

Enhancing nurses' knowledge and application of infection prevention practices

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"Let whoever is in charge keep this simple question in her head (<u>not</u>, how can I always do this right thing myself, but) how can I provide for this right thing to be always done?" (Nightingale, 1859: 40).

Abstract

The profile of infection prevention has been raised considerably within the last decade, yet compliant practice remains low. In order to enhance understanding the aim of this research was to explore whether nurses' knowledge and application of these practices were affected by training, education or experience.

A three study approach was conducted to explore this research phenomenon from multiple aspects to converge on a more comprehensive truth. An evaluation of the effectiveness of ward-based clinical skills training determined that implementation improved nurses' compliance to infection prevention practices. A questionnaire survey of 414 pre- and post-registration nurses' knowledge and application of infection prevention practice suggested that nurses with more experience had significantly increased understanding and application of practice, compared to nurses with five years or less experience. In-depth interviews explored experiences of infection prevention education from the perspective of two trainers, five pre-registration and ten post-registration nurses who attended training.

The triangulated findings of these studies suggest that delivering infection prevention education in a clinical learning environment to small groups of nursing staff at an appropriate time would enable visual, practical and relevant resources to be used and key skills to be practised and demonstrated. Centering the content on specific infections and problem-based scenarios rather than standard precautions, may more effectively enhance nurses' knowledge through facilitating interaction and engagement and motivate them to transfer the knowledge and skills learnt during education into practice. Findings also suggest that the national *Saving Lives* audit programme has little impact on improving either infection prevention knowledge or application to practice with regards to key clinical skills.

By changing the way that infection prevention education is delivered for nurses and the environment within which it is conducted may effectively improve such education by facilitating more effective interaction, engagement, transference of theory into practice and demonstration of competence. Implications of such education could consequently include enhanced infection prevention knowledge and skills, increased application of such knowledge to practice and therefore enhanced patient safety outcomes in terms of a reduced risk of infection.

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Chapter One

1. Introduction

1.1 Background

The prevention and control of Healthcare Associated Infections (HCAI) is top of National Health Service (NHS) and United Kingdom (UK) Government agendas due to the rates of HCAI growing to unacceptable levels at the beginning of the 21st century. In 2001 the Department of Health (DH) announced that mandatory reporting of meticillin resistant Staphylococcus aureus (MRSA) bacteraemia or blood stream infections was required and published Getting Ahead of the Curve (DH, 2002), which identified HCAI as a key government priority, placed emphasis on surveillance systems and called for NHS organisations to implement strategies to reduce rates of HCAI. Although a seminal document, it provided a global perspective of infectious diseases and recommended some broad executive actions to reduce HCAI but did not offer detailed practical or clinical guidance for NHS organisations. More specific local actions for decreasing HCAI were therefore detailed in Winning Ways (DH, 2003a), which included appointment of Directors of Infection Prevention & Control and actions to reduce the risk of infection through effective hand hygiene, care of invasive devices, environmental cleanliness and isolation facilities. This publication also placed particular emphasis on compulsory infection prevention training for all staff within the NHS and began to acknowledge MRSA as a HCAI of concern. However it made no reference to Clostridium difficile and provided no urgency or incentive for NHS organisations to implement the actions that it recommended.

Concurrently incidence of MRSA bacteraemia continued to increase to reach a peak of 7,700 reported cases in England in 2003-4. This prompted the Health Secretary in 2004, John Reid, to set a target for the NHS which was to reduce MRSA bacteraemia nationally by 50% by 2008. At this time the Department of Health also requested surveillance of *C. difficile* associated disease to be included in the mandatory HCAI surveillance system for acute Trusts in England. The National Patient Safety Agency (NPSA) also launched the nationwide 'cleanyourhands' campaign in 2004 to reinforce the importance of effective hand

hygiene in the reduction of HCAI and aimed to support NHS Trusts to achieve consistent and evidence-based hand hygiene practices (NPSA, 2004). Such actions were essential as approximately eight percent of patients developed a HCAI in 2004, causing 5000 deaths in England annually and costing the NHS £180 million (World Health Organisation, 2005). The Healthcare Commission was established in 2004 as a result of the *Health and Social Care (Community Health and Standards) Act* (DH, 2003b) with the statutory duty to assess the performance of healthcare organisations, award annual performance ratings and investigate allegations of potential failings of patient safety (Pellowe, 2009).

By 2005, although the number of patients acquiring MRSA bacteraemia had plateaued, the number of cases of *C. difficile* continued to rise culminating in 55,681 reported cases in England in 2005. This prompted the Chief Medical Officer, Sir Liam Donaldson, to write to NHS organisations to reinforce national guidance and request urgent action to reduce the number of cases of *C. difficile* (DH, 2005a). The tool kit *Saving Lives: Reducing Infection, Delivering Clean and Safe Care* (DH, 2005b) was subsequently launched to support NHS organisations to embed the consistent prevention of HCAI into everyday practice. *Saving Lives* (DH, 2005b) provided evidence-based practice guidance in the form of care bundles and audit tools for the key clinical procedures that *Winning Ways* (DH, 2003a) had highlighted where the risk of infection is reducible (Pratt *et al*, 2001).

The Code of Practice: for the Prevention and Control of HCAI (The Health Act) (DH, 2006) was published in 2006 which further augmented the status of HCAI within the NHS and increased the power of the Healthcare Commission to demand robust assurance that HCAI reduction and prevention was being achieved. It then became a legal requirement for NHS organisations to demonstrate compliance to the *Code of Practice* (DH, 2006), which was monitored by the Healthcare Commission (now the Care Quality Commission). One of the key duties set out in *Code of Practice* (DH, 2006) was for NHS organisations to demonstrate that action is taken from 'board to ward' to ensure that preventing HCAI is an organisational priority and is embedded into everyday practice (Pellowe, 2009). One evidence source for such assurance is the auditing of key infection prevention practices through use of tools such as *Saving Lives* audits (DH, 2005b).

Another duty required by the *Code of Practice* (DH, 2006) was to ensure that staff across the organisation receive suitable training and an understanding of how to prevent the risk of infection to patients. This reinforced the Royal College of Nursing (2005) recommendations that all healthcare staff should receive mandatory infection prevention training at induction and annually thereafter, in order to regularly update infection prevention knowledge and skills and emphasise the effect that good and poor practice has on patients. *Saving Lives* (DH, 2005b) also therefore required NHS organisations to undertake a self-assessment to ensure that all employees had a programme of education and training on the prevention and control of infection.

It is generally acknowledged that NHS organisations may reach an irreducible minimum number of HCAI and that they may not be completely preventable (Elliott, 2009). Therefore to reinforce local ownership, in 2007 the Department of Health gave the responsibility of setting and monitoring local HCAI targets to the Primary Care Trusts. The revised *Code of Practice* (DH, 2008a) supported Trusts to take responsibility by providing them with the criteria against which cleanliness and infection prevention compliance would be assessed by the Care Quality Commission. Subsequent guidance and strategies to assist NHS organisations to further reduce HCAI incidence included *Clostridium difficile Infection: How to Deal with the Problem* (DH, 2008b) and *MRSA Screening Operational Guidance* (DH, 2008c) which outlined new evidence and approaches for managing patients with suspected *C. difficile* infections effectively and identifying and treating MRSA colonised patients, with an aim towards preventing these HCAI from occurring.

Yet in 2009-2010 there were still 25,604 cases of *C. difficile* infection reported in England and 1,898 reported cases of MRSA bacteraemia (Health Protection Agency, 2011). Consequently in 2010 the Department of Health launched a further publication of the *Code of Practice* (DH, 2010a) and an augmented *Saving Lives* (DH, 2010b) programme to consolidate the learning from the previous few years and maintain the focus on a care bundle approach to reducing and preventing HCAI. This suggests that although the profile of infection prevention has been raised considerably within the last decade, there is still much to be done to protect patients from HCAI through embedding consistent compliance to infection prevention practices (DH, 2010b).

Previous studies that have evaluated infection prevention practices have reported that compliance is poor and generally no greater that 40% of healthcare workers' practices are compliant to policy (Pittet *et al*, 1999; Scott *et al*, 2005; Flores & Pevalin, 2006; Whitby *et al*, 2006; Gould *et al*, 2008). Factors that affect compliance include insufficient time and heavy workload (Ward, 1995; Madan *et al*, 2002; Sax *et al*, 2005), poor role models (Scott *et al*, 2005; Whitby *et al*, 2006), lack of availability of hand wash facilities (Sax *et al*, 2005; Ferguson *et al*, 2004; Ward, 2006) and insufficient knowledge (Stein *et al*, 2003; Trim *et al*, 2003; Mann & Wood, 2006; Vaughan *et al*, 2006). Assumptions have also been made between infection prevention compliance and experience (Stein *et al*, 2003; Osuka, 2005; Orsolini-Hain & Malone, 2007), but this has not been expanded upon. Furthermore poor knowledge is often reflected by poor application of infection prevention practices (Marshall *et al*, 2004; Mann & Wood, 2006; Trigg *et al*, 2009).

It is therefore generally thought that improvements to infection prevention education are required in order to improve knowledge and therefore application of good practice (Gould & Chamberlain, 1997; Bissett, 2002; Vaughan *et al*, 2006; Burnett, 2009). However, no clear evidence exists as to the causes for current limited learning or the best way to deliver infection prevention education effectively (Billings, 2010; Ward, 2011). Yet before improvements to training can be made, these concepts must be better understood in order to make successful and meaningful enhancements to the education provided, which may then be transferred into improved compliance to infection prevention skills in the practice setting.

1.2 Research aim and objectives

Knowledge, application and education are therefore important concepts to consider in the challenge to improve infection prevention practice and reduce the risk of HCAI. This research builds upon the work of previous studies in order to gain a better understanding of the phenomenon of infection prevention practice and whether such factors as knowledge, application and education can be enhanced in order to further reduce the risk of HCAI to patients.

The aim of this thesis is therefore:

 To explore whether nurses' knowledge and application of infection prevention practices are affected by education, training and experience.

Evaluation of the research aim will include an appraisal of the following objectives:

- To explore whether ward-based teaching packages can improve nurses' knowledge and application of infection prevention practices.
- To assess pre- and post-registration nurses' knowledge and application of infection prevention practices.
- To explore experiences of infection prevention education from the perspective of the trainers and pre- and post-registration nurses attending training.

Investigation of these aims and objectives will provide further insight into the complexities of infection prevention practices that may inform both the practice and the education arena. A greater appreciation of this concept is timely as the new *Standards for Pre-registration Nursing Education* (NMC, 2010) has increased the focus of infection prevention as an essential skills cluster throughout the pre-registration nursing curriculum and the Department of Health continues to drive further reductions of HCAI in the practice setting through a care bundle approach (DH, 2010b).

1.3 Research design

The research aim and objectives informed the design of this thesis and therefore the evolution of the three study approach that was utilised to explore the research phenomenon of enhancing knowledge and application of infection prevention practices through education. The first study (Chapter Three) was conducted following the intuitive expertise of the author to recognise that the implementation of clinical skills training in the ward environment could be evaluated effectively through *Saving Lives* (DH, 2007b) audits, a national audit tool that has not yet been formally reviewed. For this study, where the research objective was to determine whether the implementation of ward-based clinical skills training improved knowledge and application of infection prevention practices, an audit evaluation method was therefore used as it enabled this hypothesis to be tested through the analysis of numerical data.

Denzin (1989) pioneered the concept of triangulation as the use of multiple methods to draw conclusions about a phenomenon that converge on the truth and separate it from any biases (Polit & Hungler, 1999). Triangulation is useful in nursing research to reveal different aspects of the phenomenon under study that may otherwise be unattainable without such integration (Tarling & Crofts, 2002). In order to substantiate and expand upon the findings of the first study, the second study (Chapter Four) was designed using a quantitative research method to measure nurses' knowledge and application of infection prevention practices through a questionnaire. It was anticipated that this would further illuminate the findings of the first study by providing greater insight into the relationship between knowledge and application of knowledge to practice. Quantitative research follows the positivist paradigm which emphasises the reasonable and the scientific through a formal, systematic approach in which numerical data are used to quantify phenomena and the relationships among them (Bowling & Ebrahim, 2005). Positivism therefore supports the controlled collection of large amounts of data that is easily comparable to explain a specific aspect of a phenomenon. A quantitative research approach was therefore utilised to build on the findings of the first study and provide further understanding of the research phenomenon of infection prevention knowledge and how such knowledge affects application to practice.

However whilst research conducted under the positivist paradigm can reveal a narrowly focused element or aspect of a phenomenon, it does not often discover the lived experience or the meaning that people attach to that social phenomenon (Snow, 2009). Therefore there is a place for an alternative perspective of the nature of reality, that of the naturalistic paradigm. Within the naturalistic paradigm, qualitative research methods involve the investigation of phenomena through the lived human experience, typically in an in-depth and holistic fashion, through the collection of rich narrative using a flexible research design (Flood, 2010). The goal of qualitative research is to understand the social phenomena in natural, rather than experimental, settings, giving emphasis to the meanings, experiences and views of all participants (Parahoo, 2006).

Qualitative research methods can therefore be useful over or alongside quantitative methods when there is little known about a subject or the subject is a

complex one, as they enable the generation of new theories rather than the testing of existing hypotheses (Holloway & Wheeler, 2010). Therefore, a qualitative research approach was used in the third study (Chapter Five) to explore nurses' lived experiences of infection prevention education as there is little known about this topic (Ward, 2011) yet it is an important aspect and offers another dimension to understanding the complex nature of infection prevention knowledge and application. It was expected that this study would build on the findings of the preceding two studies by exploring the effect that education has on nurses' knowledge and application of infection prevention practices. This suited rich narrative data and thus facilitated the exploration of participants' perspectives of the experience of this education. Application of a qualitative method to explore this aspect of the research phenomenon under investigation therefore aimed to reveal a different aspect that complemented the quantitative conclusions of the first two studies and therefore facilitate a greater convergence of a true and meaningful understanding of the human experience of infection prevention knowledge, application and education.

The triangulated findings from the three studies conducted within this thesis (Chapters Three, Four and Five) may integrate to reveal an enhanced insight into the phenomenon of infection prevention knowledge, application and education from three different aspects. Findings have useful implications for nursing theory and practice and support infection prevention nurses and educators in understanding how best to facilitate nurses to optimise care delivery, embed infection prevention skills into routine practice and reduce the risk of negative outcomes for patients in terms of HCAI.

Chapter Two

2.1 Introduction

Infection prevention practice is the practice of caring for patients using an approach that best reduces the risk of infection (Wilson, 2004). This is largely achieved through use of standard precautions which underpin routine practice and protect both staff and patients. Standard precautions, formally universal precautions, can be defined as a set of principles based on the concept that all patients are potentially infectious (Wu *et al*, 2009). They include optimum hand hygiene, use of personal protective equipment, safe handling and disposal of waste, linen and sharps and safe management of blood spillages (RCN, 2005). Standard precautions are therefore an important aspect of infection prevention practice as if they are applied every time to every patient, the risks of infection are reduced and patient safety and quality of care delivery are increased (DH, 2007).

However it is widely recognised in recent research that adherence to infection prevention standard precautions is poor with correct practices being applied on average only 40% of the time (Pittet *et al*, 1999; Scott *et al*, 2005; Flores & Pevalin, 2006; Whitby *et al*, 2006; Gould *et al*, 2008). Studies that have evaluated nurses' knowledge of infection prevention practices (Vaughan *et al*, 2006; Easton *et al*, 2007; Trigg *et al*, 2008) and application of infection prevention practices (MacLean *et al*, 2008; Howard *et al*, 2009; Mash *et al*, 2011; Waltman *et al*, 2011) have recommended education as a key factor to enhance theory and practice. Much emphasis has therefore been placed on the importance of education in the prevention and control of HCAI and this is well documented (DH, 2003a; DH, 2007; DH, 2010a). Therefore the relationship between education, knowledge and application of infection prevention practices is important in understanding how different approaches to education and experiences of education can be used to consider how to improve infection prevention practices and therefore reduce the risk of infection to patients further.

2.2 Knowledge of infection prevention practice

It can be argued that a good knowledge and understanding of infection prevention is essential when caring for patients in order to reduce the risk of infection to both healthcare workers and patients (Wilson, 2004). Recent studies have examined healthcare workers knowledge of HCAI, particularly MRSA and *C. difficile*. Lugg & Ahmed (2008) employed a cross-sectional design to compare the knowledge and self-reported practice of adult and children nurses using a questionnaire. Findings inferred that the overall level of knowledge of infection prevention with regards to MRSA was relatively inadequate, but that adult nurses scored significantly higher on knowledge (p=0.001) than children nurses. Whilst this may be limited by the method of self-reported practice in which staff often perceive themselves to do better than they actually do, the results are supported by similar studies which found that healthcare workers were not aware of basic infection prevention measures required to contain MRSA (Trim *et al*, 2003; Marshall *et al*, 2004).

Easton et al (2007) utilised a questionnaire to assess a convenience sample of 87 doctors and 87 nurses' knowledge and perceived practice of MRSA and how it is managed in an acute setting. Results suggested that 70% of participants could not recall local infection prevention measures for MRSA colonisation, 88% could not identify risk factors for MRSA colonisation and 74% could not state the two most common sites for MRSA infection (blood and wounds). Doctors were significantly more likely to identify correct first and second line antibiotic therapies for treatment of MRSA infection (p<0.001), but this should perhaps be expected as they are prescribers whilst generally nurses are not. Interestingly, 80% of participants thought that further education or information regarding MRSA colonisation, infection and management is required, of which 92% thought this would be best delivered via lectures or tutorials (Easton et al, 2007). This study highlights a deficit in both doctors and nurses knowledge of MRSA and MRSA management. It could therefore be suggested that in order to improve infection prevention practice surrounding MRSA, it should not be assumed that staff have an adequate knowledge or awareness of this organism or how to care for patients with MRSA.

A further study that assessed a wider selection of different healthcare workers knowledge of MRSA raised similar concerns. Trigg *et al* (2008) proportionally

distributed a cross-sectional audit to 961 healthcare workers including nurses, doctors, healthcare assistants, allied health professionals such as physiotherapists and hotel services staff such as domestics. A response rate of 43% was achieved. Findings revealed that 33% of staff were not aware nor had read the MRSA policy, 54% of staff had not received any infection prevention training and 44% of staff felt that the media influenced their attitude towards MRSA. However the staff with longer length of service or more experience were less likely to be influenced by the media. Only 35% of staff could state correct isolation requirements for patients with MRSA, although 91% correctly identified direct contact as the main route of spread of MRSA 53% reported that infection prevention precautions were not consistently applied in their area (Trigg et al, 2008). The results of this study reinforce the concern that healthcare workers' knowledge and application of infection prevention practices surrounding MRSA may be substandard. It recommends that continued education is necessary to improve knowledge with regards to MRSA and that further research is required to assess the effectiveness of current education initiatives. It also suggests that infection prevention teams must regularly monitor staff to ensure that practices are adhered to. However it could be argued that monitoring practice alone is not enough and that further strategies are needed in order to better understand why healthcare workers either do not attend infection prevention education or do not apply infection prevention standard precautions in the clinical setting.

Vaughan *et al* (2006) utilised semi-structured interviews to explore 20 infection prevention link nurses' knowledge of *C. difficile*. The themes elicited from the data included poor knowledge of nature and route of transmission of *C. difficile*, good knowledge of the standard precautions required when caring for patients with *C. difficile*, and evidence of ritualistic practices that are not necessary yet continue to occur. The authors concluded that, although the nurses' knowledge of standard precautions was good, knowledge of *C. difficile* was poor. This was interesting as much of the literature has found nurses' knowledge of standard precautions to be inadequate (Pittet *et al*, 1999; Trim *et al*, 2003; Marshall *et al*, 2004).

A survey by Stein *et al* (2003) evaluated 75 doctors' and 143 nurses' knowledge of infection prevention guidelines in Birmingham teaching hospitals. It found that doctors and nurses differed significantly in their attitudes and knowledge of hand

washing before and after patient contact and with wearing gloves when taking blood (p<0.001). They found that nurses had a better understanding of standard precautions than the doctors, yet only 80% of nurses had received formal training and only 59% nurses reported always cleaning their hands before patient contact and 64% after patient contact (Stein *et al*, 2003). The self-selection of respondents and non-random questionnaire distribution method may have introduced some sampling bias but the findings demonstrate scope for improving attitudes towards, and knowledge of, infection prevention practice. Furthermore, it inferred that age, or perhaps length of service, is indirectly related to knowledge and application with standard precautions with older healthcare workers seeming to be less compliant, but did not suggest reasons for this.

A later UK study assessed 156 medical students' knowledge of infection prevention via a questionnaire (Mann & Wood, 2006). Results showed that 58% of participants did not know the correct indications for using alcohol hand rub, 50% could not state the isolation period after an episode of diarrhoea and vomiting and 35% could not identify appropriate use of gloves. However 49% reported that there was inadequate emphasis on infection prevention in their course, with 5% having never received any infection prevention education (Mann & Wood, 2006). This study raises important implications for practice regarding the infection prevention knowledge of newly qualified doctors. Yet there is a larger concern in that there is no clear research to suggest the most effective way to deliver infection prevention education to either medical or nursing students. Without clear and more standardised approaches to teaching infection prevention at undergraduate level, it perhaps cannot be assumed that newly qualified doctors are knowledgeable and confident in their infection prevention practice. Furthermore although this may not be entirely generalisable to undergraduate nursing students it does infer that an exploration into undergraduate nurses' knowledge of infection prevention could potentially yield similar results.

Studies that have introduced interventions to improve nurses' knowledge of infection prevention practices have achieved this through provision of training packages (Lin *et al*, 2008; Wu *et al*, 2009) including e-learning (Lockhart & Smith, 2009) and educational posters (Waltman *et al*, 2011). However, there is no suggestion as to whether or not the enhanced knowledge was translated into good

practice, or whether the knowledge was retained for a sustained period of time. Yet being able to determine the extent to which such knowledge of standard precautions are applied correctly to practice is important in understanding how to reduce the risk of infection through consistent application of infection prevention skills.

2.3 Application of infection prevention practice

Studies that have evaluated the relationship between knowledge and application of infection prevention practices have been conducted outside of the UK. Wu *et al* (2009) used a cross-sectional survey to measure Taiwanese nursing students' levels of knowledge of, capacity to apply and confidence of application of infection prevention issues and practices. They analysed 175 questionnaires which revealed a significant deficit in the knowledge about, and ability in, the application of infection prevention precautions. Students who had received one month of infection prevention training had higher scores than students who had had no training, which suggests that education is intrinsically linked to infection prevention knowledge and application. As the study was based in Taiwan there may be limited scope for generalising the results to UK nursing students, but it does provide an insight into the potential for improving nursing education and is supported by further findings from international research in Korea that comprehensive education is required to increase nursing knowledge which can then effectively impact on the reduction of HCAI rates (Kang *et al*, 2009).

A subsequent study conducted in Nepal identified that healthcare workers perceived knowledge was much better than their actual knowledge. Timilshina *et al* (2011) reported that during interviews 73% of staff perceived they followed standard precaution policy yet only 22% of staff actually demonstrated correct application with regards to standard precautions. Again the authors recommend formal training to improve knowledge and therefore application to practice, which suggests that in Asia current infection prevention training is not widely available for healthcare workers. However in the UK such education is provided annually at pre- and post-registration levels, yet knowledge and application still seems to be lacking (Easton *et al*, 2007; Lugg & Ahmed, 2008; Trigg *et al*, 2008).

When evaluating the application of infection prevention practices in the clinical setting in the UK, previous studies focus on assessing the application of good practice through measuring compliance. Consequently, compliance is an interesting concept as it assumes that a fundamental understanding of infection prevention theory exists in order for it to be effectively applied to practice (Cole, 2008). Compliance to infection prevention practice is an important factor for both nurses and student nurses when considering how to reduce the risk of infection to patients. Compliance to policy or practice can be measured through research, generally through cross-sectional surveys (Madan et al, 2002; Sax et al, 2005) and observational audits (Moore et al, 1998; Whitby et al, 2006). Compliance to infection prevention practices and standard precautions is essential in the reduction and prevention of HCAI, yet it is well reported that compliance to such practice is poor both in the UK (Pittet et al, 1999, Ferguson et al, 2004; Ward, 2006; Howard et al, 2009) and internationally (Kang et al, 2009; Chau et al, 2010; Chung & Lee, 2011). Average baseline rates for hand hygiene compliance in the clinical setting are 40% (Flores & Pevalin, 2006).

The majority of research surrounding compliance has focused on the measurement of compliance to hand hygiene, due to both hand hygiene being recognised as the most important factor in reducing cross-infection and being the easiest standard precaution to measure. Haas & Larson (2007) reviewed the three main approaches used to measure hand hygiene compliance which are the direct observation of practice, self-reports of practice and indirect measurement of soap, alcohol hand rub or paper towel dispensers. Whilst direct observation has historically been perceived to be the best method and is the most commonly used approach it can be subject to observer bias. Observer bias can transpire if the nurse being observed is aware that they are being audited and therefore performs better because of this, a temporary behavioural change made by the nurse to attempt to please the auditor known as the Hawthorne effect (Stein et al, 2003). Interestingly, there is no standardisation of approach across the research for evaluating hand hygiene compliance, making it difficult to draw comparable conclusions between various studies (Gould et al, 2008). There is also no national guidance regarding how to effectively measure hand hygiene compliance, yet every acute NHS organisation has a legal duty to ensure good hand hygiene compliance (DH, 2010a) and therefore report monthly hand hygiene compliance figures. It could be argued that these are perhaps not comparable if different methods and measures are used, yet no national compliance tool is recommended.

The various compliance studies that have been conducted suggest that reasons for non-compliance to infection prevention practices include insufficient time and heavy workload (Ward, 1995; Madan *et al*, 2002; Sax *et al*, 2005), poor knowledge of risk of infection (Bissett, 2002; Whitby *et al*, 2006;) poor role models (Scott *et al*, 2005; Whitby *et al*, 2006), gender (Ward, 2004), lack of availability of protective clothing or hand wash facilities (Sax *et al*, 2005; Ferguson *et al*, 2004; Ward, 2006). It could be suggested that knowledge and compliance are therefore linked, or that poor knowledge of infection prevention leads to poor application of infection prevention practices. Studies that have measured compliance of infection prevention practice have found a link between poor compliance and poor knowledge (Pittet *et al*, 2000; Kang *et al*, 2009; Gopal Rao *et al*, 2009; Waltman *et al*, 2011). It could then be suggested that if healthcare workers knowledge of infection prevention practices is improved then compliance would be improved. The literature that surrounds improving compliance therefore requires exploration to better understand this relationship.

2.4 Improving infection prevention compliance

Studies that have evaluated interventions to improve infection prevention compliance are largely collated from the international arena. Rosenthal *et al* (2005) evaluated the effectiveness of an infection prevention education and feedback programme on the rates of intravascular device-associated bloodstream infections in an intensive care unit in Argentina. Rates of infection were significantly reduced after the implementation of the infection prevention educational programme (p<0.001), and further reductions were observed after feedback sessions were commenced, but these were not statistically significant. It was concluded that education can significantly improve infection prevention practice, and combined with performance feedback may reduce rates even further, but further research is required to prove these findings (Rosenthal *et al*, 2005). This was supported by a subsequent study that assessed the effect of a six month education programme with monthly performance feedback via hand hygiene and invasive device compliance charts across two intensive care units in Mexico

(Higuera *et al*, 2005). Findings showed a significant increase in hand hygiene and invasive device care (p<0.001 and p<0.001, respectively) coupled with a significant decrease in invasive device related bloodstream infections (p<0.001). However neither Rosenthal *et al* (2005) nor Higuera *et al* (2005) suggested whether or not compliance was sustained for a substantial period of time after the education programmes ceased.

In the UK similar studies in clinical areas other than intensive care units reported that structured educational training (Brooks *et al*, 1999; Wang *et al*, 2003; Mash *et al*, 2011), use of action plans (Pratt *et al*, 2001), hand hygiene campaigns (Pittet *et al*, 2000) and infection prevention posters (Robert *et al*, 2006; Howard *et al*, 2009; Waltman *et al*, 2011) improved compliance to standard precautions. Although some studies have found that improved compliance can be maintained for a number of years following the educational intervention (Pittet *et al*, 2000; Kim, 2006), a weakness of much of the published research regarding increasing compliance is that it does not demonstrate whether the improvements to practice are sustained after the intervention.

MacLean et al (2008) implemented an integrated care pathway for patients with C. difficile infection which was supported by several teaching sessions to standardise and improve nursing practice for this group of patients. The effects were monitored over a six month period via a staff questionnaire and an audit of the integrated care pathway documentation. Results showed that nursing knowledge increased by 91% and that 86% of nurses felt more confident to care for patients with C. difficile infection. Although a pilot study, the findings agree with other studies that education can improve infection prevention compliance (Brooks et al, 1999; Pittet et al, 2000; Mash et al, 2011). Howard et al (2009) used an audit to determine whether the implementation of infection prevention posters were successful in improving compliance to infection prevention practices by doctors on surgical ward rounds. When re-audited three months later hand decontamination had significantly improved from 28% to 87% (p<0.001) and the correct use of gloves had improved to 50% (p<0.001). However, like similar studies that have used a tool to measure either knowledge or compliance of infection and control prevention practice, the tool was not validated prior to the survey and the results may not therefore be generalisable to other populations.

Flores & Pevalin (2006) utilised an overt direct observation strategy to measure healthcare workers compliance with glove use. A total of 164 episodes of patient care were observed on twelve randomly selected wards across two hospitals to evaluate the correct use of gloves and how this affected hand hygiene compliance. Findings showed that whilst compliance for using gloves when required to do so was high at 92%, gloves were also over-used and worn 42% of the time for activities for which they were not required. This practice affected hand hygiene compliance as although this was 64% overall, it was reduced to 33% following removal of gloves or glove overuse. Although this study did not evaluate an intervention to improve compliance, it did suggest that poor hand hygiene compliance is likely to be linked to poor use of gloves compliance and that education is required to improve compliance (Flores & Pevalin, 2006).

However a few studies do argue that the introduction of education programmes does not necessarily improve compliance, but there are no suggestions as to why this may be the case. Larson & Kretzer (1995) employed a quasi-experimental study and suggested that interventions such as education and feedback had minimal long-term effects on hand hygiene compliance. Lugg & Ahmed (2008) found no significant difference in self-reported infection prevention practice relating to MRSA in nurses who had had infection prevention training compared to those who had not. However if this had combined observed practice with the self-reported practice it may be more meaningful. Other studies have demonstrated that education in the form of teaching sessions (Gould & Chamberlain, 1997; Gopal Rao *et al*, 2009) and best practice posters (Morse & McDonald, 2009) can have little or no effect in improving compliance to practice if the researchers or key messages are too far removed from the sample population.

The literature surrounding nursing knowledge of, and compliance towards, infection prevention practices suggests that these two elements that are key in the reduction of HCAI are overwhelmingly misunderstood (Marshall *et al*, 2004; Vaughan *et al*, 2006; Trigg *et al*, 2008; Wu *et al*, 2009) and underperformed (Pittet *et al*, 1999, Ferguson *et al*, 2004; Whitby *et al*, 2006; Gould *et al*, 2008). However, studies do suggest that provision of infection prevention training or education can enhance knowledge and therefore application of infection prevention prevention practices (Flores & Pevalin, 2006; MacLean *et al*, 2008; Howard *et al*, 2009), which can

ultimately increase compliance and reduce the risk of HCAI to patients. The concept of education within the infection prevention arena therefore requires some consideration.

2.5 Approaches to infection prevention education

Education and application to infection prevention practices are important factors to consider in the reduction of HCAI and the importance of education in the prevention of HCAI is well documented (NAO, 2004; DH 2003a; DH 2007; DH 2010a). However reports suggest that only approximately 60% of staff receive annual infection prevention training (NAO, 2004), suggesting that infection prevention education and the issues surrounding it could provide further insight into whether nurses' knowledge and application of infection prevention practice could be improved. This is echoed in the literature surrounding infection prevention (Stein *et al*, 2003; Trigg *et al*, 2008; Wu *et al*, 2009), improvements to current infection prevention education (Mann & Wood, 2006; Vaughan *et al*, 2006) and causes for current limited knowledge to be established (Trim *et al*, 2003).

Infection prevention programmes of education are essential to increase diagnosis of infection, reduce the incidence and spread of infection, reduce length of stay and costs, and improve the quality of patient care (Ward, 1995). They must be effective in teaching improvements to poor or outdated practice and not just the impartation of knowledge (Seto, 1995) in order to influence infection prevention compliance (Scott et al, 2005). Infection prevention training sessions are usually delivered by infection prevention nurses in the classroom setting. However previous studies imply that this training tends to be short and taught didactically by the content experts, for large groups of eclectic healthcare workers in the hope that enhanced knowledge will persuade nurses to improve their compliance in relation to clinical care (Cole, 2008). This may be because infection prevention training is now annual mandatory training for all healthcare staff in the UK (DH, 2010a), so large class sizes are a necessity in order to teach the required number of staff. However infection prevention education delivered through lectures can lead to a lack of engagement and concentration and often fails to achieve effective interaction (Billings, 2010). It could be suggested that this approach can lead to theory overload and can actually therefore enhance the theory-practice gap that it aims to close (Cole, 2005).

Furthermore the aim of teaching should be the facilitation of learning, which in the classroom requires interaction with students in order to ensure they have understood the content and contribute towards the dynamic and direction of the session, yet this can be extremely difficult to achieve in lectures (Prieto, 2009). Factors that affect interaction include the size of the group (Derbyshire & Machin, 2011), skill or knowledge levels or requirements within the group, the layout of the classroom, and the resources available (Burnett, 2009). It is therefore generally considered that a more multifaceted approach to infection prevention education is required (Gould & Chamberlain, 1997; Bissett, 2002), to provide stimulating and engaging education (Billings, 2010), yet no clear evidence exists as to the best way to deliver this education to adult learners (Mann & Wood, 2006).

Adult learning theory may provide an appropriate conceptual framework for understanding how nurses learn which may then influence the most effective way to deliver infection prevention education. The three schools of adult learning theory are behaviourism, cognitivism and humanism. Behaviourist models including Pavlov's (1927) classic conditioning, Thorndike's (1931) theory of active learning and Skinner's (1971) operant conditioning support the reductionist view that learners are essentially passive, responding to environmental stimuli (Cole, 2006). However, although a behaviourist educator may rigorously teach a good technique for infection prevention skills such as hand hygiene, they may not empower the learner to bridge the theory practice gap or consider how to overcome barriers to applying the correct technique in the clinical setting (Elliott, Cognitive theory therefore emerged from the criticism that human 2009). behaviour is more complex than the behaviourist models acknowledge and the relative simplicity of the stimulus-response theory does not sufficiently explain behavioural change (Child, 1997). The cognitive perspective argues that with regards to infection prevention education, adults should learn and explore the barriers to compliance to develop problem-solving skills and prevent poor compliance when work load increases (Cole 2006). Yet cognitive approaches to teaching to improve infection prevention practice have not been successful in sustained increased compliance (Pittet et al, 1999).

Humanism therefore emerged, with the view that learning is related to individual experiences and feelings. Gagné (1977) suggested that for adult learning a hierarchy of seven types of learning exists, these are: signal learning, stimulus-response learning, motor and verbal chaining, multiple discrimination, concept learning, rule learning and problem solving, and that signal learning may occur at any level of the hierarchy (Jarvis, 1995). Problem solving is the highest order in Gagné's hierarchy and occurs when the adult learner draws on their previously learned rules in order to discover an answer to a problematic situation. This cumulative learning process is therefore significant for adult learners as a key concept is that of learning from prior experiences, which in current nurse education has developed into reflective learning. Knowles (1978) developed humanistic adult learning theory further and proposed the theory of andragogy.

"The art and science of helping adults learn" (Knowles, 1978, p 43).

He achieved this by distinguishing that adults learn differently from children, or pedagogy, through the development of six main assumptions or characteristics of adult learners: adults have a need to be more self-directive, adults accumulate an expanding reservoir of experience which acts as an increasingly rich learning resource, adults learn in problem areas that they encounter and regard as relevant, adults have a problem centred orientation so are less likely to be subject centred and adults have a need to know why something should be learned and adults are internally motivated to learn (Jarvis, 1995). Whilst Knowles may be regarded by some as the father of andragogy as he popularised adult learning theory, he was criticised for the assumption that all adult learners learn in the same way and for failing to acknowledge such factors as the effect of culture or systems of oppression on learning and development (Merriam *et al*, 2007). Furthermore, within the context of healthcare, nurse educators' knowledge of adult learning does not often extend beyond that of Knowles (1978), yet other theories are also important to consider how nurses learn best (Clapper, 2010).

It is thought that adult learners are also more motivated to learn to cope with real life situations and identify their own learning needs (Knowles, 1978). Therefore current infection prevention educators should take into consideration adult learning styles in order to successfully meet the needs of adult learners and therefore facilitate effective learning. Problem-based learning is emerging from andragogy

as a teaching method that has a student-centred approach which enables adult learners to not only find out about a subject but also how to think about it critically (Cole, 2005). Problem-based learning is beneficial as it facilitates the learner to develop problem-solving, critical thinking, team working and reflective skills that are essential in the practice setting. This method could be very appropriate for infection prevention education as there are many circumstances to which it could be applied in order to convey the same information as an educator would through the more frequently used pedagogical method, yet to date little has been documented as to the effectiveness of this (Billings, 2010; Ward, 2011). One rationale for this is that infection prevention educators are usually infection prevention nurses, who may have not received any formal education themselves with regards to teaching (Barrett *et al*, 2008). Yet if the effective facilitation of learning is to be achieved by infection prevention nurses, they must be suitably educated themselves in the various theories and approaches to education and the factors that affect conducive learning.

An alternative method of facilitation learning commonly used by infection prevention nurses to cascade information to ward staff is through infection prevention link nurses. Link nurses attend regular meetings and study sessions and disseminate new infection prevention policies, practices and products to colleagues. However link nurses must be enthusiastic and proactive as the skills they pass on are only as good as they themselves are (Scott et al, 2005). Therefore if they are poorly trained by the infection prevention team or they do not understand what is taught, there is a possibility of cascading substandard practice on to colleagues. Previous research into the experience of an infection prevention education programme for link nurses has found that practice is enhanced when education facilitates link nurses' confidence, authority and empowerment in key knowledge and skills (Cooper, 2005). It is therefore suggested that nurse educators need to explore more innovative approaches to learning, which better suit the needs of individual learners in order to improve nurses' fitness to practice, as good quality education is more likely to contribute towards compliant nurses and therefore improve practice (Cole, 2008). Yet in order to understand how to improve training further, experiences of existing education need to be determined.

2.6 Experiences of infection prevention education

There is paucity in previous research with regards to the experience of infection prevention education. Yet as this education is now mandatory to ensure that nurses and other healthcare workers are annually updated with new practices and evidence-based guidance, it could be argued that a greater understanding of the experience of this training could inform its effectiveness. The results of the few studies that have explored nurses' experiences of this education have found that nurses describe the experience as repetitious, time-consuming and too basic (Henry, 1997) or uninteresting and boring (Bryce et al, 2007). Seto (1995) argued that before planning infection prevention education, the teacher must first discover what the adult nurse learner wants to know. Seto (1995) borrowed a customer survey style methodology from industry and applied it to 1087 healthcare workers in Hong Kong to determine what they both expected and wanted to be taught. Findings showed that topics including AIDS and hepatitis received higher scores for both most expected and most useful topics, and topics including pest control and informal bedside education least expected and least useful. Seto (1995) suggested that by knowing this, infection prevention teams could then direct education towards what staff perceived as the most useful topics, or use them to help cover the less interesting topics. Yet with the current focus on infection prevention practice so closely monitored, audited and target-based, content of infection prevention education is perhaps more driven by Department of Health directives and unable to be so flexible.

Harvey-Teeley (2007) described post-graduate nursing students' experiences of a hybrid internet-based course as positive, as although some students preferred the classroom experience, most found the flexibility and opportunities to learn through the experiences of their peers beneficial. With the emphasis on continued professional development and the recent difficulties of leaving the clinical setting to study, online or blended learning hybrid courses are becoming more popular with nurses and their managers. Harvey-Teeley (2007) suggested that there is a vast potential for the internet being used as a useful medium for nursing education in the 21st century. Similarly, a completely internet-based infection prevention course was evaluated by 55 medical students and 59 newly qualified doctors who completed a 15 question test at the end of the course and again three months later

(Fakih *et al*, 2006). The medical students scored better than the newly qualified doctors initially but neither group results were statistically different after three months. Fakih *et al* (2006) therefore concluded that web-based education is a viable tool for teaching doctors' infection prevention, but only if the realisation of a reduced score after three months could help to prompt doctors who require further education to access it.

Bennett & Mansell (2004) evaluated the infection prevention experiences and practices of 379 community nurses in one Welsh Health Authority by distribution of a questionnaire survey. Whilst perhaps not generalisable to an acute setting, results reported that 68% of participants had over five years community nursing experience yet only 65% of participants had ever received any infection prevention training, either via a session or written information and only 20% had ever had an annual update. A further 28% of respondents re-sheathed sharps after taking blood or giving an infection which is out dated practice that carries a substantial risk of contamination injury. This confirms the importance of annual updates and suggests that perhaps further regular infection prevention education is required.

With regards to pre-registration nurses, the practice setting can provide the opportunity for a considerable amount of informal infection prevention education. One study that explored pre-registration nurses' experiences of infection prevention in the clinical setting concluded that student nurses learn a considerable amount of their infection prevention knowledge and skills whilst on placement and that observation of poor practice in the clinical setting can impact negatively on learning (Ward, 2010). Findings also suggest that student nurses judge good infection prevention practice based upon both what they have learnt at university and how well the practice is explained by the healthcare worker teaching the student. This has important implications for nursing practice as the quality of education that pre-registration nurses receive will inform future practice.

Morton *et al* (2006) employed a questionnaire to compare 130 medical students' experiences of education of various clinical procedures with observed performance-based assessment of these skills. Results showed that while 93%, 57% and 48% felt confident to teach colleagues the skills of venepuncture, cannulation and taking blood glucose respectively, only 80%, 67% and less than 50% passed the performance based assessments for venepuncture, cannulation

and taking blood glucose, respectively. For each of the three skills students performed the least well in the safe practice element (checking the patients' identity, labelling of specimens and documentation), and only slightly better in the infection prevention element. It could be suggested that knowing that they were under formative assessment could have hindered the participants' performance or contributed to the poor pass rate. Yet clinical skills assessment is common in current nursing and medical undergraduate training, so should be an environment to which they were accustomed. However it does perhaps infer that this style of education is not the most conducive to effective learning. As participants perceived to have done better than they were scored, there is the potential risk that they could then practice their adaptation of the skill, or teach it to colleagues, without learning from the assessment, and subsequently deliver and share substandard practice that increases the risk of infection to patients. In practice the poor concept of 'see one, do one, teach one' already exists, which although already a concern, is even more perturbing if the skill seen is not performed If assessed in a more clinical environment with constructive or adequately. corrective support, it could be suggested that the students may have learnt the skill more effectively and have the good practice elements embedded into their own practice (Brosnan et al, 2006).

A more innovative approach to infection prevention education may be more appropriate to meet the changing needs of nursing staff. The experiences of one such innovation have been evaluated by two lecturers who teach infection prevention to undergraduate nursing students (Burnett, 2009; Prieto, 2009). Turning Point is a novel audience personal response system that facilitates interaction in lectures. Students are given a handset that enables them to answer questions on various interactive slides throughout the presentation. Results of such questions are immediately displayed on the slide, allowing the lecturer to determine whether the students' knowledge on that area is sufficient. If it is they continue on to the next section but if not this tool alerts them and provides the opportunity to discuss or expand upon this section further.

Turning Point was found to effectively engage the students in problem-solving, critical thinking and reflection and the instant feedback was useful to gauge opinion, shape discussion and importantly challenge beliefs towards infection

prevention which may not have been identified in a formal pedagogical lecture (Burnett, 2009). It was also reported that although challenges for the lecturer included effective time management and assurance that all of the necessary content was covered, this student-centred rather than teacher-centred approach facilitated the opportunity to cover topics of most relevance to the students (Prieto, 2009). However it could be suggested that what is of more interest to students may not necessarily meet the requirements of the curriculum, or that although well evaluated by the students there remains a need to ascertain whether the content or practices learnt in the lecturer transfer to clinical setting. Yet this is certainly an innovative teaching style that could facilitate infection prevention learning effectively for both undergraduate and postgraduate nurses by increasing the opportunities for learners to critically think and interpret content during the lectures. Similarly, Cole (2005) agreed that approaches to learning should be adaptable and flexible, responsive to the needs of the learner, and easily altered by the educator to suit the environment. In particular this can be challenging when teaching infection prevention education in the classroom due to the very practical nature of the subject. One such alternative style is teaching staff the knowledge and skills relevant to them in their clinical or ward-based setting.

