Evaluation of a Protocol to Control Methicillin Resistant *Staphylococcus Aureus* (MRSA) in a Surgical Cardiac Intensive Care Unit

by

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Evaluation of a Protocol to Control Methicillin Resistant *Staphylococcus Aureus* (MRSA) in a Surgical Cardiac Intensive Care Unit

A Dissertation Submitted to the

School of Nursing, University of KwaZulu Natal,

in partial fulfillment of the requirements for a

Masters Degree in Critical Care and Trauma Nursing.

December 2008

By Karen Kindness

Supervised by Dr. Petra Brysiewicz

DECLARATION

I declare that this research project entitled "Evaluation of a Protocol to Control Methicillin Resistant *Staphylococcus Aureus* (MRSA) in a Surgical Cardiac Intensive Care Unit", is my own work.

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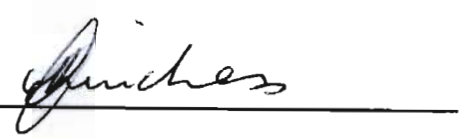
Signed  Date 20th February 2009

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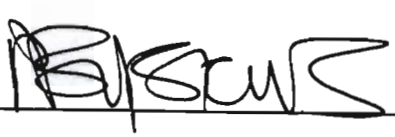
Signed  Date 20/2/2009

Name Dr. Petra Brysiewicz

ACKNOWLEDGEMENTS

I gratefully acknowledge the assistance of the many people who have facilitated my endeavours with this dissertation.

Dr. Petra Brysiewicz for her able guidance, supervision and insightful direction throughout a painful, but ultimately rewarding experience. Ms. Jennifer Chipps, for an introduction to evaluation research. Ms. Fikile Nkwanyana, for her assistance with refining the data collection instruments and her advice and support with the statistical analyses.

Sister Helen Loudon for sharing her knowledge and enthusiasm, for advice and support during data collection, assistance in locating the necessary records and acting as co-assessor for collected data. All your help is sincerely appreciated. Sister Christine Crichton for being ever willing to co-operate with requests for access to the clinical area, acting as co-assessor on collected data.

The ICU and CICU nursing teams for being so willing to assist with the pilot/study.

Mrs. Amanda van Rensburg and the hospital management team for giving permission for access to clinical areas and records. Mr. Duncan Shandu for facilitating case file collection. Mrs. Bev Everett for attempting to facilitate patient listings from head office.

Thank you to Dr. Peer at Lancet laboratory and Jenny Breederkamp at Bouwer laboratory for compiling the available MRSA data for the hospital.

Last, but by no means least, my family. Thank you to my husband Andrew for picking up the slack at home and for technical assistance. Thank you to my sons Douglas, Alasdair and Iain, who have been very good at looking after themselves during my studies. Thank you to my mother, Margaret Hunter, for proof reading and for being there for me.

ABSTRACT

Evaluation of a protocol to Control Methicillin Resistant *Staphylococcus Aureus* (MRSA) in a Surgical Cardiac Intensive Care Unit

Introduction

MRSA is a major healthcare problem with particular relevance to morbidity and mortality in ICU (Byers & Decker 2008). Due to the increased infection risks associated with cardiac surgery, MRSA screening and surveillance is widely used as a standard preoperative investigation in many settings (Teoh, Tsim & Yap, 2008). The results, in conjunction with appropriate hygiene precautions, are used to control and prevent infection with MRSA. Following an outbreak of MRSA in cardiac patients an MRSA protocol (MRSAP) was implemented in the cardiac intensive care unit in this study.

Purpose

To evaluate how nurses implement the MRSAP in the surgical cardiac intensive care unit in this study, and to evaluate the change in MRSA infection rates following implementation of the MRSAP. From the results obtained, to identify any areas for improvement in nursing practice with respect to the MRSAP.

Methods

Nursing staff knowledge with respect to the MRSAP was assessed using a survey questionnaire. Their compliance with required Infection control practice for control of MRSA was assessed through periods of observation on the unit. Screening compliance and reduction in infection rates were investigated using a retrospective records review.

