length on SIs frequencies</p>	<p>Survey</p>	<p>527 nursing students</p>	<p>50.1% (n=264) of responders sustained 1 or more SIs</p> <p>Average number of SIs per student was 8 times / year (4.9 times /year for SIs and 3.1 times / year for SI)</p> <p>The largest number occurred in Internal Medicine & Surgery departments</p> <p>42.1% were caused by syringe needles</p> <p>39% (n=103) who recalled having had a SI reported the incident</p>	<p>19/19</p>
<p>Yao, WX et al (2013)</p> <p>(China)</p>	<p>To confirm the effect of occupational safety training and education programs on needlestick injuries among</p>	<p>Quasi-experiment</p>	<p>246 randomly selected nursing students</p>	<p>Before education</p> <p>Average of 4.65 events / student of SI involving a needle</p>	<p>10/14</p>

	nursing students in China			<p>1144 SIs occurred in the 246 student nurses</p> <p>Surgery (235 times 0.955 events / student)</p> <p>Medicine (230 times 0.935 events / student)</p> <p>54.06% (n=133) had had 2-5 SI</p> <p>25.18% (n=288) caused by student handling the needle</p> <p>96.24% (n=1101) were not reported</p> <p>After education</p> <p>Average 0.163 events / student</p> <p>40 SI in total</p> <p>Surgery 4 times (0.016 events / student)</p> <p>Medicine 2 times (0.008 events / student)</p> <p>2% (n=5) had 2-5 SI</p> <p>12.5% (n=5) happened when handling the needle</p> <p>97.5% (n=39) reported the SI</p>	
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<p>Yao, WX et al (2010) (China)</p>	<p>To describe and characterize the rates and the nature of needlestick injuries among nursing students in China</p>	<p>Survey</p>	<p>246 female fourth year nursing students</p>	<p>1144 SIs involving needles in the 246 nursing students</p> <p>Average of 4.65 events / student nurse</p> <p>Surgery: 20.54% (n=235)</p> <p>54.07% (n=133) had had 2-5 injuries</p> <p>96.24% (n=1101) were not reported</p>	<p>18/19</p>
<p>Zungu, LI et al (2008) (South Africa)</p>	<p>To assess nursing student's knowledge of needle prick injury, to identify and describe factors that contribute to the occurrence of needle prick injury, and to discover the circumstances of needle prick accidents among the targeted group of students</p>	<p>Survey</p>	<p>96 second, third and fourth year nursing students</p>	<p>15.6% (n=15) nursing students declared that they had experienced an NPI sometime during their clinical practice</p> <p>Only 7.3% of respondents had reported the incident</p> <p>Reasons for non-reporting:</p> <p>41.1% (n=3) due to fear of HIV testing; 31.7% (n=2.3) due to fear of disciplinary action; 13.6% (n=1) due to 'did not know where / to whom to report; 13.6% (n=1) due to 'fear of confidentiality'</p>	<p>17/19</p>

Appendix C: The type of device involved in the sharps injury (systematic review)

Type of device	Rate	Reference	Country
Intravenous needle	2.0% (n=7)	Shiao et al (2002)	Taiwan
	2% (n=1)	Smith and Leggat (2005)	Australia
	4.1% (n=3)	Unver et al (2012)	Turkey
	6.7% (n=5)	Unver et al (2012)	Turkey
	9.8% (n=26)	Yang et al (2004)	Taiwan
	16.1% (n=11)	Hussain et al (2012)	India
	51.4% (n=35)	Hussain et al (2012)	India
	86% (n=86)	Trivedi et al (2013)	India
Needles (insulin; hypodermic; hollow-bore)	2.6% (n=9)	Shiao et al (2002)	Taiwan
	12.9% (n=37)	Ozer and Bektas (2012)	Turkey
	19.6% (n=11)	Cheung et al (2012)	Hong Kong
	20% (n=8)	Smith and Leggat (2005)	Australia
	24.12% (n=55)	Petrucci et al (2009)	Italy
	28% (n=14) in midwifery and nursing students	Karadag (2010)	Turkey
	30.4% (n=129)	Askarian et al (2012)	Iran
	37% (n=14)	Smith and Leggat (2005)	Australia

	42% (n=166)	Talas (2009)	Turkey
	42.1% (n=111)	Yang et al (2004)	Taiwan
	42.6% (n=150)	Shiao et al (2002)	Taiwan
	47.3% (n=35)	Unver et al (2012)	Turkey
	55% (n=55)	Trivedi et al (2013)	India
	75% (n=42)	Cheung et al (2012)	Hong Kong
	80.8% (n=55)	Hussain et al (2012)	India
Glass items (including bottle of patient secretion; blood collection tube; broken ampoule)	0.7% (n=2)	Ozer and Bektas (2012)	Turkey
	1.75% (n=4)	Petrucci et al (2009)	Italy
	2% (n=1)	Smith and Leggat (2005)	Australia
	14.4% (n=41)	Ozer and Bektas (2012)	Turkey
	21.3% (n=75)	Shiao et al (2002)	Taiwan
	22% (n=8)	Smith and Leggat (2005)	Australia
	25% (n=15)	Irmak and Baybuga (2011)	Turkey
	31.1% (n=82)	Yang et al (2004)	Taiwan
	37.8% (n=28)	Unver et al (2012)	Turkey
	43% (n=168)	Talas (2009)	Turkey
	49% (n=39)	Lukianskyte et al (2011)	Lithuania
	66% (n=33) in midwifery and	Karadag (2010)	Turkey

	nursing students		
Scalpel and surgical blade	0.3% (n=1)	Shiao et al (2002)	Taiwan
	1.1% (n=3)	Ozer and Bektas (2012)	Turkey
	2% (n=1)	Smith and Leggat (2005)	Australia
	5.8% (n=4)	Hussain et al 2012)	India
	31% (n=31)	Trivedi et al (2013)	India
Suture needle	0.88% (n=2)	Petrucci et al (2009)	Italy
	2.0% (n=7)	Shiao et al (2002)	Taiwan
	4% (n=2)	Smith and Leggat (2005)	Australia
	7.3% (n=5)	Hussain et al (2012)	India
	12% (n=12)	Trivedi et al (2013)	India
	29.9% (n=127)	Askarian et al (2012)	Iran
Scissors	2% (n=2)	Trivedi et al (2013)	India
	13.2% (n=9)	Hussain et al (2012)	India
Blood glucose lancet	2.1% (n=6)	Ozer and Bektas (2012)	Turkey
	2.3% (n=8)	Shiao et al (2002)	Taiwan
	4% (n=2)	Smith and Leggat (2005)	Australia
Air induction needle	3.4 % (n=12)	Shiao et al (2002)	Taiwan
Butterfly needle	1.7% (n=5)	Ozer and Bektas (2012)	Turkey

	2.0% (n=7)	Shiao et al (2002)	Taiwan
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Appendix D: The most frequent time to have a sharps injury during the administration of an injection (systematic review)