2.7 Ward-based education

One emerging trend is the use of ward-based teaching as an alternative to the traditional classroom based teaching to improve nurses' knowledge of infection prevention practices. The ward has consistently been identified as the preferred place to learn by nurses (Gould & Chamberlain, 1997; Scott *et al*, 2005) and is often regarded as the most suitable venue for teaching (Cole, 2008). Previous studies have shown that ward-based teaching sessions overcome staffing pressures (Richardson, 2001), more staff are likely to attend (Scott *et al*, 2005) and that the training can be more effective than classroom teaching (Gould & Chamberlain, 1997; King & Pilcher, 2008). Various research has evaluated the effectiveness of ward-based teaching packages and programmes to improve compliance to infection prevention standard precautions. Standard precautions are a set of basic principles applied to nursing care to reduce the risk of infection. They include hand hygiene, use of personal protective equipment, safe disposal of sharps, linen and waste, and dealing with blood spillages (Wilson, 2004).

International studies involving nurses found that ward-based education improved knowledge and compliance of standard precautions (Hung et al, 2002; Uwakwe, 2000) and attitude towards standard precautions (Mukti et al, 2000), but that compliance can be affected by shortage of equipment (Uwakwe, 2000) and that sometimes no long term effect was noted (Talan & Baraff, 1990). A UK quasiexperimental study by Gould & Chamberlain (1997) collected observational data and questionnaire data from nurses on two experimental and two control surgical wards in large teaching hospital before and after delivery of a three month wardbased education package of infection prevention. None of the results were significant which indicates that the educational intervention had not achieved its desired effect. Suggestions for this included: lack of a relationship between the individuals supplying the training and the ward staff; lack of feedback of performance at regular intervals; and lack of laboratory monitoring of the incidence of common micro-organisms. Gould & Chamberlain (1997) also evaluated the effectiveness of other ward-based teaching sessions for infection prevention and found that although the clinical environment was a preferred learning environment for nurses, the heavy and unpredictable workload prevented the teaching programme from being implemented as planned. It was suggested that the researchers were treated as 'outsiders' and that closer links with the infection prevention team would have improved the outcome of the study and subsequently nurses knowledge of infection prevention practices.

Ward-based education has also been applied effectively to areas of nursing other than infection prevention. One study audited nurses' practice of oral care one month before and several months after a programme of ward-based training was implemented in a palliative care environment. Results showed an improvement in all aspects of oral care and staff knowledge (Lee *et al*, 2001). A pilot project with the aim of promoting effective practice in continence care utilised a documentation audit and staff questionnaire covering four independent hospital sites to assess baseline knowledge. Ward-based teaching was then delivered in the form of workshops and reviewed by both focus group feedback and a post-intervention comparison of practice in the pilot ward with a similar ward using an established continence audit tool (King & Pilcher, 2008). Although no statistical significance was determined, the authors commented that the ward-based teaching had the greatest impact on the improved continence care. A study to re-introduce postoperative epidural analgesia on two orthopaedic wards used questionnaires to compare 20 nurses' knowledge of pain management before and after ward-based teaching, study days and assessment of competence. The results of the questionnaires demonstrated overall improvements in knowledge after the education package, although some elements of the questionnaires showed no improvement, and participants commented on the importance of the ward-based teaching (Richardson, 2001).

An educational intervention to improve medical students' compliance to infection prevention and standard precautions also suggests that practice-based education was effective. Diekema *et al* (1995) reported that education improved observed compliance of 170 medical students in America from 95% to 99% for glove use, 76% to 77% for sharps disposal and 56% to 78% for hand washing. An Intensive Care Unit successfully reduced prescribing errors by providing prescriber education in tutorials, ward-based teaching and feedback in three monthly cycles with each new group of trainee medical staff. The percentage of prescriptions with errors decreased over each three month cycle from 25% to 5% (Thomas *et al*, 2008). Kilminster *et al* (2001) highlighted that the introduction of ward-based skills facilitators to undergraduate medical student programmes proved to be both practicable and effective. Although perhaps not generalisable to nurses, these three studies do reinforce the benefits of ward-based education.

Previous research therefore suggests that ward-based teaching packages and programmes can improve compliance to nursing practice, including infection prevention. However, there is little to suggest whether improved compliance can be sustained over a prolonged period of time. Furthermore, in order to deliver effective ward-based education a competent expert is required. This has been overcome in some circumstances by the implementation of clinical skills facilitators.

2.8 Clinical skills facilitators

Chapman (2006) highlighted that, in order for ward-based education to be effective, both suitable mentors are required to enable effective learning in the work place and the learning needs of the student must be considered. Therefore, clinical skills facilitators have been used to meet the learning needs of medical and

nursing students and more recently newly qualified nurses and junior doctors to develop professional competence. Clinical skills facilitators are valuable in that they enable the integration of theory into practice (NMC, 2002) and professional development and enhancement of clinical skills for students or new staff (Kelly & Simpson, 2001). They are advantageous as they provide necessary support to the traditional preceptorship, which, due to increasing pressures being placed on nursing staff, may not always sufficiently support new staff as was first intended. Yet nursing is predominantly a practice-based profession (Lambert & Glacken, 2004), so it is vital for newly qualified nurses to learn the clinical skills required of them effectively and safely, and the implementation of the clinical skills facilitator therefore seems a natural solution.

The role of clinical skills facilitators has been explored to some extent in previous studies and infer that clinical skills facilitators should have the following characteristics: effective role model, enthusiasm for teaching and learning, build good rapport, set feasible goals, utilise opportunistic learning, initiate dialogue through questioning, encourage independent decision making, challenge, stimulate and deal with poor levels of performance appropriately (Bleakley, 2002; Brosnan et al, 2006). Yet little has yet evaluated whether clinical skills facilitators have these characteristics or whether they are actually appropriate for the role. Kelly & Simpson (2001) applied an action research approach to evaluate the implementation of clinical skills facilitators by administering a questionnaire to staff that the clinical skills facilitators had had contact with. The posts were positively evaluated as 95% of participants reported being satisfied or highly satisfied with the input from the skills facilitators, particularly with support towards developing effective problem solving skills. Subsequently, a small descriptive study utilised focus groups to gain an understanding of the nature and purpose of clinical skills facilitators in Ireland. The themes that emerged suggested that the purpose of the role was to facilitate students transition into the clinical setting, maximise learning opportunities and provide support (Lambert & Glacken 2004). For medical students the application of clinical skills facilitators was successful to support experiential learning and consolidate the knowledge and skills acquired from simulation education (Kilminster et al, 2001). Yet no research has evaluated or quantified the benefits of clinical skills facilitators, whether clinical skills can be improved or whether unsafe practice, near misses or infections can be reduced in the practice setting as a result of their implementation.

Although previous research has discussed the role and advantages of having clinical skills facilitators for new staff, it also has not suggested whether their application could maintain improved practice over a sustained period of time. This may be due to this fairly recent role still developing, yet this is important to consider when an emerging theme in the practice setting is to employ clinical skills facilitators or practice development nurses with this aim. Once newly qualified nurses finish their preceptorship or no longer have the support of the clinical skills facilitator it could be argued that their skills may lessen or they develop or learn substandard practice. There could therefore be benefits from further research in this area that provides an insight into or measure whether practice is improved over a sustained period of time if nursing staff having access to clinical skills facilitators for a particular duration. Furthermore, an understanding of current clinical skills facilitators are advantageous or whether there are further issues surrounding how clinical skills are taught originally.

2.9 Clinical skills

Nurses learn some clinical skills during pre-registration student nursing programmes and some as post-registration practitioners. Traditionally the quality and consistency of the skills learnt at pre-registration varied considerably, leading to a standardisation across the UK through the Project 2000 curriculum. This aimed to provide higher quality and longer placements with better teaching support, in order to equip student nurses with better clinical skills (DH, 1999). The Nursing and Midwifery Council (NMC) supported this by ensuring that nursing programmes consist of 50% theory and 50% practice placements and that students develop a portfolio as they progress through the programme (NMC, 2002). This enables pre-registration nurses to learn clinical skills and the underpinning theory in the academic setting and then refine competence in the clinical setting under supervision.

One study that evaluated the clinical skills that 132 newly qualified nurses deemed as both essential and frequently used found that frequently used skills included

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infection prevention standard precautions, vital signs assessment, patient hygiene, management of intravenous therapy and administration of medications (Boxer & Kluge, 2000). The skills rated as frequently used by nurses were the same skills they thought essential to nursing, however it did not report how competent newly qualified nurses felt to perform these skills. Yet competence is an important concept for newly qualified nurses as although they have a preceptorship in their first post, there is perhaps an assumption that they have learnt certain essential skills during their training. Therefore it is necessary for universities to both provide and assess clinical skills training to help develop confidence and competence in essential clinical skills. One method of assessment of competence of clinical skills in the academic setting is through use of objective structured clinical skills evaluations (OSCEs). OSCEs are a widely used method of assurance of competence of important clinical skills for academic staff before students enter the practice setting. Brosnan et al (2006) evaluated the OSCE process and found them to be a meaningful and fair assessment. It was reported that OSCEs enabled students to feel more prepared and confident for forthcoming placements, although some, particularly mature students found it a stressful experience (Brosnan et al, 2006).

Recently there has been criticism towards the Project 2000 curriculum suggesting that newly qualified nurses are not as skilled or as competent as they should be. A study that compared 139 student nurses' skills confidence in the Project 2000 curriculum compared to a competency based curriculum found that the students studying the competency based curriculum had higher levels of competence and confidence in their clinical skills than the Project 2000 students (Farrand et al, 2006). The Department of Health (2008d) has also reviewed the Project 2000 curriculum. Findings suggest that healthcare managers evidently feel that Project 2000 nurses do not meet their expectations of a newly gualified nurse and that Project 2000 students are often perceived as less competent than pre-Project 2000 students (DH, 2008d). As a result the NMC has recently reviewed preregistration nursing education, particularly the knowledge, skills and competencies required to deliver safe and effective care (NMC, 2010). Furthermore, the Department of Health has recommended that by 2013 all student nurses in England will be entered onto degree level courses only. These changes to the pre-registration curriculum are designed to provide a more cohesive learning

experience for student nurses that further bridge the theory-practice gap and also facilitate the acquisition of competent clinical skills.

Post-registration nurses also learn and develop new clinical skills. The theory and method of such skills e.g. cannulation, pin-site care, tend to be taught in on-site training and development departments and nurses have to then complete a workbook, assessment of competence or competency log book in order to provide the evidence and assurance of competence before performing the skill without supervision. However this also provides several challenges as a competent senior colleague is required to supervise. Yet high workloads and staffing issues can impede this and also constant improvements to practice provide the potential for the senior colleague's practice to be out dated or incorrect. It could therefore be suggested that nurses should have clinical skills assessments or updates periodically to ensure that best and safe practices are maintained. For a minority of skills this does occur, such as annually for basic life support or three yearly for taking a blood sample for transfusion, but for the many other skills there are no further assessments or refreshers. Currently competence in clinical skills is not monitored or measured proactively but reactively for example if a drug error incident is reported practice will be reviewed. This supports the aforementioned research in that there is a substantial potential for clinical skills facilitators in the practice setting to ensure that both pre-registration and post-registration skills are practiced, supervised, assessed as competent and monitored effectively and regularly.

Much of the previous research that has explored clinical skills training, clinical skills facilitators, ward-based teaching and compliance in general to infection prevention practices as previously discussed in this chapter have used various types of clinical audit to measure or monitor compliance. The application and appropriateness of audit therefore deserves further attention when considering whether infection prevention knowledge, application or education could be improved, as audit is often used to measure application or compliance in infection prevention which, by its nature, assumes some level of knowledge or understanding.

2.10 Clinical audit

Nursing has evolved into an evidence-based profession (RCN, 2005) which has led to the development of policies and protocols to standardise best practice. A commonly used method of measuring compliance to policy and protocols in the clinical healthcare setting is by audit. Clinical audit is useful to identify poor practice (Tartari & Mamo, 2011) and for departments to measure themselves against specific standards, to compare themselves with other departments and to improve practice accordingly (Tarling & Crofts, 2002).

Clinical audit is often used successfully to measure healthcare workers' compliance to policy and enhance practice, such as urinary continence (King & Pilcher, 2008), post-operative pain management (Harmer & Davies, 2002) and pressure ulcer surveillance (Gunningberg & Ehrenberg, 2004). However, it is now a requirement of Code of Practice (DH, 2010a) that organisations provide assurance that key infection prevention policies and practices are implemented appropriately and adhered to by presenting audit results as evidence of compliance, or action plans as evidence where poor compliance has been identified (Flanagan, 2009). Auditing in the infection prevention arena has increased in the last decade and infection prevention teams are now required to have annual audit programmes in place (DH, 2010a), that measure compliance to various standards and practices e.g. hand hygiene, use of personal protective equipment, disposal of linen, use of isolation rooms (Infection Control Nurses Association, 2004). Use of these audit tools has been shown to increase compliance to key infection prevention practices (Millward et al, 2010).

Clinical audits are also useful to identify education needs for infection prevention teams and can be used to reinforce key messages (Ward, 1995). Other beneficial outcomes of clinical audit include increased communication, patient care and professional satisfaction while disadvantages incorporate potential professional isolation and reduced clinical ownership (Polit & Hungler, 1999). Clinical audits tend to prove more effective when staff completing the audits have had appropriate training (Gould, 2010); have dedicated time in which to conduct the audit and when the audit process is supported by a structured programme (Johnston *et al*, 2000).

However, an audit is only useful and able to effectively inform practice if it assesses the practice being measured correctly. For example, many studies that audit hand hygiene focus on the frequency with which correct hand hygiene is performed (Pittet *et al*, 2000; Rosenthal *et al*, 2005; Donaldson *et al*, 2008; Howard *et al*, 2009), but few studies have assessed technique (Gould *et al*, 2007). Yet it could be argued that if a healthcare worker has poor hand hygiene technique the frequency with which they clean their hands is perhaps less relevant as they may still be contaminated and able to transfer micro-organisms from one patient to another. The validity of the audit tool to measure the intended practice correctly is therefore an important factor to consider when conducting or evaluating clinical audits (Gould, 2010).

Infection prevention audits generally use direct observation to measure healthcare workers compliance to local and national policy. Whilst direct observation is regarded as the gold standard for measuring compliance, particularly to hand hygiene practice (ICNA, 2004), some studies have found that the effect of being monitored be subject to observer bias or the Hawthorne effect, an improvement in compliance because participants are aware of being observed (Stein et al, 2003; Lee et al, 2008). This infers that there is a possibility that audit results may not always reflect true practice if participants are aware that they are being audited, but they are still likely to identify relevant issues. Donaldson et al (2008) identified that one way to overcome such an effect was for undergraduate students to observe practice and conduct the audits as they were more inconspicuous auditors than members of the ward team. However it could be suggested that they would need sufficient training to ensure they understood standards being audited. Furthermore audits, particularly those that require direct observation can be both time- and resource-consuming (Millward et al, 2010) and are only worthwhile if practice is improved as a result.

The audit process therefore includes not just the task of auditing per se but also the identification of the actions required to improve practice, the implementation of such actions, followed by re-audit to determine whether practice has been improved and whether further recommendations are required (Pellowe, 2009). However, the audit process also needs to be supported by the appropriate decision makers as it could be perceived as futile to conduct an audit and make the relevant or practicable recommendations for practice that are then dismissed (Donaldson *et al*, 2008). Yet if the findings are disseminated effectively and the quality of practice and ultimately patient care is improved as the result of a clinical audit then it can be a very valuable and meaningful tool. One way to achieve such sustained compliance is to feedback the audit findings in a timely manner (Berhe *et al*, 2006) or frequently (Rosenthal *et al*, 2005), to those whose practice requires improving. Lee *et al* (2008) noted that prompt feedback of the audit findings enabled immediate changes to practice to be introduced, which improved compliance to infection prevention practices in a neonatal unit on average from 70% to 95%.

Yet recently more emphasis has been placed on ward managers to complete monthly Saving Lives (DH, 2010b) infection prevention audits in order to encourage local ownership of any improvements required to practice. Saving Lives was launched by the Department of Health in 2005 and revised in 2007 and 2010, to audit key clinical procedures and skills where the risk of infection is reducible, and aimed to promote compliance with policy and evidence-based care by auditing seven high impact interventions that focus on specific aspects of daily nursing care that, if conducted correctly, can reduce the risk of HCAI to patients. The interventions are care bundles for the insertion and continuing care of central venous catheters, peripheral venous catheters, renal and urinary catheters, management of patients with patients with ventilators, surgical site wounds and C. difficile. The Department of Health recommends that every NHS organisation in England conducts monthly high impact intervention audits on all wards to measure compliance to the Saving Lives (DH, 2010b) care bundles. The aim is to increase reliability of the clinical process and to review practice by identifying where improvements to performance are required (Pellowe, 2009). The focus of Saving Lives (DH, 2010b) is to implement small changes to practice each month to gradually improve and embed compliance. Therefore if each element of the high impact intervention audit is carried out every time for every patient the risk of infection to patients will be reduced.

It is acknowledged that a standardised approach to audit is required if results are to facilitate benchmarking of practices across the organisation (Bryce *et al*, 2007). Furthermore structured action plans are required to enable ward staff to prioritise the actions necessary to enhance compliance and embed infection prevention practices into daily routines (Flanagan, 2009). For *Saving Lives* (DH, 2010b), the process of auditing and action planning must also be completed efficiently as the cycle is repeated on a monthly basis. However, no formal research has been conducted to evaluate the effectiveness of the *Saving Lives* (DH, 2010b) audits or whether HCAI risk is being reduced in the clinical setting as a result of the tools. If the effect that these audits have on enhancing practice was investigated it may provide some insight into whether they are useful in improving compliance to infection prevention practice and reducing the risk of infection to patients. It may also contribute towards understanding whether nurses' knowledge and education of infection prevention practice is adequate or could be improved.

2.11 Conclusion

With regards to nurses' knowledge and application of infection prevention practice, previous studies suggest that nurses' knowledge of basic infection prevention standard precautions or practices were inadequate (Pittet et al, 1999; Trim et al, 2003; Flores & Pevalin, 2006). This therefore affected nurse's practice as poor knowledge of infection prevention leads to poor application of infection prevention practices (Marshall et al, 2004; Vaughan et al, 2006; Trigg et al, 2008; Wu et al, Other factors that affected reduced adherence to practice included 2009). insufficient time and heavy workload (Ward, 1995; Madan et al, 2002; Sax et al, 2005), poor role models (Scott et al, 2005; Whitby et al, 2006), and lack of availability of hand wash facilities (Sax et al, 2005; Ferguson et al, 2004; Ward, 2006). Stein et al (2003) inferred that experience or length of service is indirectly related to infection prevention compliance with older nurses seeming to be less compliant, but did not explore this further. Other studies have also made assumptions between knowledge, application and experience (Osuka, 2005; Orsolini-Hain & Malone, 2007). Exploration into this divergence in the research surrounding the relationship between experience, knowledge and application may therefore provide further insight into why nurses' infection prevention practices are generally inadequate.

Furthermore previous research surrounding infection prevention knowledge, application and compliance has identified a need for increased education (Stein *et al*, 2003; Trigg *et al*, 2008; Wu *et al*, 2009), improvements to current infection

prevention education (Mann & Wood, 2006; Vaughan *et al*, 2006;) and causes for current limited knowledge to be established (Trim *et al*, 2003). Interestingly there is little in the literature concerning nurses' experience of infection prevention education, yet this may provide further understanding of how education can be increased or improved and what issues exist with regards to current infection prevention education. There is also little evidence to suggest what formal training infection prevention trainers have had with regards to teaching styles and theory. Experiences of class room based education from the perspectives of both infection prevention trainers and nurses that attend infection prevention training may therefore offer further insight into how education can be enhanced and how education impacts on compliance.

One form of infection prevention education that has emerged in the international research is ward-based education (Mukti et al, 2000; Uwakwe, 2000; Hung et al, 2002) and in UK literature the use of clinical skills facilitators in the ward environment (Kelly & Simpson, 2001; Kilminster et al, 2001). Yet it has not been ascertained whether either ward-based education or the clinical skills facilitator role can provide embedded or sustained improvements to infection prevention practice in the NHS. Furthermore, infection prevention practice is measured and monitored by clinical audits, which has been standardised across the NHS recently by the implementation of Saving Lives (DH, 2010b) audits. However, no formal research has reported the effectiveness of the Saving Lives (DH, 2010b) audits or whether HCAI risk is being reduced in the clinical setting as a result of the tools. If compliance to these Department of Health audits is researched, it may provide some insight into whether they are useful in improving compliance to infection prevention practice and reducing the risk of infection to patients. It may also contribute towards understanding whether nurses' knowledge and education of infection prevention is adequate or could be improved.

The comprehensive aim of the three studies presented in the subsequent chapters of this thesis is therefore to explore whether knowledge and application of infection prevention practices are affected by such factors as education, training and nursing experience. The intention is to gain an enhanced understanding of the complexities of infection prevention practices, which may be able to provide new

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insight and subsequently inform practice, reduce the risk of infection and improve the quality of care delivered to patients.

Chapter Three

3. The effectiveness of clinical skills training on infection prevention practices

3.1 Introduction

Saving Lives (DH, 2010b) was launched in 2005, revised in 2007 and again in 2010, and was designed to support NHS organisations to reduce HCAIs. It provides evidence-based practice guidance for key clinical procedures where the risk of infection is reducible, in the form of high impact intervention (HII) care bundles (Table 3.1).

Saving Lives (DH, 2010b) High Impact Intervention care bundles:

- Central venous catheter insertion
- Central venous catheter ongoing care
- · Peripheral intravenous cannula insertion
- · Peripheral intravenous cannula ongoing care
- Renal haemodialysis insertion
- · Renal haemodialysis ongoing care
- Prevention of surgical site infection pre-operative
- Prevention of surgical site infection intra-operative
- Prevention of surgical site infection post-operative
- Ventilated associated pneumonia
- Urinary catheter care insertion
- Urinary catheter care ongoing
- Clostridium difficile
- Cleaning and decontamination
- · Chronic wounds care actions
- Chronic wounds management
- Enteral feeding

Table 3.1: Saving Lives (DH, 2010b) high impact intervention care bundles.

The Department of Health provides standardised audit tools (Appendix I) to enable NHS organisations to audit compliance to the HII care bundles and in England

requires that NHS organisations conduct these HII audits regularly to robustly monitor the effectiveness of clinical processes and systematically improve patient outcomes (DH, 2010b). The HII audits are designed to facilitate the achievement of 100% compliance through clearly indicating which elements of the care bundles have or have not been performed, supporting the development of action plans to resolve issues and improve practice and supporting a culture of continuous improvement. If each element of the HII audits is carried out every time for every patient the risk of infection to patients is reduced (DH, 2010a). Acute NHS Trusts therefore conduct these audits monthly and many use HII audit results as key performance indicators to provide assurance to the Trust Board and the Primary Care Trust that the risk of infection is being addressed and reduced. However the effectiveness of conducting monthly HII audits to improve compliance to infection prevention practices in the clinical setting has not as yet been evaluated.

Saving Lives (DH, 2010b) advocates that NHS organisations should provide annual training on the prevention and control of infection in general to all staff. However previous studies have found that no research recommends the most effective way to deliver generic infection prevention education (Mann & Wood, 2006; Vaughan *et al*, 2006). Furthermore current training tends to be formal, short and taught pedagogically by content experts, for large groups of eclectic healthcare workers in the hope that enhanced knowledge will persuade staff to improve their compliance in relation to clinical care (Cole, 2008). Other forms of training have therefore been developed to improve the value and flexibility of education, for example the Skills Academy for Health launched the Core Learning Unit in 2009 which has an infection prevention e-learning module. This provides an assured level of quality of training and increases accessibility to training. However the content is generic so may not reflect local policies or practices and knowledge can be significantly lessened three months after completion of elearning modules (Fakih *et al*, 2006).

Another alternative is teaching staff the knowledge and skills relevant to their practice in the clinical setting. Previous studies have shown that ward-based teaching sessions overcome staffing pressures (Richardson, 2001), more staff are likely to attend (Scott *et al*, 2005) and that the training is more effective than classroom teaching (Gould & Chamberlain, 1997). Although ward-based teaching

packages and programmes have been shown to improve compliance to infection prevention standard precautions internationally (Uwakwe, 2000; Kilminster *et al*, 2001; Hung *et al*, 2002), there has been no published research into whether wardbased teaching can improve compliance to the key elements of practices recommended by the HII care bundles to reduce the risk of infections to patients. The research objective of this present study was therefore to determine whether the introduction of ward-based clinical skills training improved HII audit results and therefore compliance to key infection prevention practices.

3.2 Methodological approach

Research methods are the steps, procedures and strategies for gathering and analysing data (Tarling & Crofts, 2002). The method used in a study provides a framework to guide the researcher towards answering the research focus and is developed from the paradigm or worldview that underpins the inquiry (Flood, 2010). The traditional approach to human inquiry is positivism which emphasises the reasonable and the scientific through a formal, systematic approach in which numerical data are used to quantify phenomena and the relationships among them. Quantitative research follows the positivist paradigm and is the investigation of phenomena through precise measurement and quantification, often involving a rigorous and controlled study design (Polit & Hungler, 1999). Positivism therefore supports the controlled collection of large amounts of data that is easily comparable to explain social phenomena, however it does not often discover the meaning that people attach to that social phenomena. For this present study, where the research objective was to determine whether the implementation of ward-based clinical skills training improved infection prevention practices, a quantitative evaluation approach was most appropriate as it enabled this hypothesis to be tested through the analysis of numerical data.

Evaluation research is an applied form of research that involves finding out how well a programme, practice, procedure or policy is working, with the goal of assessing or evaluating the success of it (Bowling & Ebrahim, 2005). An evaluation approach therefore effectively answered the practical nature of the research objective for this study as it enabled the success of a program of ward-based teaching which aimed to improve infection prevention practice to be measured. Due to the nature of evaluation research, audits are often used to

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assess the effectiveness of the intervention under evaluation. Audit is a systematic process that is applied to assess, evaluate and improve patient care (Tarling & Crofts, 2002). This is achieved through the cyclical collection of routine data to review whether the correct practice is being applied and if necessary implement changes to improve practice. Beneficial outcomes of audit include improved communication, improved knowledge or skills and improved patient care (Johnston *et al*, 2000).

However because the primary method by which information is gathered when undertaking audits is by direct observation of practice, the audit process can be subject to observer bias, which can occur in two ways. Firstly because the auditor, or observer of practice, believes that what they are observing is a truthful interpretation which can be affected by the auditor's pre-conceived expectations of how well the practice will be performed, their belief regarding what constitutes safe and unsafe practice or their desire for their ward to receive a compliant score (Elliott, 2009). Observer bias can also transpire if the nurse being observed is aware that they are being audited and therefore performs better because of this, a temporary behavioural change made by the nurse to attempt to please the auditor known as the Hawthorne effect (Stein *et al*, 2003).

However, recent research suggests that the original studies that discovered the concept of the Hawthorne effect may have perhaps overstated this effect as the results have not been replicated and factors that contributed to increased productivity other than the increased management attention have since been identified (Barnes, 2010). Yet it is still important to consider the potential effect of observer bias when utilising audits as a research tool in order to prevent it from occurring. With regards to this study, the audit data was collected retrospectively to reduce any observer bias from or towards the researcher, but because of this retrospective nature it is acknowledged that the researcher had no control over whether any observer bias occurred during the actual audits from or towards the auditors. This will be considered in the interpretation of the results and when discussing the generalisability of the findings.

3.3 Ethical considerations

Written consent to conduct this study and use this data were gained from the National Research Ethics Service (Appendix II), the Research Degrees Committee at the university (Appendix III), the Research Committee at the hospital (Appendix IV) and from the lead infection prevention nurse at the hospital at which the research was conducted (Appendix V). With regards to confidentiality, ward names remained anonymous and HII audit data were coded to prevent disclosure. Bias was reduced by the researcher analysing the ward audit data anonymously, remaining objective and displaying the data fairly. Raw data were transported in a locked briefcase and stored securely in a locked filing cabinet in accordance with relevant university policy. Only the researcher had access to the data, their computer was password protected to safeguard the data once inputted, and the data will be destroyed two years after completion of the thesis as per the policy of the university at which the study was completed.

3.4 Research tools

The research tools employed were the national *Saving Lives* (DH, 2007) HII audits for peripheral intravenous cannula insertion and ongoing care, urinary catheter insertion and ongoing care and *Saving Lives* (DH, 2005b) HII audit tool for basic infection control (Appendix I), compliance to which was scored as a percentage.

Basic infection control was a HII care bundle in the original version of *Saving Lives* (DH, 2005b) but was discontinued in the 2007 revision. This was because in 2006 implementing the *Code of Practice for the Prevention and Control of HCAI* (DH, 2006) became a legal requirement for NHS organisations. *Saving Lives* (DH, 2005b) was therefore replaced with *Saving Lives* (DH, 2007) to streamline the HII care bundles into a framework that better reflected the duties of the *Code of Practice* (DH, 2006) and facilitated NHS organisations to demonstrate compliance to the code. Both the *Code of Practice* (DH, 2006) and the HII care bundles have been revised again in 2010 (Table 3.1). However during the study period the Infection Prevention Team continued to audit compliance to the basic infection control skills, particularly hand hygiene, in the reduction of infection.

All of the Saving Lives (DH, 2005b; DH, 2007) HII audits that were conducted were completed following the same procedure. The auditors observed ten episodes of practice, for example, ten insertions of a peripheral intravenous cannula, and documented compliance to each element of the HII care bundle on the HII audit tool for each observation. The audits were then sent to the hospital governance team who inputted the data electronically into Excel Saving Lives (DH, 2005b; DH, 2007) spreadsheets, which automatically calculated the 'all actions performed' column of each audit and the overall audit compliance score was generated at the bottom of this column. Monthly overall compliance scores were then fed back from the governance team to the auditors and where elements of the care bundles were not performed correctly and the overall compliance score was less than 100%, auditors took actions to improve practice and therefore improve compliance levels. All auditors received training regarding the HII care bundles and how to complete the HII audits prior to commencement of the audit programme and ongoing support was further provided by the Infection Prevention Team at the hospital.

A concept that requires consideration when using audits in a methodology is that of subjective standards. In the context of infection prevention, audits are used to measure adherence or compliance to practice or policy, but the audit results can be a reflection of the auditor's interpretation of the standard being audited (Elliott, 2009). Subjective standards may occur whereby different auditors interpret audit statements differently, for example one may misread or misunderstand the criterion being audited and then perceive the practice being observed to be compliant when it actually is not. The Department of Health have overcome the potential problem of subjective standards by developing national audit tools that are simple, evidence based and that have been piloted extensively prior to launch. The Saving Lives (DH, 2005b; DH, 2007) HII audit tools are also well supported by the HII care bundle documents, in which each element of the care bundle and audit is clearly explained to reduce the risk of subjective standards being interpreted by different auditors. Therefore the Saving Lives (DH, 2005b; DH, 2007) audits are well validated tools so were used confidently in the methodological process of this study.

3.5 Sample population

The sample population for this study was a district general hospital in the UK. In this sample population the HII audits were conducted monthly and the auditors were the ward managers, 52 wards and departments participated in this audit process every month from May 2007 and still continue to do so. In December 2007 the Infection Prevention Team introduced two clinical skills trainers for four months to provide ward-based teaching and ward-based drop-in sessions surrounding the HII care bundles for insertion and care of peripheral intravenous cannulae and urinary catheters as well as basic infection control. The clinical skills trainers had undertaken formal assessments of competence for these skills prior to commencement in post. They taught nursing staff the polices and products relevant to HII care bundles, updated their skills, and taught them the rationale that underpinned practice with regards to these HII invasive devices. The researcher sought to use this audit data retrospectively to ascertain whether the clinical skills trainers had improved compliance to HIIs and therefore improved monthly audit results.

The clinical skills trainers were only employed in the medical directorate and therefore the sample size comprised the 13 wards in that directorate. Seven wards were randomly selected as the intervention group and the clinical skills trainers taught on these wards. Six wards comprised the control group as nursing staff on these wards had no access to the clinical skills training. Both the control and the intervention groups were of a similar case mix as each group included emergency, acute and elderly medical wards.

3.6 Data analysis

This element of the study aimed to assess the effectiveness of ward-based clinical skills training. Monthly *Saving Lives* (DH, 2005b) HII audit results for basic infection control, and *Saving Lives* (DH, 2007) HII audit results for peripheral intravenous cannula insertion and ongoing care and urinary catheter insertion and ongoing care were analysed retrospectively for the six months prior to, four months during and six months following the clinical skills training. The aim was to ascertain whether the implementation of such training improved compliance to the HII care bundles for the intervention group, compared to the control group. Data

were analysed using the Statistical Package for the Social Sciences (SPSS) computer programme (version 14.0) and significance was set at 0.05.

The preliminary step in the analysis process was the determination of the normality of the data as this effected the type of test then used for further analysis. To achieve this, the Shapiro-Wilk test was applied. The Shapiro-Wilk test determines whether a distribution of scores is significantly different from a normal distribution, whereby a significant value (p<0.05) indicates a deviation from normality (Polit & Hungler, 1999). This, rather than the Kolmogorov-Smirnov test, was used because it yields exact significance values whereas the Kolmogorov-Smirnov provides approximations of significance, the Shapiro-Wilk statistic is therefore more accurate (Field, 2005). The limitation of both tests is that they are affected by large samples, in which small deviations from normality yield significant results. However, given the small sample size of this data, and the more accurate statistic obtained, the Shapiro-Wilk was appropriately applied to determine whether the data was parametric. This test revealed that the data was normally distributed for basic infection control, cannula insertion, cannula ongoing care and urinary catheter ongoing care. However, the urinary catheter insertion data was not normally distributed so was therefore analysed separately using nonparametric tests.

One-way repeated-measures analysis of variance (ANOVA) is a statistical model that compares several means for any design in which the independent variables have all been measured using the same participants in all conditions. This was therefore applied to the parametric data to determine if the clinical skills trainers affected audit scores because the same wards participated in the three different test conditions: before, during and after the clinical skills trainers. One-way repeated-measures ANOVA also reduces the unsystematic variability in the design so provides a greater power to detect an effect (Field, 2005). As there were three repeated measures conditions Mauchly's test was also used to determine whether the assumption of sphericity was violated and this was considered when interpreting test statistics. Therefore one way repeated-measures ANOVA was applied to the parametric data and the non-parametric data was analysed using Friedman's ANOVA, which is the non-parametric equivalent. To maintain

confidentiality the data was coded C1-C6 for the six control wards and I1-I7 for the seven intervention wards.

3.7 Results

The data were tested to compare the audit scores between the control and intervention group before the study to ensure that there were no differences between the data before the study period and that they were drawn from the same population. An independent t-test was used for the parametric data and Mann-Whitney test for the non-parametric data. These tests both test for a significant difference between the means of an interval dependent variable of two independent groups, for parametric and non-parametric data, respectively (Polit & Hungler, 1999). Analysis confirmed that there were no significant differences in the data between the groups before the clinical skills training started for any of the HII audits that were evaluated: basic infection control, cannula insertion, cannula ongoing care, urinary catheter insertion and urinary catheter ongoing care (p=0.317, 0.228, 0.614, 0.073 and 0.184, respectively). The HII audit results were then analysed independently. The HII scores were presented as percentages, with 100% demonstrating full compliance to infection prevention practice.

3.7.1 Basic infection control

The first HII care bundle that was evaluated was basic infection control. This audited whether nursing staff correctly applied the following basic infection prevention standard precautions before and after clinical procedures as appropriate: hand hygiene, correct use of personal protective equipment, application of aseptic technique, safe disposal of sharps and safe disposal of waste. The ward audit scores collected from the basic infection control tools are displayed in Table 3.2.

Ward control (C) or intervention (I)	Mean audit scores for the six months prior to the study ± standard deviation (n)	Mean audit scores for the four months during the study ± standard deviation (n)	Mean audit scores for the six months after the study ± standard deviation (n)
C1	54.2 ± 23.5 (6)	65.0 ± 4.4 (4)	64.2 ± 20.8 (5)
C2	71.8 ± 27.1 (6)	80.0 ± 8.2 (4)	86.7 ± 12.1 (6)
C3	49.5 ± 33.3 (4)	64.5 ± 6.0 (4)	92.3 ± 12.5 (6)
C4	78.2 ± 25.2 (6)	97.5 ± 5.0 (4)	90.7 ± 12.0 (6)
C5	80.0 ± 8.9 (6)	90.0 ± 14.1 (4)	65.5 ± 31.7 (6)
C6	63.3 ± 30.1 (6)	70.0 ± 21.6 (4)	83.0 ± 22.4 (6)
11	58.6 ± 6.2 (5)	80.0 ± 14.1 (4)	93.3 ± 5.2 (6)
12	78.3 ± 9.8 (6)	95.0 ± 7.1 (2)	72.0 ± 4.5 (5)
13	59.2 ± 30.7 (6)	65.0 ± 10.0 (4)	62.0 ± 20.5 (5)
14	73.8 ± 11.5 (5)	66.7 ± 28.9 (3)	75.6 ± 10.2 (5)
15	39.0 ± 38.7 (6)	65.0 ± 5.8 (4)	84.5 ± 18.5 (6)
16	46.1 ± 39.5 (6)	57.5 ± 9.6 (4)	65.0 ± 8.4 (6)
17	53.3 ± 41.8 (6)	62.5 ± 25.0 (4)	68.3 ± 7.5 (6)

Table 3.2: Ward audit scores for basic infection control (mean \pm SD (n)).

Analysis of this data showed that basic infection control scores increased for both the control and the intervention groups throughout the study period (Figure 3.1). The control group scores were higher overall than the intervention group, yet for the control group there was not a significant improvement (p=0.136). However, for the intervention group basic infection control scores significantly improved whilst the skills trainers were in post, compared to the before scores (p=0.037).

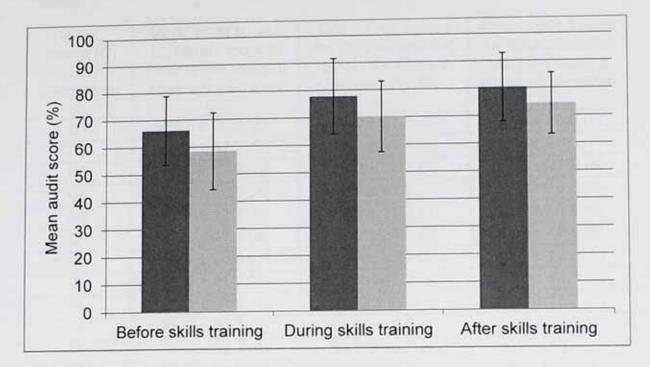


Figure 3.1: Audit scores for basic infection control (mean ± SD).

Control group 📃 Intervention group

The results suggest that *Saving Lives* (DH, 2005b) audits are useful in improving compliance to basic infection control practice as both groups improved over the study period. When considering the individual wards, three of the control wards improved consistently throughout the study compared to five of the intervention wards, which suggest that the clinical skills trainers enabled a greater improvement. However, basic infection control must be applied prior to conducting any subsequent clinical skill and is therefore of paramount importance in reducing cross-infection. Therefore although it is encouraging that *Saving Lives* (DH, 2005b) was able to facilitate improvements in this aspect of practice, this finding has implications for practice as this audit tool is no longer advocated by the Department of Health.

3.7.2 Peripheral intravenous cannula insertion

Table 3.3 presents the data collated for scores where the insertion of peripheral intravenous cannulae was audited. This assessed whether staff cleaned their hands, wore gloves and aprons and cleaned the patient's skin correctly prior to inserting a cannula, used a transparent dressing and documented the insertion time and date.

Ward control (C) or intervention (I)	Mean audit scores for the six months prior to the study ± standard deviation (n)	Mean audit scores for the four months during the study ± standard deviation (n)	Mean audit scores for the six months after the study ± standard deviation (n)
C1	73.7 ± 20.6 (6)	61.0 ± 27.6 (3)	80.0 ± 26.5 (3)
C2	66.7 ± 57.7 (3)	75.0 ± 43.3 (3)	88.0 (1)
C3	92.0 ± 17.9 (5)	90.3 ± 16.7 (3)	75.3 ± 21.9 (3)
C4	50.0 ± 40.8 (4)	67.8 ± 47.2 (4)	100.0 ± 0.0 (2)
C5	81.7 ± 11.7 (6)	73.3 ± 15.3 (3)	77.8 ± 40.4 (6)
C6	47.5 ± 41.1 (4)	20.0 ± 34.6 (3)	71.6 ± 18.5 (5)
11	20.8 ± 24.9 (4)	72.3 ± 23.4 (4)	75.4 ± 18.5 (5)
12	75.0 ± 41.8 (6)	68.8 ± 47.3 (4)	65.8 ± 44.7 (4)
13	79.3 ± 24.9 (4)	90.0 ± 8.2 (4)	82.2 ± 18.3 (6)
14	46.8 ± 20.3 (5)	91.5 ± 12.0 (2)	81.4 ± 27.2 (5)
15	59.2 ± 33.4 (6)	51.5 ± 35.7 (4)	90.6 ± 10.3 (6)
16	50.6 ± 37.0 (5)	86.7 ± 11.6 (3)	96.7 ± 5.8 (3)
17	56.0 ± 27.0 (5)	100.0 (1)	100.0 ± 0.0 (5)

Table 3.3: Ward audit scores for peripheral cannula insertion (mean \pm SD (n)).

Findings revealed that without the clinical skills trainers the control group made no significant improvements in audit results for peripheral cannula insertion (p=0.153) and only two control wards made a consistent increase in scores. However the intervention group did improve consistently over the study period. In particular the scores for peripheral cannula insertion were significantly higher whilst the clinical skills training was available compared to before (p=0.009) and increased to 84.6% in the six months after clinical skills training (Figure 3.2). This suggests that *Saving Lives* (DH, 2007) audits alone had little effect on improving the skill of peripheral cannulation during the first part of the study, whilst the implementation of clinical skills training increased scores significantly and this was sustained over the six months after the skills training was completed.

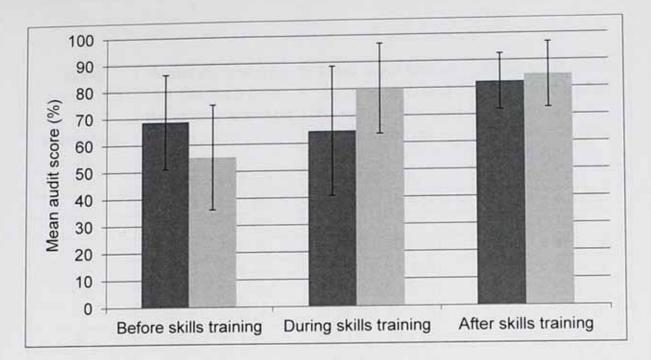


Figure 3.2: Audit scores for peripheral cannula insertion (mean ± SD).

Control group 📰 Intervention group

Figure 3.2 shows that scores for the control group did increase towards the end of the study period from 64.6% to 82.1%. This may have been due to staff sharing good practice from the intervention wards or from *Saving Lives* (DH, 2007) interventions gradually becoming embedded and being applied correctly by this time in the study, however the target of 100% was still not achieved. After a peripheral cannula has been inserted, the appropriate ongoing care of the device is also important in reducing the risk of infection.

3.7.3 Peripheral intravenous cannula ongoing care

The peripheral intravenous cannula ongoing care HII audit assessed whether staff cleaned their hands when administering fluids and medications through cannulae, cleaned the injection port correctly, checked the dressing was clean and intact, documented a site inspection for signs of infection daily and removed the cannula when clinically indicated. The audit results for this skill are shown in Table 3.4.

Ward control (C) or intervention (I)	Mean audit scores for months prior to the study ± standard deviation (n)	Mean audit scores for months during the study ± standard deviation (n)	Mean audit scores for months after the study ± standard deviation (n)
C1	66.5 ± 47.4 (2)	100.0 (1)	100.0 (1)
C2	93.3 ± 10.3 (6)	83.5 ± 15.4 (4)	98.3 ± 4.5 (5)
C3	100.0 ± 0.0 (2)	-	100.0 (1)
C4	59.0 ± 24.2 (6)	90.0 ± 20.0 (4)	47.12 ± 45.3 (6)
C5	78.3 ± 18.4 (6)	49.3 ± 35.1 (4)	88.8 ± 20.2(6)
C6	39.4 ± 37.2 (5)	35.3 ± 36.3 (4)	76.7 ± 18.4 (6)
11	89.5 ± 12.6 (4)	78.2 ± 19.7 (5)	92.6 ± 7.3 (5)
12	56.3 ± 37.7 (4)	71.3 ± 19.7 (5)	48.0 ± 37.0 (5)
13	48.5 ± 23.0 (4)	47.7 ± 31.7 (6)	63.3 ± 33.9 (6)
14	45.8 ± 27.8 (4)	64.2 ± 31.4 (6)	54.6 ± 14.8 (5)
15	75.3 ± 10.8 (3)	66.7 ± 21.6 (6)	87.2 ± 21.7 (5)
16	67.5 ± 27.5 (4)	68.2 ± 36.6 (5)	78.5 ± 33.4 (6)
17	67.5 ± 47.1 (4)	78.6 ± 16.2 (5)	55.0 ± 37.7 (6)

Table 3.4: Ward audit scores for peripheral cannula ongoing care (mean ± SD (n)).