Results

The survey revealed good awareness of the MRSAP (88%, n=23), but knowledge of the detailed content was variable. Most staff were apparently satisfied with the existing standards of infection control in CICU (84.6%, n=22).

Observation revealed that, compliance with routine hygiene measures was good (66% correct contacts, n=144) by the standard of other studies, but, given the high risk of postoperative infection for these patients improvements are required. Inadequate data in sampled records prevented meaningful analysis of screening compliance, and hence the systems for handling screening swabs and results need to be reviewed.

The change in infection rates between the pre and post MRSAP periods, which incorporated use of infection risk stratification data to demonstrate comparability of the two groups of patients, revealed that despite the high MRSA infection rate in 2005 (1.18%), and subsequent drop post MRSAP (0.35%), the actual number of cases found was too small to test statistically for significant difference. An incidental finding was that female cardiac surgery patients were getting significantly younger ($p<0.01$). There was a significant decrease in hospital MRSA infection rates for matched periods ($p<0.0001$).

Conclusions

Evidence was found to support the efficacy of the MRSAP in the reduction of MRSA infections. Deficits in staff knowledge and infection control practice were identified and feedback has been implemented in order to improve compliance with the MRSAP and maintain the improved infection rates.

Further research with respect to implementation of, and compliance with, infection control measures could both improve quality of patient care and decrease the burden of preventable infectious disease such as health care associated infections (HAIs) in South Africa.

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GLOSSARY AND ABBREVIATIONS

CABG	Coronary Artery Bypass Graft
CA MRSA	Community Acquired MRSA
CDC	Centers for Disease Control and Prevention
CICU	Cardiac Intensive Care Unit
EN	Enrolled Nurse
FY	Financial Year (e.g. 01/10/03 to 30/09/04 is FY2004)
HAI	Healthcare Associated Infection or Hospital Acquired Infection
HA MRSA	Hospital Acquired MRSA
HCW	Healthcare Worker
HPA	Health Protection Agency
ICN	Infection Control Nurse
ICP	Infection Control Policy/Protocol
ICU	Intensive Care Unit
ISO	International Standards Organisation
MI	Myocardial Infarction
MRSAP	MRSA protocol, that is an infection control protocol for MRSA
PPE	Personal Protective Equipment
RN	Registered Nurse
SCICU	Surgical Cardiac Intensive Care Unit
SPSS	Statistical Package for Social Sciences
U/A	Unit Assistant
UK	United Kingdom
UNFPA	United Nations Fund for Population Activities
USA	United States of America
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Background to the study

Nosocomial Infections, now usually termed healthcare associated/acquired infections (abbreviated to HAI or HCAI in the literature), can be defined as being the result of hospital or health care treatment but secondary to the patients' original condition (McKibben, Horan, Tokars, Fowler, Cardo, Pearson & Brennan, 2005). The Centers for Disease Control and Prevention (CDC) provides precise definitions of various types of HAI (McKibben et al. 2005). Healthcare acquired infections (HAIs) in general are costly, both directly and indirectly as they deplete the limited financial resources available to healthcare delivery according to Duse (2005) in his description of infection control in developing countries, particularly South Africa (SA). While no detailed statistics for SA were found, the guideline on the management of nosocomial infection in SA, by Brink, Feldman, Duse, Gopalan, Grolman, Mer, Naicker, Paget, Perovic and Richards (2006), estimated that one in seven patients were at high risk of a HAI in SA hospitals. The CDC statistics for hospitals in the United States of America (USA), described by Zell and Goldmann (2007), help to illustrate the extent of the problem: approximately $3.5 billion per annum is incurred in excess healthcare costs due to HAIs; annual HAIs amount to approximately 1.7 million patients; of which about 99,000 patients die; HAIs are the most common infectious cause of death and one of the 10 leading causes of death overall.

The World Health Organization (WHO, 2006) stated that the majority of these infections are preventable with fairly simple and inexpensive measures such as rigorous hand hygiene. WHO (2005a) identified factors which contribute to poor compliance with hand hygiene as understaffing, high levels of bed occupancy, and increased transfer of patients. Particularly with regard to the ratio of nursing staff to intensive care unit (ICU) beds, Scribante & Bhagwanjee (2007a) identified the acute shortage of trained and experienced ICU nurses in South Africa with only 1.1 nurses per ICU bed compared to the ideal of 6.7 nurses per ICU bed. Scribante and Bhagwanjee (2007b) further identified the consequent high use of agency staff in ICUs and the potential problem of agency staff contributing to transfer of resistant organisms between units through non-adherence to infection control policies.