Stage of procedure	Rate	Reference	Country
Preparing an injection (including withdrawing medication; manipulating needles; discharging air	9.7% (n=34)	Shiao et al (2002)	Taiwan
	16% (n=5)	Schaffer (1997)	USA
	16.26% (n=186)	Yao et al (2010)	China
	20.4% (n=11)	Cheung et al (2012)	Hong Kong
	21.2% (n=56)	Yang et al (2004)	Taiwan
	25.18% (n=288)	Yao et al (2010)	China
	51.3% (n=38)	Unver et al (2012)	Turkey
Breaking an ampoule	19.3% (n=68)	Shiao et al (2002)	Taiwan
	21.1% (n=56)	Yang et al (2004)	Taiwan
	26% (n=10)	Smith and Leggat (2005)	Australia
	37.8% (n=28)	Unver et al (2012)	Turkey
	49% (n=39)	Lukianskyte et al (2011)	Lithuania
Removing the needle cap	2.6% (n=9)	Shiao et al (2002)	Taiwan
	5% (n=3)	Irmak and Baybuga (2011)	Turkey
	9.4% (n=33)	Shiao et al (2002)	Taiwan
	23.7% (n=63)	Yang et al (2004)	Taiwan
	27.8% (n=15)	Cheung et al (2012)	Hong Kong
	34% (n=13)	Smith and Leggat (2005)	Australia
During the procedure	1.4% (n=5)	Shiao et al (2002)	Taiwan
	10% (n=8)	Lukianskyte et al	Lithuania

		(2011)	
	10.9% (n=7)	Muralidhar et al (2010)	India
	15.91% (n=182)	Yao et al (2010)	China
	16% (n=5)	Schaffer (1997)	USA
	17% (n=11)	Muralidhar et al (2010)	India
	20% (n=53)	Yang et al (2004)	Taiwan
	24% (n=12)	Wang et al (2003)	China
After administration and before disposal	0.6% (n=2)	Shiao et al (2002)	Taiwan
	1.1% (n=4)	Shiao et al (2002)	Taiwan
	3.1% (n=11)	Shiao et al (2002)	Taiwan
	51% (n=51)	Trivedi et al (2013)	India
	61% (n=39)	Muralidhar et al (2010)	India
Re-capping the needle	4.2% (n=3)	Reis et al (2004)	Brazil
	5.1% (n=18)	Shiao et al (2002)	Taiwan
	6.7% (n=4)	Irmak and Baybuga (2011)	Turkey
	7.5% (n=32)	Askarian et al (2012)	Iran
	9.3% (n=5)	Cheung et al (2012)	Hong Kong
	14.8% (n=52)	Shiao et al (2002)	Taiwan
	16% (n=5)	Schaffer (1997)	USA
	17.1% (n=45)	Yang et al (2004)	Taiwan
	18% (n=14)	Lukianskyte et al (2011)	Lithuania

	18.6% (n=49)	Yang et al (2004)	Taiwan
	20.11% (n=230)	Yao et al (2010)	China
	20.3% (n=15)	Unver et al (2012)	Turkey
	27% (n=62)	Talas (2009)	Turkey
	28.6% (n=12)	Sharma et al (2010)	India
	55% (n=9)	Tetali and Coudhury (2006)	India
	62.5%(n=40)	Muralidhar et al (2010)	India
During or after needle disposing	0.6% (n=2)	Shiao et al (2002)	Taiwan
	1.1% (n=4)	Shiao et al (2002)	Taiwan
	3.3% (n=2)	Irmak and Baybuga (2011)	Turkey
	25.8% (n=8)	Schaffer (1997)	USA

Appendix E: Legislation relating to sharps usage within the UK

<p>The Health and Safety at Work Act (1974)</p>	<p>Placed general responsibilities on employers to ensure, so far as reasonably practicable, the health, safety and welfare of their employees. The Act also requires employers to provide a safe working environment in relation to SIs, together with safe equipment, training, information and instructions on safe systems of work.</p>
<p>The Safety Representatives and Safety Committee Regulations (1977)</p>	<p>Set out the requirement for employers to consult with accredited trade union safety representatives on health and safety issues such as the choice of equipment such as safety engineered devices and gloves. It also allowed safety representatives paid time-off to inspect SI reports, wards and departments for safe working practices and safe working environment to prevent SIs.</p>
<p>The Health and Safety (First Aid) Regulations (1981)</p>	<p>Ensure employers provide adequate and appropriate equipment, facilities and personnel to make sure their employees receive immediate attention if they are injured or taken ill at work. It also included provision of first aid treatment following a SI, including out-of-hours support.</p>
<p>The Personal Protective Equipment at Work Regulations (1992)</p>	<p>Set out the requirement to provide appropriate PPE where other controls cannot adequately control the risks. This includes the use of suitable gloves, aprons and goggles where the risk of exposure to BBVs cannot be eliminated or reduced effectively through other measures.</p>
<p>The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR)</p>	<p>Exposures to HBV, HCV, or HIV are reportable to the HSE as a dangerous occurrence ('accidental release of a biological agent likely to cause severe human illness') rather than as an injury (unless the exposure results in three or more days absence from work). This regulation relates to SIs if an employee is injured by a sharp known to be contaminated with a BBV or the employee receives a SI and a BBV is acquired by this route. This is then reportable as a disease or if the injury itself is so severe that it must be reported. If the sharp was not contaminated with a BBV, or the source of the SI could not be traced, it is not reportable to HSE, unless the injury itself causes an over-seven-day injury. If the employee develops a disease attributable to the injury, then it must be reported.</p>
<p>Health and Safety (Consultation with</p>	<p>Requires employers to set up effective means of liaising and consulting with employees. Hence, employers must make</p>

Employees) Regulations (1996)	relevant health and safety documents available to safety representatives.
The Provision and Use of Work Equipment Regulations (1998)	Set out the requirement to provide suitable, maintained work equipment and provide adequate information and training in their use. This incorporates the selection of suitable equipment such as sharps bins and instructions and information on how to use then safely.
The Management of Health and Safety at Work Regulations (1999)	Require employers to assess risks to the health and safety of their employees and arrange for the implementation of a system of safety management. Employers must assess the risk of SIs from work procedures and activities and provide information and training on the risks of SIs and what measures employees should take to reduce injury risk. Instruction and information on measures that must be taken in the event of an injury should also be provided.
The Control of Substances Hazardous to Health Regulations (COSHH) (2002)	Require employers to make a suitable and sufficient assessment of the risks to the health of workers exposed to hazardous substances, with a view to preventing or controlling the risks. This includes the proper use of protective equipment and regular monitoring of exposure. There must be an assessment of the risk of exposure to biological hazards including BBVs and measures implemented to eliminate exposure to such hazards. Where it is not reasonably practicable to do so, employers need to prevent the exposure through using safety-engineered devices, designing safe systems of work and providing protective equipment. Information and training must be provided to all workers exposed to BBVs. Health surveillance in the form of follow-up blood tests is required where there has been a significant exposure to BBVs.
The Health and Social Act (2008)	Published a specific code of practice for the prevention and control of healthcare-associated infection. The code requires NHS bodies to implement policies that encompass the provision of medical devices incorporating sharps protection mechanisms. It places a legal duty on NHS healthcare organisations to make arrangements to put the provisions of the code into practice, backed up by action if there are substantial failings in relation to the code. The Care Quality Commission (CQC) regulates health and adult social care in England and every health and adult social care service in England is legally accountable for making sure it meets