This data shows that control ward one improved initially to achieve 100% during and after the study period and control ward three scored 100% constantly. However both of these wards had poor return rates during the entire study period, which may therefore have skewed the interpretation of the results as the remaining control wards did not improve regularly for ongoing peripheral intravenous cannula care (Figure 3.3). Furthermore the increase of the control group towards the end of the study was not significant (p=0.506), this was likely due to the sole 100% scores control ward one and three.

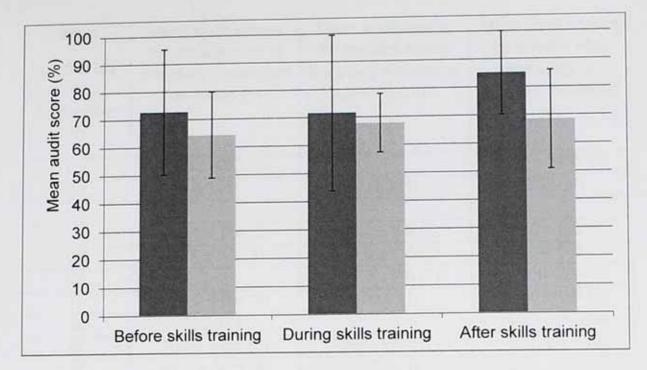


Figure 3.3: Audit scores for peripheral cannula ongoing care (mean ± SD).

Control group 📃 Intervention group

Figure 3.3 shows that whilst the intervention group achieved small but consistent improvements throughout the study period, the control group did not improve until the six months towards the end of the study. This reinforces the preceding findings of this study and suggests that the impact of the clinical skills training on peripheral cannula care facilitated the intervention group to maintain continued improvements to practice with regards to this skill.

3.7.4 Urinary catheter insertion

The urinary catheter insertion HII audit evaluated whether staff cleaned their hands, wore gloves and aprons, cleaned the patient's skin correctly prior to inserting a catheter and used aseptic technique correctly to insert a sterile, closed drainage system. Table 3.5 shows the ward audit data collected for the insertion of urinary catheters.

Ward control (C) or intervention (I)	Mean audit scores for months prior to the study ± standard deviation (n)	Mean audit scores for months during the study ± standard deviation (n)	Mean audit scores for months after the study ± standard deviation (n)
C1	75.0 ± 43.3 (3)		93.3 ± 11.6 (3)
C2	0.0 (1)	100.0 (1)	100.0 (1)
C3	1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -	-	-
C4	100.0 ± 0.0 (2)	100.0 ± 0.0 (2)	100.0 ± 0.0 (4)
C5	86.7 ± 8.2 (6)	100.0 ± 0.0 (2)	100.0 ± 0.0 (4)
C6	-	100.0 ± 0.0 (2)	100.0 (1)
11	100.0 ± 0.0 (5)	100.0 (1)	100.0 ± 0.0 (3)
12	100.0 (1)		100.0 ± 0.0 (5)
13	100.0 ± 0.0 (6)	100.0 ± 0.0 (2)	100.0 ± 0.0 (6)
14	91.8 ± 16.5 (4)	100.0 (1)	100.0 ± 0.0 (3)
15	100.0 ± 0.0 (6)	100.0 ± 0.0 (2)	100.0 ± 0.0 (6)
16	100.0 (1)	100.0 (1)	-
17	100.0 ± 0.0 (3)	100.0 ± 0.0 (3)	100.0 ± 0.0 (3)

Table 3.5: Ward audit scores for urinary catheter insertion (mean ± SD (n)).

Findings show that compliance to this care bundle was good for the intervention group prior to any intervention (98.8%), with six of the intervention wards scoring 100% consistently before, during and after the clinical skills training. For the control group, compliance was 65.4% before, 100% during and 98.7% after the study period, though this improvement was not statistically significant (p=0.135), as shown in Figure 3.4.

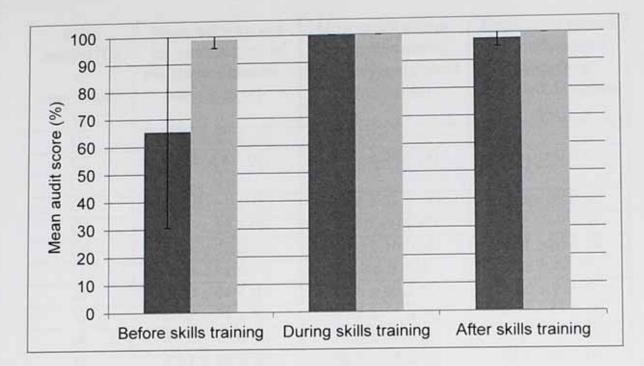


Figure 3.4: Audit scores for urinary catheter insertion (mean ± SD).

Control group 📃 Intervention group

Although the intervention group had high scores prior to the clinical skills training, they achieved 100% with further training and this was sustained after the training ceased. Yet the control group did not maintain improved scores, suggesting that *Saving Lives* (DH, 2007) audits alone may not be sufficient to improve clinical skills such as urinary catheterisation if the practice is perhaps substandard to begin with. Post urinary catheterisation, care of the urinary catheter is another skill intrinsic to reduce the risk of infection to the patient.

3.7.5 Urinary catheter ongoing care

The last HII audit analysed was urinary catheter ongoing care. This audit examined whether staff cleaned their hands when caring for the catheter, cleaned the sampling port correctly, ensured the drainage bag was positioned appropriately and removed the urinary catheter when clinically indicated. Table 3.6 shows the audit scores for ongoing care of urinary catheters.

Ward control (C) or intervention (I)	Mean audit scores for months prior to the study ± standard deviation (n)	Mean audit scores for months during the study ± standard deviation (n)	Mean audit scores for months after the study ± standard deviation (n)
C1	75.0 ± 43.3 (3)		-
C2	98.3 ± 4.1 (6)	87.5 ± 25.0 (4)	100.0 ± 0.0 (5)
C3	-	-	-
C4	100.0 ± 0.0 (5)	93.8 ± 12.5 (4)	75.8 ± 38.8 (6)
C5	86.7 ± 13.7 (6)	100.0 ± 0.0 (3)	79.2 ± 40.1 (6)
C6	91.2 ± 17.2 (6)	95.0 ± 10.0 (4)	67.4 ± 20.5 (5)
11	86.6 ± 14.0 (5)	82.3 ± 5.9 (4)	90.8 ± 4.8 (6)
12	80.0 ± 44.7 (5)	73.3 ± 46.2 (3)	96.0 ± 8.9 (5)
13	69.2 ± 31.3 (6)	91.3 ± 11.8 (4)	95.0 ± 11.2 (5)
14	87.8 ± 15.5 (6)	71.0 ± 18.3 (3)	95.8 ± 10.2 (6)
15	73.2 ± 16.6 (6)	80.0 ± 28.3 (2)	85.0 ± 36.7 (6)
16	100.0 ± 0.0 (4)	89.3 ± 15.6 (4)	94.5 ± 13.5 (6)
17	73.4 ± 26.2 (5)	95.0 ± 10.0 (4)	100.0 ± 0.0 (6)

Table 3.6: Ward audit scores for urinary catheter ongoing care (mean \pm SD (n)).

The intervention group scores for urinary catheter ongoing care increased throughout the study and were significantly better after the skills training compared to during the skills training (p=0.042). This could be because it is generally the duty of healthcare assistants to care for urinary catheters and it could have taken time for the skills relevant to this device to be disseminated from the nurses that received clinical skills training. The control group results yielded no significant improvements (p=0.168) and decreased after the study period from 94.1% to 80.6% (Figure 3.5).

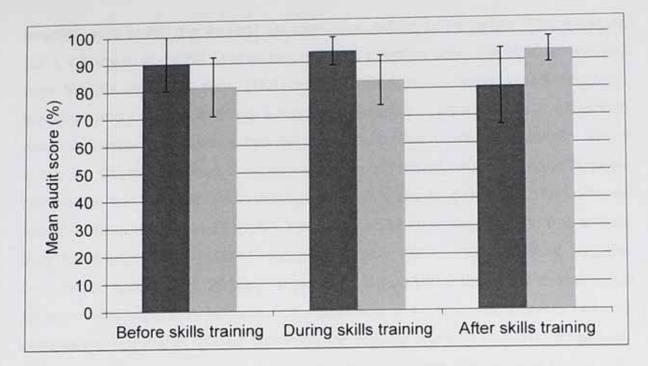


Figure 3.5: Audit scores for urinary catheter ongoing care (mean ± SD).

Control group 📃 Intervention group

Similar to the urinary catheter insertion results, these findings suggest that *Saving Lives* (DH, 2007) audits are not perhaps an appropriate tool to improve clinical skills and that the implementation of clinical skills training is more effective. However, for both groups the overall compliance throughout the study period was much higher for urinary catheterisation and catheter ongoing care than for peripheral cannulation and peripheral cannula ongoing care.

3.8 Discussion

The results of this study have offered some useful insights for nurse managers and educators in practice regarding the effectiveness of both audits and wardbased clinical skills training to improve infection prevention practice. With regards to basic infection control compliance, findings suggest that *Saving Lives* (DH, 2005b) audits are useful in improving compliance to basic infection control practice as both groups improved consistently over the study period, although the clinical skills trainers facilitated a statistically significant improvement during the intervention period (p=0.037). Much of the research surrounding basic infection control practices has focused on the measurement of compliance to hand hygiene (Pittet *et al*, 1999; Bissett, 2002; Creedon, 2006; Howard *et al*, 2009) due to both hand hygiene being recognised as the most important factor in reducing crossinfection and being the easiest standard precaution to measure (Madan *et al*, 2002; Whitby *et al*, 2006). Yet since this basic infection control audit was removed from the *Saving Lives* (DH, 2007) tool kit there is no standardised approach towards hand hygiene auditing across the research, which makes it difficult to draw comparable conclusions between various studies (Gould *et al*, 2008). There is also no universal guidance regarding how to effectively measure hand hygiene compliance and the nationwide '*cleanyourhands*' campaign (NPSA, 2004) offer no less than four different audit tools. Yet every acute NHS organisation has a legal duty to monitor hand hygiene compliance and report monthly hand hygiene compliance figures (DH, 2010a). It could be argued that these are perhaps not comparable if different methods and audit tools are used, yet there is not one compliance tool that is utilised nationally for measuring hand hygiene compliance before and after patient contact, now that the basic infection control HII tool no longer exists.

With regards to peripheral intravenous cannulation and ongoing care, results suggest that Saving Lives (DH, 2007) audits alone had little effect on improving the skills of peripheral cannulation and ongoing care during the first part of the study, and the implementation of clinical skills training increased scores for both these skills, significantly for peripheral cannulation, and these were sustained over the six months after the skills training was completed. Peripheral cannulation and ongoing care scores for the control group did increase in the last six months of the study period, perhaps because the care bundle was gradually becoming embedded, or other contributory factors that were not studied or because of the Hawthorne effect. Although direct observation has historically been perceived to be the best method of audit and is the most commonly used approach it can be subject to both observer bias and the Hawthorne effect (Stein et al, 2003). This could therefore affect the result of the Saving Lives audits as they were completed under direct observation of practice by the ward managers. Therefore the concept of self-audit must be considered as a factor that may have affected the audit results. Yet it could be suggested that if either group were influenced by either the Hawthorne effect or any self-audit bias, then the compliance scores to the care bundles would have been significantly higher than they actually were.

The Department of Health (2007) intended Saving Lives audits to be used to identify small changes or improvements to practice to be implemented each month, so that when re-audited the following month, compliance improves until 100% is achieved and sustained. Therefore, regardless of access to ward-based training, by the design of the Saving Lives (DH, 2007) programme, it could be suggested that 100% compliance should have been achieved by all wards in the study after 16 months of implementation. However, a recent study that conducted infection prevention audits (ICNA, 2004) over a four year period resulted in the improvement of compliance from 88%-93% (Millward et al, 2010), suggesting that attainment of 100% compliance may not be realistically achievable in a 16 month timeframe, if at all. This supports the findings of this present study and infers that either the Saving Lives (DH, 2007) audits are not effective at eliminating poor practice or that monthly audit results are not interpreted and acted upon in a timely manner. Although the Saving Lives (DH, 2007) audits provided useful data for the ward mangers regarding compliance with the care bundles on their wards, this information is only worthwhile if they can then translate it into actions required for their ward and then implement relevant interventions in a relatively short period of time. There is also a cost implication to the use of the audit tools. For example, assuming three hours per month of a ward manager for the 52 departments for the hospital in this study equals approximately £2.4k per month or £28.7k per annum, which could perhaps have been better utilised, for example to provide further clinical skills training.

With regards to urinary catheterisation scores findings suggest that, although the intervention group had high scores prior to the clinical skills training, they achieved 100% with further training and this was sustained after training ceased. The control group also maintained good scores, suggesting that nurses' urinary catheterisation skills were consistently compliant for both groups. Similarly, scores for urinary catheter ongoing care remained high for both groups throughout the study period, particularly when compared to the cannula insertion and ongoing care scores. This may be because initial peripheral intravenous cannulation training is not sufficient whilst initial urinary catheterisation training is adequate. For example, locally catheterisation is taught by clinical skill educators whilst cannulation is taught by representatives from private companies. Such training provided for cannulation may not include local policies, products and care plans

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whilst the training for catheterisation does, suggesting a need to improve training surrounding cannulation. This finding is echoed in the literature surrounding infection prevention knowledge, application and compliance which has identified a need for increased infection prevention education (Stein *et al*, 2003; Trigg *et al*, 2008; Wu *et al*, 2009), improvements to current infection prevention education (Mann & Wood, 2006; Vaughan *et al*, 2006) and causes for current limited knowledge to be established (Trim *et al*, 2003).

It could also be suggested that full compliance was not sustained by either group because the audit tools may not facilitate effective learning with regards to improving key nursing skills. Whilst the audit tools may be useful to identify areas of poor practice, they provide no insight as to fundamentally why compliance is poor, or how it can be resolved, learnt or embedded. Furthermore, the reduced compliance with cannulation and care of cannulae could also be attributed to the concept that over time staff forget or fail to apply the correct techniques to practice. Some research into poor compliance to practice suggest that this may be because ritualistic practices can prevail (Haas and Larson, 2007) and that nurses may believe their compliance is better than it actually is when observed, audited and guantified (Cole, 2008). Although lack of sufficient education could therefore provide a simple rationale for poor compliance with cannulation and cannula care, it may also be suggested that infection prevention compliance is far more complex, with determinants such as attitudes, beliefs, habits and organisational culture affecting behaviour and therefore practice (Whitby et al, 2006; Lee et al, 2008; Hanna et al, 2009). It could therefore be inferred that a change in attitude and behaviour is required if compliance with infection prevention practice is to be sustained without input from such staff as clinical skills trainers (Parker, 2000).

3.9 Conclusion

The findings of this study suggest that, given the high emphasis currently placed on infection prevention in healthcare settings, key skills such as peripheral intravenous cannulation and ongoing care of cannuale should be an inherent part of practice but seem not to be unless reinforced by further training or audit. Therefore either attitude towards infection prevention must be changed or else there is a necessity for such educational roles as clinical skills trainers to regularly update nurses' clinical skills in order to improved compliance to key infection prevention procedures. The results of this study suggest that, whilst *Saving Lives* (DH, 2005b, DH, 2007) audits can improve compliance to some more basic infection control skills, access to clinical skills training in a ward environment is more effective to increase the competency of staff to skills such as peripheral intravenous cannulation and urinary catheterisation.

Furthermore, for this sample population, with the exception of urinary catheterisation, *Saving Lives* (DH, 2007) audits did not achieve 100% compliance consistently for either group and therefore did not successfully eliminate poor practice or significantly minimise the risk of infection to patients, which is what the tools are designed to do. Therefore training for ward managers surrounding audit results interpretation and action planning may also be beneficial in order to develop the usefulness of the HII audits for prioritising actions (Flanagan, 2009), overcoming barriers to change (Hay, 2006) and ultimately improving compliance. Although practice is increasingly becoming more audit led and governance focused in order to drive improvements in practice, measures such as supporting nurses in the clinical environment through clinical skills education and effective audit action planning may successfully contribute to improvements in audit results, with the overall outcome of reducing infection rates, increasing the quality of patient care and meeting the *Saving Lives* (DH, 2007) objectives.

A greater understanding of nurses' knowledge and application of infection prevention practices would therefore provide further insight into why noncompliance to the HII care bundles remains. This would provide a better comprehension with regards to whether nurses know the correct procedures but due to time, attitudes or behaviour fail to apply the correct techniques to practice, or whether reduced compliance is as a direct result of poor knowledge. Such findings may then be able to inform infection prevention practice by contributing new understanding with regards to the complexities of non-compliance.

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Chapter Four

4. Knowledge and application of infection prevention practices

4.1 Introduction

This chapter presents the findings from a questionnaire survey that was conducted by pre- and post-registration nurses at two acute NHS Trusts and a university in one region in the UK. The purpose was to gain a greater insight into the extent of nurses' knowledge and application of infection prevention procedures and whether experience effected either nurses' knowledge or application of such practices. A fundamental issue in the reduction of HCAIs is the application of standard infection prevention precautions, which underpin routine practice and protect both staff and Standard precautions aim to reduce the risk of patients from infection. transmission of bloodborne and other pathogens from both recognised and unrecognised sources. They are the basic level of infection prevention precautions which are to be used, as a minimum, in the care of all patients (WHO, 2007). Standard precautions include hand hygiene, use of personal protective equipment, safe handling and disposal of waste, linen and sharps and safe management of blood spillages (RCN, 2005).

The results of previous studies have demonstrated that compliance to infection prevention standard precautions remains poor with an average of 40% compliance reported (Pittet *et al*, 1999; Scott *et al*, 2005; Flores & Pevalin, 2006; Whitby *et al*, 2006; Gould *et al*, 2008). Reduced compliance has been found to be reflected by nurses' poor knowledge of basic infection prevention standard precautions (Pittet *et al*, 1999; Trim *et al*, 2003; Marshall *et al*, 2004; Trigg *et al*, 2008). Factors that affect compliance include insufficient time and heavy workload (Ward, 1995; Madan *et al*, 2002; Sax *et al*, 2005), poor role models (Scott *et al*, 2005; Whitby *et al*, 2006), lack of availability of protective equipment or hand wash facilities (Sax *et al*, 2005; Ferguson *et al*, 2004) and lack of effective infection prevention education (Stein *et al*, 2003; Trigg *et al*, 2008; Wu *et al*, 2009).

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Effective infection prevention education can be effected by the size and the diversity of healthcare workers in the group (Cole, 2008), repetitious or uninteresting content (Henry, 1997; Billings, 2010), the layout of the classroom and the resources available (Burnett, 2009). It is therefore generally thought that a better multifaceted approach to infection prevention education is required (Gould & Chamberlain, 1997; Bissett, 2002). Alternative forms of infection prevention education that have emerged in the international research include ward-based education (Uwakwe, 2000; Hung *et al*, 2002) and in national literature the use of clinical skills facilitators in the ward environment (Kelly & Simpson, 2001; Kilminster *et al*, 2001). Also internet based infection prevention education has also been evaluated as a useful tool as it facilitates flexible learning, although some nurses prefer the classroom setting (Harvey-Teeley, 2007) and knowledge can be significantly lessened three months after completion (Fakih *et al*, 2006).

Yet it has not been ascertained whether these alternatives to classroom based teaching can provide embedded or sustained improvements to infection prevention practice in the NHS, or what other factors effect nurses' knowledge and application of standard precautions. Stein *et al* (2003) suggest that experience or length of service is indirectly related to infection prevention compliance with more experienced healthcare workers seeming to be less compliant, however Stein's study did not explore this further. The aim of this study was therefore to determine the extent of nurses' knowledge of infection prevention procedures, the degree to which knowledge of standard precautions was applied correctly, and whether experience was a factor in either nurses' knowledge or application of infection prevention procedures.

4.2 Methodological approach

A quantitative design was used to determine the effect that experience had on nurses' knowledge and application of infection prevention practices as this research style enabled the measurement of these variables and therefore the analysis of associations or trends between them. Quantitative research focuses on measuring quantities and relationships between attributes and is appropriate in situations where there is pre-existing knowledge about the phenomenon of interest which permits the use of standardised methods of data collection, such as the survey (Bowling & Ebrahim, 2005). Survey research focuses on obtaining

information regarding the knowledge, activities, beliefs, preferences and attitudes of people through direct questioning of a sample of respondents (Polit & Hungler, 1999). It therefore aims to describe variables within a given population by seeking evidence from a sample of that population so that causal relationships can be examined (Tarling & Crofts, 2002).

There are generally two types of surveys, the first are descriptive retrospective cross-sectional studies in which a cross-section of the population is surveyed at one point in time and participants respond on past and current behaviour and attitudes. The alternative surveys are analytical prospective longitudinal surveys, in which events are analysed at more than one point in time and can therefore suggest the direction of the causal relationships. Due to the time restrictions of this study a cross-sectional survey was utilised to determine nurses' confidence, understanding and application of infection prevention practices, in order to effectively study associations between variables and to establish trends, including whether length of service or experience effects infection prevention knowledge and application.

It is acknowledged that although cross-sectional studies can suggest statistical variations between variables they cannot generally establish causality, however the increasing sophistication of statistical technologies can help to minimise this limitation (Bowling & Ebrahim, 2005). Furthermore, retrospective cross-sectional studies can be criticised because the retrospective questioning can lead to the potential for selectivity in the participants' response, or recall bias, as a result of being asked questions about a past as well as current attitude or behaviour. In order to minimise bias this was therefore considered when designing the research tool and participants were only questioned on current confidence, knowledge and application to practice, no references to time periods were required or utilised within this research tool.

4.3 Ethical considerations

Written consent to conduct this study was gained from the National Research Ethics Service (Appendix II), as well as the Research Degrees Committee at the university (Appendix III), and Research Committees at both hospital settings (Appendices IV and VI) at which the study was conducted. The lead nurses for the two infection prevention teams were written to in order to inform them of the intended research and ensure it would not be inconvenient, as they were gatekeepers. They both provided written consent and support for the study (Appendices V and VII). However, there were also some ethical implications to consider.

Firstly, the rights, safety and well-being of participants must not be jeopardised. There were no issues with regards to either the participant or researcher safety, but some aspects of the questionnaires could potentially have distressed participants. Therefore questions were sensitive and diplomatic and participants were made implicitly aware of their right to withdraw from the study. This was conveyed by attaching a participant information sheet (Appendix VIII) to each questionnaire that explained the rationale and participation requirements for the study. This allowed respondents time to make an informed decision as to whether or not they wanted to take part in the study. Participants then provided informed consent by returning the questionnaire.

With regards to confidentiality, participants remained anonymous as questionnaires did not ask for names and were coded. Raw data was stored securely in a locked filing cabinet in accordance with the relevant university policy and transported in a locked briefcase. Only the researcher had access to the data whose computer was password protected to safeguard the data once inputted, and the data will be destroyed two years after completion of the thesis as per the policy of the university at which the study was conducted.

4.4 Research tool

It has been suggested that personal interviews are regarded as the most useful method of collecting survey data because of the quality of information that they yield (Polit & Hungler, 1999). However they are rather costly, time consuming and require considerable planning and interviewer training. Therefore, given the nature of the research aim of this element of the study, the use of a standardised questionnaire was more appropriate than personal interviews as the issues and questions were straightforward and simple and the population was literate (a requirement of the inclusion criteria, section 4.5). Questionnaires also enable a wide coverage of data collection from a large number of participants and can be

coded numerically for statistical analysis (Tarling & Crofts, 2002). However return rates necessary for statistical analysis can be difficult to achieve and many nursing studies use internal mail systems which require consent to use. Therefore permission was sought to use the internal mail systems at the study sites and the sample size calculation took into account the possibility of a potentially low return rate.

The questionnaire used in this study (Appendix IX) was adapted from two existing tools used in similar research projects. These were developed from the literature in collaboration with a microbiologist, and one was sent to an expert panel to obtain content validity (Gould & Chamberlain 1997; Mann & Wood, 2006). Permission was sought from the original authors to use the questionnaires, and a pilot study was conducted to identify any difficulties with the research tool and to allow for amendments to improve both the content and construct validity of the tool. The questionnaire incorporated six questions to determine participants' confidence in their practice, 20 questions to assess knowledge of procedures and ten questions to measure the application of infection prevention practices.

4.5 Sample population

The sampling frame is a list of the population members from which the survey sample is drawn, and surveys depend on this containing a complete and accurate listing of every element in the target population (Bowling & Ebrahim, 2005). The sampling frame for this element of the study was the entire nursing population at two teaching hospitals and a university in one county in the UK and consisted of 1004 nurses at hospital one, 1369 nurses at hospital two and 628 student nurses at the university. Lists of the names of staff nurses were acquired from the Human Resources departments at the two hospitals just before data collection. This ensured that they were as up to date and complete as possible with no duplications, to therefore represent the population accurately, maximise external validity and reduce the risk of coverage error. The sampling frame met the inclusion criteria, which included:

 Student nurses who were at the start of year one, end of the foundation pathway at 18 months and end of year three

- Staff nurses at both hospitals who had been qualified for 0-5, 6-10, 11-15, 16-20 and over 20 years
- English speaking (The British Council International English Language Test (IELTS) is required for NMC registration).

4.6 Sample size

In quantitative research it is important to calculate the required sample size as accurately as possible in order to be able to generalise the survey findings to the whole population of interest (Bowling & Ebrahim, 2005). Whilst sampling error, or the probability that any one sample is not completely representative of the population from which it is drawn (Polit & Hungler, 1999), may not be completely eliminated, it should be reduced to an acceptable level. A power calculation was therefore used to guide the sample size.

A normal distribution of correct responses to the knowledge tests embedded within the questionnaire was assumed and an independent groups t-test to compare the most experienced (top four groups length of service) with the least experienced (bottom four groups length of service) designed to detect a true effect size of 0.30 with a Type I error 0.05 and a power of 80% required a total of 350 participants, with 175 in each of the two groups. Also, to investigate correlation between experience and the number of correct responses a sample size of 350 would enable a correlation of 0.20 to be statistically differentiated from a correlation of zero with a power of 97%.

The relative strength of a survey often depends on the extent to which the chosen sample represents the population that is being studied (Tarling & Crofts, 2002). It is very unusual to receive more than a 60% return rate for questionnaires and average expected return rates are generally set at 35% (Polit & Hungler, 1999). Therefore the sample size took this into account to ensure enough questionnaires were returned for effective data analysis, and the sample consisted of 1060 participants in total.

4.7 Stratified random sampling

A commonly used method of guarding against obtaining, by chance, an unrepresentable sample which under- or over-represents certain groups of the population is the use of stratified random sampling, which is a method of increasing the precision of the sample (Bowling & Ebrahim, 2005). As experience was the concept being evaluated, this method was therefore applied to ensure that the different lengths of service within the population were correctly represented by dividing the population into layers, or strata, and drawing the sample from each stratum using random sampling. The eight strata comprised pre-registration nurses at the start of year one, end of the foundation pathway at 18 months, and end of year three, and post-registration nurses at 0-5, 6-10, 11-15, 16-20 and over 20 years of experience. These then represented the following two groups for data analysis: least experienced (year 1, year 2, year 3 pre-registration and 0-5 years post-registration) and most experience. To achieve the necessary 175 participants for each of the two groups for statistical analysis, 43-44 returns were required for each stratum.

Therefore, to ensure that each stratum was adequately targeted at each of the two hospital sites the questionnaires were distributed to 350 nurses at each site via a mail shot of 70 nurses from each of the five strata at each site, of which every third nurse alphabetically was randomly selected. At the university site 100 questionnaires were personally presented to each of the three pre-registration strata at university in lectures. These methods of distribution have been found to be inexpensive, efficient and likely to yield an acceptable response rate (Polit & Hungler, 1999). The questionnaires distributed at each of the three sites were coded so that each site could be identified when questionnaires were returned. A participant information sheet (Appendix VIII) was included to explain the purpose of the study and confidentiality issues. The questionnaires also included an envelope to deliver them to the post room at the hospital sites and reception at the university site, where they were collected by the researcher.

The application of stratified random sampling also facilitated in the reduction of the risk of non-response bias as sufficient responses were yielded for each of the two groups. Although initially there were not enough returns from the 11-15 years of service stratum so a further 30 questionnaires were distributed at each of the two hospital sites to increase this sample to the minimum requirement of 43 returns. The overall sample size was therefore 1060 with a return rate of 39.1% (n=414).

The numbers of questionnaires returned from each hospital site are presented in Table 4.1 and the number of returns for each stratum in Table 4.2.

Years service	Returns from Hospital 1	Returns from Hospital 2	Total returns 55 50 47 43	
0-5	27	28		
6-10	28	22		
11-15	27	20		
16-20	26	17		
20+	27	24	51	
Total 135 returns		111	246	

Table 4.1: Number of returns from the two hospital sites.

Strata	Least experienced group			Most experienced group					
	Year 1	Year 2	Year 3	0-5	6-10	11-15	16-20	20+	Total
Sample population	210	229	189	1131	483	232	182	345	2373
Distributed	100	100	100	140	140	200	140	140	1060
Returns required	43	44	44	44	44	44	43	44	350
Returns received	65	57	46	55	50	47	43	51	414

Table 4.2: Number of returns per strata.

4.8 Data analysis

A comparative data analysis was carried out between the groups to allow the identification of trends both within and between the least experienced and most experience group using Statistical Package for the Social Sciences (SPSS) computer programme (version 14.0) with significance set at 0.05. The normality of

the data was determined first as this would effect the type of test used for further analysis. To achieve this, the Shapiro-Wilk test was applied which determined that the data was non-parametric. This, rather than the Kolmogorov-Smirnov test was used because it yields exact significance values whereas the Kolmogorov-Smirnov tends to provide approximations of significance, as discussed in section 3.6.

Statistical analysis was then conducted to explore whether experience effected either knowledge or application of infection prevention practices. This was achieved by using the Mann-Whitney test. The Mann-Whitney test is a test that determines differences between two independent samples and tests whether the populations from which the two samples are drawn have the same location (Field, 2005). It is the non-parametric equivalent of the independent *t*-test, so was most suitable for this non-parametric data. In order to conduct the Mann-Whitney test, the data was divided into two groups. The student nurses in year one, year two and year three together with the nurses who had been qualified for under five years comprised the least experienced group, whilst nurses who had been qualified for 6-10, 11-15, 16-20 and over 20 years comprised the most experienced group.

The questionnaire was also devised so that 20 specific questions provided data for analysis with regards to participants' knowledge of infection control and ten questions tested their application of this knowledge to a practice scenario. This design enabled the Mann-Whitney test to ascertain whether those with the least or most experience, or length of service, had either a better knowledge or application of infection prevention practice. The responses to each individual question in the questionnaire were also examined which assisted in the identification of trends within the data with regards to both the two groups and the different standard precautions under examination. These findings were displayed as frequency graphs to clearly represent the numbers of responses from the participants (sections 4.9.1-4.9.5).

4.9 Results

A total of 1060 questionnaires were distributed to nurses with varying lengths of service and 414 were returned, achieving a return rate of 39.1%. This exceeded the expected return rate of 35% and achieved a sample size greater than 350,

which was required in order for the power calculations to statistically differentiate correlations at a power of 97% and independent groups comparisons at a power of 80%. Of the 414 returns, 135 (32.6%) were from hospital one, 111 (26.8%) were from hospital two and 168 (40.6%) were from the university. Figure 4.1 shows the length of service or experience of the participants, of which 40.6% were pre-registration nurses and 59.4% were post-registration.

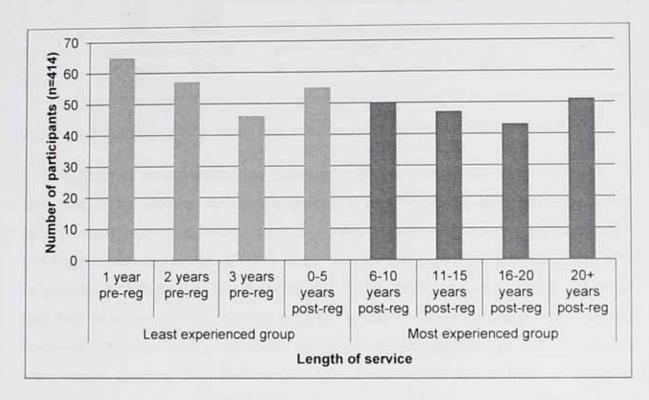


Figure 4.1: Length of service of participants.

Least experienced group
Most experienced group

4.9.1 Prior infection prevention training

Whether pre- or post-registration, infection prevention training is an annual mandatory requirement (DH, 2010a). Therefore, all participants were asked when they had last received training on this subject and in what form they had received this education. 304 (73.4%) nurses had received such training less than one year ago, 64 (15.5%) had received training 1-2 years ago, 21 (5.1%) 2-3 years ago, 13 (3.1%) 3-5 years ago, 6 (1.4%) 5-10 years ago and 4 (1.0%) 10 or more years ago. Only 2 (0.5%) had never received any infection prevention education (Figure 4.2).

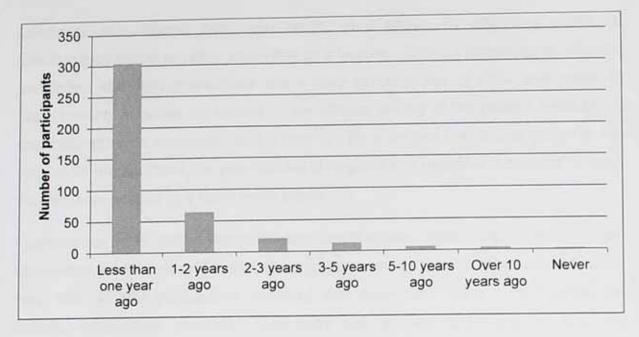


Figure 4.2: Length of time since last attended infection prevention training.

The majority of respondents had attended infection prevention training within the last year. This was an encouraging finding as all nursing staff are required to receive such training annually, to which 73.4% of participants were compliant. But the Department of Health (2010a) does not provide guidance regarding the best way to deliver infection prevention training, or the most suitable location. Of those that had received training on this subject, it was delivered through the following methods: 138 (33.3%) from a classroom-based study session, 106 (25.6%) from a ward-based session, 87 (21.0%) from a formal lecture, 40 (9.7%) from an infection prevention study day and 41 (9.9%) via informal ward training (Figure 4.3).

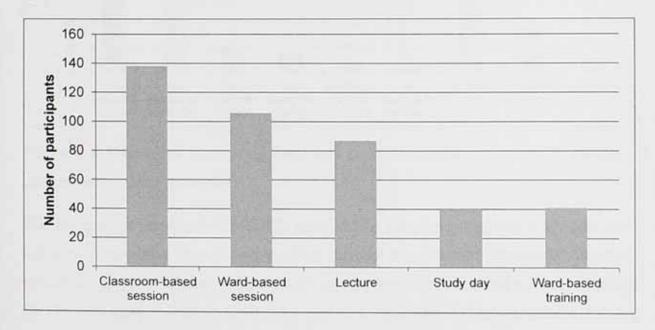


Figure 4.3: Delivery method of last infection prevention session attended.

Generally, respondents had been taught in a group, by attending either an infection prevention session, study day or a lecture. This is interesting as infection prevention standard precautions are a very practical set of skills that relate to basic nursing activities conducted in the clinical setting at the patient bedside. It could therefore be suggested that it may not be a subject that is well-suited to the classroom environment, for example hand hygiene is a practical technique to learn that requires access to a hand wash basin.

Furthermore, when asked if they thought that they had received sufficient infection prevention theoretical and practical education prior to the first placement or post, only 189 (45.7%) participants reported that they had. This is concerning as infection prevention standard precautions are required to be applied to every patient. It is therefore essential that staff feel competent in these skills before having contact with patients in order to prevent or reduce the risk of cross-infection (Figure 4.4).

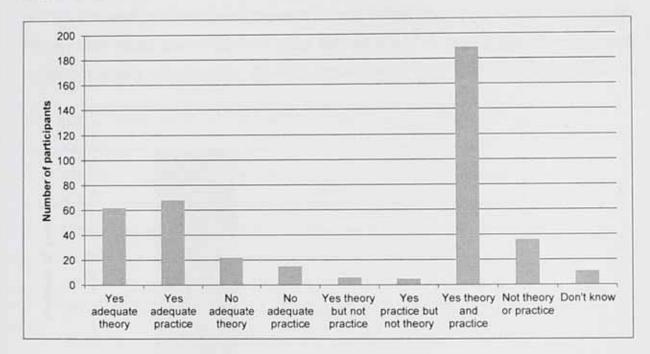


Figure 4.4: Response to whether there was sufficient training on infection control prior to first post or placement.

The majority of participants (45.7%) agreed that they had received both adequate infection prevention theory and practice to prepare them for the clinical setting. However, 62 (15.0%) respondents felt that they had only received sufficient theory, 68 (16.4%) participants thought they had only received suitable practical training and 36 (8.7%) felt that they had not received both adequate theory and practice

prior to their first post or placement. Overall however, this finding suggests that nurses were satisfied with the infection prevention education received prior to their first placement or post.

This was further supported by respondents' perception of the emphasis on infection prevention in their place of work, of which 309 (74.6%) thought there was sufficient emphasis on this topic, compared to only 89 (21.5%) who thought there was not and 16 (3.9%) who did not know. These findings suggest that most nurses do feel they are taught adequate infection prevention skills prior to entering the ward environment and are therefore confident in their knowledge and skills relating to infection prevention practices. One such skill that nurses are required to learn and apply as part of their daily routine is hand hygiene.

4.9.2 Hand hygiene

With regards to hand hygiene, results of this study suggest that nurses' perception of their knowledge of infection prevention was better than their actual knowledge. Firstly, they were asked whether they felt confident in their knowledge of hand hygiene practice, of which 401 (96.9%) did and only 13 (3.1%) did not (Figure 4.5).

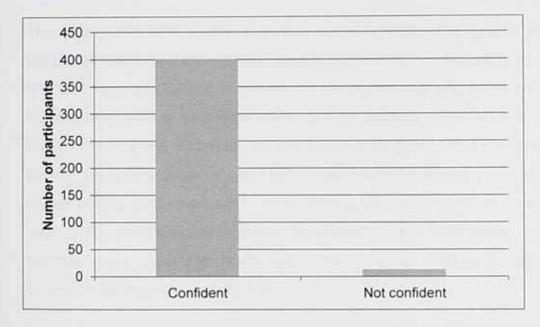


Figure 4.5: Confidence in own knowledge of hand hygiene practices.

However, further responses to questions regarding hand hygiene suggested that nurses' knowledge of hand hygiene was not as good as they perhaps supposed. The standard recommended time spent cleaning hands with either alcohol hand rub or soap and water is 10-15 seconds (RCN, 2005). Yet the majority of

participants 231 (55.8%), thought that hands should be cleaned for 16-20 seconds, whilst only 153 (37.0%) correctly thought hands should be cleaned for 10-15 seconds. Of the remaining respondents, 8 (1.9%) indicated that hands should be cleaned for 0-9 seconds and 22 (5.3%) did not know how long they should clean their hands for (Figure 4.6).

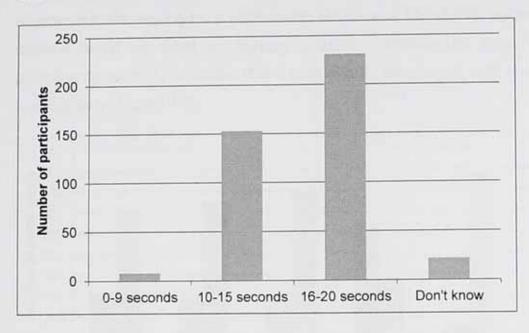


Figure 4.6: How long hands should be cleaned for.

The finding that only 37.0% of nurses correctly knew how long to clean hands to ensure effective decontamination was to some extent concerning as hand hygiene is a basic standard infection prevention precaution that should be conducted by all nursing staff before and after every patient contact. For such a large majority (55.8%) to respond incorrectly to this question suggests that perhaps participants' knowledge was lacking. It could be suggested that it is better to clean hands for a longer period than necessary, rather than a shorter amount of time. Yet this can lead to the essential oils required to prevent hands from drying out from being washed away, resulting in dry skin which has an increased risk of becoming broken or damaged (Damani, 2011).

Poor knowledge relating to hand hygiene was further confirmed when participants were asked what agents are required to clean hands with in certain situations. It is well established that hands are cleaned with soap and water if they are visibly dirty, after caring for a patient with an infection, prior to aseptic or sterile techniques and after exposure to blood or body fluids (WHO, 2007). Alcohol hand rub is sufficient when hands are visibly clean and before and after general patient

contact (NPSA, 2004). These concepts are taught in the infection prevention sessions at both participating hospitals and at the university. Yet only 106 (25.6%) and 92 (22.2%) correctly identified that either soap and water or alcohol hand rub can be used before and after patient contact, respectively. Only 22 (5.3%) of participants accurately indicated that either alcohol hand rub or soap and water is appropriate after caring for a patient with MRSA and 65 (15.7%) agreed that either method could be used on leaving a ward. Additionally, only 272 (65.7%) participants correctly indicated that hands should be cleaned with soap and water if visibly dirty (Figure 4.7).

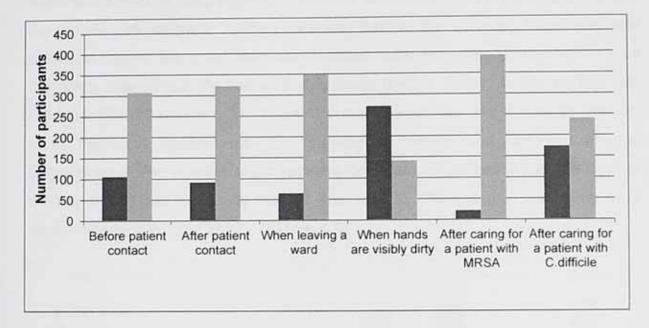


Figure 4.7: Type of hand hygiene used in various clinical situations.

Correct hand hygiene known
 Correct hand hygiene not known

Furthermore, participants indicated that both soap and water and alcohol hand rub should be used for many of the activities, in particular after caring for a patient with MRSA, caring for a patient with *C. difficile*, after caring for a patient in general, leaving a ward and if hands are visibly dirty (63.3%, 53.6%, 38.6%, 31.2% and 30.4% respectively). Yet there is rarely a need to use both types of hand hygiene methods together, particularly because over use of agents can remove too many essential oils from hands causing dry and broken skin. Also for each of the tasks between five and twelve participants (1.2-2.9%) responded that they did not know what agent to use to clean their hands. This is concerning as using the wrong agent at the wrong time can precipitate cross-infection, for example cleaning

hands with alcohol hand rub after contact with a patient with *C. difficile*, as *C. difficile* spores are not denatured by alcohol. Yet only 174 (42.0%) accurately reported that hands should be cleaned with soap and water after caring for a patient with a *C. difficile* infection. These results therefore infer that although participants felt confident in their knowledge hand hygiene practices, they were unsure of what agents should be applied to clean hands appropriately in a variety of familiar clinical situations.

As well as knowing what to use to clean hands with and for how long, another important aspect of hand hygiene practice is technique, or how well the entirety of the hands are cleaned. When cleaning hands, the thumbs, fingernails and between fingers are most frequently missed, with the back of the hands less frequently missed and the palms rarely missed (NPSA, 2004). In this survey, 306 (73.9%), 260 (62.8%) and 217 (52.4%) correctly identified that the areas that are most frequently missed are the fingernails, thumbs and between fingers, respectively. The number of participants that correctly indicated that the back of the hands are less frequently missed was 148 (35.7%) and that the palms were rarely missed was 161 (38.9%) (Figure 4.8).