An organism which has been responsible for a substantial amount of the cost associated with HAI is Methicillin Resistant *Staphylococcus aureus* or MRSA (Allen 2005). This organism is the multi-drug resistant version of *Staphylococcus aureus* (*Staph. aureus*), a gram positive bacterium which colonises epidermis and is present in the anterior nares of 25-30% of the healthy population (Grundmann, Aires-de-Sousa, Boyce & Tiemersma, 2006). These authors also explained that *Staph. aureus* can cause disease depending on factors such as host health status and potential sites for invasion. It was described as endemic in many hospitals worldwide, including SA, and difficult and expensive to treat (Grundmann et al. 2006). Perovic, Koornhof, Black, Moodley, Duse and Galpin (2006) investigated *Staphylococcus* bacteraemia at two academic hospitals in Johannesburg and found that Methicillin resistant *Staphylococcus aureus* (MRSA) was significantly associated with mortality and that stay in ICU was also a highly significant independent predictor for mortality.

Davis, Stewart, Crouch, Florez and Hospenthal (2004) identified the increasing prevalence of MRSA in the community, which implied that not only were patients admitted to hospital at risk of becoming colonised with MRSA, they were also potentially a source of infection to existing patients. Johnson, Martin, Burrell, Grabsch, Kirsa, O'Keeffe, Mayall, Edmonds, Barr, Bolger, Naidoo and Grayson (2005) explain that MRSA is endemic in hospitals worldwide, and has been since the 1960's in their study which combined the use of hand rub and a hand hygiene programme to try and reduce rates of nosocomial MRSA infection.

More recently MRSA has been identified as being epidemic in the community (Byers & Decker 2008), causing serious infections in people from all backgrounds and not just those with risk factors. Further, it was found that in a climate of escalating healthcare costs and increasing litigation (where the healthcare provider can be perceived to be at fault) it becomes necessary for healthcare facilities to be proactive both in identifying threats to their clients, and in dealing effectively with those threats in order to facilitate their clients' timeous and uncomplicated recovery (Zell & Goldmann 2007). Due to the widespread presence of MRSA in the USA and United Kingdom (UK), among other countries, there are fact sheets and information on MRSA made available to the public through national agencies such as the CDC and the Health Protection Agency (HPA).

During the researcher's studies on critical care nursing in SA, she has worked in a number of institutions in both the public and private sector. There appeared to be no consistent approach to management of MRSA in either sector. Internationally, developed countries such as the USA and UK have national guidelines available for management of HAI which include MRSA. Examples

would be the CDC infection control guidelines obtainable via the CDC website, and specifically those for multi-drug resistant organisms (Siegel, Rhinehart, Jackson, & Chiarello 2006) or the "Guidelines for the prophylaxis and treatment of methicillin resistant *Staphylococcus aureus* (MRSA) infections in the UK" by Gemmell, Edwards, Fraise, Gould, Ridgway and Warren (2006). Indeed there has been some debate as to whether HAI should be subject to mandatory public reporting in the USA according to McKibben et al. (2005). These authors advised that, public reporting was voluntary and encouraged, but not mandated. There is mandatory surveillance of MRSA bacteraemia in the UK according to Allegranzi and Pittet (2008).

South Africa has also introduced guidelines for the management of nosocomial infections (Brink et al. 2006). However, the SA public healthcare system has been identified as having an inequitable share of the healthcare spend - although approximately 7.7.% of South African gross domestic product was spent on healthcare, (similar to many developed countries) the public sector had a lower per capita budget available than the private sector (McIntyre & Thiede, 2007). This implies that it is imperative to avoid generating unnecessary costs wherever possible.