	<p>essential standards of quality and safety. The CQC registers and licenses care services to ensure they meet fundamental standards and monitor them to make sure they continue to do so. The code explicitly addresses the need to prevent exposures to BBVs including the prevention of SIs. The code states that procedures to avoid exposure to BBVs should include immunisation against Hepatitis B; the utilisation of gloves and other protective clothing; the safe handling and disposal of sharps, also comprising the provision of medical devices incorporating sharps protection, and measures to decrease risks during surgical procedures.</p>
<p>The Health and Safety (Sharp Instruments in Healthcare) Regulations (2013)</p>	<p>Supplement current health and safety legislation that already necessitate employers to take effective action to control the risk from SIs. The regulations implement the EU Council Directive 2010/32/EU on the prevention of SIs in the hospital and healthcare sector. The key requirement of the regulations ensures employers assess the risk of SIs under the COSHH regulations and where risks are recognized, the health care regulations require them to take explicit risk control measures such as steps to avoid the superfluous use of sharps. Where it is not sensibly realistic to avoid the use of medical sharps, the sharps regulations require employers to use safe sharps (incorporating protection mechanisms) where it is reasonably practicable to do so. This prevents the recapping of needles. Additionally secure containers and guidelines for safe disposal of medical sharps should be close to the work area. There is also a requirement within the directive to make available information to employees on the risks from injuries, relevant legal duties of employers and employees and good practice in preventing injuries, the benefits and disadvantages of vaccination and the support accessible to an injured person from their employer. The employer must also work with safety representatives in developing and endorsing this information and provide suitable training to ensure employees know how to work safely. The training must cover the correct use of safe sharps, safe use and disposal of sharps, what to do in the event of an injury and the employer's arrangements for health surveillance. There must be provisions in place in the event of an injury, which includes keeping a record of the incident, an investigation of the circumstances of an incident and taking action to prevent a reoccurrence. The employer must confirm that injured employees who may have been exposed to a BBV have instantaneous contact to medical advice and are offered</p>

	<p>PEP or other treatment as advised by a doctor and offered counselling where applicable. The directive also states that there must be a review, at appropriate intervals, of the effectiveness of procedures and control measures.</p>
<p>The Reporting of Injuries, Deaths and Dangerous Occurrences Regulation (RIDDOR) (2013)</p>	<p>Requires employers to report certain types of occupational diseases, injuries and dangerous occurrences. Employers are required to report formally known exposures to BBVs following a SI, such as when an employee is injured by a sharp known to be contaminated with a BBV such as HBV, HCV or HIV (this is reportable as a dangerous occurrence); when the employee obtains a SI and a BBV is acquired by this route sero-converts (this is reportable as a disease), or if the injury itself is so severe that it must be reported. If the sharp is not contaminated with a BBV, or the source of the SI cannot be traced, it is not reportable, unless the injury itself causes an over seven-day injury. If the employee develops a disease attributable to the injury, then it must be reported.</p>

Appendix F: EU Council Directives relevant to sharps usage

<p>EU Council Directive 89/391/EEC - Safety and Health at Work Directive</p>	<p>Published in 1989, and aimed to introduce measures to stimulate enhancements in the safety and health of workers at work. It incorporates principles regarding the prevention of risks; the protection of safety and health; the assessment of risks; the elimination of risks and accident factors; and the informing, consultation and balanced participation and training of workers and their representatives (European Agency for Safety and Health at Work 2018).</p>
<p>EU Council Directive 89/655/EEC - Use of personal protective equipment</p>	<p>Published in 1989, laid down the minimum necessities for PPE used by workers at work. It stated that PPE must be used when the risks cannot be circumvented or sufficiently limited by technical means of collective protection or procedures of work organization. The responsibilities of the employer are to ensure that PPE conforms with the relevant provisions on design and manufacture with respect to safety and health. This ensures that all PPE is suitable for the risks involved, without itself leading to any amplified risk; resembles existing conditions at the workplace; takes account of ergonomic necessities and the worker's state of health and fits the wearer correctly after any necessary adjustment. Additionally, the employer must organize training and demonstrate the use of PPE to employees. The appropriate PPE equipment should be provided free of charge and must be in good working order and hygienic condition (European Agency for Safety and Health at Work 2018a).</p>
<p>EU Council Directive 2000/54/EC) - Biological agents at work</p>	<p>Published in 2000, and laid down the minimum requirements for the health and safety of workers exposed to biological agents at work. Biological agents were classified into four risk groups according to their level of risk of infection. The directive states that workers' risk of exposure to biological agents should be reduced where conceivable to protect their health and safety and that the employer must ensure hygiene and individual protection by supplying protective clothing and upholding protective equipment properly. Additionally, workers and their representatives must obtain appropriate training involving working with biological agents and be provided with written instructions and display notices of the procedure to be followed. The directive states that effective vaccines must be made available free of charge for workers not already immune to the biological agent to which they are (or are likely to be)</p>

	<p>exposed. If a worker is discovered to be suffering from an infection or illness as a consequence of an exposure, surveillance should be offered to other workers. The directive states that specific attention should be paid to uncertainties about the hazards represented by biological agents present in human patients and the risks posed by the nature of the work. Finally, suitable decontamination and disinfection procedures should be implemented for contaminated waste to be handled and disposed (European Agency for Safety and Health at Work 2018b).</p>
<p>EU Council Directive 2010/32/EU - Prevention from sharp injuries in the hospital and healthcare sector</p>	<p>Published in 2010, has been previously explained when outlining The Health and Safety (Sharp Instruments in Healthcare) Regulations (2013).</p>

Appendix G: Key HSE guidance relevant to sharps usage

<p>'Advisory Committee on Dangerous Pathogens. Protection against blood-borne infections in the workplace: HIV and Hepatitis' (1995)</p>	<p>Offered assistance to those that need to assess the risks associated with exposure to such viruses. The guidance proposed to cover any workplace situation where exposure to BBV is possible and explained controls that reduce risks during exposure-prone procedures, and recommended actions in the event of an exposure. The HSE advised that for safety and security, small sharps should be placed in sharps disposal containers or otherwise suitably contained or guarded until decontaminated or incinerated and that there should never be a need to re-sheath a used syringe needle as the use of a sharps container can always avoid this. The guidance stated that whenever possible, separation of needle from syringe should also be avoided as this increases the risk of blood spillage and SI. They also stated that there are a quantity of initiatives to decrease the number of contaminated SIs, including the use of safer needle devices and needle exchange programmes.</p>
<p>'Safe working and the prevention of infection in clinical laboratories and similar facilities' (2003)</p>	<p>Advises employers on health and safety law, health and safety management, standard operating procedures and safe working practices, waste disposal and incident management.</p>
<p>'Biological agents: Managing the risks in laboratories and healthcare premises' (2005)</p>	<p>Gives advice to employers regarding health and safety issues, the assessment and management of biological agents including reporting incidents, emergency procedures, immunisation information and waste disposal.</p>
<p>'Blood-borne viruses in the workplace. Guidance for employers and employees' (2011)</p>	<p>Reiterates the legal duty of the employer to protect the health of employees and others. It links to the Health and Safety at Work Act (1974), the Management of Health and Safety at Work Regulations (1999) and the Control of Substances Hazardous to Health Regulations (COSHH) (2002) to advise that with regards to BBV the employer must assess the risk, prevent and control the risk, advise on immunisation and decontamination procedures, ensure disposal of waste, have a procedure for reporting incidents and have first aid procedures in place.</p>