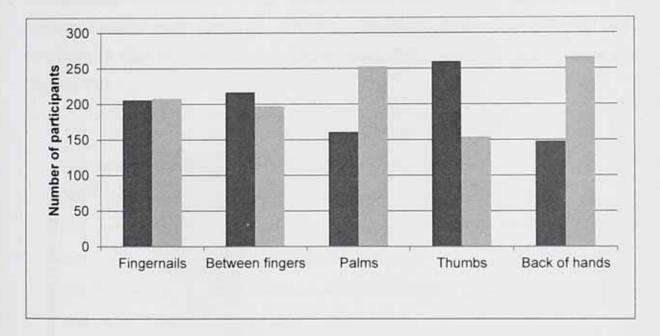
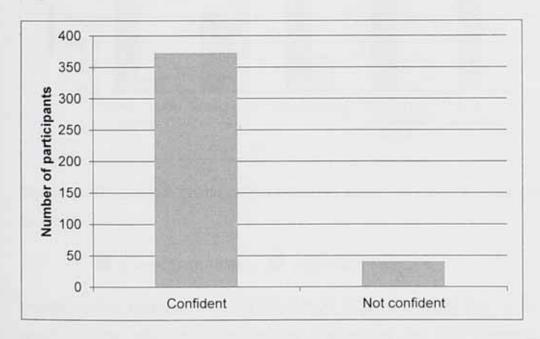


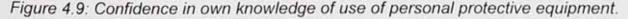
Figure 4.8: Identification of the frequency with which various parts of the hands are missed when cleaned.

Correctly identified frequency missed Incorrectly identified frequency missed These results show that only 53.6% of nurses correctly answered all five elements to this question and further suggests a deficit between what nurses perceive to know and actually do. To summarise, with regards to hand hygiene practices, although 96.9% of respondents felt confident in their understanding of hand hygiene, only 24 (5.8%) answered all of the hand hygiene knowledge questions correctly.

4.9.3 Use of personal protective equipment

Hands are a substantial vector for the transmission of infection in the clinical setting and the importance of effective hand hygiene has been discussed (Pittet *et al*, 1999; Bissett, 2002; Creedon, 2006; Howard *et al*, 2009). As an extra precaution, disposable personal protective equipment (PPE) such as gloves are available for use during direct contact with body fluids and moist body sites to reliably reduce the risk of micro-organisms from contaminating hands (Wilson, 2004). As well as gloves, disposable aprons are PPE that must be worn when there is a risk of contamination to clothing from blood or body fluids (RCN, 2005). Furthermore, to effectively reduce the risk of infection, PPE must be worn appropriately, disposed of after each patient contact and hands must be decontaminated after removal. Of the 414 participants, 373 (90.1%) were confident in their knowledge of when to wear PPE, whilst 41 (9.9%) were not (Figure 4.9).





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Self-confidence with regards to knowledge of when to use PPE was then tested in the knowledge section of the questionnaire. PPE should be worn in clinical practice when there is a risk of exposure to blood or body fluids or the patient has an infection. Therefore PPE should always be worn when taking blood samples, administering intravenous fluids or medications, caring for a patient with MRSA or emptying urinary catheter bags. Conversely, when making beds or during medication rounds PPE are rarely worn. Responses correctly indicated that 382 (92.3%) nurses thought PPE should always be worn to take blood, 341 (82.4%) when administering intravenous fluids or medications, 407 (98.3%) when caring for a patient with MRSA and 406 (98.1%) when emptying urinary catheter bags. Interestingly, whilst 162 (39.1%) agreed that PPE are rarely worn to make beds, 134 (32.4%) thought they should always be worn for this task which is unnecessary. During medication rounds 241 (58.2%) nurses thought PPE should rarely be worn (Figure 4.10 by whether participants answered correctly or not for each clinical situation).

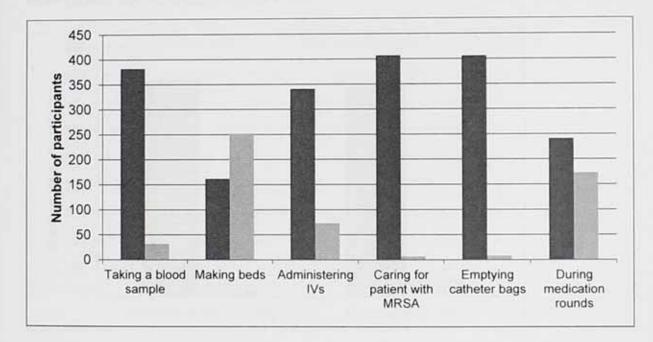
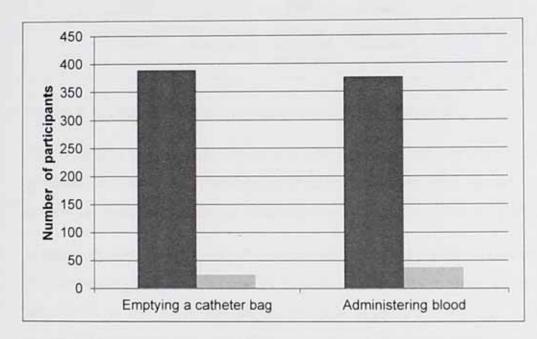


Figure 4.10: Correct identification of when personal protective equipment should be worn.

Correct response 📃 Incorrect response

However, the number of tasks for which nurses thought that it did not matter whether they wore PPE or not is concerning as this suggests a lack of understanding of the rationale for use of PPE. These tasks were during medication rounds, making beds, administering intravenous medications and taking blood samples (26.6%, 22.0%, 4.8% and 1.9%, respectively). Also some nurses who did not know whether to wear PPE or not during medication rounds or when making beds, administering intravenous medications, taking blood samples, caring for patients with MRSA or emptying urinary catheter bags (8.9%, 6.5%, 4.3%, 2.4%, 1.2% and 1.0%, respectively). Although these are relatively smaller numbers, they further indicate a lack of understanding of the principles surrounding correct use of PPE.

Later in the questionnaire participants were asked what PPE they personally apply when at risk of exposure to blood or body fluids in the clinical setting. Before emptying a urinary catheter bag, 389 (94.0%) correctly responded that they cleaned their hands and put on gloves and a disposable apron. However 10 (2.4%) did not clean their hands before putting apron and gloves on, 8 (1.9%) did not know what to do and 7 (1.7%) indicated that they cleaned their hands and wore gloves but no apron (Figure 4.11).





Correct application of PPE Incorrect application of PPE

Whilst the majority of nurses correctly applied PPE to empty catheter bags, Figure 4.11 also indicates that, 376 (90.8%) nurses complied with policy by cleaning their hands and putting on gloves and a disposable apron prior to the administration of

blood. Figure 4.12 represents further measurement of the application of participants' knowledge of use of PPE through practice conducted following glove removal, when hands must always be cleaned (WHO, 2007). Yet after removing gloves in practice only 300 (72.5%) of nurses reported that always cleaned their hands, whilst 79 (19.1%) did this to provide additional protection, 21 (5.1%) did depending on the procedure and 13 (3.1%) did not know whether to clean their hands after glove removal.

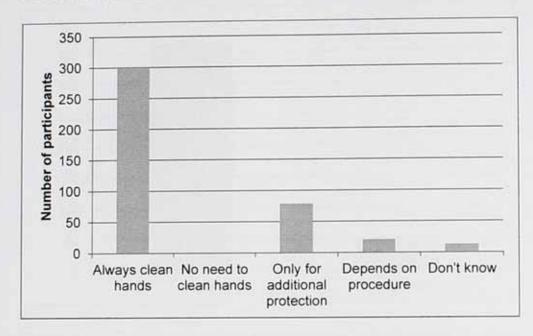


Figure 4.12: Applied correct procedure after glove removal.

This finding is also concerning as it is well documented that the procedure of glove removal can lead to cross-contamination of hands and hands must therefore always be decontaminated or cleaned after gloves are removed (NPSA, 2004).

Analysis of use of PPE infers that although 90.1% of participants were confident in their knowledge of when to use PPE, only 102 (24.6%) correctly identified when to wear PPE in the all of the six knowledge questions. Yet 324 (78.2%) applied compliant practices and used PPE correctly in the three clinical setting scenarios. The findings regarding the use of PPE therefore suggest that although knowledge of PPE use is insufficient, application of the correct procedures is remarkably high in comparison. This could be due to the perception that staff acknowledge that PPE are important to prevent cross-infection or to protect staff from exposure themselves to pathogens, even though the knowledge that informed such practice was inconsistent.

4.9.4 Safe disposal of waste, linen and sharps

The safe disposal of waste includes the disposal of clinical and non-clinical waste, sharps and linen. How to deal with a blood spillage was also surveyed under this standard precaution. Of the 414 participants, 365 (88.2%) felt confident in their understanding of safe disposal of waste principles whilst only 49 (11.8%) did not (Figure 4.13).

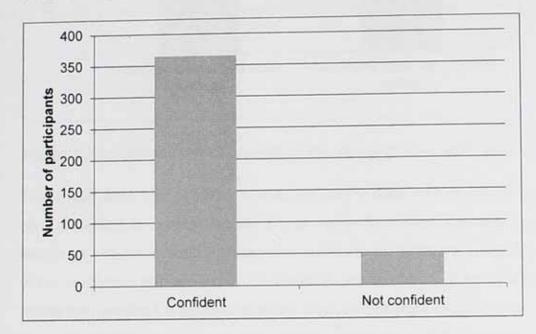


Figure 4.13: Confidence in own knowledge of safe disposal of waste.

In both hospitals surveyed, sodium hypochlorite is used to clean a blood spillage, of which 180 (43.5%) nurses indicated that they used in practice. However, 162 (39.1%) reported that they used Chlorclean, a detergent and disinfectant solution that is not effective for denaturing blood, 65 (15.7%) did not know what to use and 7 (1.7%) used detergent wipes which are ineffective at removing blood (Damani, 2011) (Figure 4.14).

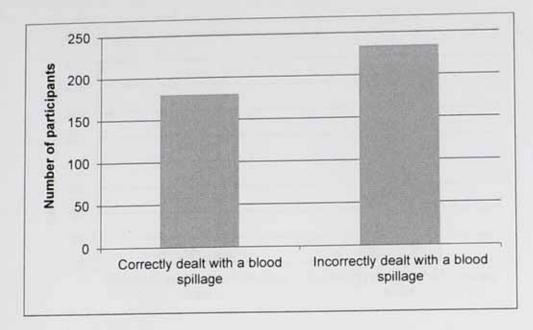


Figure 4.14: Applied correct product when cleaning blood spillages.

The result that few (43.5%) nurses correctly deal with a blood spillage in the clinical setting is concerning as this is evidently a high infection risk task that is taught at annual infection prevention sessions for both staff and student nurses, yet is somehow not applied in the practice environment. Also of concern was the procedure applied by respondents for disposing of linen from a patient with MRSA. Only 28 (6.8%) conformed with local policy in both hospitals and correctly indicated that they used a white linen bag and disposed of it immediately. Surprisingly, 226 (54.6%) reported that they placed such linen in a red linen bag and disposed of it immediately (Figure 4.15). Yet red linen bags are used to identify soiled or infected linen and are not appropriate for patients in general with MRSA.

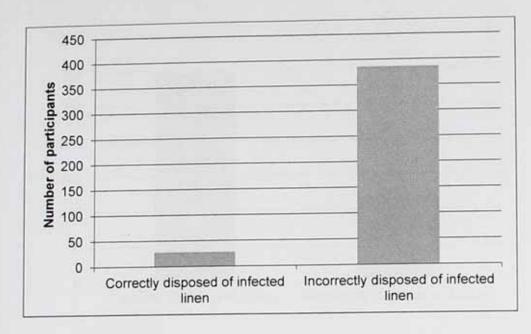


Figure 4.15: Applied correct procedure when disposing of infected linen.

This is of particular concern for practice as such a small number of participants (6.8%) apply the correct procedure for a rather common and simple task. Furthermore, 121 (29.2%) of participants indicated that they placed linen from a patient with MRSA in a red linen bag but then left it in the side room and 19 (4.6%) placed this type linen in a white bag but left it in the side room. Such findings are concerning as leaving linen from a patient with MRSA in the isolation room, whichever colour linen bag is used, both increases the risk of contamination of the environment and impedes effective cleaning of the room (Damani, 2011). Therefore, respondents' practice with regards to the safe disposal of linen in the clinical environment suggests that their self-reported confidence in their knowledge of this standard precaution is perceived to be much better than it actually is.

Another important practice to reduce the risk of infection to both patients and staff is the safe disposal of sharps. Sharps must be disposed of into sharps bins at the point of care without resheathing needles, as this increases the risk of inoculation injuries (RCN, 2005), now referred to as contamination injuries (DH, 2010a). Of the 414 participants 297 (71.7%) correctly indicated that they did not resheath sharps and disposed of them at the point of care, yet 46 (11.1%) reported that they did resheath sharps but disposed of them at the point of care, a further 46 (11.1%) did not resheath needles but carried them away to a sharps bin and only 11 (2.7%) resheathed and carried sharps away to be disposed of. Also, 14 (3.4%) did not know how to dispose of sharps (Figure 4.16).

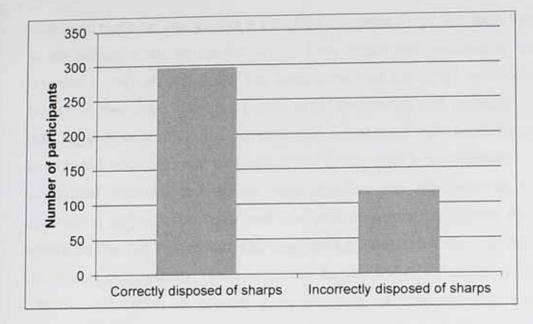


Figure 4.16: Applied correct procedure when disposing of sharps.

The majority of nurses therefore correctly disposed of sharps in the clinical setting. Furthermore, 289 (69.8%) respondents correctly identified what constitutes an inoculation injury whilst only 120 (29.0%) could not and 5 (1.2%) stated that they did not know what an inoculation injury was. Also, 360 (87.0%) knew local policy following an inoculation injury and only 48 (11.6%) did not, whilst 6 (1.4%) did not know what to do (Figure 4.17).

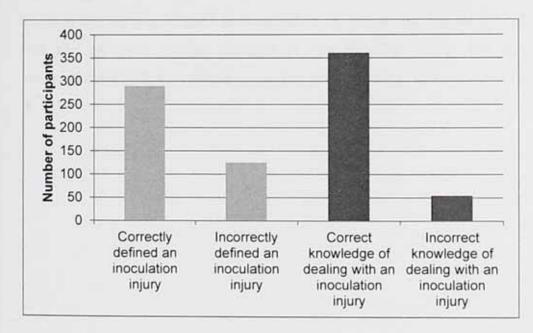
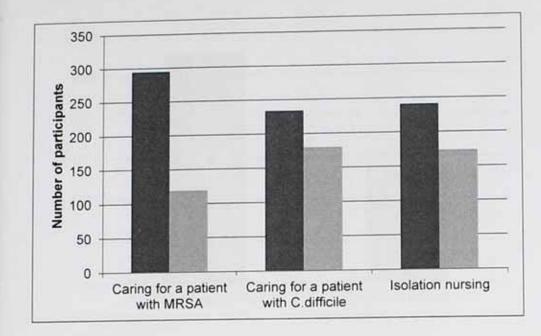


Figure 4.17: Knowledge of inoculation injuries.

This finding may have interesting implications for practice as although fewer nurses knew the definition of an inoculation injury, more knew what to do if they sustained such an injury. Yet it could be suggested that although they knew what to do following an inoculation injury they might not necessarily carry out that practice if they do not know the conditions that comprise an inoculation injury. However, this does infer that participants' knowledge and application of practices with regards to sharps was considerably better than their application of practices associated with disposal of linen and dealing with blood spillages. It could be suggested that this is because staff perceive the infection risk to themselves associated with sharps as a real risk and therefore comply to these practices, where as the risk associated with disposing of linen correctly may be perceived as much less of a hazard. This reinforces earlier findings that imply that as well as effective education, a greater understanding of attitudes and behaviours are intrinsic factors in improving some infection prevention practices.

4.9.5 Care of patients with infections

The skill of caring for a patient with an infection is an important element of basic nursing practice to ensure that both the infected patient is managed appropriately and that other patients are not at risk of infection from cross-contamination (Ward, 2011). Of the 414 respondents, 295 (71.3%) were confident in their knowledge regarding MRSA whilst 119 (28.7%) were not. Interestingly, only 241 (58.2%) nurses felt certain in their knowledge of isolation nursing whilst 173 (41.8%) did not and an even smaller number of 234 (56.5%) nurses felt confident in their understanding of *C. difficile* infection (CDI) whilst 180 (43.5%) did not (Figure 4.18).





Confident Not confident

These findings suggest that participants were much less confident in their knowledge of these aspects of infection prevention compared to practices such as hand hygiene and use of gloves. Furthermore, this lack of self-perceived understanding was reflected in participants' appreciation of relevant theory. When asked about their knowledge of MRSA, only 277 (66.9%) of respondents correctly identified that MRSA was spread mainly via direct contact whilst 118 (28.5%) thought transmission was mainly via the air and direct contact. A further 15 (3.6%) were unsure how MRSA is transmitted at all and 4 (1%) thought it was mainly via the air (Figure 4.19).

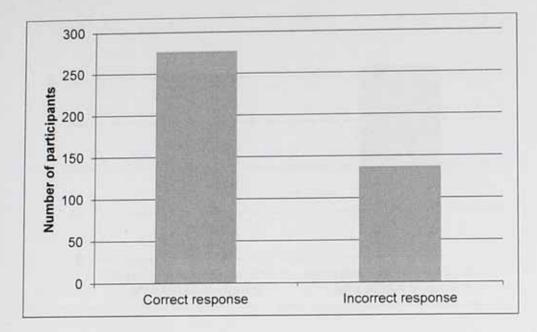


Figure 4.19: Correct identification of MRSA transmission.

This result is in accordance with the percentage of nurses who claimed to be confident in caring for patients with MRSA (71.3%) so is not surprising. However when asked what they as a practitioner would do when a patient had completed their MRSA decolonisation treatment the correct responses were much lower. Only 204 (49.3%) indicated that they followed policy and rescreen two days after completion of the treatment whilst 155 (37.4%) rescreened patients on the day treatment finished which is inappropriate. Furthermore, 50 (12.1%) did not know what to do and 5 (1.2%) reported that they simply stopped the MRSA care plan (Figure 4.20).

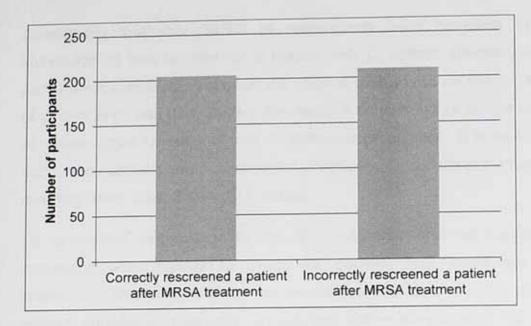


Figure 4.20: Applied correct procedure when caring for a patient with MRSA.

This result was concerning as less than half (49.3%) of the participants applied the correct practice when caring for a patient with MRSA. This was also the case when caring for a patient with *C. difficile* infection. In this instance, only 181 (43.7%) of nurses indicated that they followed policy by isolating the patient and asking for their antibiotics to be reviewed. 166 (40.1%) reported that they would isolate the patient and stop their antibiotics, 50 (12.1%) did not know what to do, and only 17 (4.1%) thought the patient should remain in a bay and be reviewed (Figure 4.21).

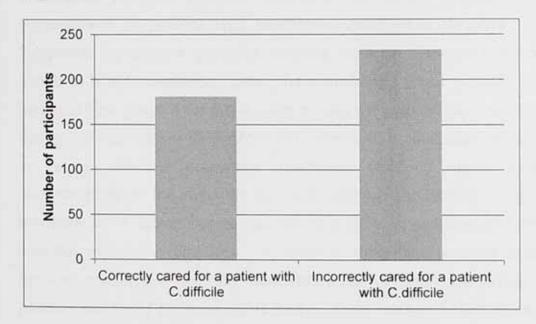


Figure 4.21: Applied correct procedure when caring for a patient with C. difficile infection.

Considering that only 56.5% of respondents were confident in their own knowledge of how to care for a patient with *C. difficile* infection, this result is perhaps not surprising. Yet given the national drive to reduce the number of cases of *C. difficile* by half (DH, 2005a), this result is concerning as such a small number of nurses cared for patients with *C. difficile* appropriately. It is well documented that if such patients are not managed effectively, *C. difficile* outbreaks can occur relatively easily (DH, 2008b; DH, 2010b).

To summarise, on average 62.1% (257) of participants felt confident in their knowledge with regards to caring for patients with healthcare associated infections. This was reflected by the finding that 66.9% (277) answered the relevant knowledge questions correctly and further supported in that only 21.0% (87) applied both actions correctly when caring for a patient with either MRSA or *C. difficile* in the practice environment. The answers to this section of the questionnaire therefore suggest that participants' infection prevention knowledge is at times poor and therefore application to practice can be inadequate. Furthermore, some of the knowledge and application of knowledge to practices aimed at prevention of infection were high, for example hand hygiene. Yet the understanding and application to practice of these concepts regarding care of patients with infections were particularly substandard.

This raises concerns over the education that nurses receive with regards to management of patients with healthcare associated infections. It could be suggested that current education focuses more on standard precautions and is aimed at a wide audience, rather than providing nurses with the knowledge to underpin their practice for those patients who will unavoidably acquire an infection during their admission (Billings, 2010). However it could also be suggested that for some infection prevention practices, ritualistic habits exist although understanding of the rationale for such practices is lacking. Experience may therefore be a factor that is intrinsic to nurses' knowledge and application of infection prevention practices. In order to determine whether experience can provide any insight into the inconsistencies identified to nursing theory and practice portrayed by participants in this study, nurses' length of service will be examined in relation to their knowledge and application of infection prevention

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4.9.6 Experience and application of knowledge

Analysis was conducted to determine whether experience effected nurses' knowledge and application of infection prevention practice by analysing the score for the 20 knowledge questions and ten application questions in the questionnaire. As the data were not normally distributed, the mean, mode and median were interpreted rather than the standard deviation, as they provide a greater insight into non-parametric data. These descriptive statistics for the knowledge question scores and application questions scores are presented in Table 4.3.

	Mean score for knowledge questions	Mean score for application questions	Mode score for knowledge questions	Mode score for application questions	Median score for knowledge questions	Median score for application questions
Least experienced group	10.47	6.55	10	7	10	7
Most experienced group	11.16	7.01	10	8	11	7

Table 4.3: Descriptive statistics for knowledge and application scores compared to length of service.

Table 4.3 shows that for both groups there were disparities in nurses' knowledge and application of infection prevention practices. However, analysis using the Mann-Whitney test revealed that the most experienced group had significantly higher scores regarding their knowledge of infection prevention compared to the least experienced group (U=18133.5, p=0.009). Furthermore, the most experienced group also had significantly higher scores for the application of correct practice questions than the least experienced group (U=17378.5, p=0.001) (Figure 4.22). Additionally, there were no significant improvements in scores between the pre-registration nurses or those who had been qualified for five years or less (p= 0.975, 0.618 and 0.106, respectively) (Figure 4.22).

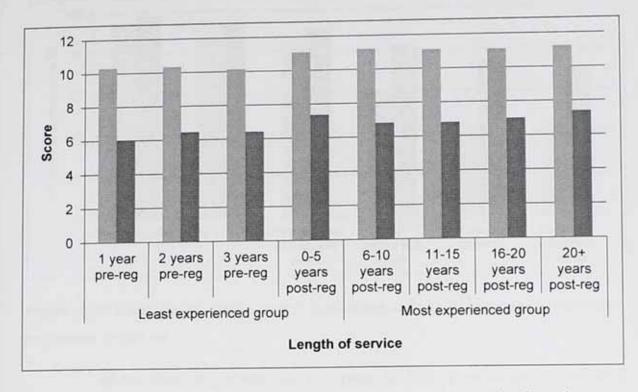


Figure 4.22: Knowledge and application scores compared to length of service.

Mean score for knowledge questions (n=20)
 Mean score for application questions (n=10)

This result demonstrates that the greater the experience, both nurses' knowledge and application of infection prevention practice is significantly increased. This finding was investigated further to determine any trends in the data between the two groups with regards to knowledge or application of infection prevention practices. This was split in to three aspects: the self-reported confidence that participants had in their own knowledge of infection prevention standard precautions and practices (Figure 4.23), the correct knowledge demonstrated (Figure 4.24) and the correct application of practices (Figure 4.25). These results showed that for all aspects of infection prevention practices, the most experienced group were more confident in their understanding of the practice, had increased knowledge and a greater application of that knowledge to practice, compared to the least experienced group. However, the extent of this varied for the different standard infection prevention precautions, and the most experienced group still only demonstrated an average knowledge and application to practice (11.16 for the 20 knowledge questions and 7.01 for the ten application questions).

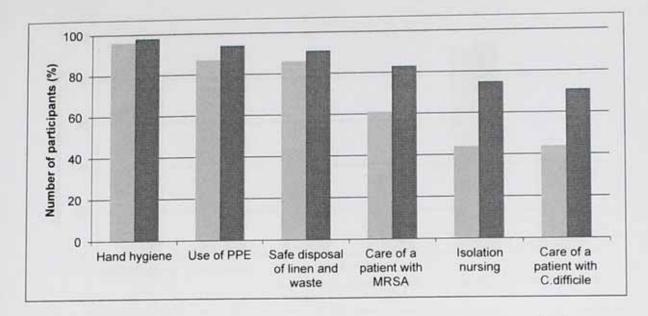
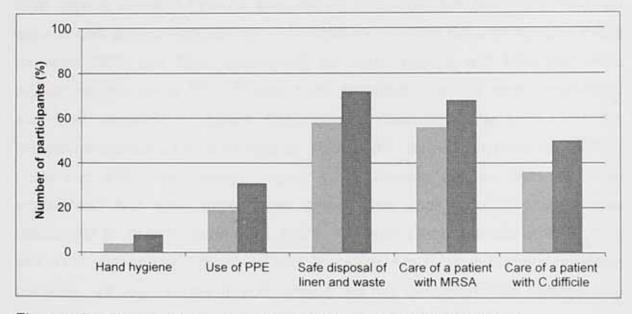


Figure 4.23: Participants' self-reported confidence in their knowledge of infection prevention practices.

Number of participants confident in their knowledge in the least experienced group (n=223)

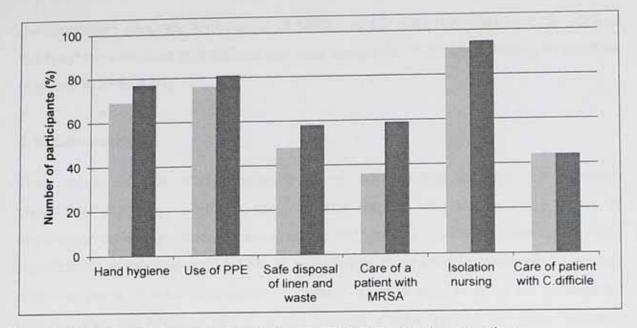
Number of participants confident in their knowledge in the most experienced group (n=191)

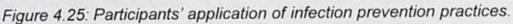




Number of participants who correctly answered the knowledge questions in the least experienced group (n=223)

Number of participants who correctly answered the knowledge questions in the most experienced group (n=191)





Number of participants who correctly answered the application questions in the least experienced group (n=223)

Number of participants who correctly answered the application questions in the most experienced group (n=191)

With regards to hand hygiene and use of PPE, both the least and the most experienced groups reported high self-confidence in their understanding of these practices (96% and 98%, respectively for hand hygiene and 87% and 94%, respectively for use of PPE) (Figure 4.23). However, both the least experienced and most experienced groups demonstrated particularly low scores for the knowledge questions for hand hygiene (4% and 8%, respectively) and use of PPE (19% and 31%, respectively) (Figure 4.24). Despite this for both the least experienced and most experienced groups, the application to practice was reasonable for hand hygiene (69% and 77%, respectively) and use of PPE (76% and 81%, respectively) (Figure 4.25). Therefore, for these infection prevention practices, although nurses in both groups did not understand the underpinning theory, they did adhere to practice.

Yet for the disposing of waste and linen and caring for a patient with MRSA and *C.difficile* elements, findings suggest that poor knowledge led to poor application. For example, 61% of the least experienced and 83% of the most experienced group were confident in their understanding of caring for a patient with MRSA, yet only 56% of the least experienced and 68% of the most experienced group

demonstrated accurate knowledge of MRSA which was reflected by only 36% of the least experienced and 59% of the most experienced group adhering to practice (Figures 4.23 to 4.25).

4.10 Discussion

The results of this study highlight some constructive insights for infection prevention practice. Findings suggest that nurses with six or more years of experience have significantly increased understanding of infection prevention and significantly increased application of knowledge to practice compared to nurses with five years or less experience. Whilst this result may in itself be considered unsurprising, the findings of this study provide a new insight into how infection prevention knowledge effects application for the different elements of infection prevention practice. In particular, findings illustrate that understanding of hand hygiene and use of PPE was poor yet application of these skills was good, whilst knowledge of the care of patients with MRSA and *C. difficile* was limited which was reflected by substandard application of knowledge to practice.

For safe disposal of waste and linen and caring for patients with MRSA or C. difficile, findings suggest that poor knowledge led to poor application of practice. This finding is supported by similar studies which found that healthcare workers were not aware of basic infection prevention measures required to care for patients with MRSA (Trim et al, 2003; Marshall et al, 2004; Easton et al, 2007; Lugg & Ahmed, 2008) or C. difficile (Vaughan et al, 2006), and suggests that this has not changed with time and a raising awareness strategy within the NHS. Considering the care of patients with C. difficile, 44% of the least experienced group reported confidence in their understanding of a patient with this infection, 36% answered the knowledge question correctly and 44% reported applying this knowledge to practice. In the most experienced group 71% reported confidence in their understanding, 50% demonstrated correct understanding and 44% reported applying the correct practice when caring for a patient with C. difficile (Figures 4.23, 4.24 and 4.25). This implies that the more experienced nurses perceived themselves to know more about this aspect of infection prevention than they actually did, and subsequently the appropriate practices were applied the least frequently as a result of this insufficient knowledge, suggesting that for both

groups, for this element of infection prevention practice, knowledge informs application of compliant practice. In particular, less than half of the respondents appropriately cared for patients with *C. difficile*, which has considerable implications for practice given the Department of Health targets to reduce these infections by half (DH, 2005a). The findings of this element of the questionnaire therefore imply that poor application of *C. difficile* practices are a result of lack of knowledge of the skills required to care for patients with infections effectively. Previous studies have also reported nurses' knowledge of *C. difficile* as poor (Vaughan *et al*, 2006), but that effective education programmes increased knowledge of *C. difficile* by up to 91% and confidence in caring for patients with *C. difficile* by 86% (MacLean *et al*, 2008).

Infection prevention training is now annual mandatory training for all healthcare staff in England to improve knowledge (DH, 2008a), but large classes or lectures are often used in order to teach the workforce basic infection prevention policy. Yet infection prevention education delivered through lectures can lead to a lack of engagement and concentration and often fails to achieve effective interaction (Billings, 2010). It could be suggested that this approach can lead to theory overload and can actually therefore enhance the theory-practice gap that it aims to close (Cole, 2005). Similarly for other areas of mandatory training it has also been reported that a 'one size fits all' approach does not meet the learning needs of healthcare professionals attending (Turner et al, 2011) and that practical skills and knowledge decline after three to six months following training delivered by lectures (Hamilton, 2005). This is often because overuse of lecture-based teaching resources can lead to lack of concentration and engagement and often fails to encourage interaction, usually because of the large audience (Billings, 2010). This raises concerns that the content and delivery of infection prevention education in current pre-registration and post-registration nurse education curricula may not be adequate or effective.

It is thought that adult learners are also more motivated to learn to cope with real life situations and identify their own learning needs (Knowles, 1978). Current infection prevention educators should perhaps take into consideration adult learning styles in order to successfully meet the needs of nurses and therefore facilitate effective learning. Problem-based learning is emerging from andragogy as a teaching method that enables adult learners to not only find out about a subject but also how to think about it critically (Cole, 2005). Problem-based learning is beneficial as it facilitates the learner to develop problem-solving, critical thinking, team working and reflective skills that are essential in the practice setting. This method could be very appropriate for infection prevention education as there are many circumstances to which it could be applied in order to convey the same information as an educator would through the more frequently used pedagogical method, yet to date little has been documented as to the effectiveness of this (Billings, 2010; Ward, 2011). If infection prevention education therefore focuses less on basic standard precautions and more on problem-based scenarios of patients with specific infections, particularly MRSA and *C. difficile*, improved understanding may well be achieved and reflected by improved application of knowledge to practice.

With regards to hand hygiene and use of PPE, findings of this study suggest that although knowledge of these practices was poor, application of these skills was good. Previous studies that have evaluated knowledge and application of standard precautions found that poor knowledge of this element of infection prevention led to poor practice (Stein *et al*, 2003; Scott *et al*, 2005; Whitby *et al*, 2006; Wu *et al* 2009). It is possible that recent national and international campaigns such as the '*cleanyourhands*' campaign, the WHO 5 moments of hand hygiene, Bare Below the Elbows and monthly hand hygiene audits in local hospitals has embedded good practice for hand hygiene and use of PPE even though the rationale may be poorly understood.

Alternatively it could be suggested that nurses perceive their practice to be applied more consistently than it actually is. It is acknowledged that nurses can believe their compliance may be better than it genuinely is when observed, audited and quantified (Cole, 2008). Whilst it is suggested that ineffective teaching methods may reduce compliance for MRSA and *C. difficile*, it may also be inferred that infection prevention compliance is far more complex with determinants such as attitudes, beliefs, habits and organisational culture affecting behaviour and application for other elements of infection prevention practices (Cole, 2006; Whitby *et al*, 2006; Hanna *et al*, 2009). For example in this study 82.4% knew that gloves must be worn when administering intravenous fluids such as blood, but only 62.6%

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actually applied this principle to practice, suggesting that the explanation for why theory is not applied to practice is more complex than simply an educational issue, but that perhaps cultural and behavioural attitudes and beliefs are also factors that require further consideration. Also participants scored higher for the questions surrounding inoculation injuries than for disposal of waste and linen. This could be due to the perceived higher risk to self associated with sharps than with linen and waste that may be perceived as having much less of a risk to staff. Hanna *et al* (2009) found that nurses' perceived importance of hand hygiene was directly related to their beliefs regarding the transmission of infections. Other studies have suggested that a change in attitude and behaviour by healthcare workers are required if compliance to infection prevention practice, particularly hand hygiene, is to be sustained (Parker, 2000; Whitby *et al*, 2006; Lee *et al*, 2008).

Furthermore it might be suggested that it is not acceptable to have good practice but poor knowledge of such skills as hand hygiene and use of PPE. Whilst nurses may practice such skills correctly in a routine circumstance, the application of such practices or problem solving in a novel situation may require a sound knowledge base. For example, the knowledge that alcohol hand rub does not denature *C*. *difficile* spores should inform nurses to use soap and water to clean hands effectively after caring for a patient with *C*. *difficile*, yet only 42% of participants demonstrated an understanding of this knowledge. It is therefore recognised that interactive education that fosters critical thinking and a questioning approach is essential to facilitate the development of both underpinning theory and positive attitudes to change towards infection prevention practice (Billings, 2010).

The findings of this study make recommendations for improvement in NHS organisations and universities where infection prevention education is delivered by infection prevention nurses. As such these findings may have limited generalisability to organisations in which this education is provided by other means. However it could be suggested that regardless of how such education is delivered, the finding that poor knowledge of HCAI is reflected by substandard practice, whilst poor knowledge of hand hygiene and use of PPE is not, may be used to inform improvements to infection prevention education in both the clinical and the academic setting.

It is acknowledged that reliability and validity of studies that use self-reporting measures may be questioned as respondents may report what they believe the researcher expects to see rather that what they actually do, or may report higher self-confidence than they actually have. Nichols & Badger (2008) report a disparity between espoused infection prevention knowledge and actual compliance in practice. Yet in this study poor responses to the knowledge questions were generally reflected by low self-reported application to practice, suggesting that self-reporting is unlikely to limit the reliability of the findings. Furthermore, the tool used in this study was amalgamated from two previous tools that were developed from the literature in collaboration with a microbiologist, and one was sent to an expert panel to obtain content validity (Gould & Chamberlain 1997; Mann & Wood, 2006). However, although the tool had a confidence question and an application question for isolation nursing, it did not contain any knowledge questions surrounding this topic, which may have provided further insight into the relationship between infection prevention theory and practice.

In this study 73.4% of participants had attended infection prevention education less than a year previously which raises the question of the effectiveness of the training provided. It may be that the content or delivery of the training was not sufficient, or that the classroom environment in which the majority (89.6%) were taught does not enable nurses to effectively learn these skills, which are very practical by nature in that they are applied during episodes of patient care. Similarly for the least experienced nurses, findings raise concerns with current preregistration infection prevention education. For this sample population it is the hospital infection prevention nurses that provide education to the pre-registration nurses at the university, generally utilising the same education package that is used to provide annual post-registration training at the hospital. It is therefore suggested that nurse educators need to explore more innovative approaches to learning, which better suit the needs of individual learners in order to improve nurses' fitness to practice, as good quality education is more likely to contribute towards compliant nurses and therefore improve practice (Cole, 2008). These finding have implications for both pre- and post-registration infection prevention education and suggests that centring education around HCAI such as MRSA and C. difficile rather than on individual standard precautions may more effectively enhance knowledge and therefore application to practice.

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4.11 Conclusion

Education and application of infection prevention practices are important factors to consider in the reduction of HCAI and the importance of education in the prevention of HCAI is well documented (DH 2003a; DH 2010a; DH 2010b). However reports suggest that only approximately 60% of staff receive annual infection prevention training (NAO, 2004), suggesting that understanding education on this topic and the issues surrounding it could provide further insight into whether nurses' knowledge and application of infection prevention practice could be improved. Previous studies into infection prevention knowledge, application and compliance have identified a need for increased education (Stein *et al*, 2003; Trigg *et al*, 2008; Wu *et al*, 2009), improvements to current infection education (Mann & Wood, 2006; Vaughan *et al*, 2003).

The results of this study suggest that experience enhances infection prevention knowledge and application to practice. Furthermore, knowledge of HCAI is limited and is reflected by poor practice whilst poor theoretical understanding of hand hygiene and use of PPE is not. Therefore, focusing infection prevention education on care of patients with specific infections, such as MRSA and C. difficile, rather than on individual standard precautions may more effectively increase knowledge and therefore application of infection prevention practices related to reducing these HCAI. This is timely as the new Standards for Pre-registration Nursing Education (NMC, 2010) have continued to require infection prevention as an essential skills cluster throughout the pre-registration curriculum which emphasises the importance of effective infection prevention education to underpin good practice. There is little published information on nurses' experience of preor post-registration infection prevention education, yet this may provide further understanding of how education effects knowledge and application of practice, or insight into what issues exist with regards to current infection prevention education.

Chapter Five

5. Experiences of infection prevention education

5.1 Introduction

This chapter presents the results from semi-structured interviews that were undertaken in order to gain a more in-depth understanding of the experience of infection prevention education, from both the perspective of those that teach it and those that attend. Annual infection prevention education for all healthcare staff is now a mandatory requirement for NHS organisations in order to demonstrate compliance to the *Code of Practice* (DH, 2010a). This follows on from various studies that have linked frequent education to an increase in compliance to infection prevention practice by ensuring that staff have received the relevant training (Stein *et al*, 2003; Trigg *et al*, 2008; Wu *et al*, 2009).

For nursing staff, infection prevention training sessions are usually delivered by infection prevention nurses in a classroom setting using a standardised electronic presentation. This education should be effective in teaching improvements to poor or outdated practice and not just the impartation of knowledge in order to effectively influence infection prevention compliance (Seto, 1995; Scott *et al*, 2005). Within the sample population of the study, it is reported that infection prevention education is delivered to various sized groups of nurses, although it is well documented that the size of the group affects both the delivery style and the learning achieved (Cole, 2005; Burnett, 2009; Prieto, 2009). It is therefore suggested that, although increasing the availability or frequency of infection prevention training facilitates compliance to practice if the size of the group is too large to be conducive to effective learning (Morison *et al*, 2004; Derbyshire & Machin, 2011).

Furthermore, the little research that has explored nurses' experiences of infection prevention education has reported that nurses describe the experience as repetitious, time-consuming, too basic, uninteresting or boring (Henry, 1997; Billings, 2010). It is therefore generally thought that improvements to infection

prevention education are required (Gould & Chamberlain, 1997; Bissett, 2002; Vaughan *et al*, 2006; Burnett, 2009). Yet no clear evidence exists as to the causes for current limited learning (Trim *et al*, 2003), or the best way to deliver infection prevention education effectively (Mann & Wood, 2006). Yet before improvements to training can be made, these concepts must be better understood in order to make successful and meaningful enhancements to the education provided, which may then be transferred into improved compliance to infection prevention skills in the practice setting.

One useful way of achieving a better understanding of potential causes for limited learning or factors that affect delivery of infection prevention education would be through considering the experiences and views of those that both teach and attend such training. Furthermore, the results from Chapter Three and Chapter Four have also identified a need for a greater insight into the experience of infection prevention education in order to begin to understand the issues that surround it and how learning impacts on nurses' compliance to infection prevention practices. Therefore the research objective of this study was to explore both trainers and trainees experiences of infection prevention education by understanding factors that facilitate learning, barriers to learning and how both the environment and the teaching methods used impact on learning.

5.2 Methodological approach

The research methodologies used in Chapter Three and Chapter Four centred on positivism and quantitative research approaches. In contrast to this is the naturalistic paradigm, the methodology which explores the way in which humans make sense of their subjective reality and attach meaning. Researchers with this worldview believe that understanding human experiences is as important as focusing on explanation, prediction and control. Qualitative research follows this paradigm and involves the investigation of phenomena, typically in an in-depth and holistic fashion, through the collection of rich narrative using a flexible research design (Polit & Hungler, 1999). The goal of qualitative research is to understand the social phenomena in natural, rather than experimental, settings, giving emphasis to the meanings, experiences and views of all participants (Parahoo, 2006). Qualitative approaches can therefore be useful over quantitative methods when there is little known about a subject or the subject is a complex one, as they

enable the generation of new theories rather than the testing of existing hypotheses (Holloway & Wheeler, 2010). Therefore, a qualitative methodological approach was used in this study as it most appropriately met the requirements of the research objective which was to discover nurses' experiences of infection prevention education. This suited rich narrative data and thus facilitated the exploration of participants' perspectives of the experience of this education.

Qualitative approaches to research tend to be based on the assumption that reality varies for different people in different contexts. Phenomenology is one qualitative approach that has its disciplinary roots in both philosophy and psychology and is a research tradition that is concerned with illuminating experiences and perspectives (Polit & Hungler, 1999). The goal of a phenomenological research framework is to fully describe a lived experience and gain an understanding of the meaning of the experience from those who have experienced it (Flood, 2010). Husserl (1931) pioneered phenomenology from the belief that quantitative scientific research had become so detached from human experiences that it could not be used to study all human phenomena (Mapp, 2008). Husserl argued that in order to understand the essence of a phenomenon one has to understand how the life world, or everyday world that is experienced and taken for granted, is directly experienced (Green & Thorogood, 2009). These philosophical ideas formed the Husserlian or descriptive approach to phenomenological inquiry that seeks to describe the manner in which a phenomenon is experienced and the individual perceptions of the experience (Earle, 2010), which enables the essence of the experience to be revealed and understood.

Alternatively the interpretive or hermeneutic approach to phenomenology is guided by Heidegger (1962), who although mentored by Husserl (1931), argued that rather than focus on description, the phenomenologist should interpret the experience by exploring the meanings of the experience and how such meanings influence an individual's choices (Flood, 2010). Whilst a Husserlian researcher will therefore 'bracket' any prior beliefs about the experience, a Heideggerian researcher will use their own personal beliefs and experience to inform the interpretation and gain an understanding of the 'meaning of being' (Snow, 2009). However, a constraint of the Heideggerian approach is that the researcher therefore requires an in depth knowledge of the experience under study in order to comprehensively interpret the data (Mapp, 2008). A Husserlian phenomenological approach was therefore used to explore nurses' experiences of infection prevention education, as the researcher has firsthand experience of delivering but not of receiving this education. This descriptive framework therefore enabled the essence of the experience of infection prevention education to be described and understood comprehensively from the perspectives of both those that teach it and those that attend.

The aim of descriptive phenomenology is to describe the essence or structure of the phenomenon, rigorously and without distortion (Bradbury-Jones et al, 2010). Therefore the Husserlian approach includes the concept of bracketing, which is the process whereby any conceptualisations, theories or prejudices that the researcher may have towards the phenomenon are acknowledged and set aside so that the phenomenon can be understood in its own and purist essence (Earle, 2010). Robinson (2006) suggested that in order to successfully bracket personal beliefs, the phenomenon should be unfamiliar to the researcher. Yet this may be paradoxical in healthcare research as generally nurses explore an area of practice that is pertinent to them in order to improve policies or procedures within that domain. Therefore a more practical approach to bracketing is to use a reflective diary to help illuminate the beliefs or influence of the researcher on the emerging phenomenon (Parahoo, 2006). Bracketing was therefore applied during the research process by keeping a reflective journal throughout the research process to clearly acknowledge any thoughts or theories that the researcher had regarding nurses' experiences of infection prevention education and ensure they did not then obscure the objectivity of the data analysis process. Data analysis was also carefully substantiated (section 5.6) to maintain transparency and confirm that the themes emerged directly from the data and not from the researcher's preconceived beliefs.