As with most other healthcare facilities, the private hospital in this study has had to deal with MRSA. Following an outbreak in the Cardiac Intensive Care Unit (CICU) in 2005, an MRSA protocol was implemented. The MRSAP incorporated the CICU, cardiac high care and cardiac ward into the pre-existing MRSA screening programme which was in place to protect high risk elective surgery patients. The researcher is currently working as a registered nurse in the hospital's CICU which incorporates a six bedded surgical CICU (SCICU), the most vulnerable patient group are those undergoing cardiac surgery.

The MRSAP in use at present is comprehensive and is comprised of sections on risk assessment of patients and healthcare workers, control measures for prevention/adequate treatment of infection and guidance on the implementation of standard, contact and other precautions. The full MRSAP is available in Appendix 1, but a summary is presented below.

Risk assessment of patients entails identification of significant medical history such as diabetes, immunocompromise, or previous hospitalisation. Where relevant criteria are identified, screening swabs for MRSA are taken. All admissions to CICU must be screened for MRSA. The healthcare workers assessment involves screening of newly appointed staff, staff with chronic skin lesions and guidance on extra screening to be done should an outbreak of MRSA occur.

The control measures described strongly emphasise the importance of strict hand hygiene. Also included are: the use of standard barrier precautions for all contact with MRSA colonised/infected patients; recommendation for isolating or cohorting these patients; recommendations on treatment of colonised/infected patients with antiseptic scrub and appropriate antimicrobial therapy.

Other control measures include the records of colonised/infected patients being both labelled for that admission and electronically flagged for future admissions infection control nurse. Healthcare workers, such as agency staff, from outside the hospital are required to use hospital issued ICU scrub suits instead of their own uniforms.

The final section on implementation of standard, contact and other appropriate precautions details what is expected of the healthcare worker with respect to the different types of precaution and when these may be discontinued.

It also stipulates that there will be surveillance of bacterial susceptibility pattern by both the infection control nurse and the hospital laboratories.

The infection control nurse at this private hospital has noted an increase in the number of patients presenting to the hospital already colonised with MRSA, (identified by the screening component of the protocol) and is currently seeking approval for a study into the local colonisation rates.

1.2 Problem Statement

The evidence presented regarding the actual and potential threats of MRSA and HAI, such as Davis et al. (2004), Allen (2005), Duse (2005), Johnson et al. (2005), Brink et al. (2006), Gemmell et al. (2006), Perovic et al. (2006), Zell & Goldmann (2007), and Byers and Decker (2008) emphasised the importance of managing HAI in general. Adequate management will help to prevent unnecessary mortality and morbidity, with its consequent suffering and wastage of healthcare resources.

A report by the Healthcare Commission in the UK (2007) entitled, "Healthcare associated infection: What else can the NHS do?", indicates that compliance audits of infection control measures for prevention of HAI are necessary and that the quality of these compliance audits should be assured through registration with the organisation's clinical audit department, but the same report identifies that systems are not consistently in place within organisations to allow this to happen. Bryce, Scharf, Walker and Walsh (2007) writing on infection control audit confirm that this area has not received much attention.

Scribante and Bhagwanjee (2007a & 2007b), identify, the shortage of ICU nurses in SA and the consequent high use of agency staff which has implications for lack of effective infection control in ICUs through non-adherence to institutional policies and transfer of organisms between units.

The MRSAP provides a comprehensive standard of care for the management of MRSA risk and MRSA infection. Critical care units contain the patients most vulnerable to HAI as they have the most potential invasion sites, are least able to participate in their own care, and often suffer from multiple pathologies (Schelenz, Tucker, Georgeu, Daly, Hill, Roxburgh & French, 2005; Thompson, 2006). Humphreys, Newcombe, Enstone, Smythe, McIlvenny, Fitzpatrick, Fry, and Spencer (2008), writing on the results of risk factor analysis, identified cardiac surgery patients as having particularly high rates of HAI, and increasing age from 35 years, diabetes and male gender as independent risk factors for HAI. Given that cardiac surgery patients are at relatively high risk for HAI and the concerns regarding MRSA colonisation locally which has implications for possible increases in HAI rates, it is imperative that high standards of infection prevention and control are sought and maintained. Thus evaluation of compliance with the MRSAP and the effects of the MRSAP was necessary.