Appendix H: Guidance from a range of sources relating to sharps usage

<p>'Protection against infection with Blood-borne viruses' (The Expert Advisory Group on AIDs and the Advisory Group on Hepatitis 1998)</p>	<p>Offered guidance on the implementation of procedures for the safe handling and disposal of sharps to reduce the risks. These include placing all disposable sharps in sharps containers immediately after use. It is advised that the containers should be placed safely out of reach of children as near as practicable to sites of use, be puncture resistant, of adequate depth and capacity, suitable for incineration and conform to British Standard 7320 and UN 3291; if they are for use where on site disposal takes place. If sharps containers are to be transported off site for disposal the guidance states that they must be of a type approved under the requirements of the Carriage of Dangerous Goods (Classification, Packaging and Labelling) and Use of Transportable Pressure Receptacles Regulations 1996. Sharps containers should also be provided in adequate numbers and never be overfilled and should be disposed of as clinical waste after closing securely, and replaced promptly.</p> <p>The guidance also states that there should be an avoidance of re-sheathing needles manually and that needles should only be re-sheathed if a device is available to allow this to be done using one hand only. If such a device is not immediately accessible, the single handed scoop method may be used, i.e. the HCW holds the barrel of the syringe and scoops the needle cap from a hard, flat surface on to the end of the needle. The guidance states that only when the needle tip is covered should re-sheathing be completed with the other hand and that the disposable syringes and needles should be discarded wherever possible as a single unit into sharps containers. The removal of needles from syringes should only be performed when vital such as when transferring blood to a container, or when the needle is disposable but the syringe is not. In these cases, needle forceps or other suitable devices should be readily available.</p>
<p>'The management of health, safety and welfare issues for NHS staff' (The NHS Employers 2005)</p>	<p>These are recommendations regarding the use of sharps. The recommendations are that needlestick incidents must be reported locally and the exposures should be managed based upon evidence which is available. Surveillance systems should be instigated and there should be an assessment of the risk, such as the identification of technologies to decrease exposures, eradicate the superfluous use of sharps by using</p>

	<p>sharps-free devices. Training is also recommended concentrating upon the risk of exposure, the correct use and disposal of sharps and the utilisation of sharps protection systems. The final recommendation is for the improved sharps disposal, including the provision of plentiful portable sharps bins in order for the sharp to be disposed of once used.</p>
<p>'Toolkit for implementation of European Directive on Prevention from Sharps Injuries (council Directive 2010/32/EU) in Member States' (The European Biosafety Network 2011)</p>	<p>Produced to aid the effective implementation of the Directive 2010/32/EU on the prevention of SIs in hospitals and healthcare sectors. The toolkit advises on risk management and prevention, reporting, surveillance systems, information and awareness-raising, the cost-effectiveness of change, the necessary education and training and the implementation process.</p>
<p>'Eye of the needle: United Kingdom Surveillance of significant occupational exposures to blood-borne viruses in HCWs (HPA 2012)</p>	<p>Had the following objectives. These were to collect data on HCWs following significant occupational exposure to HIV, HBV (HBsAg), and HCV in England, Wales and Northern Ireland; to scrutinize the categories of exposures, the staff involved and circumstances surrounding exposure episodes; to notify the development of national prevention policies; to monitor the implementation of national HIV PEP guidelines and to inform future HIV PEP policy; to monitor the implementation of and adherence to national guidelines on the management and follow-up of HCWs exposed to the risk of HCV infection, to inform the management of HCWs who seroconvert following occupational exposures; to monitor adherence to the policy on HBV vaccination of HCWs, and to raise awareness of occupational exposures and encourage all NHS Trusts and other healthcare providers to reduce the risk of injury to HCWs.</p>
<p>'Sharps safety. RCN guidance to support the implementation of the Health and Safety (Sharps Instruments in Healthcare</p>	<p>Gives advice regarding the implementation of the Health and Safety (Sharps Instruments in Healthcare Regulations, guidance on the law and the requirements on healthcare providers which has been previously outlined.</p>

Regulations) 2013' (RCN 2013)	
'Sharps and sharps containers transported in staff vehicles (Alert EFA/2013/001) Department of Health and Social Care (2013)	<p>Was concerned about needlestick injuries being reported by a car leasing company which affected servicing and valeting personnel. The injuries were caused by used, loose and unprotected hypodermic needles (sharps) left in lease or ex-lease vehicles which had been used by clinical staff. The incidents reported highlighted that passengers and drivers are also at risk and clinical staff who may use their own private vehicle at work. Sharps were found underneath and down the backs and sides of seats as well as in carpets, boot spaces and spare wheel wells. It is alleged that these circumstances arose as a result of failure to clear up appropriately after spills from un-secured sharps containers. The Alert stated that healthcare organisations are responsible for setting safe systems of working and that healthcare staff are responsible for following them and failing to take adequate precautions to protect oneself and others from the risk of needlestick injury is potentially both a disciplinary issue and a criminal offence under health and safety legislation. The recommendations were that healthcare staff who travel in the community and carry sharps (used or unused) in the course of their work should follow a safe system of working at all times, in line with their local clinical and waste disposal policies. Sharps should always be stored safely and securely and staff should ensure that they dispose of sharps immediately after use in a container suitable for transport; close the lid immediately after use and secure the container in the vehicle to avoid tipping; follow instructions for the assembly and use of sharps containers, including the use of lid closing and locking mechanisms; report any lid closing and locking mechanisms problems so that the suitability of the container can be reviewed and check the container at the end of each shift to ensure no sharps have been dropped or spilled in the vehicle. The Alert also stated that if staff cannot follow a safe system of working, this should be reported to their manager and additional support and facilities provided, for example placing sharps containers inside a robust secondary carrier or container. Healthcare organisations should thus review their procedures for the provision, use and return of leased cars for staff travelling and carrying sharps, and should work with staff using their own vehicles to ensure the same standard of risk</p>

	control.
'Workplace health and safety standards' (NHS Employers 2013)	<p>Issued a standard for the 'Management of sharps' which set the following criteria. Organisations should have policies and procedures in place and should make the necessary risk assessments in relation to sharps. Where reasonably practicable, the use of safer sharps should be employed, as should clearly marked and secure containers placed close to where sharps are used. The standards state that needles must not be recapped, unless the risk assessment has identified risks of not recapping are greater than recapping. If this is the case, a suitable appliance or tool should be provided. Organisations should give the necessary information and have training in place regarding the use of sharps. The standards state that a robust system of reporting all incidents should be in place and a system to investigate the circumstances and causes of the incident in order to take steps to prevent reoccurrence. Organisations should offer appropriate treatment and follow-up, such as immediate access to medical advice, PEP and counselling.</p>
'Managing and preventing sharps injuries. A UNISON guide for safety reps (UNISON 2014)	<p>Outlined best practice for employers in regards to sharps. The identification of the hazards and deciding who might be harmed and how was highlighted as an important issue for employers. The guide stated the importance of evaluating the risks and deciding upon the necessary precautions, such as the use of a safer form of the product such as sharps with safety mechanisms. UNISON also promoted the elimination of the unnecessary use of needles, by the adoption of alternative procedures for giving drugs. Changing or enclosing the process was also mentioned as an imperative issue and this related to preventing the recapping or re-sheathing of sharps; disposing of sharps immediately after use in designated sharps containers which should be within arm's length; not over-filling sharps containers and not passing sharps from hand to hand. Best practice outlined also encompassed limiting the number of people who handle sharps and the provision of PPE such as gloves, and ensuring health surveillance procedures are in place to protect employees. These include the collection of data to evaluate health hazards and prevent serious disease from developing and checking current control measures are working effectively. The guide also promotes vaccination against HBV for HCWs who may be in direct contact with patient's blood, blood-stained fluids or</p>

	<p>tissues. UNISON also call for the monitoring and treatment of workers in the event of an injury such as first aid and access to medical treatment. Finally, the recording of findings and the monitoring of the effectiveness of risk assessments are promoted.</p>
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Appendix I: WHO approved recommendations and guidance relevant to sharps usage