Suggested weaknesses of phenomenological inquiry surround time-consuming data collection, difficulties during the data analysis process and the possibility that clear patterns may not emerge from the data (Polit & Hungler, 1999; Snow 2009). There is also the potential for de-contextualising the meaning of the data if an interpretation is taken out of context (Bradbury-Jones *et al*, 2010). These issues were therefore carefully considered during the analysis process and the data was

presented in a critical descriptive structure once the phenomenon was understood. From a positivist perspective it can be argued that the phenomenological research process, particularly the data analysis aspect, is not structured and therefore not rigorous. Therefore Colaizzi's (1978) seven steps of data analysis were used during the data analysis process to provide a framework for analysis (section 5.6) to develop an analytical description of the data that was not affected by prior assumptions (Holloway & Wheeler, 2010).

5.3 Ethical considerations

For this study written consent was gained from the National Research Ethics Service (Appendix II), the Research Degrees Committee at the university (Appendix III), as well as the Research Committees and the two lead infection prevention nurses from the hospitals at which the study was undertaken (Appendix IV, V, VI and VII). Consideration was given to the value of using focus groups for data collection but difficulties surrounding limited participant availability within the practice setting led to interviews being the more conducive tool. Therefore both those who taught and those that attended infection prevention training were interviewed and use of this research tool was given favourable opinion by the National Research Ethics Service (Appendix X).

Furthermore, the rights, safety and well-being of participants must not be endangered so requires consideration. Whilst no issues were identified with regards to either the participant or researcher safety, some aspects of the interviews could potentially have distressed participants, for example if poor practice was discussed. Therefore questions were sensitive and diplomatic and all participants of interviews were made implicitly aware of their right to withdraw from the study at any time. This was achieved by giving potential contributors a participant information sheet (Appendix XI) that explained the rationale and requirements for the study which allowed participants time to make an informed decision as to whether or not they wanted to be included in the study. They then provided informed consent by signing a consent form (Appendix XII) prior to interview.

With regards to confidentiality, contributors remained anonymous as in each interview transcript the participant name was replaced with a pseudonym so that

no names could be disclosed. Raw data was transported in a locked briefcase and stored securely in a locked filing cabinet in accordance with relevant university policy. Only the researcher had access to the data, the computer was password protected and the data will be destroyed two years after completion of the thesis as per the policy of the university at which the study was undertaken.

5.4 Research tool

In phenomenology the main source of data is typically in-depth conversations in which the informant describes the lived experience without leading the discussion (Polit & Hungler, 1999; Flood, 2010). A common phenomenological research tool is therefore the interview as it is a simple structured encounter between researcher and research participant which facilitates a practical, flexible and relatively economical way of gathering research data (Bowling & Ebrahim, 2005). Interviews therefore were an appropriate tool to facilitate exploration of the research objective of this study as they enable interpersonal communication to understand the meanings of lived experiences. The purpose of an interview is the discovery of the respondent's feelings, perceptions and thoughts (Earle, 2010), which is fundamental to the research aim, to explore nurses' experiences, affirming that interviews were appropriate tools for all participants in this study. It is acknowledged that in phenomenological inquiry interview duration is lead by data saturation, the method whereby no new data is revealed and the description becomes cyclical (Mapp, 2008). Interview durations in this study therefore ranged from 15 to 40 minutes.

It may be argued that from a pure phenomenological perspective interviews should be unstructured to enable the true lived experience to be understood from the perspective of the participant (Parahoo, 2006). Yet when the Husserlian researcher has a common plan regarding the direction that the dialogue will take, the data collected can provide a more comprehensive account of the experience (Flood, 2010). Furthermore when unstructured interviews are used, the researcher often has to ask participants to illuminate or clarify their descriptions of the experience being studied. It could therefore be suggested that as long as a vivid description of the experience is achieved which leads to an understanding of the essence of the phenomenon without being influenced by the researcher (Sorrell & Redmond, 1995), then the aim of Husserl's descriptive approach is

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achieved. Therefore the use of semi-structured interviews may be acceptable in a phenomenological research approach to facilitate the probing and exploration of descriptions of the experience, as long as they do not reflect the researchers preconceived beliefs or biases (Mapp, 2008).

Therefore the interviews used in this study were semi-structured to allow the participants the opportunity to expand on areas which they felt were important, but also to ensure the discussion remained centred around their experiences of infection prevention education. It is recognised that when conducting semistructured interviews participants may span more than one question, digress or respond with yes or no answers, and therefore it is up to the researcher to probe, encourage and engage them in the topic (Green & Thorogood, 2009). An interview schedule is a useful tool to ensure this is achieved. Interview schedules (Appendix XIII) were therefore used to cover similar topics in all of the interviews without leading the discussion. There were subtle differences between the interview schedules used for the infection prevention trainers compared to those who had attended such education to reflect the different perspectives of the participants, but essentially they facilitated exploration of the same parameters. The structure of the interview schedule was developed from the research objectives of this study which were to better understand the experience of infection prevention education by exploring:

- · The factors that facilitated learning
- · The barriers to learning
- · How the environment impacted on learning
- How the teaching methods impacted on learning

These objectives were then developed into questions that were written within the context of infection prevention education that interviewees could expand upon to provide insight into the experience of the training from their perspective. For example, 'in this particular infection prevention session, what factors did you feel facilitated learning?' This was done in accordance with referral to the reflective journal to ensure that any preconceived assumptions were not embedded into the interview schedules so that they remained free from any researcher bias. The questions were put into a logical order, from general questions regarding a description of the education to more specific questions surrounding what affected

participants learning. These questions then provided the framework for the interview schedules (Appendix XIII) and therefore the semi-structured interviews. The questions were worded as open questions to encourage discussion from the participants. They were concise, neutral and free from jargon to facilitate rather than disrupt the flow of the interviews. The researcher became familiar with the interview schedules prior to data collection to ensure that they were comfortable with them and would not have to heavily rely upon them during the interview process but use them as a tool to guide the discussion.

It is acknowledged that interviews are time-consuming (Polit & Hungler, 1999; Flood 2010), thus two pilot interviews were conducted to ensure that the interview schedules facilitated discussion surrounding the research objectives effectively, discouraged digression away from the research topic, yet did not influence the opinion of the participants in any way. The interview schedules proved appropriate and no amendments were required. In addition, sufficient time was arranged for each discussion and suitable locations were selected by the participants as it was important to allow them to explain their perspectives and ideas in detail and in confidence without interruption or being hurried. The interviews were therefore generally held in either ward managers offices, ward day rooms or the infection prevention nurse's office. The interviews were taperecorded so that all data was collected efficiently and accurately and were then transcribed verbatim by the researcher.

5.5 The sample

This study required participants who had either attended or taught an infection prevention teaching session. Inclusion criteria therefore included:

- Nurses who provided infection prevention education to both pre- and postregistration nurses
- Pre- or post-registration nurses who had attended infection prevention education within the last two years
- Nurses or lecturers who spoke English (IELTS is required for NMC registration).

Participants for this study were drawn from a sample population of 2373 nurses at two district general hospitals and 628 student nurses at a university in one county

in the UK. In qualitative research there are no firmly established criteria or rules for sample size (Bradbury-Jones et al, 2010) and emphasis is on the depth and richness of the evidence collected rather than coverage (Holloway & Wheeler, 2010). The sample size for this study therefore consisted of two interviews of infection prevention nurse educators who taught both post-registration nurses at the hospitals and pre-registration nurses at the university at which the study was Additionally five interviews were conducted with pre-registration conducted. nurses at the university and ten interviews with post-registration nurses at the two hospitals, at which point it was felt that data saturation was accomplished as clear themes emerged from the data. Pre-registration nurses and post-registration nurses were included in the study because both groups receive their infection prevention education from the infection prevention nurses at the two hospitals, so both groups provided different insights into their experiences and therefore the essence of that training. After completion of the interviews the transcripts were subjected to critical data analysis (section 5.6) and consistent themes emerged (section 5.7). It was then confirmed that saturation had been reached as there was adequate data to describe the entirety of the phenomenon (Parahoo, 2006) and no further interviews were conducted.

Participants were selected by both purposive and convenient sampling. Purposive sampling is a method that explicitly selects interviewees who are likely to generate appropriate and useful data (Green & Thorogood, 2009), which is therefore commonly used in phenomenological sampling in order to effectively elicit rich information about the phenomenon and enable an in depth study of that phenomenon (Mapp, 2008). The two infection prevention nurse educators that teach both pre- and post-registration nurses in the sample population were therefore approached personally and asked to participate in the study. Participants who had attended infection prevention teaching sessions. They were then informed of the study, invited to take part and were given a participant information sheet. The researcher then contacted them at least a week later to ask if they would participate and if so to arrange a suitable time and venue for an interview.

5.6 Data analysis

Data analysis was conducted separately for the three different perspectives within the study sample: infection prevention nurse educators, post-registration nurses who had attended training and pre-registration nurses who had attended education. This was so that an insight into the phenomenon of infection prevention education could be gained from three different perspectives in order to provide a comprehensive understanding of the essence of the experience. It is essential that analysis of phenomenological data demonstrates both validity and transparency in order to maintain a rigorous quality. This is largely achieved by conducting data analysis in a systematic, orderly and structured way (Holloway & Wheeler, 2010), through using a framework. There are three frameworks for data analysis in descriptive phenomenology: Van Kaam (1966), Colaizzi (1978) and Giorgi (1985), who all developed approaches to data analysis that are rooted in the ideas of Husserl (Earle, 2010). The philosophical underpinnings of the study being conducted inherently inform the method of analysis that is applied to the data (Flood, 2010). Therefore an understanding of the three different frameworks is essential in order for the most appropriate process to be applied to the data.

The three data analysis methods are comparable in that they all transcribe the data and categorise key words or codes into themes (Robinson, 2006). However there are also differences between the three methods. Van Kaam's (1966) method formulates a hypothetical theory of the phenomenon, tests this against random extracts and then revises the theory until finally the description is identified (Mapp, 2008). However it may be argued that this process only guides the researcher towards a fundamental description of the phenomenon, as it discounts the essence of that description and the preconceived assumptions of the researcher that are both critical to understanding the fundamental structure of the phenomenon (Valle, 1998). Alternatively Giorgi's (1985) four stage model of analysis focuses on interrogating and articulating the raw data into 'meaning units' of the experience from the perspective of the various participants, in order to generate themes (Flood, 2010). This framework provides a more universal description of the phenomenon across all of the participants under study as the meaning units are synthesised into group statements (Earle, 2010). Therefore individual experiences that may be atypical are disregarded during this analysis

process as these 'redundant themes' are not considered in the formulation of the overall description of the phenomenon.

Lastly, Colaizzi's (1978) seven steps for data analysis (Table 5.1) provide a logical process that generates a clear description of the fundamental structure of the phenomenon (Snow, 2009). This is achieved through formulating meanings from 'significant statements' extracted from the data, and integrating clusters of themes into an exhaustive description of the phenomenon (Holloway & Wheeler, 2010). This method differs to both Van Kaam and Giorgi as during the final step of data analysis the respondents validate the findings, or the fundamental structure of the phenomenon, by confirming that they are true (Valle, 1998). Although each of these analysis frameworks incorporates the core Husserlian principles of bracketing, intuition, analysing and describing the data (Snow, 2009), it is suggested that Colaizzi's seven steps is the most comprehensible and most easily applied to achieve a clear description of the phenomenon (Robinson, 2006). It is also the most appropriate framework for the data in this study as it will provide a more rigorous and validated analysis process that takes into account both the researchers prior assumptions and any nonconforming experiences of infection prevention training in the formulation of the fundamental structure of the experience of this education. The latter is achieved through preserving the integrity of the individual participants' responses throughout the analysis process (Green & Thorogood, 2009). Furthermore, this method will enable the phenomenon to be described exhaustively from the three different perspectives of those providing and those attending pre- and post-registration infection prevention training. Therefore Colaizzi's (1978) seven steps for data analysis were applied to the data to enable rigorous analysis and identification of themes from the data to be completed within a structured framework.

Colaizzi's (1978) seven steps for phenomenological data analysis:

- Read the informants' descriptions of the experiences in order to acquire a sense of the whole
- 2. Extract significant statements
- 3. Formulate meanings from the significant statements
- 4. Organise the formulated meanings into clusters of themes
- 5. Integrate the themes into an exhaustive description
- 6. Formulate the fundamental structure of the phenomenon
- 7. Respondent validation

(Holloway & Wheeler, 2010).

Table 5.1: Colaizzi's (1978) seven steps for data analysis.

All interviews were transcribed by the researcher which assisted familiarisation with the phenomenon through immersion in to the data. During transcription participant names were replaced with pseudonyms to maintain the confidentiality of the participants without compromising the narrative style of the critical description of the emergent themes (Table 5.2).

Pseudonyms ap	plied to the transc	ripts during the data an	alysis process:
Participant A	Anna	Participant J	Joe
Participant B	Beth	Participant K	Kate
Participant C	Claire	Participant L	Lisa
Participant D	Debbie	Participant M	Martin
Participant E	Ellie	Participant N	Natalie
Participant F	Fiona	Participant O	Olivia
Participant G	Gemma	Participant P	Paula
Participant H	Hannah	Participant Q	Rachel
Participant I	Isobel		

Table 5.2: Pseudonyms applied to the interviews transcriptions.

The transcripts were then read several times, the interview tapes listened to and the reflective journal read in order to gain an understanding of the inherent feelings of the participants meaning and sense of whole of their experience of the infection prevention education. Significant statements were then extracted from the data by examining every sentence within the transcripts and isolating statements or key words that were considered important by the participants with regards to understanding the phenomenon (Appendix XIV). In order to ensure that the significant statements were transparent, reliable and not subject to researcher bias, they were only extracted if they provided insight into the experience of infection prevention education, by meeting the following criteria of the research objective:

- Factors that facilitated learning
- Barriers to learning
- · How the environment impacted on learning
- How the teaching methods impacted on learning

Each individual significant statement was then considered within the context in which the participants made it to formulate meanings from the significant statements. These were then labelled and organised into clusters of themes as common patterns emerged from the data. The clusters of themes were taken back to the transcripts to ensure that they had not been taken out of context. This is important to confirm and validate the emerging patterns from the data and is repeated until all the themes are accounted for (Holloway & Wheeler, 2010). Appendix VIII illustrates how these clusters of themes emerged from the significant statements that were originally extracted from the data.

The themes extracted through the analysis process were then integrated into an exhaustive description, whereby the participants' experiences and feelings that constituted each theme were portrayed. The exhaustive descriptions of each theme are presented in section 5.7. An exhaustive description of the experience of infection prevention education as a whole was then formulated to enable the identification of the fundamental structure of the phenomenon, from which generalisations were then critically discussed. Respondent validation was completed by returning the overall description of the experience to the participants to confirm accurate representation. The application of both a structured

framework for analysis and researcher bracketing therefore ensured that the themes that emerged provided a credible and reliable portrayal of the experiences of infection prevention education.

The emergent themes from the data analysis will be justified and presented from the three different perspectives towards infection prevention education that were explored, that of infection prevention trainers, post-registration nurses who attended training and pre-registration nurses who attended education. Although data analysis was conducted separately for the three different perspectives towards infection prevention education within the study sample, during sixth stage of data analysis as the fundamental structure of the experience of this training was developed, the relationships, themes and associations between the different perspectives were explored further and discussed. Validity was maximised by the provision of direct quotations to substantiate the interpretations of the data within sufficient context and divergences in the data were acknowledged and discussed.

5.7 Results

The themes that emerged from the insights and experiences of infection prevention education (Table 5.3) were drawn from the clusters of themes that represented the perspectives of the infection prevention nurse educators, staff nurses that had recently attended training at the two hospitals and student nurses who had attended education at the university.

Themes	Clusters of themes			
	Trainers	Staff nurses	Student nurses	
The learning environment	The classroom Ward environment	The classroom Ward environment	The classroom	
The group dynamics	Size of the group Mixed audience	Size of the group	Size of the group	
Effect of time	Time of day	No significant statements emerged	Length of class	
Effect of the trainer	Attitude of the trainer	No significant statements emerged	Proficiency of the trainer	
Teaching methods and resources	Teaching methods Teaching resources Pressure of targets	'I can't remember' Visual content Practical resources	Subject content Equipment	
Improving education to enhance learning	Improve resources Improve audience Improve frequency	Improve content	Improve content Improve frequency	

Table 5.3: Emergent themes from the data analysis of the experience of infection prevention education.

The two infection prevention nurses, Paula and Rachel, were interviewed to gain an insight into their experiences of delivering infection prevention education to staff nurses at the two hospitals in this study, and how this compared to teaching student nurses at the university. Paula and Rachel have specialised in infection prevention for seven and nine years, respectively, and Rachel has also completed a post-graduate teaching qualification. They provide education to post-registration nursing staff on Trust induction, preceptorship courses and at annual mandatory training sessions. They also have experience of teaching pre-registration nurses at the university.

The ten post-registration nurses from the two district general hospitals in this study have provided their views and opinions of the experience of infection prevention education, from the perspective of having attended such teaching within the last two years at their place of work. They were drawn from a variety of medical and surgical wards and theatre settings and have been qualified practitioners for between one and forty years. The five pre-registration nurses interviewed were in the first and second year of nursing education at the university in this study. All of them last received infection prevention education at the university at the beginning of their first year of study prior to their first placement in the clinical setting. These classes were delivered by the infection prevention nurses from the local hospitals and Kate, Lisa, Martin, Natalie and Olivia provide an insight into their experience of this education.

The themes (Table 5.3) that have emerged from analysis of the narrative provided by these educators, staff nurses and student nurses of the experience of infection prevention education shall be presented sequentially. Within each theme the three perspectives will be explored, reflected upon objectively and corroborated in order to gain a comprehensive understanding of the phenomenon of infection prevention education.

5.7.1 The learning environment

The first theme that emerged from the data as the infection prevention nurses, staff nurses and student nurses discuss their experiences of teaching or attending this subject is the effect that the learning environment has on the ability to effectively learn. All of the participants feel that the environment in which they either teach or are taught, can both facilitate or inhibit learning, depending on the context in which it is applied. The ambience, climate and accessibility of the learning environment can all have an effect on the level of learning achieved.

With regards to the infection prevention nurse trainers' perspectives of this phenomenon, the two nurses explain how the learning environment can either improve or impinge upon nurses' capacity to learn from infection prevention training. Rachel describes the two very different environments in which she delivers infection prevention training, that of the classroom and the ward-based training environment. She feels that the classroom environment is 'conducive to learning' because:

"The seats are comfortable and the temperature can be regulated to make it a comfortable learning environment... there are no interruptions" [Rachel].

However Rachel also finds that a classroom setting does not always facilitate effective learning as it can 'get too full'. For Rachel, the ward-based learning

environment is an alternative venue to the formal surroundings of the classroom, but this can also either positively or adversely impact on the nurses' potential to learn. She explains that it is beneficial in that the learning outcomes can be tailored to meet the specific needs of the audience in that environment, but that learning can be limited as there can be lots of interruptions from other ward staff.

The classroom setting where Paula conducts the majority of her education is a clinical skills lab which she describes as 'a bit gloomy' but a useful environment that has convenient facilities for the practical hand hygiene element of her training. Paula also feels that ward-based training can be more beneficial as she can manipulate the learning outcomes to better suit the speciality of nurses being trained, but she also acknowledges that this is not without problems as the sessions tend to be much shorter, rather rushed and there can be frequent interruptions from the ward, all of which she feels can lead to much less being learnt.

Therefore both educators find that learning can either benefit from, or be impeded by, the learning environment with an ambient surrounding and atmosphere with minimal disturbances providing the most conducive learning environment and therefore optimising the learning achieved.

The staff nurses interviewed also explained how the environment impacts on their learning experience. They received infection prevention training in a variety of different environments that included clinical skills laboratories, classrooms and the clinical environment of the ward. Anna, Debbie and Fiona describe how the hospital clinical skills laboratories are beneficial learning environments as they have easily accessible facilities for the practical elements of the training. For Anna this environment facilitates effective learning of the practical aspect of the session:

"It was in the clinical skills lab...it's really good as it's got sinks in there so that everyone can have a go at washing their hands easily" [Anna].

Therefore for Anna, receiving education out of the practice setting but still within a clinical environment enhances the learning experience as she is able to demonstrate her competence in infection prevention skills. Similarly Debbie and Fiona explain that this setting is beneficial as it enables them to practice their

clinical skills effectively and this provides them with a sense of assurance that they are then conducting key skills correctly in the practice setting.

In contrast, some of the other post-registration nurses attended training in lecture theatres. Gemma, Joe and Hannah reflect how this more formal learning environment impedes their learning as it is more challenging to engage and interact with the trainer. Joe describes that this is because he finds it too easy to 'zone out' and not assimilate the information being taught to him when he is 'sat there in a row'. For Gemma the environment negatively impacts on her ability to learn as she feels it is more difficult to interact with the infection prevention nurse:

"It was in the big lecture theatre which...made it less personal and harder to ask questions" [Gemma].

For Gemma, being able to feel welcome to ask questions to affirm her understanding or apply the theory being delivered to her practice setting is an important outcome of learning. She feels that receiving training in the lecture theatre environment therefore adversely affects her learning as it inhibits the opportunity for her to feel engaged and able to communicate her enquiries to the trainer.

Similarly Hannah feels that this environment is not effective for learning infection prevention skills. Whilst she acknowledges that it is useful to be away from the clinical environment as this enables her to 'concentrate properly', she also describes the notion that it feels 'false' learning about clinical skills in a formal learning environment. For Hannah, it can be difficult to bridge the theory-practice gap and relate what she has learnt to her practice as it she finds it challenging to consider 'what to actually do on the ward' when in an unfamiliar location.

The remainder of the post-registration nurses accessed infection prevention training that was delivered in the clinical setting. Their experiences of this form of environment had a positive influence on their learning. Isobel reflects that ward-based education is more effective for her as it is 'more practical' which enables her to relate it to her clinical skills more successfully. For Ellie, the most effective way to learn 'is by doing':

"It's better to have infection control training on the ward than in a training room...our infection control nurse taught us on the ward and actually physically showed us how to clean commodes properly...it made me think if she can tip it over to clean the bottom then so can I and now I do" [Ellie].

Ellie therefore finds it much more effective to learn in the clinical environment than to be 'lectured at' in a formal classroom setting as it provides the opportunity to observe practical demonstrations, which for her enables the subject matter to immediately resonate to her practice which she then embeds in to her daily routine.

Similarly for Beth, receiving infection prevention education within her specific clinical setting is invaluable for her as it provides effective learning of key clinical skills that she can then entrench in to her practice:

"When it is in the area you work like the handwashing it is better as you use the sink you normally use, the infection control nurse said...I didn't wet my hands before I put the soap on and she was right, when I did it again I realised that I don't and she said not wetting my hands before I put soap on is more likely to dry them out...now I make sure I wet them first and she is right they're not as dry" [Beth].

For Beth, access to ward-based education where she can demonstrate her clinical skills enables her to learn effectively from discrepancies in her practice that may have not been identified had she attended training in the lecture theatre as these skills are not able to be assessed at this more formal venue. The post-registration nurses therefore provide insight into how the environment impacts on their ability to learn, with the consensus being that a clinical learning environment facilitates effective learning by enabling them to more easily apply theory to practice and to physically evaluate their clinical technique.

The student nurses interviewed also feel that the environment can either facilitate or obstruct effective learning. They all received infection prevention education in the clinical skills laboratory at the university. This included hand hygiene, use of standard precautions and for some aseptic technique. For Kate, this environment enhances the learning experience as it enables it to 'feel more real' or reflective of the practice setting. Martin is of the same opinion in that, "The clinical skills lab...is like a simulated ward so it felt quite realistic" [Martin].

For Martin, the environment therefore facilitates the learning of practical skills when it has a clinical ambience with facilities and equipment that are echoed in the practice setting. However Martin does also reveal that there is a disparity between the university and the practice setting in that the university surroundings can feel so detached from the clinical setting that when he is in practice he 'forgets' the fundamental procedure and rationale for the skills. So although an environment that feels authentic is more conducive to learning than the classroom for Martin, he is also aware that because it is 'simulated' it can be more difficult to retain knowledge or skills learnt there, compared to learning in the genuine practice setting.

Similarly the reproduced clinical learning environment at the university can hinder learning for Natalie, Olivia and Lisa who find that this venue is too isolated or dissimilar from the practice setting and that it seems to generate a noisy and 'hectic' atmosphere. For Lisa the very warm climate also makes it 'difficult to concentrate'. Olivia further explains how the environment can negatively affect learning:

"The space was really small...it felt very remote and distant from the real thing...and it doesn't have any patients to talk to, to explain what you are doing" [Olivia].

Therefore for Olivia there is no substitute for learning in the clinical setting, in the environment in which such knowledge and skills will be employed. Kate also feels she learns more about infection prevention on placement as she is 'doing it all the time'.

Pre-registration nurses' experiences of education therefore provides insight in that they find the practice setting the most conducive learning environment for learning clinical proficiencies such as infection prevention skills. Although the clinical skills laboratory surpasses the classroom environment for enhancing learning, it is still not as favourable as the practice setting where they feel they learn new skills the most effectively. The three different perspectives of the experience of infection prevention training all agree that the learning environment is an intrinsic factor in providing effective learning. However, whilst Paula and Rachel can see benefits from both the classroom and the ward environment, the staff nurses and student nurses feel that a clinical environment better facilitates their learning of infection prevention knowledge and skills, which by their nature are of a practical essence.

5.7.2 The group dynamics

Inextricably linked to concept that the environment can affect the level of learning achieved from infection prevention training, is the perception that the dynamics of the group of staff that attend training can also impact on the effectiveness of learning.

From the experience of the infection prevention nurse educators, the size of the group can influence the learning outcomes achieved in that a smaller group enhances learning as it more effectively enables discussion within the group. Paula explains how the size of the group 'definitely' alters the learning achieved,

"I do prefer it when the group is smaller as you can be more interactive with them, it is easier to tailor the session to make it more relevant to them or apply it to situations that they can identify with better to make it a more useful session for them" [Paula].

For Paula, there seems to be a correlation between the size of the group or audience being taught and the perceived learning achieved, in that the smaller the group is the more effective the learning. This feeling is comparable for Rachel, who describes the effect that she feels a large audience has on nurses' ability to learn from an infection prevention session. The example she uses is that the audience in the lecture theatre that she often teaches in can sometimes be too large, in which case she struggles to make eye contact with everybody, which she feels is important when teaching in order to engage the group effectively.

Rachel reflects on one other aspect of the group being taught that can affect the quality of the learning,

"Having mixed groups of staff I think is the biggest barrier" [Rachel].

For Rachel, a diverse audience can therefore inhibit effective learning. This is challenging for her as she feels that she wants to teach at the 'appropriate level' for all staff that attend infection prevention training so that they can learn 'something useful'. Yet having such an assorted group of clinical and non-clinical staff makes effective learning for everyone difficult. Whatever level the session is 'pitched' at, Rachel describes how some of the group will not learn elements that she feels they should, whilst others will be listening to information that is not relevant to them or their area of work, and any interaction will be challenging.

Therefore, from the perspective of the infection prevention nurse educators, the characteristic of the group receiving training can affect learning and a small group of just nursing staff most effectively facilitates learning for both pre and post-registration nurses. For the two infection prevention trainers, being able to interact at the same professional level with the group is important for them to feel that the training is effective and that the group have achieved the desired learning outcomes.

For the post-registration nurses the dynamics of the group also impact on learning. They unanimously feel that the size of the group affects the quality of learning achieved and that a smaller group provides optimal learning opportunities. For Anna the small group size enables interaction between the trainer and the nurses allows her to 'get more out of' or learn more effectively from the session through supporting her to 'make sense' of how the content is relevant to her ward. For Claire the more compact group is beneficial as it enables to trainer to ensure that the group understand each element of the session comprehensively. Gemma reflects that having a small group facilitates her learning as the educator can tailor the content to better suit her clinical skill set:

"...it made it more personal and she could direct it to be more relevant to your specific area like surgery, so you got more out of the training that was helpful for your type of patients" [Gemma].

For Gemma, receiving training that was more specific to her clinical setting was advantageous as it relates more appropriately to patients under her care and therefore improves her learning. Joe provides further insight into how the size of the group can adversely affect learning by reflecting upon his experience of being part of a very large audience:

"Because it was a lecture to such a big group it made it really difficult for the presenter to be interactive" [Joe].

For Joe, attending training in a large group can impact negatively on the learning experience as it prevents the educator from being interactive with the group, an attribute which he perceives is an important factor in enabling him to feel engaged with the subject material and therefore learning effectively from it.

The experiences of training provided by the post-registration nurses suggest that a smaller group of nurses facilitates more effective learning as it facilitates the interaction between the teacher and the learners and therefore improves the quality of learning achieved. The compact group size also enhances the engagement of the audience and therefore the perceived ability to learn by ensuring that the subject material is tailored to provide content that is relevant to their clinical environment.

This finding was comparable to the insights that the pre-registration nurses provided into the experience that the dynamics of the group had on learning. Their perceptions also focus on the impact that the size of the group has on the ability to be interactive with the infection prevention nurse. Kate explains how a small group size is advantageous,

"It was a small group so it was very interactive...we asked lots of questions and learnt a lot more than if it had been a large group" [Kate].

For Kate then, being part of a small group can have a beneficial impact on learning as it facilitates interaction with the teacher. This was supported by Lisa who finds that the large group size leads to the class being 'very squashed'. For Lisa this acts as a barrier to effective learning to it leads to distractions and reduces the amount of possible interaction. Similarly, Martin also reflects how a large group can impede on effective learning:

"There were too many people in the room so it was hard to concentrate...the amount of noise made it guite confusing" [Martin].

For Martin, the dimension of the group can therefore influence the learning achieved as a sizeable group can be harder for the educator to control, which leads to interruptions and a higher level of background noise than he experiences when in smaller groups.

The size of the group therefore seems to influence the students' perception of whether it is appropriate to ask questions and interact with the educator. Furthermore, they relate the ability to concentrate and opportunity to ask questions as important factors when considering the capacity to learn from infection prevention education.

5.7.3 The effect of time

Time was a theme that emerged that effected learning from the perspectives of the infection prevention nurse educators and the pre-registration nurses, but not for the post-registration nurses. For the nurse educators the time of day that training was conducted considerably affected learning whilst for the student nurses the half an hour to one hour duration of time allocated for the class altered their learning. Yet for the post-registration nurses, although with regards to time Claire was despondent that she has to access infection prevention training annually which she feels will become 'monotonous', there were no other contributions to this theme from this perspective. Therefore for the staff nurses time is not a factor that they feel impacts on their learning in any way. For the pre-registration nurses time was instrumental in that learning was enhanced when there was sufficient time to effectively interact and engage with the teacher.

The infection prevention nurse educators describe how the time of day that they conduct training can affect learning outcomes. Paula explains that recently she had taught a group of nurses at the end of the day and found it difficult as they had attended a whole day of mandatory training already. She sensed that 'they had had enough' by the time she was allocated to teach, she thought they looked 'fed up' and found that it was challenging to get 'some interaction going'.

Rachel also refers to the time of day as a key element to effective learning. She reflects that 'staff seem tired' if attending an afternoon session, which makes it 'harder to engage' and therefore can inhibit learning. It seems the trainers perceive that the most effective learning is achieved during the morning and that

conducting sessions in the afternoon can negatively impact on the learning accomplished from the training.

Similarly, for the student nurses, time can act as both a barrier and a catalyst to learning. For Lisa, Olivia, Martin and Natalie, the infection prevention classes are 'very rushed' as not enough time is allowed for both the theoretical component to be learnt and the practical element to be practised with in the allotted timeframe. The swift pace leads Lisa to question the learning outcomes of the class as she expects to receive education regarding the management of patients with MRSA and *C. difficile* yet has not. For Natalie, the length of the class impedes her learning as she feels unable to interact with the teacher,

"It was impossible to ask any questions as there was just not enough time" [Natalie].

Again, Natalie provides insight into the concept that the reduced opportunity or ability to interact with the educator has an adverse effect on learning from an infection prevention session. The majority of the student nurses' experience therefore suggests that insufficient time for a class is not conducive to the learning experience.

Interestingly, whilst Kate disagrees that the pace of her infection prevention class is 'rushed', she, like Lisa, feels that it does not cover sufficient content to effectively prepare her for placement. Therefore it seems that time can have an impact on the learning outcomes for the pre-registration nurses by enhancing learning if there is sufficient time in which to cover the content but also by impinging upon learning when time is too limited.

The concept that some infection prevention nurse educators have sufficient time in which to deliver their content but others do not is an interesting one, and suggests that there may be discrepancies between the teaching material being covered and the quality of learning achieved, or that different students learn more effectively when exposed to different teaching methods.

5.7.4 The effect of the teacher

The role or influence of the teacher on learning is a concept that emerged from the experiences of infection prevention training provided by the nurse educators and

the pre-registration nurses. Interestingly, the effect of the teacher on learning was not a theme that emerged from the experiences gained from the staff nurses, perhaps because they had only ever experienced such education from the local infection prevention nurses. However, it resonates consistently throughout the experiences gained from the student nurses and the infection prevention nurses. For the infection prevention nurse educators the manner or attitude with which they deliver education affects the learning achieved by the audience. In contrast for the student nurses the proficiency or role of the teacher can influence the quality of the education that they receive, particularly in the clinical setting.

For Paula, the manner in which the infection prevention nurse approaches the training or addresses the group can impact on the learning accomplished. She feels that her attitude can alter the quality of learning achieved from a session in that those attending training can detect unenthusiastic undertones exhibited by the educator:

"I'm bored of teaching it so they must be bored of listening to me" [Paula].

Paula believes that her apathetic attitude towards delivering education has the potential to be reflected in the feelings of those that attend training, and that this can therefore negatively influence the learning process through making the communication of the subject matter a laborious or uninspiring task.

Similarly, Rachel considers the attitude of the trainer as a factor that can facilitate or inhibit effective learning from infection prevention education:

"If you're having a bad day or go in a bit grumpy this can affect the quality of the session you deliver as they seem to pick up on it" [Rachel].

Again Rachel refers to the quality of the training provided here which she feels is an important aspect of enabling nurses to learn from the training. She discusses how the trainer can also promote effective learning, through being realistic with regards to the time, staffing and resource pressures currently on nursing staff in practice and appreciate nurses' comments or concerns on the content of the session 'from the ground up'.

The insight provided by the pre-registration nurses also finds that the teacher impacts on learning by affecting the quality of the training provided. However,

whilst for Paula and Rachel this is due to the manner in which the teacher delivers such training, the students do not consider the attitude of the teacher as an aspect that influences their learning from infection prevention training in any way. For the student nurses, learning is affected by the standing or qualifications that the teacher possesses.

Natalie explains how she learns the majority of her infection prevention knowledge and skills not by infection prevention nurses in class but by healthcare assistants on placement:

"The HCAs are fantastic and you learn so much from them, especially the really practical elements like how to clean commodes and why things are done in certain ways, so that it all starts to make more sense" [Natalie].

For Natalie, the skills that the healthcare assistants impart to her enable her to put prior theoretical knowledge that she has learnt in class into context and begin to build the theory-practice gap to underpin her understanding of practice. Similarly, Kate also reflects that she discovers valuable 'bits and pieces' and key skills from the healthcare assistants and housekeeping staff and relatively little from her mentor or her infection prevention classes in comparison. Kate explains that this is beneficial to her learning about infection prevention as the healthcare assistants explain the rationale behind practices that the nursing staff seem not to, which has helped her to understand how applying good practice impacts on the risk of infection being reduced.

However, Olivia comments that it is perhaps not the responsibility or the role of the healthcare assistant to provide such clinical supervision to student nurses when in the practice setting:

"The HCAs have taught me an awful lot about infection control...but if you didn't have a good HCA you might not learn these skills so is it fair that it is left up to them to teach us these things?" [Olivia].

This is perhaps concerning, as although healthcare assistants are generally very competent, it is not their role to mentor student nurses and their knowledge may in some situations provide an inaccurate evidence base for drawing upon the

rationale for best practice, simply because they are not generally exposed to the underlying principles of practice that nurses are.

Interestingly, both Natalie and Olivia have sought the knowledge and experience of clinical nurse specialists and have spent a morning with an infection prevention nurse. For Natalie this positively impacts on her experience of learning about infection prevention:

"There is so much more to it than telling people off for not washing their hands, I think this needs to come across to make students see infection control actually runs through all of our clinical skills we do every day" [Natalie].

This observation suggests that the current infection prevention education that student nurses receive in general, in either the clinical or the academic setting, may not sufficiently depict infection prevention as a skill set that underpins daily practice. Similarly, Olivia feels that shadowing the infection prevention nurse in the clinical environment facilitated her learning about this topic as it made her realise that infection prevention plays a 'vital part' in every clinical skill she undertakes in the practice setting.

Therefore from the perspective of the pre-registration nurses, the teacher has a significant impact on the learning that they achieve from both the classroom and the clinical setting. Perhaps the continued focus of infection prevention as an essential skills cluster in the *Standards for Pre-registration Nursing Education* (NMC, 2010) will help to embed this concept into future curricula.

5.7.5 Teaching resources and methods

Closely linked to the concept of the teacher effecting learning is the theme that explains how teaching methods and resources can influence learning. Within this context the infection prevention nurses discuss the teaching resources being standardised, reflective of current practice and also explain how the pressure they feel to conduct training to meet targets impact on the teaching methods available to them and therefore the quality of the learning. The staff nurses provide insight into how the practical resources and visual subject material utilised enhance the learning experience and the student nurses reflect how the teaching resources and equipment available can both facilitate or hinder effective learning.

From the perspective of the infection prevention nurse educators, Paula and Rachel talk extensively around their experiences of delivering infection prevention education and the different elements of the teaching process that in their understanding effect successful learning of this topic. With regards to the resources utilised to provide infection prevention education, Rachel explains how she feels that inclusion of an overview and insight into the Trust rates of infection improves the learning achieved in a session. For her, part of the session 'shows them the bigger picture' by emphasising the impact that the introduction of specific infection prevention measures have had on the reduction of healthcare associated infections. Rachel feels that this is an essential element that can enhance learning if it is included in the content,

"I think that if they can see how the new practices, policies and products affect infection rates and make it safer for patients then they are more likely to listen and take it away with them" [Rachel].

For Rachel, linking the theory of infection prevention to the practices and policies that staff are expected to comply with enhances the learning achieved during the session. Rachel also stresses how important she feels it is to keep her teaching material up to date in order to maintain quality and provide 'proactive and interactive' learning and is also concerned that those that attend training should learn something useful from it in order for the training to be effective.

Similarly Paula feels that the content of the resource used can have a negative impact on learning if it is does not reflect current practice,

"The presentation that we use needs refreshing...some of the photos are outdated...some of the slides are really old as well...I just don't think it meets their needs" [Paula].

Paula therefore considers that the educational content of the session can adversely affect nurses' learning in that imparting subject matter that is obsolete does not successfully fulfil the learning outcomes in a manner with which she is satisfied. For Paula, outmoded resources do not inspire effective learning. This is an interesting perception that reinforces the desire that both trainers convey to maximise the learning potential from the training they provide. They are mutually keen to ensure that not only a minimum learning outcome is achieved, but that nurses learn effectively from the training they are attending and to apply new knowledge to practice.

However, Paula also feels that having a 'standardised presentation' impacts positively on learning outcomes as it ensures that regardless of whichever of her colleagues delivers training, the same material is taught. However, she also explains that this learning material is a very cumbersome resource that can become monotonous,

"Some of them even fall asleep at the back occasionally" [Paula].

Paula feels that although standardised across the Trust, the training resource utilised to deliver infection prevention education can therefore impede effective learning as it does not facilitate interaction or generate enthusiasm for the topic.

Conversely, Rachel uses a variety of resources to enhance the quality of the teaching provided and therefore the learning achieved. For example she utilises a video to demonstrate correct hand hygiene technique and a question and answer section at the end of the session to reinforce the teaching plan and to keep the training fluid and interactive. Both nurses therefore provide an insight into how the teaching resources can impact both positively and negatively on the teaching process of infection prevention education. If the aim of learning is to achieve a change in behaviour as a result of an interactional experience, then the trainers have identified a variety of factors that affect the success of learning that are related to the teaching resources employed.

The nurse educators identify that they use the same teaching methods which include theory and practical elements. For Rachel the variety of teaching methods employed during each training session constructively impacts on the learning process so that those with different learning styles are accommodated:

"Some learn best from numbers, some from the practical element and some from the question and answer part of the session so you have to use a range of methods to include the whole group" [Rachel]. Therefore for Rachel utilising a range of teaching methods during a training session enhances learning by enabling it to be 'flexible'. Meeting the needs of her audience is important to Rachel and she feels that infection prevention teaching needs to be delivered in a 'dynamic and proactive' manner in order to gain the most interaction and facilitate successful learning by providing opportunities for the group to apply the material that she has presented to them.

However, Rachel does find that the organisational approach to training means that she predominantly delivers training through lectures that are 'open to all staff'. She reflects that this is challenging as aforementioned in the theme surrounding how the dynamics of the group impact on learning. Rachel 'makes no apologies' when delivering lectures to combinations of staff that the session will be clinically orientated, but she feels compelled to ensure that the nursing and medical staff receive the necessary knowledge and skills to 'affect the reduction' of infection rates. For Rachel, a sense of pressure to therefore lecture to mixed groups of staff, factors that she earlier identified as contributing towards ineffective learning, surfaces in frustration as although she knows this is not the most effective way of teaching, she must conduct training in this manner anyway:

"Our most common feedback from the annual refresher is that 'most of it was not relevant to me' but what can you do, you don't want to waste people's time or teach them things they don't understand or aren't relevant but you have to include the clinical aspects for the clinical staff that are there" [Rachel].

Rachel therefore perceives that the pressure to predominantly lecture to a large variety of staff groups impacts negatively on the teaching process as it means she has to impart knowledge and skills that are largely irrelevant for many of the staff that attend. Rachel does explain that although teaching in this manner is not ideal, for her the consolation is that she can see how the result of increased training contributes towards decreased rates of infection through enabling her to 'communicate new practices and policies' to the nursing staff.

Paula also discusses the teaching methods that she utilises and how they impact on the teaching process. She reflects that the principle method of lecturing that she uses can inhibit effective teaching as it 'bombards' the group, reduces the amount of interaction and does not retain the interest of the audience. Yet there is a substantial target of staff that must attend infection prevention training each month that means that Paula has to train vast numbers of staff. This forces a despondent attitude towards training upon her as she feels restrained to the lecture style of teaching method that she knows can be tedious to teach:

"I know we have got to train train train to meet our targets but what is the point if they are not taking anything new away with them and then actually applying that in their clinical area" [Paula].

Paula feels that by predominantly training through a lecture style of teaching she is not fulfilling the teaching process sufficiently for this practical subject and consequently the nurses do not learn effectively or apply new knowledge or skills to their practice.

Therefore equally for the nurse educators the pressure put upon them to deliver infection prevention education to large groups in order to meet mandatory training targets can affect the teaching delivered, with both beneficial and futile consequences. Effective teaching involves the process of interacting over a subject in order facilitate the impartation of new knowledge or skills (Ranse & Grealish, 2007). Therefore for the two trainers, the teaching methods employed can impact on the quality of the teaching provided by determining the amount of interaction that is achievable. Thus together the nurses' experiences of teaching demonstrate that the teaching methods and resources utilised are intrinsic elements in the effectiveness of learning, which is enhanced when the methods are varied, interaction is maximised and the resources are relevant and inspiring.

The teaching resources and methods utilised by the infection prevention nurse educators also impact on the quality of learning for the staff nurses. All of the post-registration nurses reflect that the practical resources used for part of the education contribute positively towards the learning that they achieve as they enable a visual teaching method to be used. For this group, the practical demonstration and audience participation that enables them to assess their own skills provides effective learning and supports them to improve their practice as an outcome of the training. Fiona, Claire and Anna reflect that the practical resources provide a discernable reminder of how to improve their clinical skills or technique. Similarly Joe explains that,

"The handwashing demo was good, it's good for people to see that bugs can be spread by our hands and I think a lot of staff don't realise that or forget it" [Joe].

For Joe, practical teaching resources provide a memorable learning experience that he then feels able to apply to his practice. Therefore the post-registration nurses are able to both recollect and reflect upon the improvements to learning that the practical teaching resources and methods facilitate. Anna also describes how practical and visual resources enhance her learning by leaving a lasting impression that she is then able to embed into her practice:

"She had some photos...a linen skip that was overfull and we had to say why that was a risk of cross-infection, now I always take the skip to the patient instead of carrying linen around the ward so that was a really good way of teaching good practice...that was more memorable than just being told that say linen bags are white" [Anna].