<p>'Alert. Preventing needlestick injuries in health care settings' (National Institute for Occupational Safety and Health 1999)</p>	<p>Outlined safe and effective practice for employers and employees in relation to the use of needles and the prevention of sharps injuries. It states that employers should implement the use of improved engineering controls to reduce SIs involving needles, such as eliminating the use of needles when possible and the implementation of devices with safety features. The employer is encouraged to analyse SIs to help to identify hazards and injury trends and set priorities and strategies for prevention. Training was seen to be imperative and the document states that all HCWs should be properly trained in the safe use and disposal of needles. The employer should also modify work practices that pose a SI risk and promote safety awareness in the work environment. The document recommends that employers establish procedures to encourage the reporting and timely follow-up of all SIs. Finally, the document states that there should be an evaluation of the effectiveness of prevention efforts and feedback on performance. The document also states recommendations for HCWs. This includes avoiding the use of needles if safety devices are available; avoiding re-capping; planning the safe handling and disposal of needles before beginning any procedures; disposal of used needles promptly in appropriate sharps disposal containers and the reporting of all SIs involving needles in order to receive the necessary follow-up care.</p>
<p>'American Nurses Association's Needlestick Prevention Guide (American Nurses Association 2002)</p>	<p>Promoted the 'methods of control hazards' in relation to needles ranging from the most effective to the least effective. The elimination of the hazard was seen to be imperative, such as removing all unnecessary injections and introducing substitutes such as jet injectors or needles that retract, sheathe or blunt immediately after use. Administrative controls such as policies aimed to limit exposure to the hazard were seen as favourable with examples including a needlestick prevention committee and consistent training on the use of safe devices.</p> <p>The paper also promoted work practice controls such as not re-capping, placing sharps containers at eye-level and at arm's reach, emptying sharps containers before they are full, and establishing the means for safe handling and disposing of</p>

	<p>sharps devices before beginning a procedure. PPE was also promoted including the use of gloves and the thorough documentation of the incident.</p>
<p>'Best infection control practices for intradermal, subcutaneous and intramuscular needle injections' Bulletin of the World Health Organisation (Hutin et al, 2003)</p>	<p>Provided some key evidence for the prevention of SIs following a literature review of evidence-based best practices. The Bulletin stated that as some injuries can happen from glass ampoules and it was recommended to use pop-open ampoules rather than ampoules that require opening with a metal file. Additionally a clean barrier such as a small gauze swap could be used.</p> <p>The movement of patients was seen as a contributing factor and it was recommended that HCWs anticipate this and take measures to prevent the sudden movement of the patient during and after injection. In some instances, it is recommended that physical assistance from other HCWs or family members might help to ensure that the procedure is carried out under appropriate circumstances.</p> <p>Recapping was highlighted as a major hazard. The Bulletin recommends avoiding recapping of needles and other hand manipulations of used needles in order to prevent SIs involving needles. A high proportion of needle-stick injuries happen due to two-handed recapping (Jagger et al 1988) and the teaching of the one-handed, scooping–re-sheathing–recapping technique was effective in reducing the risk of recapping-related needle-stick injuries in one study (From et al 1998). Thus, it is recommended to use the singlehanded scoop technique if recapping is necessary (e.g. in circumstances where a sharps container is not available).</p> <p>Sharps collection was also seen as a major hazard regarding SIs. It is recommended that syringes and needles are collected and properly contained at the point of use in a sharps container that is puncture and leak-proof and that is sealed before it is completely full.</p>

Appendix J: An appraisal of six classic types of mixed methods research design strategies

Name	Characteristic	Purpose	Suitability for the proposed study
Sequential Explanatory	Collection and analysis of quantitative data followed by a collection and analysis of qualitative data.	To use qualitative results to assist in explaining and interpreting the findings of a quantitative study.	Rejected because the purpose is to use qualitative results to assist in explaining and interpreting the findings of a quantitative study which was not the case in the study as some of the quantitative and qualitative results were seen as separate entities.
Sequential Exploratory	An initial phase of qualitative data collection and analysis followed by a phase of quantitative data collection and analysis.	To explore a phenomenon. This strategy may also be useful when developing and testing a new instrument	Rejected because in this design qualitative data collection happens first, whereas in this study the survey occurred first.
Sequential Transformative	Collection and analysis of either quantitative or qualitative data first. The results are integrated in the interpretation phase.	To employ the methods that best serve a theoretical perspective.	Rejected because even though some of the results will be presented in an integrated form, the nature of quantitative and qualitative results means that some will be presented separately.
Concurrent	Two or more methods used to confirm, cross-	Generally, both methods are used	The 3 types of 'Concurrent' design

Triangulation	validate, or corroborate findings within a study. Data collection is concurrent.	to overcome a weakness in using one method with the strengths of another.	were rejected because the study could not be completed in a concurrent fashion.
Concurrent Nested	A nested approach that gives priority to one of the methods and guides the project, while another is embedded or “nested.”	The purpose of the nested method is to address a different question than the dominant or to seek information from different levels.	
Concurrent Transformative	The use of a theoretical perspective reflected in the purpose or research questions of the study to guide all methodological choices.	To evaluate a theoretical perspective at different levels of analysis	

Appendix K: The results and an appraisal of the existing questionnaires

Name of author / date / type of study	Themes of the questions	Reliability or validity
Unver et al (2012) Survey	<ul style="list-style-type: none"> • Type of occupational injury • The cause of needlestick / sharps injury • The procedure being performed • The reporting of the injury • Completion of a risk assessment 	No mention of reliability or validity
Reis et al (2004) Survey	<ul style="list-style-type: none"> • How many accidents had been suffered • The object causing the accident • The treatment of the injury • The activity occurring when the participant had the accident • The cause of the accident • The vaccination status of the participant 	No mention of reliability or validity

Appendix L: Appraisal of five other existing questionnaires

Name of author / date / type of study	Themes of the questions	Reliability or validity
Small et al (2011) Survey	<ul style="list-style-type: none"> • whether the student had encountered a needle stick injury • the number of needle stick injuries per a specified year • the reporting of the needle stick injury, the demographics of the student • the type of clinical area in which the needle stick injury occurred • whether a registered nurse was present when the injury occurred. 	No validity or reliability
Mengal et al (2008) Survey	<ul style="list-style-type: none"> • whether an accident had occurred during the previous 3 months • the procedure involved in the injury • the post-injury procedure followed. 	Used Cronbach's Alpha to assess the reliability of their questionnaire. Additionally, two experts reviewed the CV.
Kermode et al (2005) Survey	<ul style="list-style-type: none"> • any needle stick or sharps injuries occurring in the previous week • how many needle stick or sharps injuries in the previous year • how many times needle stick or sharps injury had occurred during the respondents working life • the reporting of these needle stick and sharps injuries • the psychological impact of these incidents. 	A 4-month period of field observation and interviews with 40 HCWs in 2 other rural north Indian health settings; an extensive review of the literature; adaptation of existing questionnaires used in previous surveys of US HCWs.
Karadag (2010) Survey	<ul style="list-style-type: none"> • whether a cut, piercing or pricking with a sharp had occurred • the equipment involved • the location of the injury • the time of the injury • whether the sharp was used or unused • the reporting of the sharps injury • knowledge of the reporting process. 	Based upon the research information in the literature and the researcher's experience (nursing and midwifery teacher and hospital nurse and midwife); Expert opinion was taken to determine whether the questions were appropriate for the study's aims and whether the desired information would be sufficient.
Petrucci et al (2009) Survey	The questionnaire was translated by Loreto Lancia (one of the researchers). The key relevant questions related to:	Especially tailored to other previous international nursing student investigations, but with no

	<ul style="list-style-type: none"> • knowledge of good practice relating to sharps usage • how many skin, mucous or percutaneous exposures to blood or other biological material from patients participants had during the last year • whether the student was alone when the injury happened • the sharp involved in the injury • the procedure when the injury happened • the location of the injury • the reporting of the injury • the reasons why the participant may not have reported the injury after the exposure. 	<p>reference to reliability or validity.</p>
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Appendix M: Permission to use the PC-PTSD Screen Tool

Hi Kevin,

Thanks for reaching out to the National Center for PTSD. These assessment tools were created by government employees and therefore are not copyrighted. They are intended for use by qualified health professionals with advanced graduate training in psychodiagnostic assessment. No permission is required for their use.