Debbie also describes how visual resources are beneficial to her learning as they 'make it memorable' in comparison to more formal resources used in a lecture and empower her to effectively introduce what she learns from visual resources in to her daily practice. The staff nurses therefore prefer practical teaching methods and resources that are interactive and that they can connect with to enable them to transfer learning to the clinical setting.

In contrast, with regards to the theoretical teaching resources that they experience, the staff nurses collectively cannot recall what they learnt from the academic aspect of the education. Beth discusses how she cannot remember 'anything striking' from the theoretical element of the session and Ellie questions whether it is a 'waste of time' attending education if unable afterwards to recall what was taught. For Hannah, it is not a concern that she cannot recollect the academic component of the training, as she feels confident that it comprises knowledge and skills that are already familiar to her:

"We did handwashing and I can't remember what else...it was probably things I already know so it didn't really register" [Hannah].

For Hannah, the rationale that she provides for not distinguishing what she has learnt being because she already knows it is perhaps tenuous, but this same justification is used by the majority of the post-registration nurses who fail to recollect what they learnt. Claire describes how it is acceptable as she knows 'a lot of it' already and Joe explains it is because the subject material provides 'nothing new' or no new knowledge for him. Gemma feels that the theoretical element constitutes basic learning objectives that 'everyone knows already', which makes it challenging to show enthusiasm towards and to remember the content delivered. The justification that the staff nurses provide for failing to recollect the theory learnt at infection prevention training is a nonchalant consensus that it is because they have previously apprehended this knowledge.

However there is also the intimation that a further rationale prevails for the postregistration nurses not effectively learning from infection prevention training that the subject matter is onerous and the teaching resources and methods are unconstructive. Claire feels that the cumbersome nature of the teaching resources adversely affects her learning as they are 'not very inspiring' or do not prompt her to engage with the lecture or learn from it. Similarly Joe experiences that there is 'too much information' or content imparted which prevents him from learning effectively and Gemma describes a sense of 'information overload' due to excessive subject material delivered in a lecture style:

"I can see why you have to have it as a lecture to tick the box that everyone has had infection control training but it really is a lot crammed in that covers everything for everywhere just in case there is someone there from that area" [Gemma].

For Gemma there is a feeling that the content does not facilitate her learning as it is very generic and is considerably altered by the audience in that the depth of the subject material is lessened the broader the audience. Fiona also feels that the 'lecture' approach to infection prevention education is challenging to learn effectively from and reflects that, for her, ward-based education enhances the learning process as it better bridges the theory-practice gap making it 'easier to remember' which empowers her to 'do better in future' and apply what she has learnt directly to her practice. Similarly for Isobel, the teaching method utilised also adversely affects learning by creating a formal learning environment:

"The ICN used projector which made it like a lecture, I can remember drifting off on some bits it reminded me too much of university" [Isobel].

The teaching methods therefore impact on Isobel's ability to recollect what she has learnt as they were not interactive and did not facilitate her engagement in the session. From the perspective of the staff nurses, the teaching methods used can therefore impact on the capacity to learn the topic of infection prevention nursing in that lectures are not conducive to learning skills that are practical in nature as they do not facilitate interaction or allow the nurses to practise the skills being taught.

The student nurses' experience of infection prevention education also reveals that the teaching resources can affect the level of learning achieved, although they do not specifically discuss teaching methods as a contributing factor, perhaps because as pre-registration nurses this is a concept that they have not yet learnt about. They have the unanimous view that the theoretical content delivered to them did not provide them with the knowledge and skills they feel they require prior to their first placement in the clinical setting.

Within this context, Natalie describes how for her the teaching resources did not provide sufficient understanding to 'make me feel happy' about infection prevention practices before working in the practice environment. Similarly Martin reflects that the resources applied to teach him with regards to MRSA and *C. difficile* were patient information leaflets. He feels these resources are 'not really good enough' to afford him the knowledge to feel confident with regards to caring for patients who present with or acquire these micro-organisms in practice. Kate has a comparable experience with regards to insufficient teaching content and resources:

"It should have covered MRSA and C.diff as straight away on placement we need to know how to look after patients with these infections" [Kate].

It is therefore important to Kate that the education she receives effectively equips her with the proficiency to feel competent to care for patients with diseases, particularly infections she is likely to encounter in practice such as MRSA and *C. difficile*. Therefore, all of the pre-registration nurses feel that the teaching resources for the theoretical element of the class did not sufficiently prepare them for the clinical environment.

However, a perception that enhances the student nurses' experience of infection prevention education is the equipment used during class. All of the pre-registration nurses reflect that the resources used for the practical element of the education are 'really good' as they effectively facilitated them to understand and retain the learning objectives regarding hand hygiene. Martin explains how these teaching tools have enabled him to embed good technique into his practice:

"The ultraviolet light box was really good, I was horrified that I missed my thumbs so now I always make sure I clean them when I wash my hands" [Martin].

For Martin, the practical component of the class is therefore both memorable and beneficial to his practice as it helps to bridge the theory-practice gap by allowing the students to practice a clinical skill that underpins every element of their practice in the clinical setting. This opinion is reinforced in the experiences of infection prevention education for the other student nurses in that the practical resources and equipment facilitate effective learning compared to the theory aspect of the class that they feel did not adequately prepare them for the clinical setting.

For the pre-registration nurses, the concept of teaching resources and within that the equipment utilised suggest that a practical approach to infection prevention training effectively facilitates learning as it provides more memorable outcomes to learning that the student nurses then successfully apply and embed within their clinical skills in the practice environment.

5.7.6 Improving education to enhance learning

The final theme that emerged from the trainers' experiences of infection prevention training is the variety of solutions available to improve learning from infection prevention education. The two trainers discuss their views and understanding of how training could be developed in order to enhance the learning opportunities provided for this subject. Within this theme they explore the improvements that they feel would augment the learning achieved in both post- and pre-registration education.

With regards to post-registration infection prevention education, the two trainers feel that developing the teaching resources and methods and having specific groups of professional audiences would improve the learning outcomes for nurses receiving training at the two hospitals. For Paula, being able to provide training to small groups of clinical staff, rather than large groups of various staff that she currently educates, would improve the teaching she provides and subsequently the learning achieved. She feels that by 'targeting' the clinical staff,

"We could stop wasting our time and theirs by only training the clinical staff... the ones that actually touch the patients...they're the only ones that need training, for the rest it's a waste of all our time" [Paula].

Paula also explains how by being able to focus training on the clinical healthcare staff would enable her to be more 'proactive' and 'innovative' with her teaching methods. She expresses how she would like infection prevention training to include the 'consequences of poor practice'. She feels that the lessons learnt from root cause analyses when patients acquire MRSA bacteraemias or unfortunately die from C. difficile 'never get back to the staff at the cold face', and that by sharing such outcomes and local consequences of poor practice would assist in reinforcing the importance of infection prevention compliance. For Paula, using past experiences would be a more constructive use of her 'training time', coupled with 'spot the difference' practical examples of good and poor practice. She feels that introducing such teaching resources would facilitate improvements in teaching by providing more 'visual' material that would increase interaction, and enhance learning by conveying a more 'memorable' content. For Paula the most important aspect towards improving training is delivering the relevant knowledge and skills in a manner that enables nurses to 'relate them to their own practice' and apply them in their practice setting:

"I've been thinking about some scenarios we can include to bring in all of the infection control elements we know they need to know but in a more sensible way...that is much more applicable to their practice...that gives them the thought process...about what to do, and in what order...so that they can go back and implement it, which is the key" [Paula].

Paula therefore feels that training would be significantly enhanced if the focus was to facilitate or nurture nurses to develop the skills, knowledge and 'thought processes' necessary to implement the infection prevention practices relevant to their clinical setting.

Similarly, Rachel reflects that the training experience would be enhanced if the audience present comprised comparable professional groups as this would enable the teaching to be aimed at the appropriate depth:

"Training could be improved by better suiting the needs of those that attend" [Rachel].

For Rachel this would therefore enable her to teach relevant content in order to enhance interaction and therefore learning. However, whereas Paula is keen to 'break the mould' and transform her approach towards training, Rachel is working with infection prevention nurse leads from various regions to 'standardise' infection prevention training nationally. She feels that this will 'raise the quality' of training and facilitate educators to 'embed key elements' into training. For Rachel, this will therefore enhance the quality and the effectiveness of the learning achieved.

Rachel also provides infection prevention education for the pre-registration nurses at the university prior to their first placement in year one. She explains that this is challenging as infection prevention skills are very practical by nature and at this early point in the pathway the students do not have any familiarity with the practice environment. Rachel remarks that:

"They are so new that they find it difficult to relate to what I am teaching them about what happens in the clinical setting as they have no practical experience yet" [Rachel].

Rachel feels that it would be much more valuable to teach the nursing students once they have gained some experience in the clinical setting as this would permit them to be more reflective and able to apply the learning outcomes from the classroom to their practice. Paula has similar experiences of delivering infection prevention education to the pre-registration nurses. She agrees that they are so 'new' to nursing that she feels she 'bombards' them with too much content but senses that she has to in order to 'prepare' them for practice as they so rarely have access to infection prevention education. Paula reflects that the pre-registration nurses would benefit more from having regular infection prevention classes throughout their training,

"It feels like it is thrown in as an afterthought rather than running through their training" [Paula].

For Paula, improving the frequency of teaching would enable the educators to underpin knowledge and skills, 'build upon' previous learning material and embed more effective learning. She does identify a concern that because the education is shared among infection prevention nurses from various Trusts, there is a lack of clarity and communication regarding learning content, outcomes and expectations:

"Because we share this task with [the infection prevention nurses] from [two other hospitals] you don't know what the last nurse taught them so you might be repeating things they already know and completely missing things that no-one has taught them" [Paula].

Paula therefore has concerns surrounding the lack of cohesion towards the teaching plans and learning objectives for pre-registration infection prevention education, and feels that some 'joined up thinking' towards this education would be reflected by improvements in both teaching and learning for student nurses. Together the two educators therefore feel that the pre-registration experience of infection prevention education would be improved if a collaborative approach were implemented between the different infection prevention nurses to ensure that regardless of the educator, standard foundations are established and then built upon and embedded in each subsequent year.

The post-registration nurses also suggest that improvements to the educational content are required in order to increase the learning experience from infection prevention education. From this perspective, education on this topic would be significantly enhanced if it was delivered in a more practical nature with more examples from and emphasis on the clinical setting in which they practice.

For Ellie, attending education that has a clinical and 'hands-on' focus facilitates learning as she finds it 'easier to learn' clinical skills by physically practising them. Similarly Joe discusses how being able to perform skills at training sessions enhances his learning and consequently his practice:

"The last one at [university] was much more practical, actually having a go at aseptic technique is much more useful to me than hearing someone talk about it...it means I could actually make sure that my practice was right and that I wouldn't be causing infection" [Joe].

Joe therefore feels that by practising infection prevention skills at training provides him with the confidence and reassurance to conducts key skills correctly in the clinical environment and reduce the risk of infection to patients as a consequence. The other staff nurses also reflect that education would be of greater benefit if it empowered them to learn key skills more effectively. For Beth, learning how to improve her documentation proficiency would be advantageous and she feels that this needs to be 'taught better' to improve her practice. Equally Anna reflects on the last training session she attended and describes how although the trainer reported concerns in the clinical with regards to inadequate documentation, they did not teach the group how to complete nursing records accurately:

"The ICN said that there was poor documentation in the cannula care plan...but she didn't show us how to fill it in properly...so I might still be filling it in wrong I don't know" [Anna].

For Anna this was not a useful use of educational time as she has attended training but not learnt how to improve her practice as an outcome. Anna therefore feels that infection prevention education would be more effective if it had a more practical essence that facilitated the learning of key clinical skills such as documentation.

One suggestion that the post-registration nurses have for enabling infection prevention education to achieve a more practical focus to empower them to learn more effectively is the concept of clinical-based scenarios. Gemma explains how for her scenarios would enhance the quality of the training provided by enabling it to become more interactive rather than teaching 'absolutely everything every time'. She advocates using examples of 'real patients' or previous cases of healthcare associated infections and teaching the lessons leant to enable the nurses to identify 'where things went wrong' and how such infections can be prevented from reoccurring. Similarly Claire feels that the current teaching resources do not facilitate her to transfer what she has learnt to the clinical setting:

"It isn't that simple in practice when you think 'oh, this patient might have C.diff, what should I do?' I think that scenarios would be a better approach...it pulls all the relevant bits of infection control together...and would make it much more memorable and easier for us to think what to do and do the right thing if it happens on our shift" [Claire].

For Claire, attending infection prevention training that is practical-based increases the amount of content that she remembers or learns as she is able to directly relate it to her practice. Ellie also feels that if the session was more practical it would be 'much easier to learn and remember it' for the next time such skills were required in the clinical setting. The concept that being able to remember or to learn effectively from infection prevention education is important to the staff nurses to enable them to feel confident when they return to the practice environment. Joe would also rather attend training that utilised 'realistic situations' or practice-based scenarios to 'test' his knowledge as this would better empower him to 'think through the actions' he would need to apply in similar circumstances if they arose in his area of practice.

The use of visual teaching resources is also discussed by the staff nurses as a tool to enhance the learning experience by making it more memorable. For example Debbie feels that the use of images from the clinical setting would improve the learning she could achieve from infection prevention education. Debbie 'can't really remember much' of the theoretical element of the session, yet the visual aids utilised 'stuck in my head' much more effectively. She feels that learning about infection such as MRSA and *C. difficile* through images rather than through pedagogical lecturing would 'make people remember what to do' more successfully. Gemma also suggests that visual aids to teaching enhance the learning experience. For her images such as graphs that depict the decline of infection rates as an outcome of improved practice would enable her to appreciate how 'your work on the ward really does count' towards the reduction in the risk of infection to patients.

The inferences to improve learning for the post-registration nurses have centred around the concepts of being able to access training that is more interactive with a focus on the practice setting and opportunities to demonstrate clinical skills and gain a better understanding through visual resources and problem-solving scenarios. However, the staff nurses also consider the context of the learning environment as another influential factor towards enhancing their learning and therefore their practice. For this group of participants, there is a feeling that the environment that most effectively facilitates their capacity to learn is that of their own clinical setting.

Hannah feels that attending classroom-based training becomes monotonous and that training in the practice setting would be more beneficial. She feels that this would enable the trainers to 'reinforce the basics' as staff often 'go into auto-pilot' and perhaps unknowingly conduct poor practice although they have recently attended a training session. Similarly Claire feels that staff nurses would learn more effectively from having the clinical expertise of the infection prevention nurse in the ward environment to support nurses to identify episodes of substandard practice:

"It would be better to have the ICN on the ward to point out poor practice or the wrong ways of doing things as although people can sit in a classroom and think 'I don't do that' they go into auto-pilot on the ward and do it anyway" [Claire].

For Claire being able to practise clinical skills under supervision in the practice setting and gain constructive feedback that facilitates improvements to practice would therefore enhance learning by addressing the concept that nursing routines can become habitualised, and on occasion, non-compliant as a consequence. Isobel also feels that learning would be improved if infection prevention education was delivered in the clinical setting. For Isobel, this would permit the subject material to be tailored to better suit the needs of the nurses attending training. This would empower nurses to 'get more out of it' or learn more effectively from the training as it would enable the training to be both more interactive and focused on practising key clinical skills that specific nurses regularly perform in that setting,

"I think you get more out of training by physically doing a skill like cleaning a commode or completing a care plan with someone is better than just seeing it on a PowerPoint" [Isobel].

Therefore for Isobel receiving infection prevention training in the clinical environment would be significantly more valuable as it provides assurance for her that she is conducting skills relevant to her specific area of practice competently. However it may be considered unrealistic or controversial to ensure that all postregistration nurses receive their annual infection prevention training in their own clinical setting. Yet there is a definitive sense among the staff nurses that the most effective way for them to learn about this topic is in a very practical environment with visual or practical resources that support them to gain confidence and reassurance that they are performing key infection prevention skills effectively in their clinical setting. This perhaps reinforces the need for improvements to infection prevention training to be made in that post-registration nurses do not seem to feel competent in their aptitude with key clinical skills.

For the pre-registration nurses the potential improvements to infection prevention education centre around the subject content and regularity of pre-registration education. All five student nurses feel that in order for this education to be improved the teaching material should be expanded upon to include the nursing management of specific infections. In addition Lisa, Natalie and Olivia feel that the teaching resources should also incorporate the 'practical' infection and prevention control skills that they require in the clinical setting, rather than just standard precautions. Kate's reflection encapsulates the temperament of the group.

"It would be better for us to learn more about MRSA and other infections while we are at university" [Kate].

For Kate, and indeed all of the students, the current subject material that they are receiving does not meet their needs to sufficiently prepare them for the clinical environment in the first year of university.

Furthermore, for Olivia and Martin who are in their second year of pre-registration education, the basic knowledge and skills that they learnt in year one do not seem to have been expanded upon as they have received no further infection prevention education since the session they attended prior to their first placement at the commencement of year one. Martin explains how increasing the frequency of education would enhance his knowledge and understanding of infection prevention practices more effectively. For him, more regular education on this subject would provide the opportunity to effectively gain an understanding of infectious diseases, 'rather than just hand washing'. Natalie also discusses how even the current education provided in the first year can be difficult to retain:

"If your first placement is the community project you can forget what you learnt in clinical skills weeks by the time you work on the ward so it would be better to have a smaller session before each placement rather than it all at the beginning of the year" [Natalie].

For Natalie, increasing the frequency of education available for clinical skills, including those pertinent to infection prevention practices, would facilitate more effective learning of such skills that underpin daily nursing practice and better empower her to become a competent practitioner.

The experiences into infection prevention education from the pre-registration nurses therefore suggest that if this education was embedded or mapped throughout the pre-registration nursing curriculum it may improve both the quantity and the quality of content able to be delivered and therefore better equip student nurses with the skills to manage patients with infections and invasive devices effectively when on placement. An additional observation from Natalie was that infection prevention education could be included in the ward student induction packs that student nurses are provided with at the start of each placement. This again perhaps emphasises that student nurses are keen to learn more about infection prevention and that there is a need for current education to be improved and increased.

5.8 Discussion

There is currently paucity in the literature surrounding pre- or post-registration nurses' experiences of infection prevention education in both the practice and the academic settings (Ward, 2010). The findings of this study have therefore provided an original understanding of the phenomenon of infection prevention education by gaining an in depth insight into the experiences and perceptions of those that both teach and attend this pre- and post-registration education. The

themes that emerged from the data were: the learning environment, the group dynamics, the effect of time, the effect of the teacher, teaching resources and methods and improving education to enhance learning. A concept that has underpinned each theme and is central to the phenomenon of infection prevention education for all of the participants in this study is that of the importance of achieving effective learning and translating learning into practice.

The learning environment has been shown to affect learning both positively and adversely. For the infection prevention nurse educators the most conducive environment is one that limits interruptions and facilitates effective learning by enabling them to tailor the learning outcomes to suit the needs of the nurses. For the pre- and post-registration nurses a clinical learning environment is the more favoured setting as it enables them to practise key clinical skills and learn how to improve their clinical technique effectively. This finding is consistent with previous research that the practice setting is the preferred learning environment for nurses (Gould & Chamberlain, 1997; Scott et al, 2005) and may often be regarded as the most suitable venue for teaching (Cole, 2008) as it can better facilitate critical thinking than the classroom environment (Zimmerman et al, 2010). However a finding that has not previously been reported is the concept that, in this study, for those attending infection prevention education, a practice-based environment reduces the barriers between learning theory and practice as it empowers them to physically demonstrate the clinical skills being taught and provides nurses with the assurance that they are conducting such skills competently.

The finding that the post-registration nurses would prefer infection prevention education in an environment that enables them to physically practise their skills has original yet important implications for the clinical setting. It is concerning that the post-registration nurses express a need to physically practise infection prevention skills at training sessions. It could be suggested that nurses with this experience should be competent with such basic skills, but this study infers that they feel a need for further assurance, which does imply that current education strategies may be inadequate. Yet in other areas of nursing practice, the concept of work-based learning is becoming increasingly accepted as it supports postregistration nurses to gain the experience, knowledge and skills relevant to a specific field of nursing by working and indeed learning in that environment, such as critical care (Hardcastle, 2008), theatres (Quick, 2010) and gerontological nursing (Coffey, 2009). Education through work-based learning can facilitate nurses to learn technical clinical skills confidently as well as critical thinking and problem solving skills by fostering education and experience in the same environment (Hardcastle, 2008). Whilst it may be unrealistic to suggest that infection prevention education could be delivered entirely through work-based learning, it does affirm that the practice setting is the most conducive for learning clinical skills and knowledge.

Furthermore, it must also be considered that particularly for pre-registration nurses, the clinical setting is only a valuable learning environment when there is engagement and participation that facilitates learning by providing support from clinicians and opportunities for repeat experiences (Ranse & Grealish, 2007). Yet where this is achieved, the practice learning environment significantly improves the pre-registration learning experience by providing a greater understanding of how patient care is delivered (Derbyshire & Machin, 2011). The three different experiences of infection prevention education that have been explored in this study all place an emphasis on the clinical environment in enhancing effective learning as it better facilitates the ability to demonstrate competence with key clinical skills compared to the classroom environment.

The three different views of the infection prevention nurse educators and the preand post-registration nurses that attend such training all discuss how the dynamics of the group affect the experience and how this impacts on learning. Unanimously they feel that a small group of nurses most effectively improves learning as it enhances the ability both to concentrate and to engage, and ensures that the content being delivered is relevant to the audience. Interestingly, for both the infection prevention nurse educators and those attending training is the association between interaction and learning. They all feel that a smaller size group facilitates more effective interaction and opportunities to reaffirm understanding and that this leads to more successful learning. This finding is reflective of previous studies that concur that a smaller group enhances the delivery style and the learning achieved from education for post-registration nurses (Gould & Chamberlain, 1997; Cole, 2005; Burnett, 2009; Prieto, 2009). With regards to pre-registration nurses, there is a requirement by the NMC (2004) for higher education institutions to ensure that interprofessional education is provided in pre-registration programmes as this prepares practitioners for collaborative practice at the point of entry to the register. However pre-registration nursing students highly value the opportunity to learn in small and interactive groups (Derbyshire & Machin, 2011) and covey concerns over interprofessional education as it increases the size of the class and dilutes the professional relevance of the content (Morison *et al*, 2004). Whilst interprofessional education may be beneficial towards improving communication and collaboration between different healthcare professionals and services (Hammick *et al*, 2007), the results of this study suggest that it would not enhance learning with regards to infection prevention education. For this subject, findings suggest that a mixed group of professionals may inhibit learning for nursing students, as when delivered to meet the learning requirements of those with the least proficiency it may not be worthwhile for the pre-registration nurses (Zimmerman *et al*, 2010).

With regards to time, infection prevention nurse educators feel that the time of day in which they teach affects the learning achieved, with audiences being more receptive and interactive earlier in the day. For some of the student nurses the sense emerged that education on this topic was rushed and that this impeded learning as it prevented interaction with the teacher. Whilst no previous research has identified time as a factor that can effect infection prevention education, this finding is of concern as this education is delivered by infection prevention nurses yet some seem to have sufficient time to deliver the required content whilst others do not. This suggests that there may be inconsistencies between the teaching material and methods being utilised by different educators and therefore the quality of learning being achieved, which should perhaps be explored further locally to identify any such discrepancies.

The concept of the teacher was discussed by both infection prevention nurse educators and pre-registration nurses as a factor that affects learning. For those that provide education this related to the attitude or manner with which training was delivered in that an enthusiastic and dynamic teacher promotes effective learning. This finding is reflective of previous research surrounding education (Quinn & Hughes, 2007; Cole, 2008; Billings, 2010).

For pre-registration nurses the role or proficiency of the teacher influenced their It was revealed that they learn most of their infection prevention learning. knowledge and skills in the clinical setting from healthcare assistants. Whilst the student nurses find this beneficial as it enables them to learn and to practise a variety of essential clinical skills under supervision, it may not necessarily be an appropriate aspect of the role of the healthcare assistant. Although many healthcare assistants are indeed competent and have extensive clinical experience, they do not receive the same education as nurses with regards to the evidence-based knowledge that underpins practice. In some circumstances they may therefore teach student nurses an erroneous rationale for practice, simply because they are not exposed to the underlying theoretical principles of practice that post-registered nurses are. Ward (2010) explored nursing students' experiences of infection prevention in clinical placements in the UK and concluded that observation of poor practice in the clinical placement can impact negatively on learning. Findings also suggest that student nurses judge good infection prevention practice based upon both what they have learnt at university and how well practice is explained by the healthcare worker teaching them.

For the student nurses in this study, they reported that they learnt a significant amount of their practical knowledge and skills from healthcare assistants and felt they did not learn sufficient skills or knowledge at university. It may therefore be suggested that they may not be informed enough to determine differences between good or poor practice because they have not been supported enough in either the clinical or the academic environment. This can lead to student nurses feeling anxious about placement due to a lack of necessary knowledge and skills, lack of clinical supervision and lack of integration of theory into clinical practice (Sharif & Masoumi, 2005). Yet student nurses have a right to be supported effectively within each placement and mentors are a key component to providing learning in practice through facilitating critical thinking, rationale for care strategies and development of competent skills (Burns & Paterson, 2005). Yet practice assumptions and skills can often pass uncritically and implicitly between teacher and student in the clinical setting (Ranse & Grealish, 2007), particularly if that teacher has not themselves been taught how to teach, for example a healthcare assistant. Nurse mentors therefore need to be more aware of the impact of both

their practice and their colleagues' practices on their students' learning and consequently future practice (Ward, 2010).

Furthermore, the pre-registration nurses also disclose the concept that, for them, current education does not sufficiently emphasise the fundamental importance that infection prevention skills have. They are unaware that such skills underpin all elements of daily nursing practice until they spend time with an infection prevention nurse in the clinical setting. This raises concern as to the quality of the education being provided in the classroom for pre-registration nurses by these clinical nurse specialists as currently it may not sufficiently prepare them for the practice setting. Yet having specialist nurses teach at higher education institutions can enhance the learning achieved because they are actively engaged in practice they provide credibility to the topic (Murray et al, 2010). This does not seem to be echoed by this study, although the influence of the teacher on student nurses' experience of learning infection prevention knowledge and skills are able to inform both the practice and the education arenas as they suggest that improvements to pre-registration education of this subject are required, in both the clinical and the academic setting. Perhaps the increased focus for this subject as an essential skills cluster on the 2012 pre-registration nursing curriculum (NMC, 2010) will address this deficit and facilitate more effective and embedded learning for student nurses.

The teaching methods and resources were identified as a factor that affects learning from the three different perspectives. For the infection prevention nurse trainers learning is optimised when the teaching material is varied and reflective of current policy and practice. This finding is echoed in recent literature (Cole, 2009; Billings, 2010; Birks, 2011). However, with regards to teaching methods that most effectively enhance learning, the educators seem to face a conflict. They acknowledge that the most conducive learning is delivered through interactive and relevant subject material to small groups. Yet there is a significant pressure put upon them by their Trusts to deliver education to large and diverse audiences in order to meet mandatory training targets due to the Department of Health requirement that all staff must receive infection prevention training every year (DH, 2010a). This pressure to meet targets forces them to use pedagogical teaching methods to lecture in a style that they know does not facilitate effective learning for

nurses and they both express concerns regarding the reduced quality of learning that this achieves for nursing staff. The outcome of education delivered to meet the needs of the lowest denominator or staff group produces the consequence that nurses are not being taught the knowledge and skills that they require to conduct infection prevention practices effectively.

For other areas of mandatory training it has also been reported that a 'one size fits all' approach does not meet the learning needs of healthcare professionals attending (Turner *et al*, 2011) and that practical skills and knowledge decline after three to six months following training delivered by lectures (Hamilton, 2005). This is often because overuse of lecture-based teaching resources can lead to lack of concentration and engagement and often fails to encourage interaction, usually because of the large audience (Billings, 2010). Furthermore, due to the pressure put upon infection prevention nurse educators to annually train the entire workforce, NHS organisations often now provide e-learning as an alternative teaching resource to lectures or classroom-based sessions. As the internet has been identified as a constructive resource for infection prevention learning (Harvey-Teeley, 2007), the Skills Academy for Health launched the Core Learning Unit (CLU) in 2009 which supports an independent learning style through an infection prevention e-learning module.

For post-registration nurses e-learning has been identified as useful as it is accessible throughout the 24 hour shift pattern (Columbine & Wharrad, 2007) and provides an assured level of quality (Harvey-Teeley, 2007). However the learner must be active in the process of learning in order to engage with the content and gain knowledge of the subject (Quinn & Hughes, 2007) and this can be difficult to achieve with computer aided learning packages. Furthermore, the CLU e-learning modules are rather protracted and time-consuming (Hitcock, 2011), the content is generic so may not reflect local policies or practices and knowledge can be significantly lessened three months after completion of e-learning modules (Fakih *et al*, 2006). E-learning content can also become outdated and requires a commitment to regularly review and update the material (Billings, 2010). Therefore compared to studies that have found that face-to-face teaching can improve compliance to standard precautions for six months to two years following attendance (Brooks *et al*, 1999; Kim, 2003; Wang *et al*, 2003; MacLean *et al* 2008;

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Howard *et al*, 2009), it could be suggested that e-learning by itself is not a conducive teaching resource or method for facilitating effective learning of infection prevention knowledge and practical skills amongst post-registration nurses.

However, e-learning has been found to be useful for pre-registration nurses learning for infection prevention. Pellowe *et al* (2010) evaluated the value placed on the CLU infection prevention modules by 282 student nurses. They found that 94% either agreed or strongly agreed that they enjoyed the learning style and found the content relevant and 96% reported applying the knowledge learnt from this teaching resource to their practice. However, in this circumstance e-learning is not the sole teaching method for this subject but is then underpinned and expanded upon to link this theory to practice with classroom-based sessions and practical skills workshops prior to placements commencing. The results may have not been so favourable if e-learning was the only teaching resource and suggest that providing practical situations where infection prevention theory can be practised and contextualised is essential to delivering effective education on this topic.

Similarly, Barrett *et al*, (2008) suggest that as learning infection prevention requires the translation of theory into practice, e-learning perhaps should be complemented with experiential learning in the practice setting to ensure effective learning has been achieved. With regards to pre-registration learning of key clinical knowledge and skills, Derbyshire & Machin (2011) also found that students valued learning professionally relevant content in small interactive groups, using a problem-based approach. With regards to infection prevention, the results of this study highlight that the student nurses felt that the classroom-based education they received did not provide them with sufficient knowledge and skills to feel competent prior to placement, so it could be suggested that e-learning would not improve this finding. Therefore, whilst e-learning teaching methods may be effective for more theory-based subjects, the findings of these studies also suggest that it would not provide effective learning for the practical nature of infection prevention topics, unless it is consolidated with practical skills-based learning.

Furthermore, the post-registration nurses' experience enhanced learning when they receive infection prevention education that utilises examples from and emphasis on the clinical environment, delivered with practical and visual resources that enable them to practise the skills they have learnt and relate the content to their clinical setting. For the staff nurses there is a correlation between the education of this subject having practical resources to it being memorable, or indeed learnt. Billings (2010) also found that anecdotally when asked, nurses could remember and recall the content of education when it was delivered interactively including through role pay and games, irrespective of the time that had lapsed since the event, compared to through lectures. The nurses in this study demonstrate that they have applied or embedded into practice the practical concepts that they can recollect from such education, but fail to remember any of the theoretical elements that they have been taught.

Previous research into the experience of an infection prevention education programme for link nurses has found that practice was enhanced when education facilitated nurses' confidence, authority and empowerment in key knowledge and skills (Cooper, 2005). Furthermore, Breimaier *et al* (2011) explored nurses' attitudes and perceived barriers towards implementing research into practice. Findings suggest that nurses fail to apply research theory to practice due to lack of time, lack of knowledge or lack of interest. This supports the outcome of this study in that infection prevention educators must contextualise such theory in to practice and provide training that is practice-focused to ensure effective learning is achieved.

Another original finding from this study was that the rationale given by the postregistration nurses for unsuccessfully recalling the theoretical aspect of the last infection prevention training session attended was that it was likely to be knowledge that they have learnt previously. Yet when they discuss how education could be improved the staff nurses propose having infection prevention nurses provide training in the clinical setting because they feel that colleagues can subconsciously or habitually conduct non-compliant practice when in a clinical environment that is familiar to them. This finding may therefore inform practice for infection prevention nurse educators in that infection prevention practice can be ritualistic (Seto, 1995). Previous research has identified that nurses believe their compliance may be better than it actually is when observed, audited and quantified (Cole, 2008). Whilst it may be suggested that ineffective teaching methods may reduce compliance, it may also be inferred that infection prevention compliance is far more complex with determinants such as attitudes, beliefs, habits and organisational culture affecting behaviour and therefore practice (Whitby *et al*, 2006; Cole, 2008; Hanna *et al*, 2009). However it is recognised that interactive education that fosters critical thinking and a questioning approach is essential to facilitate the development of positive attitudes to change towards infection prevention practice (Cooper, 2005; Billings, 2010).

Although previous research has identified a need for increased infection prevention education (Stein *et al*, 2003; Trigg *et al*, 2008; Wu *et al*, 2009) and improvements to current infection prevention education (Mann & Wood, 2006; Vaughan *et al*, 2006;), there is relatively little research on how to achieve this or how to provide alternative interactive teaching methods and resources effectively (Billings, 2010). Findings of this study highlighted the need to be able to practise key clinical skills and have knowledge and skills tested or informally assessed. Research into other areas of nursing has identified that assessment enhances the practice development experience for nurses (Coffey, 2009). Incorporating elements into education that can assess learners' infection prevention knowledge and skills is therefore likely to improve both learning and consequently application of such knowledge and skills within the clinical setting.

This study also found that post-registration nurse education would benefit from the inclusion of more visual resources and scenarios that are reflective of their practice to facilitate nurses to develop the 'thought processes' or critical thinking required to deal with infection prevention situations that are likely to arise in their clinical setting. Other mandatory training research has found that using hospital-based scenarios to demonstrate evidence-based guidance enhances learning as it ensures that training reflects potential situations that may arise in the local clinical setting (Hamilton, 2005). The use of visual images to identify good or poor practice in infection prevention education has also been well received as it facilitates interaction, engagement, discussion and reflection and tests nurses understanding of best and poor infection prevention practices and influences

change to improve practice (Billings, 2010; Matias *et al*, 2010). This may be because visual images enable the learner to more easily access the thoughts and emotions associated with the subject content, compared to written texts (Sandars & Murray, 2009).

Some previous research has evaluated the effectiveness of storytelling to improve education. Stories are reflective and creative descriptions that guide the learner to explore and reflect upon the realities of practice (Haigh & Hardy, 2011), which in the context of this study may surround infection prevention skills and practices. The use of storytelling in formal education can provide opportunities to learn from each other through sharing meaningful experiences that can be replicated to other areas of practice (Cole, 2009). For medical students, storytelling also facilitates effective engagement and enables reflection on practice to occur (Sandars & Murray, 2009). However, it is noted that storytelling may only be effective when the learners are motivated and willing to participate and interact and this may be most successfully achieved when an informal environment and approach to teaching are utilised (Abma, 2003). Also some healthcare workers may not learn effectively from this different teaching method as they may not appreciate the richness or diversity that stories can demonstrate (Garrett, 2006). Yet when used as an element of an interactive teaching session, storytelling may effectively enhance learning by empowering nurses to question practice, challenge pre-existing behaviours and consequently change and improve clinical practice (Haigh & Hardy, 2011).

The use of storytelling in infection prevention education has only been evaluated in one study from Canada where Mah *et al* (2005) included a storytelling element in infection prevention workshops. Whilst formal research findings were not published or quantified, the response to the inclusion of storytelling was reported as exceptionally positive. Storytelling could therefore enhance learning from infection prevention education in the UK as it encourages the audience to think critically and speak freely which can enhance their understanding of compliance behaviour and ultimately improve practice (Cole, 2009).

With regards to improving the student nurses' experiences of infection prevention training at the university findings from this study suggest that it should be more practical and better related to the clinical setting, with the rationale behind practical skills embedded to facilitate a better understanding of the theoretical concepts of infection prevention. Storytelling has become well established in other areas of pre-registration nursing subjects as an evidence-based method for stimulating thought and reflection to enhance the learning experience (Davidson, 2004; Werle, 2004). The addition of storytelling could therefore be useful to improve infection prevention education for pre-registration nurses as it helps to bridge the theory-practice gap by creating thought and discussion around examples or stories from practice (Cole, 2009). Yet further research is required to develop and evaluate the usefulness of this approach to infection prevention education.

This study has identified that the content of pre-registration infection prevention needs to be expanded upon to include the care of patients with specific infections and the frequency of training should be increased to enable student nurses to build upon their knowledge and skills throughout the curriculum. This study has highlighted a deficit currently for this sample population with regards to a lack of cohesion between teachers and mapping of pre-registration infection prevention education throughout the curriculum. If this were to be improved it may enable these essential knowledge and skills that pre-registration nurses require prior to registration to be effectively embedded into their practice. For example, Thames Valley University have adopted a blended learning framework for pre-registration infection prevention education. The learners develop the required knowledge and skills through classroom sessions, practical skills-based workshops, e-learning resources and a virtual learning environment that concludes with a formative assessment centred on authentic patient care events (Pellowe et al, 2010). The embedment of the topic throughout the curriculum by incremental learning and the variety of learning styles has effectively facilitated learning by enabling prior knowledge to be linked and reinforced. Similarly in other areas of pre-registration education, Lynch-Sauer et al (2011) found that nursing student learning was enhanced through using new media technologies to learn from healthcare simulations that were integrated in to the curriculum to contextualise the theory learnt in the classroom.

5.9 Conclusion

The findings of this study therefore provide new insight into the experience of infection prevention education. The nature of the environment, the dynamics of

the group, the time, the teacher and methods and resources utilised all influence learning by affecting the ability of the nurses to interact and engage with the educator, practise skills and demonstrate competence and effectively apply the theory being taught to the clinical setting. It is imperative that infection prevention education, often considered dull or uninteresting by healthcare workers, is stimulating and engaging, and that educators of this subject consider novel approaches to impart knowledge, inform practice and encourage critical thinking (Billings, 2010). To conclude, if such knowledge is to be effectively applied to practice, then the education provided for both pre- and post-registration nurses must attain a more clinical focus, incorporate visual and authentic examples from practice and enable nurses attending such training to gain assurance that their knowledge and skills are compliant to both local policy and best practice.

Chapter Six

6. Discussion

6.1 Introduction

The preceding chapters have evaluated whether nurses' knowledge and application of infection prevention practices are affected by such factors as training, education or experience. They have also explored nurses' experiences of infection prevention education, from the perspective of both those that teach and those that attend this training. Synthesis of these findings into a corroborative and well substantiated framework for enhancing nursing knowledge and application of infection prevention practices may therefore provide useful implications for both education and practice.

6.2 Enhancing infection prevention knowledge and application

Findings from all three studies highlight concerns with current nursing knowledge and application of infection prevention practices. The evaluation of the effectiveness of clinical skills training in the practice setting suggests that existing understanding and application of infection prevention knowledge is less than optimal. This is already well established within the literature (Pittet *et al*, 1999, Ferguson *et al*, 2004; Ward, 2006; Howard *et al*, 2009). However, the *Saving Lives* (DH, 2007) audits evaluated in this study failed to score 100% consistently and did not improve significantly without the input of clinical skills training. This suggests that *Saving Lives* (DH, 2007) audits are not useful for facilitating nursing staff to learn how to improve practice with regards to clinical infection prevention skills, the application of which therefore remains inadequate.

This finding is supported by the results of the questionnaire survey that provide a new insight into how infection prevention knowledge effects application for the different elements of infection prevention practice. In particular, findings suggest that understanding of hand hygiene and use of PPE was poor yet application of this knowledge to practice was compliant, whilst knowledge of the care of patients with MRSA and *C. difficile* was poor which was reflected by substandard application of knowledge to practice. Furthermore, the qualitative study results

suggest that from the perspective of both those that currently teach and those that attend infection prevention education, the existing environment, group dynamics and teaching methods do not facilitate effective learning with regards to infection prevention knowledge and skills.

Findings from the three studies also collaboratively offer new insight into how knowledge and application of infection prevention practices can be enhanced. The evaluation of the effectiveness of clinical skills trainers suggests that the provision of infection prevention skills training in the clinical environment can effectively increase nurses' knowledge of key clinical skills such as peripheral intravenous cannulation and urinary catheterisation. Furthermore, this can be reflected through enhanced application to practice which may then be successfully Therefore augmenting knowledge and application through skills sustained. training in the clinical setting may successfully contribute to improvements in knowledge, application and audit results with the overall outcome of reducing infection rates, increasing the quality of patient care and meeting the Saving Lives objectives. The salient finding from both the questionnaire survey and the qualitative research support this contribution as they also recommend that improvements to current education are required if both nurses' knowledge of HCAIs and application of key infection prevention skills are to be effectively Similarly, previous studies have also called for improvements to enhanced. current infection prevention education in order to enhance knowledge and skills (Mann & Wood, 2006; Vaughan et al, 2006; Trigg et al, 2008; Cole, 2009). Yet the issues that prevail with regards to why existing education is not adequate remain poorly understood (Trim et al, 2003; Billings, 2010; Ward, 2011).

6.3 Enhancing infection prevention education

Through exploring nurses' knowledge and application of infection prevention practices, the three studies collaboratively indicate that education is intrinsically linked to knowledge and application and that current education is often not conducive to effective learning with regards to infection prevention skills. The evaluation of the effectiveness of clinical skills training study highlights concerns with current infection prevention education as results suggest that without the provision of clinical skills education in the practice environment, infection prevention prevention prevention prevention study for the questionnaire survey.

supported this concept further through the revelation that although a large number of participants had attended infection prevention education within a year of the study both knowledge and application of knowledge to practice was poor. This suggests that either the content or delivery of the training was not sufficient, or that the classroom environment in which the majority were taught infection prevention skills does not facilitate nurses to effectively learn these skills, which are very practical by nature in that they are applied during episodes of patient care. Furthermore, the exploration of nurses experiences of infection prevention education indicate that from the perspective of both those that teach and those that attend infection prevention training, currently the classroom environment, the group dynamics and the teaching methods and resources are not conducive to effective learning.

The combined conclusions of the three studies conducted therefore highlight concerns with regards to existing infection prevention education. They support the notion that current education may not be sufficient to equip nurses with the knowledge and skills required to effectively care for patients in an environment in which the risk of infection reduced. Previous research has also suggested that the classroom environment (Cole, 2008; Billings, 2010; Zimmerman *et al*, 2010), the group dynamics (Gould & Chamberlain, 1997; Cole, 2005; Burnett, 2009; Prieto, 2009) and the teaching methods (Barrett *et al*, 2008; Sandars & Murray, 2009; Billings, 2010; Pellowe *et al*, 2010) can act as barriers to effective learning.

Yet the finding from the qualitative study that the current environment and teaching methods can obstruct learning because they inhibit the opportunity for nurses to practise key clinical skills and have knowledge and skills tested or informally assessed provides new insight into why these barriers to learning prevail. This study also highlighted a deficit currently for pre-registration nurses with regards to a lack of cohesion between teachers and mapping of pre-registration infection prevention education throughout the curriculum. If this were to be improved it may enable these essential knowledge and skills that pre-registration nurses require prior to registration to be effectively embedded into their practice. Yet little has been published to inform either the practice or the education setting with regards to how to improve education in order to improve knowledge and application of infection prevention practices (Ward, 2011).

Findings from the three studies conducted provide some innovative insight surrounding how infection prevention education could be enhanced, which may inform both the practice and the academic arena. The clinical skills training evaluation suggests that the provision of infection prevention skills training in the clinical setting improves application to practice. This is reinforced by findings from the qualitative study undertaken which revealed that all three perspectives of infection prevention education place an emphasis on the clinical environment in enhancing effective learning as it better facilitates the ability to demonstrate competence with key clinical skills compared to the classroom environment. This is an important result that may provide new insight into why current infection prevention training may not be being transferred into enhanced knowledge or application to practice.

Furthermore, the results of both the questionnaire survey and the qualitative study offer constructive initiatives for improving the quality of infection prevention education. Those of the questionnaire survey recommend that focussing infection prevention education on patients with specific infections, such as MRSA and C. difficile, rather than on individual standard precautions may more effectively increase knowledge and therefore application of HCAI and infection prevention practices. This is supported by the conclusions drawn from the exploration of nurses' experiences of infection prevention education that makes further recommendations for how to improve both pre- and post-registration infection prevention education in order to enhance effective learning. This study suggests that delivering education in a clinical learning environment to small groups of nursing staff using practice-based scenarios and visual resources by a dynamic teacher with a practical skills assessment may augment interaction, engagement, competence and successful application of theory to practice. Combined, the findings from the three studies therefore provide a new insight into how infection prevention education may be enhanced, as illustrated in Figure 6.1.

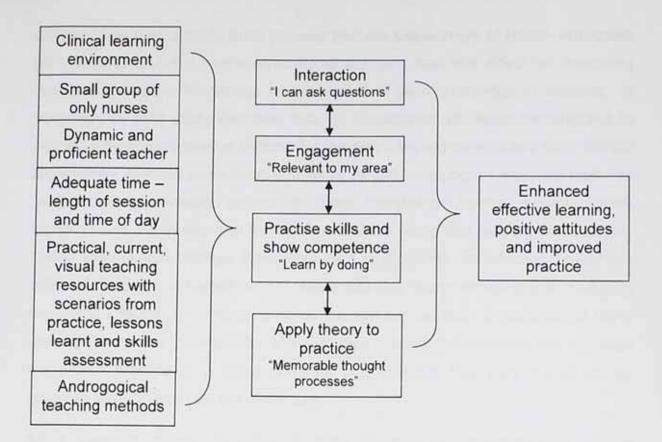


Figure 6.1: Enhancing infection prevention education

Application of a three study approach to explore the research phenomenon of enhancing knowledge and application of infection prevention practices through education has enabled the above framework for education to be developed robustly. Conducting this research from three different aspects enabled more cohesive and comprehensive findings to be elicited that collaboratively have converged to provide a practical framework for enhancing infection prevention education. For example, triangulated findings reveal that the content should include specific HCAIs and clinical skills that can be practised within a clinical learning environment. On reflection, although implementation of a three study approach was arduous and on occasion rather overwhelming, it enabled a far more holistic and credible understanding of the truth of the phenomenon under study to be attained than any of the three studies would have achieved if conducted in isolation.

The triangulation achieved in this thesis and the greater understanding of infection prevention knowledge, application and education that it has provided has also identified some important implications for policy with regards to enhancing infection prevention education. For example, the first study highlighted that the Saving Lives (DH, 2007b) audit process that the Department of Health advocates (DH, 2010a) is not a useful educational tool and has little effect on improving infection prevention knowledge or application of such knowledge to practice. In addition, the third study identified that the Department of Health requirement to provide infection prevention training for the entire workforce annually (DH, 2010a) pressurises infection prevention educators to use pedagogical teaching methods to teach large eclectic groups to meet mandatory training targets, which compromises the quality and the content of the training that nursing staff receive. These triangulated findings have important implications for infection prevention policy makers in that Department of Health (2010a) recommendations for reducing the risk of infection to patients, whether through regular audit or provision of basic training, may not necessarily achieve their intended outcomes as infection prevention prevention prevention prevention that may not so easily resolved through such simple measures.

Adult learning theory provides a more conceptual understanding of the multifaceted nature in which nurses learn and is able to underpin the educational framework illustrated in Figure 6.1 from a theoretical perspective and reinforce the positive influence it would have on enhancing nurses' infection prevention knowledge and application to practice. This is because adult learning theory is based upon the interactive relationship between theory and practice and emphasises the value of the process of learning for nurses through utilisation of approaches to learning that are problem-based and collaborative rather than didactic or pedagogical (Elliott, 2009). Whilst Knowles (1978) theory of andragogy was seminal towards raising the profile of adult learning theory, it was criticised for assuming that all adult learners learn in the same way and that it was a set of good principles rather than a theory of learning (Merriam *et al*, 2007). Yet although all adults may not learn in the same way they certainly draw on different resources to learn compared to children, which Knowles encapsulates succinctly.

The six assumptions that Knowles made centred on the concept that adults learn most effectively using self-direction, problem-centred orientation, using experience as a learning resource and are internally motivated to learn (Jarvis, 1995). It is therefore thought that adult learners are also more motivated to learn to cope with real life situations and identify their own learning needs (Knowles, 1978). This

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adult learning theory supports the framework to enhance infection prevention education for nurses (Figure 6.1) by providing a theoretical foundation for the framework. The framework demonstrates that incorporating the andragogical learning principles of nurses' prior clinical experience, self-direction and genuine practice-based scenarios into the teaching methods and resources can effectively enhance learning by increasing interaction and engagement which can result in transference of knowledge learnt into practice.

Furthermore, problem-based learning is emerging from andragogy as a teaching method that enables adult learners to not only find out about a subject but also how to think about it critically (Cole, 2005). Problem-based learning is beneficial as it facilitates the learner to develop problem-solving, critical thinking, team working and reflective skills that are essential in the practice setting (Barratt et al, 2008). This method could be very appropriate for infection prevention education as there are many circumstances to which it could be applied in order to convey the same information as an educator would through the more frequently used pedagogical method, yet to date little has been documented as to the effectiveness of this (Billings, 2010; Ward, 2011). If infection prevention educators were able to move away from the current didactic approach to teaching basic standard precautions and towards an andragogic learning approach that uses problem-based scenarios of patients with specific infections and enables key clinical skills to be practised as recommended in this thesis, then improved learning may well be achieved and reflected by improved transference of knowledge into practice.

The findings of this three study approach suggest that using a problem-based and collaborative approach to the delivery of infection prevention education in a clinical learning environment to small groups of nursing staff at an appropriate time would enable visual, practical and relevant resources to be used and infection prevention skills to be practised and demonstrated. Centering the content on HCAI and problem-based infection prevention scenarios rather than standard precautions, may more effectively enhance nurses' knowledge through facilitating interaction and engagement. This may then enhance nurses' attitudes towards infection prevention prevention prevention practices and motivate them to transfer the knowledge and skills learnt during education into practice. This framework for providing enhanced education

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has implications for the practice setting for those that deliver infection prevention education to nursing staff. However it also informs the academic arena as the new *Standards for Pre-registration Nursing Education* (NMC, 2010) has increased the focus of infection prevention as an essential skills cluster throughout the preregistration curriculum. This may therefore provide a national impetus to guide improvements to current pre-registration education as recommended by these studies and consequently facilitate more effective and embedded learning for student nurses.

6.4 Training or education?

Exploration into nurses' knowledge and application of infection prevention practices has revealed a fundamental issue that impacts significantly on infection prevention education, this is the Department of Health requirement that all NHS staff must receive infection prevention and control training every year (DH, 2010a). Conclusions drawn from interviews with infection prevention nurse educators emphasise a divergence between the outcomes achieved from training as opposed to education, with regards to enhancing knowledge and application to practice. It is acknowledged that more conducive learning is delivered through interactive education that utilises relevant subject material to small groups (Burnett, 2009; Prieto, 2009; Billings 2010). Yet there seems a significant pressure by Trust executive teams to train large and diverse audiences in order to meet mandatory training targets. This pressure to meet targets influences the way in which infection prevention training is delivered, with infection prevention nurses using pedagogical teaching methods to lecture in a style that they feel does not facilitate effective learning for nurses. It could be argued that one outcome of such education delivered to meet the broad needs of an audience that comprises various staff groups, is that nurses are not being taught the knowledge and skills that they require to conduct infection prevention practices effectively (Cole, 2009). It could therefore be suggested that the government decision to make infection prevention education compulsory for all staff has diluted both the quality of the content delivered and the learning achieved for nursing staff.

It is perhaps therefore important to distinguish between education and training. The concept of education involves the attainment of new knowledge or skills through a process of learning (Quinn & Hughes, 2007). Within a nursing context education also promotes professional development, intellectual curiosity and encourages the transference of knowledge learned into practice (Gould *et al*, 2007). Conversely mandatory training is instruction that is considered necessary for the safety or wellbeing of staff and also for the safe and proficient operation of the organisation (Murphy, 2010). It is suggested that the aim of mandatory training such as infection prevention training is therefore to familiarise nurses with the latest evidence-based guidance and practices (Taylor, 2008). Whilst no previous research has been published which has evaluated the experience or usefulness of mandatory infection prevention training, some studies have provided insight into whether mandatory training can improve compliance to practice for other mandatory subjects such as basic life support (Stokamer & Soccio, 2000) fire safety (Hamilton, 2005) and communication skills (Turner *et al*, 2011).

For other areas of mandatory training it has been reported that a 'one size fits all' approach does not meet the learning needs of healthcare professionals attending (Turner *et al*, 2011) and that practical skills and knowledge decline after three to six months following training delivered by lectures, for example for fire safety skills (Hamilton, 2005). This is often because overuse of lecture-based teaching resources can lead to lack of concentration and engagement and often fails to encourage interaction, usually because of the large audience (Taylor, 2008). Yet several studies have recently called for further subjects to become mandatory, including end of life training (Lomas, 2009; Murphy, 2010), communication skills training (Scates & Sutherland, 2010; Hitcock, 2011), learning disability care training (RCN, 2009), medicine management training (Russell, 2009) and awareness training (Blakemore, 2010). This suggests an assumption or perception that the status of mandatory for a training subject improves compliance to practice, when there is no published research to support this inference.

The obligation for training to be mandatory may fulfil NHS Litigation Authority requirements, but the findings of the studies presented in this thesis suggest that for the subject of infection prevention such training is currently not sufficiently meeting the needs of either pre- and post-registration nurses and therefore not familiarising them with latest guidance or empowering them to improve compliance to practice. Furthermore, a recent survey of 3000 nurses (RCN, 2009) found that due to the current economic climate in the NHS, one third of participants were

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unable to access mandatory training such as infection prevention in 2009, one third accessed such training during annual leave and one third had to pay to access mandatory training courses (Duffin, 2010). Yet mandatory training by its nature is designed to be compulsory (Taylor, 2008). It could therefore be suggested that if NHS organisations do not endorse a culture that supports staff to access mandatory training whilst at work, the importance of such training to promote patient safety through enhanced knowledge and skills is not being recognised at a corporate level let alone disseminated down to those staff that can actually improve such application to practice as a result of effective training.

Therefore although from a policy and Trust executive perspective, the emphasis is on provision of mandatory infection prevention training, in order to deliver such training so that it is transposed into enhancing nursing practice, concepts from effective education such as appropriate teaching methods and resources should be utilised. For example, infection prevention educators seem to take the role as trainer rather than facilitator or teacher. Yet if they were to facilitate effective infection prevention education they may be more conducive to adult learning styles as they will utilise teaching strategies that will enable nurse learners to actively engage in the learning process rather than become submissive tools in the teaching process (Clapper, 2010). Therefore if infection prevention nurses were able to educate nurses during their mandatory training, they may be able to implement more flexible teaching methods and resources, increase the level of engagement and interaction achieved and enhance effective learning and application of such learning to the practice environment.

6.5 Application of behavioural theory

The findings from the studies conducted in this thesis have identified concerns with current infection prevention education and provided an insight into how this may be improved. However, they do also suggest that whilst a lack of sufficient education may provide one rationale for poor knowledge and application of key infection prevention skills, findings also illustrate that infection prevention practice is far more complex with determinants such as attitudes, beliefs, habits and organisational culture affecting behaviour (Whitby *et al*, 2006; Cole, 2008; Hanna *et al*, 2009). Previous studies often report that application after an intervention is not sustained (Ward, 2011). Healthcare workers appear to regress to the way

they worked before the education or intervention was implemented. If infection prevention practice is to be improved this needs to be considered, as it could be proposed that solely improving knowledge may not translate to increasing application. One way in which this could be addressed is through the use of behavioural change models. Such models have been used in other areas of nursing to successfully improve application to practice. Social cognitive theory has been applied to patients to improve diet (Clark & Dodge, 1999) irritable bowel syndrome (Van der Veek et al, 2009) and exercise (Van Ah et al, 2004). Similarly, Prochaska & DiClemente's (1982) transtheoretical behaviour change model has been utilised to improve patients behaviour towards exercise in chronic obstructive pulmonary disease patients (Yang & Chen, 2005), stress (Evers et al, 2006) and smoking cessation (Kim, 2006). There is therefore a considerable implication that behavioural change models can successfully change patients' attitudes and behaviour. Yet whilst a major framework for health promotion, health behavioural models have not widely been used to explain relationships between attitudes and behaviour with regards to healthcare practices (Jenner, 2002; Creedon, 2006).

One study by Hanna *et al* (2009) evaluated the association between different psychological variables and 76 nurses self-reported hand hygiene compliance via a questionnaire. Nurses' perceived importance of hand washing (p<0.001), perceived risk to self (p<0.001) and perceived risk to others (p=0.001) correlated significantly with self-reported hand hygiene. It was suggested that nurses' perceptions of whether their workplace was conducive to conducting hand hygiene was related to whether infection prevention training had been received together with increased workload. Also, nurses' perceived importance of hand hygiene was directly related to their beliefs regarding the transmission of infections. Hanna *et al* (2009) concluded that nurses' perception of risk are intrinsic factors in their behaviour with regards to hand hygiene. However, in contrast Creedon (2006) applied the Precede-Proceed health education theory to hand hygiene and reported that application was increased, yet no follow up was reported to ascertain whether this was sustained which perhaps limits the contribution of this study.

Whitby et al (2006) used the theory of planned behaviour to determine factors that affected nurses' hand hygiene behaviour. The authors noted two distinct

behavioural practices, inherent hand washing when hands were visibly dirty or after high risk contact such as emptying a catheter bag, and elective hand washing after low risk contact with patients such as taking a blood pressure. Inherent behaviour was significantly affected by nurses' beliefs in the benefit of the activity, attitudes and peer pressure from senior colleagues or role models. Whitby *et al* (2006) reported that facilitation of compliance is highly dependent on altering behavioural perceptions, without which sustained compliance will not be achieved.

A further study suggested that nurses have to risk assess their hand hygiene practice as the choice of hand hygiene method after each activity is based upon the nurses judgement (Lee *et al*, 2008). If this assessment is made intuitively rather than rationally or is based on attitude or belief, the incorrect decision could be made, resulting in a reduction in compliance to hand hygiene. Furthermore it is perhaps unclear whether the reason for such a decision is due to the nurses' inability to discriminate between correct and incorrect decisions, or whether they have not been taught how to effectively make such decisions in the first place. Lee *et al* (2008) therefore recommended that education should include risk assessment training. This could assist in changing attitudes and beliefs towards hand hygiene as although nurses believe they think rationally, decisions are often made under pressure and are often subjective as nurses internalise objective data and act upon it in ways that affect their own best interests (Cole, 2008).

This notion was also acknowledged by Pittet *et al* (1999) who studied hand hygiene practices and found that as the need for hand hygiene increased, nursing compliance actually decreased. Pittet *et al* (1999) reported that workload and being too busy were the two main perceived reasons for choosing not to comply. Another reason for poor compliance is that ritualistic practice prevails (Seto, 1995), particularly amongst medical staff where junior staff are more likely to follow incorrect practice set by their role models (Stein *et al*, 2003). An additional concern is that nurses believe their compliance is better than it actually is when observed, audited and quantified (Cole, 2008). Attitudes and beliefs can therefore make an important contribution to informed decisions. Initiatives to change attitudes and behaviour in order to improve infection prevention compliance include altering the emphasis and rewarding good practice (Bissett, 2002), education surrounding informed decision making (Lee *et al*, 2008) and good role

models and leadership (Stein *et al*, 2003; Howard *et al*, 2009). It could therefore be suggested that whilst measures that comprise good infection prevention practice are not complicated, in the clinical setting the commitment to conduct such measures is perhaps lacking (Cole, 2008). The application of health behavioural models to change nurses' behaviour may therefore positively affect knowledge that is then effectively translated into more permanent application of infection prevention practices by influencing change in attitudes, beliefs and self-efficacy of nurses (Lee *et al*, 2008).

The findings of this thesis may contribute towards understanding how nurses' attitudes affect behaviour with regards to infection prevention practices by using health behavioural theory that seeks to explain the relationship between attitude and behaviour. The theory of planned behaviour (Ajzen, 1985) is derived from social psychology, particularly the theory of reasoned action, which uses the notion that people make decisions about their behaviour based on reasonable consideration of the evidence available regarding the behaviour (Sarafino, 2008). The model illustrates three factors that together affect intentions, and that intentions then influence actual behaviour (Forshaw, 2002). The three factors that influence behavioural intentions directly or indirectly are the attitude towards the behaviour, subjective norms and perceived behavioural control (Figure 6.2).

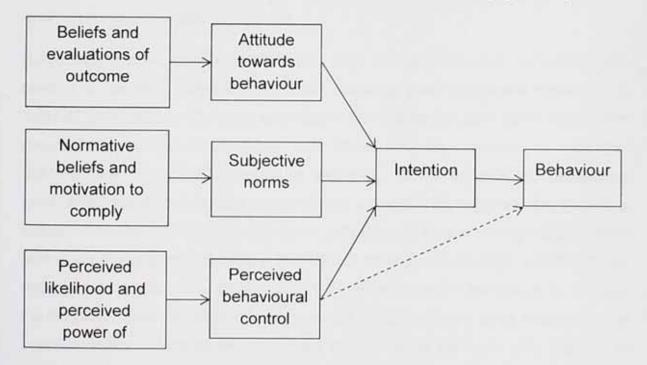


Figure 6.2: The theory of planned behaviour (Azjen, 1985)

Whilst a major framework for health promotion, models such as the theory of planned behaviour have not widely been used to explain relationships between attitudes and behaviour with regards to healthcare practices such as infection prevention (Jenner, 2002; Creedon, 2006). Yet utilisation of health behavioural theory may provide an insight into how attitudes, social norms, and external factors can affect infection prevention behaviour, and therefore how behaviour can be changed (Whitby *et al*, 2006). The theory of planned behaviour can be applied to reinforce the findings of this thesis, that enhancing education is one such factor that is central to improving infection prevention behaviour and therefore practice.

With regards to the attitude towards the behaviour, findings from the questionnaire survey suggest that nurses do not feel confident in their understanding of how to effectively care for a patient with either MRSA or *C. difficile*, which is supported by the interviews conducted with pre- and post-registration nurses which revealed that attending current training or education did not help to improve such feelings. Additionally, the infection prevention nurse educators exhibited a frustrated attitude towards the teaching methods they felt compelled to use in order to train large audiences. The attitudes conveyed towards infection prevention practice therefore encapsulate a scarcity of knowledge or education as a factor that affects nurses' behaviour as they are not acquiring the necessary knowledge and skills to enable informed changes to practice.

Subjective norms were identified that may influence nurses' behaviour with regards to infection prevention practices. Findings from the questionnaire survey suggest that nurses with more experience have a better application of infection prevention practices or behaviour than those with less experience, and that although the supporting rationale is generally poorly understood, behaviours surrounding hand hygiene and use of gloves is good. This suggests that there is a socially determined norm or expectation with regards to performing hand hygiene and using glove when required in the clinical setting even though, particularly for more junior nurses, the knowledge that underpins such behaviour is lacking. Furthermore, when education was provided through clinical skills training in the practice setting, it could be suggested that a social pressure was created to conduct clinical skills in a certain way, which enhanced compliance or good

behaviour for other key infection prevention clinical skills for a sustained period of time.

The last factor that affects an intended behaviour is the perceived behavioural control, or the belief that one can carry out the planned behaviour, has the necessary skills and abilities to do so and that any potential external barriers can be overcome (Sarafino, 2008). Findings from the interviews with post-registration nurses identified that nurses did not believe they had the required knowledge and skills to conduct infection prevention practice effectively and felt that attending education sessions where they could practise skills and demonstrate competence would facilitate changes in behaviour. This was supported by findings from the questionnaire survey where nurses reported a lack of confidence in their understanding of key infection prevention practices, particularly with regards to caring for patients with HCAIs.

However, a criticism of the theory of planned behaviour is that it does not account for emotional variables such as mood or anxiety (Forshaw, 2002). Yet it could be argued that emotions would inform both an attitude towards a behaviour and the perceived behavioural control so can be effectively accounted for within the model. For some infection prevention practices such as hand hygiene and use of gloves, subjective norms seem to have contributed towards compliant behaviour becoming embedded. Whitby et al (2006) also found that hand hygiene behaviour is significantly affected by peer pressure from senior colleagues. Other studies have suggested that changing attitude will improve behaviour and therefore sustain further compliance to infection prevention practices (Parker, 2000; Lee et al, 2008). It has also been argued that attitudes are a key factor for motivating staff to improve infection prevention behaviour (Jenner, 2002) and that both compliance and attitudes towards effective practice can be increased following education (Creedon, 2006). The theory of planned behaviour as applied to the findings of this study therefore provides theoretical reinforcement to the notion that improving education effectively is a fundamental factor to improving attitudes and perceived behaviour controls that may then enhance nurses' practice when caring for patients with infections.

Furthermore it might be suggested that it is not acceptable to have good practice but poor knowledge of such skills as hand hygiene and use of gloves. Whilst

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nurses may practice such skills correctly in a routine circumstance, the application of such practices or problem solving in a novel situation may require a sound knowledge base. It is therefore recognised that interactive education that fosters critical thinking and a questioning approach is essential to facilitate the development of positive attitudes to change towards infection prevention practice (Billings, 2010). A key goal of infection prevention education should surely be to motivate nurses to change behaviour to improve compliance to practice (Cole, 2006). The understanding of nurses' behaviour that the model of planned behaviour provides can therefore be used to shape effective teaching methods that may achieve such behavioural changes and effectively improve compliance to infection prevention practices.

6.6 Recommendations for further research

Findings from all three studies also suggest that attitude can impact on behaviours when conducting key infection prevention skills. Further exploration of the role that health behavioural theory can play on improving knowledge and application to practice may provide more permanent adherence to infection prevention practices by influencing change in attitudes, beliefs and self-efficacy of nurses (Lee *et al*, 2008). Education has been identified as one fundamental factor that can enhance attitudes and therefore the ability to perform key skills correctly. However, research into other factors that motivate nurses to change their behaviour or practice is required if application of good practice is to be achieved and sustained without input from educational roles such as clinical skills trainers. A greater understanding of such motivators of change may therefore inform the enhancement of knowledge, application and compliant behaviours further.

The research reported here allows the conclusion to be drawn that the clinical setting is the most conducive learning environment for infection prevention training. Suggested recommendations for further research therefore include providing a greater understanding of how the clinical environment can best be utilised to conduct effective infection prevention training as this would be valuable for infection prevention nurse educators endeavouring to enhance such education. Lastly further insight into the role that innovative teaching methods such as storytelling can have on enhancing infection prevention mandatory training may

enable infection prevention trainers to deliver training that is more interactive and engaging, the learning from which may then be transferred into compliant practice.

6.7 Conclusion

The findings from this thesis have contributed towards understanding how knowledge and application of infection prevention practices can be enhanced through improving education. The introduction of clinical skills training in the practice environment effectively sustained an improved compliance to practice with regards to key infection prevention skills, suggesting that improvements to current education are required and that a clinical learning environment may be more conducive than the classroom.

Further findings provide an insight into specific elements of infection prevention practices that are well understood and performed and those that are not. Knowledge of HCAI is limited and is reflected by poor practice whilst poor theoretical understanding of hand hygiene and use of PPE is not. Therefore, focusing infection prevention education on care of patients with specific infections, such as MRSA and *C. difficile*, rather than on individual standard precautions may more effectively increase knowledge and therefore application of infection prevention practices related to reducing these HCAI. This is timely as the new *Standards for Pre-registration Nursing Education* (NMC, 2010) have continued to require a focus on infection prevention as an essential skills cluster throughout the pre-registration curriculum which emphasises the importance of effective infection prevention education to underpin good practice.

Findings have also highlighted that infection prevention nurse educators need to explore more innovative approaches to learning, which better suit the needs of individual learners in order to motivate nurses to improve their fitness to practice, as good quality education is more likely to contribute towards compliant nurses and therefore improve practice (Cole, 2008). The results of the studies conducted in this thesis therefore have implications for both pre- and post-registration infection prevention education as they suggest that current education could be improved. A more clinical focus is required that incorporates visual resources and problem-based scenarios from practice. This may then effectively enhance understanding and competence of infection prevention skills. The findings that

have emerged from this research collectively (Figure 6.1) can inform infection prevention nurse educators to improve education on this topic that will enhance learning and may consequently improve compliance to practice.

Although currently a main motivator for nurses to attend infection prevention training is because it is a mandatory requirement (DH, 2010a), does not mean that they should not acquire new knowledge or skills whilst attending such education, or not be motivated to apply the learning outcomes to practice. Yet current approaches to infection prevention education have generally failed to deliver the improvements to practice that are required to reduce the risk of infection to patients further (Ward, 2011). By changing the way that infection prevention education is delivered for nurses and the environment within which it is conducted may effectively improve such education by facilitating more effective interaction, engagement, transference of theory into practice and demonstration of competence. Outcomes of such education could consequently include enhanced infection prevention knowledge and skills, increased application of such knowledge to practice and therefore enhanced care delivery and patient safety outcomes in terms of a reduced risk of HCAI.

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Appendices

Appendix I: Saving Lives (DH, 2005; DH, 2007) audit tools

Saving Lives (DH, 2005; DH, 2007) audit tools

States -	200	Are all elements					
Observation	Hand Hygiene Before	Personal Protective Equipment	Aseptic Technique	Disposal of Sharps	Disposal of Waste	Hand Hygiene After	compliant? (fills in automatically)
1							-
2							
3						_	
4							
5							
6						-	
7							
8			1				
9							
10							-
Total number of times an element was performed		1					
% When all elements of care were given							

Figure I.I: Saving Lives (DH, 2005) basic infection control audit tool

		Are all elements					
Observation	Aseptic Technique	Hand Hygiene	Personal Protective Equipment	Skin Preparation	Dressing	Documentation	compliant? (fills in automatically)
1							
2							
3							
4			_				
5							
6							
7							
8							
9							
10							
Total number of times an element was performed							
% When all elements of care were given							

Figure I.II: Saving Lives (DH, 2007) peripheral intravenous cannula insertion audit tool

	Elements							Are all elements compliant	
bservation	Hand Hygiene	Continuing Clinical Induction	Site Inspection	Dressing	Cannula Access	Administration Set Replacement	Cannula Replacement	Documentation	(fills in automatically)
1									N.
2									
3									
4									
5									
6									
7									
8									
9									
10					1				
Total no of times an element performed									
% When all elements of care given				L	_				

Figure I.III: Saving Lives (DH, 2007) peripheral intravenous cannula care audit tool

	REAL	Elements									
Observation	Aseptic Technique	Personal Protective Equipment	Catheter Needed?	Clean The Urethral Meatus	Sterile, Closed Drainage System	Hand Hygiene	Documentation	elements compliant? (fills in automatically)			
1											
2											
3											
4											
5			-								
6											
7						_					
8											
9						_					
10											
Total number of times an element was performed											
% When all elements of care given											

Figure I.IV: Saving Lives (DH, 2007) urinary catheter insertion audit tool

		All elements?					
Observation	Hand Hygiene	Catheter Hygiene	Sampling	Drainage Bag Position	Catheter Manipulation	Catheter Needed?	(fills in automatically)
1							
2							
3						_	
4			_				
5							
6					1		
7							
8							
9							
10							
Total number of times an element was performed							
% When all elements of care given		linde	n R	i mar			Ynn

Figure I.V: Saving Lives (DH, 2007) urinary catheter care audit tool

Appendix II: National Research Ethics Service letter of favourable opinion National Research Ethics Service

26 August 2008



Dear Miss Broughton.

Full title of study:

REC reference number:

An investigation of nurses' knowledge and application of infection control practices 08/H0402/58

Thank you for your letter of 18 August 2008, responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair.

Confirmation of ethical opinion

On behalf of the Committee. I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Ethical review of research sites

The Committee has designated this study as exempt from site-specific assessment (SSA). The favourable opinion for the study applies to all sites involved in the research. There is no requirement for other Local Research Ethics Committees to be informed or SSA to be carried out at each site.

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission or approval must be obtained from each host organisation prior to the start of the study at the site concerned.

Management permission at NHS sites ("R&D approval") should be obtained from the relevant care organisation(s) in accordance with NHS research governance arrangements. Guidance on applying for NHS permission is available in the Integrated Research Application System or at <u>http://www.rdforum.nhs.uk</u>.

This Research Ethics Committee is an advisory committee to East Midlands Strategic Health Authority. The National Research Ethics Service (NRES) represents the NRES Directorate within the National Patient Safety Agency and Research Ethics Committees in England.

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document	Version	Date
	AB/121548/1	29 May 2008
Application		31 January 2008
Investigator CV. Chief Investigator	1	31 May 2008
Investigator CV: Educational Supervisor	5	01 August 2008
Protocol	D	27 May 2008
Letter from Sponsor		ALC REPORT
Statistician Comments		19 May 2008
Compensation Arrangements		07 August 2007
Interview Schedules/Topic Guides: Interview	4	30 April 2008
Interview Schedules/Topic Guides: Focus Group	4	30 April 2008
Questionnaire Infection Control	2	30 April 2008
Participant Information Sheet Focus Group	3	01 August 2008
Participant Information Sheet: Interview	3	01 August 2008
	2	01 August 2008
Participant Information Sheet: Questionnaire	3	01 August 2008
Participant Consent Form	5	18 August 2008
Response to Request for Further Information		10 August 2000

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Now that you have completed the application process please visit the National Research Ethics Website > After Review

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use the feedback form available on the website.

The attached document "After ethical review – guidance for researchers" gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Progress and safety reports
- Notifying the end of the study

The NRES website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

We would also like to inform you that we consult regularly with stakeholders to improve our service. If you would like to join our Reference Group please email referencegroup@nres.npsa.nhs.uk.

08/H0402/58

Please quote this number on all correspondence

With the Committee's best wishes for the success of this project

Yours sincerely,

PP/Rinets! 1xi

Mr Ken Willis/Miss Jeannie McKie Chair/Committee Coordinator

Email: jeannie mckie@nottspct.nhs.uk

Enclosures:

"After ethical review - guidance for researchers"

Copy to:

Professor Carol Phillips – University of Northampton R&D office for NHS care organisation at lead site Appendix III: University Research Degrees Committee letter of approval



RESEARCH & KNOWLEDGE TRANSFER DIRECTORATE MEMORANDUM

то:	Holly Broughton
Cc:	Carol Phillips, Jackie Parkes
FROM:	Prof Hugh Matthews
DATE:	4 November 2008
SUBJECT:	Registration as an Advanced Postgraduate Student

At its meeting on 20 October 2008 the Research Degrees Committee approved your registration as an Advanced Postgraduate Student.

Your supervisory team has been confirmed as:

Director of Studies:	Carol Phillips
First Supervisor:	Jackie Parkes

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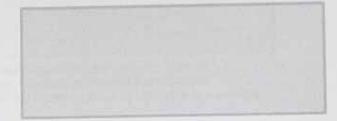
Your EARLIEST submission date is September 2010. Your LATEST submission date is September 2013.

If you have any queries please contact David Watson (01604) 892812 or email David.Watson@northampton.ac.uk

Hugh Maachens

Prof H Matthews Chair of the Research Degrees Committee

Appendix IV: Acute NHS Trust Research Committee letter of favourable opinion



Research Committee

5 August 2008

Dear Holly

Project: An investigation into nurses' knowledge and application of infection control practices

Rdb Ref: 220

Research Committee on 4th Thank you for attending the August 2008 and describing your proposed study, sponsored by University of Northampton.

The following documents were reviewed:

- Research Proposal (version 4, May 2008) •
- Participant information sheet: interview (version 2, January 2008)
- Participant information sheet: questionnaire (version 2, January 2008)
- · Participant information sheet: focus group (version 2, January 2008)
- Consent form, focus group and interview (version 2, January 2008
- Questionnaire, (version 2 April 2008)
- Interview Schedule, (version 4 April 2008)
- · Focus Group Schedule, (version 4, April 2008)
- Ethics application 08/H0402/58
- SSI application
- Provisional Ethical opinion, 03 July 2008
- CVs, Holly Broughton, Prof Carol Phillips (academic superviser)
- Statistical and peer reviews University of Northampton
- Schedule of Sponsors' Indemnity Insurance

The Committee is pleased to approve your application subject favourable ethical opinion, further to suggestions already made (letter 03 July 2008)

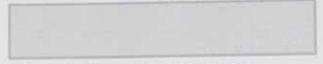
Please provide copies of revised ethically approved version of documents, to Linda Lavelle, Research Co-ordinator

· Also a copy of Ethical Approval letter.

2111

The Research must be conducted in accordance with the principles of Research Governance Framework, Legislation eg Health and Safety, Data Protection Act 1998, ICH GCP Guidance and Clinical Trial Regulations 2004 (where applicable).

> Chair: Steve Hone: Interim Chief Executive: Nerissa Vaughan



The Research will be registered on the Trust Research Database and any other national Database, as required by the Department of Health. If you are concerned that this could jeopardise any intellectual property, please contact the Research Co-ordinator in the first instance.

If you have any questions please do not hesitate to contact Linda Lavelle, Research Co-ordinator or myself.

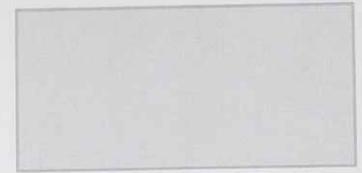
Yours sincerely

Smileanor

Gwyn McCreanor Associate Medical Director, Clinical Services, Chair, I Research Committee

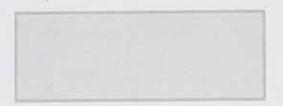
> Chair: Steve Hone: Interim Chief Executive: Nerissa Vaughan

Appendix V: Acute NHS Trust Lead Infection Prevention Nurse letter of approval



Pathology Directorate

8th October 2008



Dear Holly

Re: PhD study "Nurses knowledge and application of infection control practices"

I am happy to confirm that the infection control team at are willing to support in any way the above proposed study and look forward to seeing your final report once completed. If there is anything we can do to help, please feel free to contact us

Regards

1111

Dawn Westmoreland Lead Nurse –Infection Control

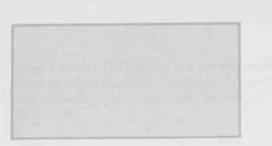
> Chairman: Steve Hone Chief Executive: Dr Mark Newbold

Appendix VI: Acute NHS Trust Research Governance Sub-Committee letter of approval



23 October 2008

Research and Development Centre



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Dear Miss Broughton

Full title of study: An investigation of nurses' knowledge and application of infection control practices

REC Reference: 08/H0402/58

Thank you for your letter of 04 October 2008 responding to the Sub-Committee's request for further information on the above research.

I have considered the further information on behalf of the Sub-Committee, and I am pleased to confirm that there are no outstanding issues and that you have Trust approval for this study.

Approved documents

The documents reviewed and approved in relation to this study are as follows:

- REC 2 ethical approval letter dated 26/08/2008
- NHS REC Application Form signed and dated by Holly Broughton on 29/05/2008
- Site Specific Information Form signed and dated by Holly Broughton on 04/08/2008
- CVs Holly Broughton dated 04/08/2008; and Carol Phillips Version 1 dated May 2008
- Research Proposal Version 5 dated August 2008
- Participant Information Sheet Focus Group Version 3 dated August 2008
- Participant Information Sheet Interview Version 3 dated August 2008
- Participant Information Sheet Questionnaire Version 2 dated August 2008
- Interview and Focus Group Consent Form Version 3 dated August 2008
- Interview Schedule For Infection Control Trainers Version 4 dated April 2008
- Focus Group Schedule For Participants of Infection Control Sessions Version 4 dated April 2008
- Infection Control Questionnaire Version 2 dated April 2008
- Letter from Dr S M Allen dated 27/05/2008 confirming peer-review
- Letter from Professor Jackie Campbell dated 19/05/2008 confirming statistical analysis
- Letter from Lee Harris dated 07/08/2007 regarding liability insurance

I would like to formally remind you that in undertaking the project at this site that the research team must adhere to the responsibilities laid out in the Research Governance Framework for Health and



Social Care (ref. DoH 2001). The key responsibilities are laid out in the attachment to this letter, so please take time to read it. In addition, this study will also be reviewed for possible disclosure to other statutory bodies which may require this information. If you wish to enquire about this please contact the R&D office.

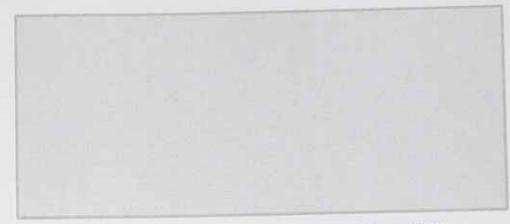
Finally, can I please request that you advise the R&D Office if you are named in any papers that are published as a consequence of this research.

Best wishes.

Julie Wiber

Julie Wilson R&D Manager

Appendix VII: Acute NHS Trust Lead Infection Prevention Nurse letter of approval



14th April 2009

Dear Holly,

Thank you for your letter dated 19th March 2009 and your research Degree Proposal on An investigation of Nurses' Knowledge and Application of Infection Control Practices.

The team and I support you with your proposal and please let me know if you require further assistance and support in your investigations.

Yours Sincerely

S P. Q soldiero .

Pat Wadsworth Senior Infection Control Nurse. Appendix VIII: Questionnaire participant information sheet

Questionnaire participant information sheet

Study title

An investigation of nurses' knowledge and application of infection prevention and control practices.

Invitation paragraph

You are invited to take part in a research study. Before you decide to participate you need to understand why the research is being conducted and what it would involve for you. Please take time to read the following information carefully, talk to others about it if you wish. Please ask if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

What is the purpose of this study?

The purpose of this study is to investigate nurses' knowledge and application of infection prevention and control practices, to ascertain whether infection prevention and control training and management of healthcare associated infections could be improved.

Why have I been invited?

You have been invited to complete the enclosed questionnaire and return it in the envelope provided because you are a student nurse or registered nurse, 1000 pre- and post-registration nurses have been invited to return the questionnaire in total.

Do I have to take part?

Taking part is completely voluntary and will not affect your employment in any way.

What will happen to me if I take part and what will I have to do?

You will complete the enclosed questionnaire about infection prevention and control, which should take approximately 20 minutes to complete. By returning the questionnaire you will agree to take part, the questionnaire is anonymous and therefore cannot be withdrawn once you have returned it.

What are the potential risks, benefits and expenses?

All research in the NHS is looked at by an independent group called the National Research Ethics Service, to protect your safety, rights, well-being and dignity. The study has been reviewed and given a favourable opinion by them. There will be no expenses paid and no risks in taking part. No special arrangements are in place for potential compensation.

Will my taking part in the study be kept confidential?

Yes, ethical and legal practice will be followed and all information about you will be handled in confidence. Your name will not be documented on the questionnaire so you cannot be recognised. I will lock data away securely, no one else will have access to it and it will be destroyed two years after submission of the thesis. The results of the study will be published in a PhD thesis in 2011, journal articles and conferences, but you will not be identified at all.

What if there is a problem?

If you have any concerns about any aspect of the study, please contact me via the and I will do my best to answer Email your questions: following holly broughton@hotmail.co.uk Tel: 01604 545785. If appropriate you may contact my supervisor via the university. Thank you for your time, Holly Broughton.

Appendix IX: Questionnaire research tool

Infection prevention and control questionnaire

Please answer the following questions. Your answers will be strictly confidential. If you have any queries please contact <u>holly_broughton@hotmail.co.uk</u>.

Site 1

SECT	ION 1: Please tick any boxes that may apply.
1	Years NHS service pre-registration: 1 2 3
	post-registration: 1-5 🗌 6-10 🗌 11-15 🔲 6-20 🗌 20+ 🗌
2	Band (if post-registration): 5
3	When were you last taught about infection prevention and control?
	0-1 year ago 1-2 years ago 2-3 years ago 3-5 years ago 5-10 years ago 10+ years Never
4	How were you last taught about infection prevention and control?
	In a lecture Ward-based study session Working on a ward Infection control session Infection control study day No teaching before
5	Is there enough emphasis on infection prevention and control teaching in your hospital? Yes No
6	Do you think you were taught good hand hygiene before your first placement/post?
	Yes adequate theory Yes adequate practice No adequate theory No adequate practice
7	Which areas of infection prevention & control are you confident you understand? When to wash hands How to dispose of waste When to wear PPE Care of a patient with MRSA Isolation nursing Care of a patient with C.difficile
8	When washing with soap, how long should hands be rubbed for? 0-9 seconds 10-15 seconds 16-20 seconds
9	How should you wash your hands?Soap &waterAlcohol gelEitherBothAfter patient contactBefore patient contactOn leaving a wardWhen hands are visibly dirtyAfter contact with a patient with MRSAAfter contact with a patient with C. difficile

10	Which part of the hands are	e most frequently Most frequently	missed when was Less frequently	ning hands? Rarely
	Fingernails Between fingers Palms of hands Around the thumb Backs of hands			
11	When do you wear gloves?	P Always	Doesn't matter	Never
	Taking blood Making beds Administering IV fluids Nursing a patient with MRSA Emptying a catheter bag Drug round			
12	What constitutes a needles	stick injury?		
	Percutaneous exposure to c Percutaneous exposure to a Any exposure to bodily fluids Any exposure to a healthcar	ny contaminated sh (blood/excretions/	harp object	
13	How is MRSA spread?			
	By air and some direct conta	act 🗌 Mainly via	direct contact 🗌 🛛	Mainly via air 🗌
	TION 2: please answer the question.	following quest	tions honestly an	d tick 1 box
	ves was admitted to the ward	last week and is	MRSA positive. To	oday you are
14	What precautions do you t nursing Mr Ives?	take to prevent th	e spread of infecti	on when
	Wear gloves, no apron, was	h hands carefully		

14 What precautions do you take to prevent the spread of infection will nursing Mr lves? Wear gloves, no apron, wash hands carefully Wear gloves, an apron, wash hands carefully Wear an apron, gloves, no need to wash hands Wear an apron, no gloves, wash hands carefully 15 If you have worn gloves for a procedure do you: Always wash your hands Not need to wash your hands Wash your hands to give additional protection

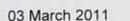
16 **Do you place Mr lves' linen in:** A red bag kept inside his room A white bag kept inside his room A red bag and dispose of it immediately A white bag and dispose of it immediately

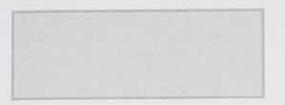
Depending on the procedure wash your hands

17	Before emptying Mr Ives' urinary catheter do you: Wear an apron, gloves, no need to wash hands
	Wear gloves, and apron and wash hands carefully
	Wear gloves, no apron and wash hands carefully
	Wear gloves, no apron and wash hands carefully
	Wear an apron, no gloves and wash hands carefully
18	Mr Ives develops C. difficile. What action do you take?
	Isolate him and review his antibiotics
	Isolate him, stop antibiotics and keep a stool chart
	Nurse him in the bay, review antibiotics and increase cleaning
	Don't know
19	Mr lves has finished 5 days of MRSA decolonisation. What action do you
	take?
	Don't know
	Stop the MRSA care plan
	Rescreen him swabbing his nose, throat and groin
	Wait two days then rescreen him swabbing his nose and groin
20	When administering Mr Ives' blood transfusion do you:
20	Wear gloves
	Wash your hands
	Wash your hands, wear gloves and wear a gown
	Wash your hands, wear gloves and wear an apron
21	You accidentally spill some blood on the floor. What action do you take?
	Clean it with Chlorclean
	Clean it with detergent wipes
	Clean it with HazTabs
	Don't know
22	You give Mr Ives an IM (intramuscular) injection. What do you then do with
	the needle?
	Recap it and place in a sharps bin at once
	Not recap it and place in a sharps bin at once
	Recap it and carry to a sharps bin on a cardboard tray
	Not recap it and carry to a sharps bin on a cardboard tray
23	When administering the injection you sustain a needlestick injury. What do
20	you do?
	Don't know
	Report to Occupational Health and wash hands with Hibiscrub
	Encourage bleeding, wash it, cover, report to Occupational Health
	Report to Occupational Health, encourage bleeding and cover it
	Report to Occupational Health, encourage bleeding and cover it
Tha	nk you for your time.

Version 2, April 2008

Appendix X: National Research Ethic Service letter of approval of minor amendments





Dear Miss Broughton,

Study title:

REC reference: Amendment date: An investigation of nurses' knowledge and application of infection control practices 08/H0402/58 02 March 2011

Thank you for your letter of 02 March 2011, notifying the Committee of the above amendment.

The Committee does not consider this to be a "substantial amendment" as defined in the Standard Operating Procedures for Research Ethics Committees. The amendment does not therefore require an ethical opinion from the Committee and may be implemented immediately, provided that it does not affect the approval for the research given by the R&D office for the relevant NHS care organisation.

Documents received

The documents received were as follows:

Document	Version	Date
Notification of a Minor Amendment		02 March 2011

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

08/H0402/58:	Please quote this number on all
correspondence	

Yours sincerely

Miss Catherine Dixon

Assistant Committee Co-ordinator

Appendix XI: Interview participant information sheet

Interview participant information sheet

Study title

An investigation of nurses' knowledge and application of infection prevention and control practices.