You can access the PC-PTSD at: <http://www.ptsd.va.gov/professional/assessment/screens/pc-ptsd.asp>.

Best wishes in your research,

Matthew Yoder, Ph.D.
Clinical Psychologist & Consultant
PTSD Consultation Program
National Center for PTSD
matthew.yoder@va.gov
(804) 246-9984

Appendix N: The survey questionnaire

A survey to determine the extent, type and impact of sharps injuries within a nursing student population

This survey is part of my PhD project which is investigating the extent, type and impact of sharps injuries on nursing students.

Please read the following information before commencing the survey

- Your participation in this survey is voluntary
- Your responses to the questions in this survey are totally confidential and anonymous, so please do not write your name anywhere on the paper
- This survey is not a test of your knowledge. We are interested in your views and opinions, so please answer each item as honestly as possible
- You are free to withdraw your participation in this survey at any time until the questionnaire is submitted
- By completing the survey, and reading the information provided about the study, you are giving your consent to be a participant in the study
- This research project has been approved by the Ethics Committee of Plymouth University
- Summarised results from this research will be published in professional journals, but no individual person or hospital will be identifiable
- If you have any questions or concerns about this project please contact:
kevin.hambridge@plymouth.ac.uk

A survey to determine the extent, type and impact of sharps injuries within a nursing student population

A definition of a 'sharp'

Sharp devices, or sharps, are items capable of piercing the skin and include, but are not limited to, needles, surgical instruments, lancets, scalpels and glass.

Please answer the following questions by ticking the appropriate boxes. The survey is only interested in any sharps injuries you may have sustained in your role as a student nurse on the BSc Adult Nursing Programme. If you have had multiple sharps injuries, please answer as appropriate to record all of the injuries, by ticking more than one box if necessary.

Gender: Male <input type="checkbox"/> Female <input type="checkbox"/>

Please state your age.....

Please indicate the University where you are studying your BSc Adult Nursing Programme: Plymouth University (Plymouth campus)..... Plymouth University (Truro campus)..... Other (please state).....
--

Have you had any previous experience working within healthcare before starting the BSc Adult Nursing Programme? Yes..... No.....

If yes, please state what healthcare experience you have had:

Health Care Assistant.....

St John Ambulance Volunteer.....

First Responder.....

Other (please state).....

Not applicable.....

Before commencing the BSc Adult Nursing course, how many years of healthcare experience did you complete?

.....

What is your current Academic year:

1st year

2nd year

3rd year

1. Have you had a sharps injury in this current Academic year?

Yes

No

If No, thank you very much, that is the end of the survey

If Yes, please complete the rest of the survey:

2. How many sharps injuries have you had in this current Academic year?

Amount.....

3. Did you report the sharps injury (injuries)?

Yes.....

No.....

**4. Please state what device(s) were involved when you had the sharps injury (injuries).
Please tick all boxes which apply.**

Needle (hollow bore) for intramuscular.....

Needle (hollow bore) for subcutaneous injection.....

Intravenous needle.....

Glass.....

Scalpel / stitch cutter.....

Scissors.....

Razor.....

Blood glucose lancet.....

Other (please state).....

**5. Please indicate what procedure was happening when the sharps injury (injuries)
occurred. Please tick all boxes which apply.**

Administration of an injection.....

Preparation of an injection.....

Removing a suture.....

Performing an aseptic technique.....

When cleaning or clearing up following a procedure.....

Assisting in a surgical procedure.....

Handling or transferring a specimen.....

Processing or cleaning instruments.....

Accidentally injured by a colleague.....

Other (please state).....

6. If the sharps injury (injuries) happened during an injection procedure, please state at what stage of the process the injury (injuries) occurred:

When assembling the syringe and needle

Drawing up the drug

When administering the drug

When disposing of the syringe & needle

When re-capping the needle

When closing a safety needle device

Other (please state).....

Not applicable

7. Please state what time of day or night the sharps injury (injuries) happened. If you have sustained more than one injury, please reply as follows: Injury 1 = 1000, Injury 2 = 0230

.....

8. Please state which shift you were working at the time of the injury (injuries). If you have sustained more than one injury, please reply as follows: Injury 1 = early, Injury 2 = long day.

Early shift.....

Late shift.....

Night shift.....

Long day.....

9. Please state what you consider were the potential 'causes' or 'contributing factors' of the sharps injury (injuries):

- Your inexperience.....
- Your inattention.....
- Your haste.....
- Your carelessness.....
- Lack of supervision.....
- Your stress levels.....
- Your lack of sleep or tiredness.....
- Your lack of familiarity with the device.....
- Your heavy workload.....
- Lack of protective devices.....
- The equipment you were using.....
- Other (please state).....

10. Were you being directly observed by your Mentor, or a trained nurse, or a health professional, or a University Lecturer at the time of the sharps injury (injuries)?

Yes / no

11. Please state if the sharp involved in the injury (injuries) was 'used' (contaminated) or 'unused' (sterile):

- Used.....
- Unused.....
- Not applicable (e.g. glass).....

12. Please state the exact location where the sharps injury (injuries) occurred:

Treatment room.....

Patient's bedside.....

Clinical Skills Ward at the University.....

Delivery room.....

Operating theatre.....

Patient's own home.....

Other (please state).....

13. Please state the 'specialty' of the placement where you had the sharps injury (injuries):

Surgical.....

Medical.....

Accident and Emergency.....

Out Patients Department.....

Obstetrics or gynaecology.....

Oncology.....

Theatres.....

Recovery.....

Intensive Care Unit.....

University Skills Ward.....

Community Hospital.....

District Nursing.....

Other (please state).....

14. Please state if you reported the sharps injury (injuries) to your:

Mentor or Ward manager yes / no

Lecturer or Personal Tutor yes / no

Placement Development Team member yes / no

Local Occupational Health team Yes / no

Local Infection Prevention and Control Team Yes / no

15. Did you record the injury (injuries) on an accident form, or an incident form, or an electronic reporting system?

Yes / no

16. If you did not report the sharps injury (injuries), please state the main reason why you did not report the sharps injury (injuries):

It was 'Unused' or clean equipment.....

It was a minor injury.....

You did not know how to report the injury (injuries).....

You were afraid to report the injury (injuries).....

You were too shy to report the injury (injuries).....

You were embarrassed to report the injury (injuries).....

It was a complicated reporting procedure.....

There was a lack of time to report the injury (injuries).....

You were worried about confidentiality.....

The patient was not infected.....

You were worried reporting would affect your assessment of competence.....

Other (please state).....

17. Please state which part of your body was injured when the sharps injury (injuries) occurred?

Hand.....

Foot.....

Other (please state).....

18. Are you right handed or left handed?

Right handed.....

Left handed.....

19. In the month following the sharps injury (injuries) did you have nightmares about it or thought about it when you did not want to?

Yes

No

20. In the month following the sharps injury (injuries) did you try hard not to think about it or went out of your way to avoid situations that reminded you of it?

Yes

No

21. In the month following the sharps injury (injuries) were you constantly on guard, watchful or easily startled?

Yes

No

22. In the month following the sharps injury (injuries) did you feel numb or detached from others, activities or your surroundings?

Yes

No

Finally

I am looking to recruit volunteers to be interviewed on an individual, confidential and anonymous basis to discuss the impact of the sharps injury (injuries). If you would be happy to volunteer to take part in an individual interview, please send an email to the researcher:

kevin.hambridge@plymouth.ac.uk

Thank you very much for completing the survey

Appendix O: The interview schedule

Introduction	Hello and thank you for participating in the interview
The injury	Please tell me about your experience of having a sharps injury in your role as a student nurse (<i>Probes: the injury, location, specialty, device, cause, part of body affected, time of day</i>)
Following the injury	What happened following the sharps injury? (<i>Probes: immediately, first aid, Mentor / Personal Tutor involvement, reporting of injury, further treatment, other support, long-term</i>)
The impact of the sharps injury	I would now like to ask you some questions about the <i>IMPACT</i> of the sharps injury
	What impact did the sharps injury have on your life? (<i>Probes: personal life, professional life</i>)
	Can you tell me if the sharps injury affected you physically? (<i>Probes: pain, any follow-up treatment?</i>)
	Did the sharps injury affect you emotionally in any way? (<i>Probes: stress, anxiety, depression, irritability, worry, frustration, panic...if so, how long did this last for? Further treatments required?</i>)
	Can you tell me if the sharps injury affected your relationships, either professionally or personally? (<i>Probes: mentor, other HCWs, family, friends?</i>)
	Did you find that the sharps injury affected your 'nursing student experience' in any way? (<i>Probes: performance, confidence, attendance in placement, interactions with fellow students?</i>)
	Following the sharps injury did you have any nightmares about the sharps injury or think about it when you did not want to? (<i>Probes: If yes, please tell me a little more about that</i>)
	Following the sharps injury did you try hard not to think about it or go out of your way to avoid situations that reminded you of it? (<i>Probes: If so, please tell me a little bit more about your experience</i>)
	Did the sharps injury make you feel constantly on guard, watchful or easily startled? (<i>Probes: If so, please tell me a little bit more about your experience</i>)
	Did the sharps injury make you feel numb or detached from others, activities or your surroundings? (<i>Probes: If so, please tell me more about your that</i>)
Please tell me of any other short-term or long-term impacts of the sharps injury on yourself?	

Other themes	Is there anything else about your experience of having a sharps injury that you would like to share? Do you have any further questions or comments to make?
If the SI involved a clean sharp	How do you think you would feel if the sharp involved in the injury had been used?"
Thanks	Thank you very much for being a volunteer in my study

Appendix P: Content Validity Index ratings by ten experts

Item	Expert 1	E 2	E 3	E 4	E 5	E 6	E 7	E 8	E 9	E 10	Number in agreement	Item CVI
1	X	X	X	X	X	X	X	X	X	X	10	1.0
2	x	x	x	x	x	x	x	x	x	x	10	1.0
3	x	x	x	x	x	x	x	x	x	x	10	1.0
4	x	x	x	x	x	x	x	x	x	x	10	1.0
5	x	x	x	x	x	x	x	x	x	x	10	1.0
6	x	x	x	x	x	x	x	x	x	x	10	1.0
7	x	x	x	x	x	x	x	x	x	x	10	1.0
8	x	x	x	x	x	x	x	x	x	x	10	1.0
9	x	x	x	x	x	x	x	x	x	x	10	1.0
10	x	x	x	x	x	x	x	x	x	x	10	1.0
11	x	x	x	x	x	x	x	x	x	x	10	1.0
12	x	x	x	x	x	x	x	x	x	x	10	1.0
13	x	x	x	x	x	x	x	x	x	x	10	1.0
14	x	x	x	x	x	x	x	x	x	x	10	1.0
15	x	x	x	x	x	x	x	x	x	x	10	1.0
16	x	x	x	x	x	x	x	x	x	x	10	1.0
17	x	x	x	x	x	x	x	x	x	x	10	1.0
18	x	x	x	x	x	x	x	x	x	x	10	1.0
19	x	x	x	x	x	x	x	x	x	x	10	1.0
20	x	x	x	x	x	x	x	x	x	x	10	1.0
21	x	x	x	x	x	x	x	x	x	x	10	1.0
22	x	x	x	x	x	x	x	x	x	x	10	1.0
PR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
PR: Proportion relevant												
Average I-CVI = 1.00												

Appendix Q: Test-Retest reliability results for survey questionnaires (1)

Participant	Demographic questions answered the same	Percentage of similarity
Respondent 1	9/9	100%
Respondent 2	8/9	88.9%
Respondent 3	9/9	100%
Respondent 4	9/9	100%
Respondent 5	9/9	100%
Respondent 6	9/9	100%
Respondent 7	7/9	77.8%
Respondent 8	9/9	100%
Respondent 9	9/9	100%
Respondent 10	9/9	100%
Respondent 11	9/9	100%
Respondent 12	9/9	100%
Respondent 13	9/9	100%
Respondent 14	9/9	100%
Respondent 15	9/9	100%
Total	132/135	97.8%

Appendix R: Test-Retest reliability results for survey questionnaires (2)

Respondent	Numbers of questions answered the same in both surveys	Percentage of similarity
Respondent 1	27/30	90%
Respondent 2	28/30	93%
Respondent 3	30/30	100%
Respondent 4	27/30	90%
Respondent 5	29/30	97%
Respondent 6	29/30	97%
Total	170 / 180	94.4%

Appendix S: The participant information sheet for the interviews

Participant Information Sheet (April 2016)

“The extent, type and impact of sharps injuries within a pre-registration adult branch nursing student population: A PhD study”

This is an information sheet explaining the qualitative (Interview) stage of the PhD project which you have kindly volunteered to participate in. If you would like clarification of any points or any further explanations, please ask.

The aim of the study

The aim of the study is to investigate the type, extent and impact of sharps injuries within a pre-registration adult branch nursing student population. The interview stage will be exploring the ‘impact’ of sharps injuries.

The interview

Participation involves being interviewed by Kevin Hambridge. The interview will involve questions about your experience of sharps injuries and their impact on your life. The interview may last for up to 1 hour. Written notes may be taken during the interview and an audio-tape will be utilised to record the interview verbatim.

Confidentiality and anonymity

Data gained will be anonymised with confidentiality being maintained. This will be preserved by not using the names of the participants or placement locations within the study. The only exception to this is if interviewees reveal evidence of practice that needs reporting to the NMC or other relevant agencies, then confidentiality will need to be broken. The Plymouth University policy contained within the ‘Nursing Handbook’ relating to ‘Health and Safety’ (12.8 ‘Incidents in the clinical area’ and 12.9 ‘Guidelines for dealing with unsafe practice / inappropriate professional behaviour’ will then be followed to report the incident.

Each participant will be assigned a unique number, as close as possible to the time when the data is collected. A list of the unique study number / individuals names will be kept separately and secured electronically and will not be referred to unless there is a specific reason i.e. safety. The research data will only be accessible to my 2 PhD supervisors and myself, and participant's data will not be discussed beyond the needs of the study.