Invitation paragraph

You are invited to take part in a research study. Before you decide to partake you need to understand why the research is being conducted and what it would involve for you. Please take time to read the following information carefully, talk to others about it if you wish. Part 1 tells you the purpose of the study and what will happen if you take part. Part 2 provides more detailed information about the conduct of the study. Please ask if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Part 1

What is the purpose of this study?

The purpose of this study is to investigate nurses' knowledge and application of infection prevention and control practices, to ascertain whether infection prevention and control training and management of healthcare associated infections could be improved. This part of the study aims to explore nurses' experiences of infection prevention and control training.

Why have I been invited?

You have been invited because you have either taught at or attended an infection prevention and control study session or lecture in the last two months that I have conveniently sampled. 17 pre- and post-registration nurses have been invited in total.

Do I have to take part?

Taking part is completely voluntary. I described the study to you at the end of an infection prevention and control session and gave you this sheet to read further. I will then ask you if you would like to participate and ask you to sign a consent form to show you have agreed to take part, but you are free to withdraw at any time without giving a reason. This will not affect your employment in any way.

What will happen to me if I take part and what will I have to do?

You will be expected to attend one 30-45 minute interview with me to describe your experience of either teaching or attending an infection prevention and control session or lecture. The interview will be audio-taped and a summary of the interview checked with you after the interview so you can confirm and/or correct the interpretation.

Will my taking part in the study be kept confidential?

Yes, ethical and legal practice will be followed and all information about you will be handled in confidence. The details are included in Part 2.

What are the potential risks, benefits and expenses?

There will be no expenses paid and there will be no risks in taking part. Please note that any specific incidents of poor practice revealed will have to be reported to the relevant line manager. No special arrangements are in place for compensation.

What if there is a problem?

Any complaint about the way you have been dealt with during this study will be addressed: detailed information on this is given in Part 2.

> If the information in Part 1 has interested you and you are considering participation, please read the additional information in Part 2 before making any decisions.

Part 2

What will happen if I don't want to carry on with the study?

If you withdraw from the study and data collected from you will be destroyed and not used.

Will my taking part in the study be kept confidential?

All information that is collected about you during the interview will be kept strictly confidential. Direct quotes and audio-taping will be used but your name will not be documented in the interview transcripts but replaced with a pseudonym so you cannot be recognised. I will lock data away securely, no one else will have access to it and it will be destroyed two years after submission of the thesis.

What will happen to the results of this research study?

The results of the study will be published in a PhD thesis in 2011, which will be available in the University of Northampton library. Data may also be used in journal articles and conferences, but you will not be identified in any publications.

Who has reviewed to study?

All research in the NHS is looked at by an independent group called the National Research Ethics Service, to protect your safety, rights, well-being and dignity. The study has been reviewed and given a favourable opinion by them.

What if there is a problem?

You will be able to keep this information sheet and also given a signed consent form to keep. If you have a concern or complaint about any aspect of the study, please contact me and I will do my best to answer your questions: Email holly broughton@hotmail.co.uk Tel: 01604 545785. If appropriate you may contact my supervisor Carol Phillips via the university.

Thank you for your time.

Holly Broughton.

Version 3, August 2008

Appendix XII: Interview consent form

An investigation of nurses' knowledge and application of infection prevention and control practices.

esea	archer: Holly Broughton		Please initial b	ox:
1.	I confirm that I have read an sheet dated August 2008 (V had the opportunity to cons have had these answered s	/ersion 3) for the ab ider the information	ove study. I have	
2.	I understand that my partici withdraw at any time withou legal rights being affected.	pation is voluntary a It giving any reason	and that I am free to , and without my	
3.	I understand that the data of as a PhD thesis but my nan recognised in any way.	collected from this s ne will not be used	tudy will be published and I will not be	
4.	I give my permission for the	e interview to be au	dio-taped.	
5.	I give my permission for dir	ect quotes to be us	ed in the thesis.	
6.	I agree to take part in the a	bove study.		
Na	ame of participant	Date	Signature	
10055	ame of researcher king consent	Date	Signature	

One consent form will be given to the participant, one to the researcher to file.

Version 3, August 2008.

Appendix XIII: Interview schedules

Interview schedule for trainers of infection prevention and control

- 1. How long have you been in nursing?
- 2. How long have you been teaching infection prevention and control?
- 3. What infection prevention and control training have you had?
- 4. Can you tell me about the last infection prevention and control teaching session you taught?
- 5. Was this typical of the infection prevention and control sessions you usually teach?

If YES to question 5:

- 6. When you teach infection prevention and control, what factors do you feel facilitate learning?
- 7. When you teach these sessions, what barriers to learning do you think there are?
- 8. Thinking about the nature of the environment when you teach infection prevention and control sessions, how might it impact on a participant's ability to learn?
- 9. When you teach infection prevention and control, what teaching methods do you use?
- 10. How do you feel the teaching methods you use might affect the participants' learning?
- 11. Have these teaching methods changed since you first began delivering infection control training?
- 12. Do you think infection prevention and control teaching could be improved?
- 13. How is it different teaching student nurses compared to qualified nurses?

If NO to question 5:

- 6. Why was it different to a typical infection prevention and control teaching session?
- 7. In this particular infection prevention and control session, what factors did you feel facilitated learning?
- 8. In this particular infection prevention and control session, what barriers to learning do you think there were?
- 9. Thinking about the nature of the environment where you taught this last session, how might it have impacted on a participant's ability to learn?
- 10. When you teach infection prevention and control, what teaching methods do you use?
- 11. How do you feel the teaching methods you used to deliver this last session might have affected the participants' learning?
- 12. Have these teaching methods changed since you first began delivering infection control training?
- 13. Do you think that the teaching in this session could be improved in any way?
- 14. How is it different teaching student nurses compared to qualified nurses?

Version 4, April 2008

Interview schedule for pre- and post-registration nurses that attended infection prevention and control training

- 1. What clinical area do you work in?
- 2. How long have you been in nursing?
- 3. What infection prevention and control training have you had during you career?
- 4. Can you tell me about the last infection prevention and control teaching session you attended?
- 5. In this particular infection prevention and control session, what factors did you feel facilitated learning?
- 6. In this particular infection prevention and control session, what barriers to learning do you think there were?
- 7. Thinking about the nature of the environment where you attended this last infection prevention and control session, how might it have impacted on your ability to learn?
- 8. In this infection prevention and control session, what teaching methods were used?
- 9. How did the teaching methods compare to the teaching methods used in previous infection prevention and control sessions?
- 10. Do you think that there could be any improvements to the teaching of this infection prevention and control session?

Version 4, April 2008

Appendix XIV: Significant statement extraction from interview transcripts

Significant statements extracted from interview transcripts of infection prevention and control nurse trainer Rachel

Interview transcription	Significant statements
Rachel	
I qualified in 1982 so have been in nursing for 28 years and came into infection control in 2002, nine years ago. I completed the Infection Control in Clinical Practice course in 2003 and in 2005-06 completed the bachelor with specialist nurse practitioner qualification in infection control.	
I taught on the preceptor course to newly qualified nurses and midwives. This was a classroom based session that involved teaching them about aseptic technique, isolation nursing, current paperwork, care plans for cannulas and catheters and KIP.	Classroom based session
I regularly teach on the preceptor course. I also teach on the monthly trust induction where I have 40 minutes to teach basic infection control including standard precautions to all healthcare staff and a further 50 minutes with just clinical staff to teach them the clinical aspects, aseptic technique, isolation nursing, cannula and catheter care plans and so on. I also teach on the annual refresher two or three times a month for 30 minutes to update clinical and non-clinical staff on their infection control. Something that you will be interested in is that I am working with infection control lead nurses from different regions to look at what everybody teaches and compile a definitive list of topics that must be included. The aim of this is to standardise infection control training nationally so that key aspects are included in every trust, this will raise the quality of training, standardise it and help to embed key elements such as including The Hygiene Code, standard precautions and so on.	I am working to standardise infection control training nationally this will raise the quality of training and help to embed key elements The environment is really
The environment is really important, we use the lecture theatre a lot where the seats are comfortable	

and the temperature can be regulated to make it comfortable learning environment, but it can get too full which can be a barrier as you try to make eye contact with everybody throughout the session which can be difficult with a really large group. The attitude of the speaker is important, if you're having a bad day or go in a bit grumpy this can affect the quality of the session you deliver as they seem to pick up on it. Also the time of day you teach can affect their learning, if it is after lunch when they are tired it can be harder to engage with them. Part of the session is to demonstrate how all of the measures we have implemented have impacted on rates of infections and show them the bigger picture, I think that if they can see how the new practices, policies and products affect infection rates and make it safer for patients then they are more likely to listen and take it away with them.

Having mixed groups of staff I think is the biggest barrier. For example the refresher is open to all staff so you could be teaching porters, nurses and say secretaries all in the same session. This makes it challenging as you want to teach at the appropriate level for all staff who have attended the session so that they can learn something useful from it. But this can be difficult as especially with the time constraint you really want the clinical staff to be updated on the clinical aspects of infection control practice as that will have the biggest impact on reducing the risk of infection to patients. Our most common feedback from the annual refresher is that 'most of it was not relevant to me or my area of work' but what can you do, you don't want to waste people's time or teach things that they don't understand or are not relevant but you have to include the clinical aspects for the clinical staff that are there.

Well, there is the formal environment of the lecture theatre and classroom seven for the refresher training which is conducive as it is comfortable, temperature regulated and there are no interruptions. I also do some ad hoc teaching to small groups in the clinical setting, such as nurses in a staff room on a ward. This is good in that you can tailor it to their

can get too full which can be a barrier as you try to make eye contact with everybody... which can be difficult with a really large group

The attitude of speaker... can affect the quality of the session... they pick up on it

The time of day can affect their learning... when they are tired it can be harder to engage with them

Show them the bigger picture... they are more likely to listen and take it away with them

Mixed groups of staff I think is the biggest barrier... you want to teach at the appropriate level for all staff who have attended... so that they can learn something useful from it... but this can be difficult as with the time constraint you really want the clinical staff to be updated on the clinical aspects of infection control practice as that will have the biggest impact on reducing the risk of infection to patients

'Most of it was not relevant to my area'

Lecture theatre...classroom conducive to learning

ad hoc teaching to small groups in the clinical setting... tailor it to their specific learning requirements much specific learning requirements much easier but we usually only have about 20 minutes and there can be lots of interruptions from the ward.

I use PowerPoint presentations, practical hand hygiene teaching with the glow bugs and I do a question and answer bit in each session as well. We are developing a workbook which will be available on the intranet with a quiz at the end so that staff can quiz to demonstrate their the me email This would be good for say night understanding. staff who find it difficult to access the refresher sessions during the day, although we have held them in the evenings but the attendance levels tend not to be very good.

I use the variety of methods so that those who learn in different ways can be part of the session, some learn best from numbers, some from the practical element and some from the question and answer part of the session, so you have to use a range of methods to include the whole group.

Yes we used to use overhead projectors! Infection control teaching is now more dynamic, there are more resources to use, I can show them where information is on the trust intranet or play them a hand washing video. I did use the CleanYourHands campaign video for a while but people complained about the music so you can't win! I think the most important thing to remember is that infection control affects so many different areas within the trust and there is so much new guidance that it is really important to update your teaching material regularly in order to keep the sessions proactive and interactive. Because, as infection control nurses we see how the results of increased training contributes to decreasing rates of infection through enabling us to communicate to nurses the new practices in our policies, it is definitely beneficial. It is also really good for them to see how updating their practice can impact on the trusts rates of infections and the bigger picture. Also in my team, we all have experience of working on the wards and know only too well the pressures on the nursing staff out there with regards

easier but... there can be lots of interruptions

PowerPoint presentation

Glow bugs

Question and answer bit

Workbook and quiz

Night staff

Variety of methods so that those that learn in different ways can be part of the session... to include the whole group

Teaching is now more dynamic... more resources

It is really important to update your teaching material regularly... to keep the sessions proactive and interactive

Infection control training is... definitely beneficial

It is also really good for them to see how updating their practice can impact on the trusts rates of infections and the bigger picture to time, staffing and resources, therefore we are able to be realistic when we teach and appreciate their comments from the ground level, for example in an emergency situation they may not put their gloves and aprons on but that is ok as some times exceptions have to be made for the immediate safety of the patient.

Infection control training could be improved by better suiting the needs of those that attend, within the constraints of the hours that they work. I make no apologies when I teach on the refresher training that the session will be very clinical but I have to get the clinical content across to the nurses and healthcare assistants as it is their practice that will most affect the reduction of rates of infection and cross-infection. Infection control training has to be flexible so that as many staff as possible can access it, so by offering evening sessions and soon the workbook I hope to capture a wider range of staff.

I find that teaching the student nurses at the university very strange, it feels too formalised. It is a very strange environment for me and I teach them in year one before their first placement when they are so new that they find it difficult to relate to what I am teaching them about what happens in the clinical setting as they have no practical experience yet. It would be much better to teach them again once they have been working on the wards so that they could be more reflective and able to apply what they are being taught in the classroom to their practice. They seem to think that infection control is just hand hygiene and MRSA when it is much more than that. I do tell them that if they ring up they can come and spend a day with the infection control team once they are on placement and those that do find it really enjoyable. By that time they understand nursing a bit more, how the wards work and how infection control fits into daily practice so they learn a lot out from spending the day with us and learning about patients with infections, the isolation wards, the audits and surveillance that we do and going to the lab. It is just a shame that they can't all benefit from learning more about infection control after they have

We all have experience of working on the wards... we are able to be realistic when we teach and appreciate their comments

Training could be improved by better suiting the needs of those that attend it...

I have to get the clinical content across to the nurses and HCAs as it is their practice that will most affect the reduction of rates of infection

Training has to be flexible so that as many staff as possible can access it... I hope to capture a wider range of staff

I find teaching the student nurses at the university very strange, it feels too formalised... it is a very strange environment for me

They find it difficult to relate to what I am teaching them about... the clinical setting as they have no practical experience yet... better to teach them again once they have been... on the wards so that they could be more reflective and able to apply what they are being taught in the classroom to their practice

started their placements.	It is a shame they can't all benefit from learning more about infection control after they have started placements

Appendix XV: Journal Publication 'Saving Lives audits: do they improve infection prevention and control practice?'



Saving Lives audits: do they improve infection prevention and control practice?

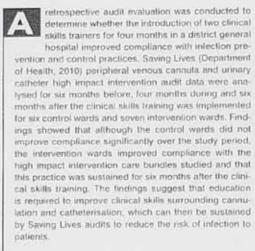
H Slyne^{1,*}, C Phillips², J Parkes²

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Accepted for publication: 24 August 2011 Key words: Infection prevention and control, ward-based education, compliance, audit.

Abstract



Introduction

reviewed article

Peer

Saving Lives (Department of Health (DH), 2010) was launched in 2005 revised in 2007 and 2010, and was designed to support National Health Service (NHS) organisations to induce healthcare associated infections (HCAI). It provides endence-based practice guidance for key clinical peocedures where the ratio of infection is reducible, in the form of high impact intervention (HII) care bundles (Box 1).

The Department of Health provides standardised audit lools to enable NHS organisations to audit compliance to the HII care bundies, and recommends that NHS organisations in England conduct these HII audits regularly to embed good practice and continually improve compliance. Therefore if each idement of the HII audits is carried out every time for every patient the risk of infection to patients will be reduced (DH, 2010). Most acute NHS trusts conduct there

audits monthly and many use Hill audit results as key performance indicators to provide assurance to the prust board and the primary care must that the risk of infection is being addressed and reduced. However the effectiveness of conducting monthly HII audits to improve compliance with infection prevention and control practices in the clinical setting has not yet been evaluated. Saving Lives (DH) 2010) also advocates that NHS organisations should provide annual training on the prevention and control of infection in general to all stall. However previous studies have found that no matarch recommends the most effective way to deliver generic injection prevention and control education (Mann and Wood, 2006: Vaughan et al. 2006). Furthermore current training tends to be formal, short and taught didactically by content experts, for large groups of effects; braithcare workers in the hope that enhanced knowledge will persuade staff to improve their compliance in relation to clinical care (Cole, 2008). Other forms of training have therefore been developed to improve the quality and Texobility of training. for example the Skills Academy for Health launched the Core Learning Unit in 2009 which has an infection prevention and control e-learning module. This provides an assured level of quality of training and increases licial-lity and access to training. However the content is generic so may not reflect local policies or practices and knowledge can be significantly lessened there. months alter completion of elearning modules (Fakih et al. 2006). Another alternative is traching staff the knowledge and skills relevant. to their practice in the clinical setting. Previous studies have shown that ward-based teaching sessions overcome staffing pressures. (Richardson 2001) that more staff are likely to attend (Scott et al. 2005) and that the training is more effective than classroom teaching (Gould and Chamberlain, 1997). Although ward based teaching pack ages and programmer have been shown to improve compliance with infection prevention and control standard precautions (Hung et al. 2002: Kilminster et al. 2001; Uwakwe, 2000), there has been no published research into whether ward based teaching can improve com pliance with the key elements of practices recommended by the Hill care bundles to reduce the risk of infections to patients.

> The Author(s) 2011 Reports and permission http://www.sagepub.co.uk/journalsPermanaons.sov 10:1177/1737177411474785

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Box 1

Saving Lives (DH, 2010) High Impact Intervention care bundles

- Central venous catheter inservion
- · Central venous catheter ongoing care
- Peripheral intravenous cannula insertion
 Peripheral intravenous cannula ongoing care
- Renal harmodalvsis insertion
- Renal haemodialysis insertion
 Renal haemodialysis ongoing care
- HEIMI INCLUSION AND COLOURS COM
- Prevention of surgical site infection pre-operative
 Prevention of surgical site infection intra-operative
- Prevention of surgical site infection post-operative
- · Ventilated associated pneumonia
- · Uninary catheter care insertion
- · Uninary catheter care ongoing
- Clostridium difficile
- · Cleaning and decontamination
- Chronic wounds care actions
- · Chronic wounds management
- Enteral leeding

Methods

A retrespective audit evaluation was used to assess whether the implementation of a programme of ward-based traching improved infection prevention and control practice. The research fools were the national Saving Lives (DH. 2007) HII auties for peripheral intravenous catinula insertion and ongoing care and uninary catheter insertion and ongoing care, compliance with which was scored as a percentage. The sample population was a destrict general hospital in the United Kingdom (UK) where the HII audits were conducted monthly by ward managers: 52 wards and departments participated in this audit proonas every month from May 2007 and still continue to do so. In December 2007 the Infection Prevention and Control Team intinduced two clinical skills trainers for four months to provide ward based teaching sunounding the insertion and care of peripheral cannulae and unnary catheters. The clinical skills trainers had under taken formal assessments of competence for these skills prior to commencement in post. They taught nursing staff the policies and products relevant to HII care bundles, updated their skills, and explained the rationale that underpins practice with regards to these HII invasive devices.

The clinical skills trainers were only employed in the medical direct torate and therefore the sample size comprised the 13 wards in that directorate. Seven wards were randomly selected as the intervention. group and the clinical skills trainers laught on these wards. So wards comprised the control group as nursing stall on these wards had no access to the clinical skills training. Both the control and the intervention groups were of a similar case mot as each group included emer gency, acute and elderly medical wards. Monthly Hill audit results for peripheral cannula insertion and care and unmary catheter insertion. and care were analysed retrospectively for the six months before, the four months during and the six months following the training to ascertain whether the clinical skills training improved compliance with these Hill care bundles and therefore improved monthly audit results. for the intervention group. Consent to access and use of this data was gained from the National Research Ethics Service, the Research and Development Committee at the hospital and from the Lead Infection. Prevention and Control Name. Data were analysed using \$P\$5 (ver sion: (4.0) and significance set at 0.05.

Results

The HII audit results for peripheral cannula insertion and origoing care and unmary catheter insertion and origoing care were analysed for the six months below, the four months during and the six months after the clinical skills trainers were in post. The data were normally distributed except for unmary catheter insertion data: therefore this data was analysed separately using non-parametric tests. There were no significant differences in the data between the control and intervention groups before the clinical skills training started for peripheral cannula insertion, peripheral cannula origoing care, unmary catheter insertion and unmary catheter orgoing care (p=0.225, 0.614, 0.073 and 0.184, respectively). Mean audit scores for each HII care bundle before during and after the intervention for both groups are presented in Table 1.

For penpheral cannula insertion, without the clinical skills trainers the control group made no significant improvements in audit results (into 153) but did improve in the last six months of the study. from 64.57% to 82.13%, perhaps as this care bundle became gradually embedded. The intervention group improved consistently over the study period, in particular the scores for peripheral cannula insertion were significantly better, while the clinical skills training was available compared with before the training (p=0.009) and increased to 84.57% in the six months after the training. Similarly for peripheral cannula ongoing care, the intervention group made small and consistent improvements to compliance throughout the study period, while the control group did not improve until the last six monthis (Table 1).

With regards to unnary catheter insertion compliance, the findings showed that compliance with this care bundle was good for the intervention group before any intervention (98.82%), which increased to 100% during and 100% after the clinical skills training. For the control group, compliance was 65.42% before. 100% during and 98.67% after the study period, though this improvement was not statistically uppincare (peol.155).

For unitary catheter ingoing care results, the intervention group acures for catheter ongoing care increased throughout the study and were significantly better after the skills training compared with during the training (j=0.042). The control group results yielded no significant improvements (j=0.069) and decreased after the study period from 94.06% to 80.60% (Table 1). However, for both groups the overall compliance throughout the study period was much higher for unnary catheteristation and catheter torgoing care than for peripheral canoniation and peripheral cannots origoing care.

Discussion

The results of this retrospective audit evaluation offer some useful insight for practice relating to the effectiveness of both audit and ward-based clinical skills training to improve practice.

With regards to peripheral intravenous cannulation and ongoing care, results suggest that Saving Lives audits alone had little effect on improving the skills of cannulation and ongoing care during the Trist part of the study, and the implementation of clinical skills train ing increased scoles for both these skills, significantly for cannula tion, and these were sustained over the six months alter the skills. training was completed. Cannulation and ongoing care scores for the control group did increase in the last six months of the study period perhaps because the care bundle was gradually becoming embedded, or other contributory factors that were not studied or because of the Hawthorne effect. Although direct observation has historically been perceived to be the best method of audit and is the most commonly used approach it can be subject to both bias and the Hawthome effect (Stein et al. 2003). This could therefore affect the result of the Saving Lives audits as they were completed under direct observation of practice by the ward managers. Therefore the concept of self audit must be considered as a factor that may have

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Table 1. Peripheral intravenous cannula insertion, periphera urinary catheter ongoing care mean audit scores	I Intravenous cannula ongoing care, urinary catheter insertion and Peripheral intravenous cannula insertion Peripheral intravenous cannula ongoing care			
	Control group	Intervention group	Control group	Intervention group
Mean audit scores before skills training on intervention wards (%) Mean audit scores during skills training on intervention wards (%) Mean audit scores after skills training on intervention wards (%)	68.58 64.57 82.13	55.37 80.10° 84.57	72.76 71.60 85.11	64.33 67.83 68.46

	Urinary catheter insertion		Urinary catheter ongoing care	
	Control group	Intervention group	Control group	Intervention group
Acan audit scores before skills training on intervention wards (%)	65.42	98.82	90.23	81.45
Mean audit scores during skills training on intervention wards (%)	100.00	100.00	94.06	83.15
Mean audit scores after skills training on intervention wards (%)	98.67	100,00	80.60	93.88'

*rr < 0.05 repeated measures ANOVA

affocted the audit results. Yet it could be suggested that if either group were affected by either the Hawthorne effect or any self-audit bias, then the compliance scores to the care bundles would have been significantly higher than they actually were.

The Department of Health (2007) interided Saving Uves audits to be used to identify small changes or improvements to practice to be unplemented each month, so that when re-audited the following month, compliance improves until (00% is achieved and suitained. Therefore, regardless of access to ward-based training, by the design of the Saving Lives programme, it could be suggested that 100% compliance should have been achieved by all wards in the study after 16 months of implementation. However, a recent study that completed Infection Control Narses Association audits ever a four year period. resulted in the facilitation of improvement of compliance from \$8% to 93% (Milward et al. 2010), suggesting that 100% compliance may not be achievable in a 16 month timeframe. Therefore, for this study it could be suggested that either the Saving Lives audits were not effective at eliminating poor practice or that monthly audit results were not intermeted and acted upon in a timely manner. Although the Saving Lives audits provided useful data for the word mangers regarding compliance with the care bundles on their wards, this information is only worthwhile if they can then translate it into actions required for their ward and then implement relevant interventions in a relatively short period of time. There is also a cost implication to the use of the audit tools. For example, assuming three fround per month of a ward manager for the 52 departments for the hospital in this study equals. approximately 12.4k per month or 128.7k per annum, which could perhaps have been better utilised. for example to provide further clinical skills training.

With regards to unnary catherensation scores, findings suggest that although the intervention group had high scores before the clinical using they achieved 100% with further training and this was unumed after the training created. The control group also maintained good scores, suggesting that nurses, unnary catheterisation skills were consistently compliant for both groups. Similarly, scores for unnary catheter ongoing care emained high for both groups throughout the study period, pathetically when compared with the cannot uncertain tion and ongoing care scores. This could be because initial perpheral

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intravenous cannulation training is not sufficient, while initial sumary catheterisation training is adequate. For example, locally catheterisation is taught as a pre-registration skill by clinical skill educators, while cannulation is taught post registration by representatives from private companies. Such training provided for cannulation may not include local policies, products and care plans, while the training for catheter isation does, suggesting a need to improve training surpunding cannulation. This include a epileas while the training infection prevention knowledge, application and compliance, which has identified a need for increased infection prevention education (Stein et al. 2003) Trigg et al. 2008. Wu et al. 2006), improvements to current infection prevention education (Marin and Wood. 2006; Vaughan et al. 2006) and the eauses for current limited knowledge to the establiched (Tim et al. 2003).

Attenuatively, the reduced compliance with cannulation and care of cannulae could also be attributed to the concept that over time stall lorget or fail to apply the correct techniques to practice. Some research into poor compliance to practice suggest that this may be because ntualistic practices can prevail (Haas and Larson, 2007) and that nurses may believe their compliance is better than it actually is when observed, audited and quantified (Cole, 2008). Although tack of sullicient education could therefore provide a simple rationale for poor compliance with cannulation and cannula care. It may also be suggested that infection prevention and control compliance is far more complex, with determinants such as attitudes, beliefs, habits and organisational culture affecting behavious and therefore practice (Cole, 2008: Hanna et al. 2009; Whitby et al. 2006). It could therefore he inferred that a change in attitude and behaviour is required if compliance with infection prevention and control practice is to be sustained without input hom such staff as clinical skills trainers (Parker, 20001

To conclude, the findings of this study suggest that, given the high emphasis cuitently placed on infection prevention and control in healthcare settings, key skills such as peripheral intravenous cannula insertion and care of cannulae should be an inhereni part of practice but seem not to be unless reinforced by further training and audit. Therefore either attrude towards infection prevention and control mistible changed or else there is a necessity for such educational roles as clinical skills trainers to regularly update nurses' clinical skills in order to improve compliance with key infection prevention and control procedures. Furthermore, for this sample population, with the exception of cathetensation, Saving Lives audits did not achieve 100% compliance consistently for either group and therefore did not successfully eliminate poor practice or significantly minimise the risk of infection to patients, which is what the tools are designed to do. Therefore training for ward managers sumounding audit results interpretation action planning may also be benefocal in order to develop the usefulness of the Saving Lives audits. Although practice is increasingly becoming more audit led and governance focused in order to drive improvements in practice, measures such as supporting nurses in the clinical environment through clinical skills education and effective audit, action planning may successfully contribute to improvements in audit results, with the overall outcome of reducing infection rates, increasing the quality of patient care and meeting the Saving Lives objectives

Conflict of interests None declared

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About the Infection Prevention Society

The Infection Prevention society works together with healthcare colleagues, professional bodies, industry, government agencies and voluntary organisations in the prevention and control of infection. Our main aim is to advance the specialty of infection prevention and control through education, professional development of our members and research. With the continued need to prevent and control existing, re-emerging and new infections the Society is at the forefront of initiatives across the United Kingdom and Eire in both hospital and community settings. Members of the Society are active locally, regionally, nationally and internationally in cross boundary activities that support the quality and clinical governance agenda in providing safe and effective patient care. *The Journal of Infection Prevention* is provided as a benefit to members of the Infection Prevention Society.

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Appendix XVI: Journal Publication 'Infection prevention practice: how does experience affect knowledge and application?'



Infection prevention practice: how does experience affect knowledge and application?

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Key words: Education, knowledge, experience, infection prevention and control

Abstract

he purpose of this study was to evaluate nurses' knowledge of infection prevention procedures, the degree to which they were applied correctly, and whether length of service affected either knowledge or application. Nurses with over five years of experience had significantly increased understanding of intection prevention (p=0.009) and significantly increased application of knowledge to practice (p=0.001), compared to nurses with five years or less experience. In particular, understanding of hand hygiene and use of personal protective equipment (PPE) was poor although application was compliant, while knowledge of care of patients with meticillin resistant Staphylococcus aureus (MRSA) and Clostridium difficile was poor, which was reflected by substandard application of knowledge to practice. The results of this study suggest that focusing infection prevention education around patients with specific infections, such as MRSA and C. difficile, rather than on individual standard precautions may more effectively increase knowledge and therefore application of infection prevention practices.

Introduction

The prevention and control of healthcare associated infections (HCAI) is top of National Health Service (NH5) and Department of Health (DH) agendas in England because the rates of HCAI have grown to unacceptable levels (DH, 2003). The increasing incidence of MRSA bacteraemia during the 1996s to reach a peak of 7.700 reported cases in England in 2001-04 was the tigger for the first ever infection reduction target for the NH5 to reduce MRSA bacteraemia by 50% by 2008 (Durden 2008). This was essential as approximately 8% of patients developed an HCAI in 2005, causing 5000 deaths annually and costing the NH5 £180% each year (World Health Oreanization (WHO), 2005).

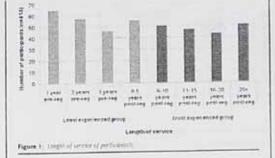
One fundamental issue in the reduction of HCAIs is the application of standard infection prevention precautions, which underpirt routine practice and protect both staff and patients from infection. Standard precautions aim to reduce the risk of transmission of bloodborne and other pathogens from both recognised and unrecognised sources. They are the basic level of infection control precautions, which are to be used as a minimum in the care of all patients (WHO, 2007). Standard precautions include hand hypene, use of personal protective. equipment, sale handling and disposal of waste, linen and shurps and sale management of blood spillages (RCN, 2005). The results of several studies have demonstrated that compliance with infection prevention standard precautions remains poor, with an average of 40% compliance reported (Pittet et al. 1999; Scott et al. 2005; Flores and Pevalin, 2006, Whitby et al. 2006; Gould et al. 2008). Reduced complance has been found to be reliected by nurses poor knowledge of standard precautions (Pittet et al. 1999; Trim et al. 2003; Marshall et al. 2004; Trigg et al. 2008). Factors that affect compliance include insulhcient time and heavy workload (Waid: 1995; Madan et al. 2002; Sax et al. 2005), poor role models (Scott et al. 2005; Whitby et al. 2006), lack of availability of protective equipment or hand wash lacilries (5as et al. 2005. Ferguson et al. 2004) and lack of effective infection prevention education (Stein et al. 2003; Wu et al. 2006; Trigg et al. 2008). Stein et al (2003) suggest that experience or length of service is indirectly related to infection prevention compliance, with more experienced healthcare workers appearing to be less compliant. but Stein's study did not explore this lutther. The aim of the present study was to determine the extent of nurses' knowledge of infection prevention procedures, the degree to which knowledge of standard piecautions was applied correctly, and whether experience was a factor in either nurses knowledge or application of infection prevention practices.

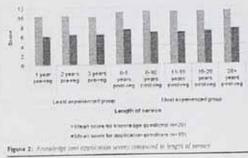
Methods

A cross-sectional survey was distributed in March to june 2009 to determine morses knowledge and understanding of infection prevention practices, from a population that comprised two district general hospitals and a university in one region. A stratified random sample was selected from 1.373 qualified nursing stall and 628 student nurses to ensure that the sample population was fairly represented. The eight strata were divided into the following two groups for data

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analysis: least experienced (year 1 pre-registration nurses, year 2 preregistration nurses, year 3 pre-registration nurses and 0.5 years postregistration nurses) and most experienced (6-10 years, 11-15 years, 16-20 years and over 20 years post-registration nurses).

In total 1.060 postal questionnaires were distributed with a return rate of 39.1% (me414), and there was a minimum of 44 returns from each strata. The questionnaire was adapted from two existing tools used in similar studies (Gould and Chamberlain 1997, Mann and Wood, 2006). Permission was sought from the original authors to use the questionnaires, ethical approval was obtained and a pilot study was conducted. The questionnaire incorporated six questions to assess parlicipants self-reported confidence of their understanding of infections prevention procedures. 20 questions to determine their knowledge, and ten questions to measure application of knowledge to infection prevention proctices. Data were non parametric and write analysed by a Mann-Whitney test using SPS (version 14.0) with significance set at p< 0.05.

Results

Of the 414 returns, 168 (40.6%) of participants were pre-registration nurses and 246 (59,4%) were post registration, of which 233 (53.8%) comprised the least experienced group and 191 (46.2%) represented the most experienced group (Figure 1). Nearly three quarters (73%) of those responding had received education in infection prevention and control less than a year previously, and 90% of the sessions had taken place in a traditional classroom setting. For the knowledge element of the questionnaire, the most experienced group had statistically tognificantly higher scores compared with the least experienced group (p=0.00%) (Figure 2). The most experienced group also had significantly higher scores for the application of conect practice questions than the least experienced group (p=0.001). Additionally, there were no significant improvements in scores between the pre-registration nuises and those who had been qualified for five years or less (p=0.975. 0.618 and 0.106; respectively). These results suggest that nurses knowledge and application of infection prevention practice was significantly increased when they had a longer length of service.

This finding was analysed further to determine trends in the data between the twei groups. This was split into three aspects: the self reported confidence that participants had in their own knowledge of infection prevention standard precautions and practices (Figure 3), the correct knowledge demonstrated (Figure 4) and the correct application of practices (Figure 5). These results suggest that for all aspects of infection prevention practices, the most experienced group were more confident in their understanding of the practice. That microarted knowledge and a greater application of that knowledge to practice, compared with the least expenienced group. However, the extent of this varied for the different standard infection prevention precautions, and, the most expenienced group demonstrated only an average knowledge and application to practice (1116 for the 20 knowledge questions). With regard to hand hygene and use of PPE both the least and the most experienced groups reported high self-confidence in their under standing. Of these practices (96% and 98%, respectively for hand hygene and 87% and 94%, respectively for use of PPE) (figure 3). However, both the least experienced and most experienced groups demonstrated particularly low scores for the inowledge questions for hand hygene (4% and 8%, respectively) and use of PPE (19% and 31%, respectively) (Figure 4). Despite this for both the least experienced and most experience and most experience and most experience and the respectively) (Figure 4). Despite this for both the least experienced and most experience groups, the application to practice was reasonable for hand hygens (69% and 77%, respectively) and use of PPE (76% and 81% respectively) (Figure 5). Therefore, for these infection prevention practices, although nurses in both groups did not understand the underprinning theory, they did adhere to practice.

Yet for the disposing of waste and linen and caring for a patient with MRSA and C oi/ficite elements, findings suggest that poor knowledge led to poor application. For example, 61% of the least expenenced and 83% of the most experienced group were confident in their under standing of caring for a patient with MRSA, yet only 56% of the least experienced and 68% of the most experienced group demonstrated accutate knowledge of MRSA, which was reflected by only 36% of the least experienced and 59% of the most experienced group adhering to practice (Figures 3.10.5).

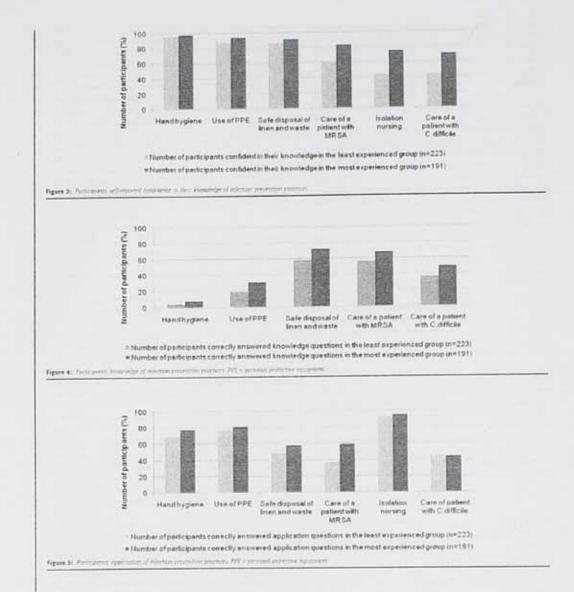
Discussion

The results of this study suggest that nonses with six or more years of experience, have significantly increased understanding of infection prevention and significantly increased application of knowledge to practice compared to nuises with live years or less experience. Although this result may in itself be considered unsurprising, the findings of this study provide a new insight into how infection prevention knowledge affects application for the different elements of infection prevention practice. In particular findings illustrate that understand ing of hand hygiene and use of PPE was poor yet application of this intevidege to practice was compliant, while knowledge of the care of patients with MRSA and C. difficule was limited, which was reflected or substandard application of knowledge to practice.

For sale disposal of waste and linen and caring for patients with MRSA or C difficule, findings suggest that poor knowledge led to poor application of practice. This finding is supported by similar studies which found that healthcare workers were not aware of basic infection prevention measures required to care for patients with MRSA (Tim et al. 2003; Marshall et al. 2004; Easton et al. 2007; Lugg and Ahmed. 2008) or C difficule (Vaughan et al. 2006), and suggests that this has not changed with time and a range awareness statlegy within the NHS.

Infection prevention training is now mandatory training annually for all healthcare staff in England to improve knowledge (DH, 2008), but large classes or lectures are often used in order to teach the workforce basic infection prevention policy. Yet infection prevention education

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delivered through lectures can lead to a lack of engagement and concentration and often fails to achieve effective interaction (Billings, 2010). It could be suggested that this approach can lead to theory overload and can actually therefore enhance the theory-practice gap that it aims to close (Cole, 2005). Similarly for other areas of manda tory training it has also been reported that a 'one size fits all' appusach does not meet the learning needs of healthcare professionals attend ing (Turner et al. 2011) and that practical skills and knowledge decline. after three to six months following training delivered by lectures (Hamilton, 2005). This is often because overvise of lecture-based teaching resources can lead to lack of concentration and engagement and often fail to encourage interaction, usually because of the large audience (Billings 2010) This takes concerns that the content and delivery of infection prevention education in current pre-registration and post-registration nurse education curricula may not be adequate or effective.

It is thought that adult learners are also more molivated to learn to cope with real-life situations and identify their own learning needs (Knowles, 1978). Current infection prevention educators should perhaps take into consideration adult learning styles in order to successfully meet the needs of nucles and therefore facilitate effective learning. Problem based learning is emerging from andragogy at a teaching method that enables adult learners to not only find out about a subject but also how to think about it mitically (Cole 7005) Problem based learning is beneficial as it facilitates the learner to develop problem solving, critical thinking, inam working and reliective skills that are estendial in the practice setting. This method could be very appropriate for infection prevention education as there are many discumstances to which it could be applied in order to convey the same information as an educator would through the more liequently used pedagogical method, yet to date little has been documented as to the effectiveness of this (Billings, 2010;

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Ward, 2011). If infection prevention education therefore locuses less on basic standard promittions and more on problem based scenarios of patients with specific infections particularly MRSP and C di/Note improved understanding may well be achieved and reflected by improved application of knowledge to practice.

With regards to hand hygiene and use of PPE findings of this study suggest that although knowledge of these practices was poor application of these skills was good. Previous studies that have evaluated knowledge and application of standard precautions found that poor knowledge of this element of infection prevention led to poor practice (Stein et al. 2003; Scott et al. 2005; Whithy et al. 2006; Wu et al. 2005). It is possible that recent national and inter national campaigns such as the *CleonYourNendsComposity* the WHO's 5 Moments of Hand Hygiene. Bare Below the Elbow's and monthly hand hygiene audits in local hospitals has embedded good practice to hand hygiene and use of PPE even though the rationale may be poorly understood.

Alternatively it could be suggested that nurses perceive their practice. to be applied more consistently than it actually is. It is acknowledged that nurses can believe their compliance may be better than it genu inely is when observed, audited and quintibled (Cole, 2008). Although it is suggested that ineffective teaching methods may affect compliance for MRSA and C. difficile, it may also be intered that infection prevention compliance is far more complex, with determine nants such as attitudes, beliefs, habits and organisational culture affecting behaviour and therefore practice (Whitby et al. 2006: Cole 2006. Hanna et al. 2009). Hanna et al (2009) found that nurses' per ceived importance of hand hygiene was directly related to their beliefs regarding the transmission of infections. Other studies have suggested that a change in attitude and behaviour by healthcare workers. are required if compliance with infection prevention practice, particularly hand hygene, is to be sustained (Parker, 2000; Whitby et al. 2006: Lee et al. 2008)

Furthermore it might be suggested that it is not acceptable to have good practice but poor knowledge of skills such as hand hygiene and use of PPE. While musses may practise such skills correctly in a motine circumstance, the application of such practices or problem solving in a novel situation may require a sound knowledge base. It is therefore recognised that interactive education that fosters entired thinking and a questioning approach is essential to facilitate the development of positive attitudes to change towards infection prevention practice (Billings, 2010).

The Indings of this study make recommendations for improvement in NHS organisations and universities where infection prevention education is delivered by infection prevention nurses. As such these findings may have limited generalisability to organisations in which this education is primited generalisability to organisations in which this education is primited generalisability to organisations in which this education is primited generalisability to organisations in which this education is primited generalisability to organisations in which this education is primited generalisability to organisations the linding that prior knowledge of how such education in delivered. The linding that prior knowledge of hand hygoene and use of PPE is not: may be used to inform improvements to infection prevention education in both the clinical and the academic setting.

The reliability and validity of studies that use self-reporting measures should be treated with some caution as respondents may report what they believe the researcher expects to see rather that what they actually do, or may report higher self-confidence than they actually have. Nichols and Badger (2008) report a doparity between espoused infection prevention knowledge and actual compliance in practice. Yet in this study poor responses to the knowledge questions were generally reflected by low self-reported application to practice, suggesting that self-reporting is unlikely to limit the reliability of the findings. Furthermore, the tool used in this study was amalgamated from two previous tools that were developed from the literature in collaboration with a microbiologist, and one was sent to an experi panel to obtain content validity (Gould and Chamberlain 1997). Mann and Wood, 2006). However, although the tool had a confidence question and an application question for isolation musing, it did not contain any knowledge questions surrounding this topic, which may have provided further insight into the relationship between infection prevention, theory and practice.

The fact that many of the participants had attended infection prevention education less than a year previously raises the question of the effectiveness of the training provided. It may be that the content or delivery of the training was not sufficient, or that the classicom environment in which the majority were taught does not enable noises to effectively learn these skills, which are very practical by nature in that they are applied during episodes of patient care Similarly for the least experienced nurses, findings raise concerns with current pre-registration inlection prevention education. For this sample population it is the hospital infection prevention nurses who provide education to the pie registration nurses at the university, generally utilising the same education package that is used to provide annual post-registration training at the hospital. It is therefore sugrested that nume educators need to explore more innovative approaches to learning, which better suit the needs of individual learners in order to improve nurses' htness to practise, as good quality education is more likely to contribute towards compliant nurses and therefore to improve practice (Cole. 2008). These lindings have implications for both pre-and post-registration inlection prevention education and suggest that centring education around HCAIs such as MRSA and C. ddficile rather than net individual standard precautions. may more effectively enhance knowledge and therefore application to practice.

These is little published information on nurses' expenence of preor post-registration infection prevention education, yet this may provide further understanding of how education affects knowledge and application of practice, or insight into what issues easily with regards to current infection prevention education Lastly, further exploration of the role that adult learning theory and behavioural theory can play on improving knowledge and application to practice may provide more permanent adherence to infection prevention practices by influencing change in atitudes, heliefs and self-efficacy of nurses (Lee et al. 2008).

Conclusion

The results of this study suggest that experience enhances infection prevention knowledge and application to practice. Furthermore, knowledge of HCAIs is limited and is inflected by poor practice while poor theoresical understanding of hand bygione and use of PPE is not. Therefore, focusing infection prevention education on care of patients with specific infections, such as MBSA and C difficile, rather than on individual standard preclausions may more effecitively increase knowledge and therefore application of infection prevention practices related to inducing these HCAIs. This is timely as the new Standards for Pre-registration Nursing education (Nursing G Midwifery Council 2010) have continued to require a locus on infection, prevention and control as an essential skills cluster throughout the pre-registration curriculum, which emphasizes the importance of effective infection prevention and control education to undergo endicide.

Conflict of interests

None declated

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