Storage, retention and security of data

Data in paper, audio-tape or digital-tape form, and portable data will be stored correctly, safely and securely within locked fireproof cupboards. Portable data will be stored on password-protected computers or memory stick with a firewall, virus and spyware protection. Information will be retained for a time-frame of up to 10 years only (or for a time frame stated by the Plymouth University Human Ethics Committee) to facilitate realistic completion of the research, review of all data by PhD assessors, dissemination and any further analysis of the data.

Voluntary participation / the right to withdraw

Participation in the qualitative stage of the study (Interview) is voluntary and you have the right to withdraw without giving a reason. This should be done within a month of the interview. If you chose to withdraw, this will not impact on your relationship with the researcher or the School.

Counselling / occupational health services

Due to the delicate nature of the study, and if you feel you have been harmed in any way in relation to sharps injuries (physically or psychologically) you will be directed to any of the following services: the Plymouth University Student Counselling Service, the Plymouth University Occupational Health Department or your GP.

There will also be an opportunity for a debriefing session for participants of the interview in order to discuss any issues raised within the study. This can happen immediately following the interview or at any point afterwards.

Ethics

The study has been reviewed and approved by the Plymouth University Human Ethics Committee.

Questions or concerns

Having read the information, if you feel you would like to participate in the Interview stage of the study, please sign and return the consent form. Again, if you would like any clarifications or any further explanations, please ask me or Professor Ruth Endacott, my PhD Director of Studies. Contact details are found below.

Thanks for taking the time to read this information and for your cooperation within the study.

Contact details

Kevin Hambridge
Lecturer in Adult Nursing
Faculty of Health and Human Sciences
Plymouth University
Tel: *****
Email: *****

Professor Ruth Endacott
Professor of Clinical Nursing
Faculty of Health and Human Sciences
Plymouth University
Tel: *****
Email: *****

Appendix T: The consent form for the interviews

Consent form (April 2016)

“The extent, type and impact of sharps injuries within a pre-registration adult branch nursing student population: A PhD study”

Name of Interviewer: Kevin Hambridge

Having read the Participant Information Sheet, if you would like to participate in the interview, please complete the consent form by **initialling each box** and **signing at the bottom of the page**.

1	I confirm that I have read the Participant Information Sheet dated April 2016 for the above study.	
2	I have had an opportunity to ask Kevin Hambridge any clarifications or questions about the qualitative (Interview) stage of the study before the interview takes place. I do not have any further questions about the study.	
3	I understand how the data produced by the interview will be handled, shared and stored and I understand how confidentiality and anonymity will be maintained and accessible only to appropriate members of the PhD project team.	
4	I understand that my participation is voluntary and I have the right to withdraw from the study without giving a reason (within 1 month of the interview) and with no detrimental effects on my studying at Plymouth University.	
5	I understand that if I feel uncomfortable in any way during the interview session, I have the right to decline to answer any questions or to end the interview.	
6	I understand that if I have been affected by the interview in any way, I can have a debriefing session with Kevin Hambridge, seek counselling, visit my GP or be referred to counselling services, or Occupational Health services within Plymouth University.	
7	I agree to the interview being audio taped.	
8	I agree to the use of anonymised quotes in future publications.	
9	I volunteer to participate in the above study being conducted by Kevin Hambridge.	

Name of participant.....date.....

Name of researcher.....date.....

1 copy of the consent form to be retained by the participant; 1 copy to be retained by the researcher

Appendix V: University X Ethics Panel approval

RESEARCH WITH PLYMOUTH UNIVERSITY

2nd July 2015
CONFIDENTIAL

Kevin Hambridge
3 Portland Villas
Drake Circus
Plymouth
Devon
PL67EP

Dear Kevin

Application for Approval by Faculty Research Ethics Committee

Reference Number: 14/15-397

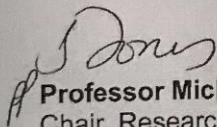
Application Title: The extent, type and impact of sharps injuries in a pre-registration adult branch student nurse population

I am pleased to inform you that the Committee has granted approval to you to conduct this research.

Please note that this approval is for three years, after which you will be required to seek extension of existing approval.

Please note that should any MAJOR changes to your research design occur which effect the ethics of procedures involved you must inform the Committee. Please contact Sarah Jones (email sarah.c.jones@plymouth.ac.uk).

Yours sincerely



Professor Michael Sheppard, PhD, FAcSS
Chair, Research Ethics Committee -
Faculty of Health & Human Sciences and
Peninsula Schools of Medicine & Dentistry

Appendix W: The demographic characteristics of the respondents of Survey 1 (local) and Survey 2 (national) who had sustained a SI

Criteria	Survey 1: Local (number and %)	Survey 2: National (number and %)
Have you had a sharps injury in this current academic year?	(n=537)	(n=274)
Yes	56 (10.4%)	63 (23%)
No	481 (89.6%)	211 (77%)
Branch	(n=56)	(n=63)
Adult	56 (100%)	63 (100%)
Current academic year	(n=56)	(n=63)
1 st year	12 (21.4%)	11 (17.5%)
2 nd year	23 (41.1%)	31 (49.2%)
3 rd year	21 (37.5%)	21 (33.3%)
Age	(n=56)	(n=63)
Range	19-49 (30 years)	19-51 (32 years)
Mean (standard deviation)	28.64 (8.974)	27.97 (7.896)
Gender	(n=56)	(n=63)
Female	50 (89.3%)	58 (92.1)
Male	6 (10.7%)	5 (7.9%)
Previous experience	(n=56)	(n=63)

in healthcare		
Yes	32 (57.1%)	34 (54%)
No	24 (42.9%)	29 (46%)
Type of previous experience	(n=32)	(n=35)
HCA or equivalent	26 (81.3%)	31 (88.6%)
Months of experience	(n=32)	(n=35)
Range	6-324 (318 months)	6-300 (294 months)
Mean (standard deviation)	66.44 (65.532)	61.80 (75.619)
Right or left handed	(n=56)	(n=63)
Right handed	46 (82.1%)	59 (93.7%)
Left handed	9 (16.1%)	3 (4.8%)
Ambidextrous	1 (1.8%)	1 (1.6%)

Appendix X: The amalgamated demographic characteristics of the respondents from Survey 1 (local) and Survey 2 (national) who had sustained a SI

Location	98.3% (n=117)
England	90.6% (n=106)
Scotland	6% (n=7)
Wales	2.6% (n=3)
Northern Ireland	0.9% (n=1)
Gender	100% (n=119)
Female	90.8% (n=108)
Male	9.2% (n=11)
Age	(n=119)
Range	19-51 (32 years)
Mean (standard deviation)	28.28 (8.391)
Previous experience in healthcare	(n=119)
Yes	55.5%(n=66)
No	44.5% (n=44.5)
Type of previous experience	(n=67)
Health Care Assistant (or equivalent)	88.1% (n=59)
St John Ambulance	7.5% (n=5)
Other, including GP receptionist, dental nurse, volunteer, nursery nurse, health trainer	4.5% (n=3)
Months of previous healthcare experience	(n=67)
Range	6-324 (318 months)
Mean (standard deviation)	64.01 (70.486)

Academic Year in which the sharps injury was sustained	(n=119)
1 st year	19.3% (n=23)
2 nd year	44.5% (n=53)
3 rd year	36.1% (n=43)
Right or left handed	(n=119)
Right	88.2% (n=105)
Left	10.1% (n=12)
Ambidextrous	1.7% (n=2)

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