1.3 Purpose of the study

To evaluate how nurses implement the MRSAP in the SCICU and to evaluate the change in MRSA infection rates following implementation of the MRSAP. From the results obtained, to identify areas for improvement in nursing practice with respect to the MRSAP.

1.4 Objectives of the study

- To evaluate the MRSAP in the SCICU with respect to nursing compliance.
- To identify any areas for improvement in utilisation of the MRSAP by nurses.
- To evaluate the MRSAP with respect to change in MRSA infection rates following implementation

1.5 Research questions

- Do the nurses in the SCICU comply with the MRSAP?
- Which parts of the MRSAP, if any, must be utilised better by nurses?
- Was there a significant decrease in the number of MRSA infections in the SCICU following implementation of the MRSAP?

1.6 Significance of the study

The significance of the study for nursing management, practice education and research will be addressed.

1.6.1 Significance for nursing management and practice

The MRSAP had been operational in the hospital for approximately six years and operational in CICU for three years. Monthly reports had been generated

on the numbers of MRSA positive colonised admissions and the number of MRSA positive infections at hospital level. While there was a reduction in **cases** of MRSA infection both in the CICU and in the hospital since 2005, no evaluation of the MRSAP in practice or its effect on MRSA infection **rates** had been done. There appeared to be an increasing number of MRSA colonised patients coming into hospital, which potentially increases risk of MRSA infections.

O'Rourke (2006) highlighted the trust placed in nurses for safe, competent care and noted that there is a professional obligation to monitor and evaluate practice. Thus, in order to maintain and improve the standard of nursing care with respect to prevention of infection in general and MRSA in particular, an assessment was needed as to how well the MRSAP had been implemented in practice and how effective it had been.

With regard to procedures and protocols in general the process of on-going quality improvement in healthcare requires that the care given needs to be evaluated according to set standards in order to identify failings, rectify problems and thus improve the quality of care given. Further, this on-going process requires regular up-dating of the standards to ensure that they are in accordance with the current state of knowledge and expert guided clinical practice (Muller 2002). The International Standards Organisation (ISO) identifies continual improvement of processes and systems as being necessary for quality management within an organisation. An evaluation of the implementation of the MRSAP enabled hospital management, to make evidence-based decisions on how best to improve utilisation of the MRSAP by the nurses within the organisation in order to improve patient care.

Thus both from a practice perspective and from an administrative perspective there was a requirement for formal evaluation of the existing MRSAP and its efficacy in order to ensure on-going quality of care with respect to management of the identified risks associated with MRSA.

1.6.2 Significance for education and research

Duse (2005) discussed infection control in developing countries and emphasised the importance of increasing knowledge about nosocomial infection and good infection control practices. By evaluating the effects of the MRSAP and making the results available to other institutions, knowledge of infection control practice in the SA context could be increased. Brink et al. (2006) identified that education on infection control is often neglected in undergraduate curricula in health sciences, thus targeting infection control practice increases awareness among staff and creates opportunities for improving staff knowledge in this vital area of healthcare.

1.7 Definition of terms

1.7.1 *Staphylococcus aureus*

A Gram positive bacterium which colonises epidermis, is present in the anterior nares of 25-30% of the healthy population and which potentially causes disease depending on various factors such as host health status and potential sites for invasion (Grundmann et al. 2006).

1.7.2 Methicillin Resistant *Staphylococcus aureus* (MRSA)

Originally a strain of *Staph. aureus* resistant to "methicillins", now resistant to multiple drugs and consequently difficult and expensive to treat. It is endemic in many hospitals worldwide including SA (Grundmann et al. 2006).

1.7.3 Nosocomial Infection

Now usually termed healthcare associated infection (HAI or HCAI in the current literature) – is defined as being the result of hospital or healthcare treatment, but secondary to the patients' original condition. The CDC provides precise definitions of various types of HAI (McKibben et al. 2005).

1.7.4 Infection Control Protocol

A written standard statement, ratified by the hospital's infection control committee, which stipulates the specific infection control measures to be taken with regard to the subject of that protocol in order to prevent or control transmission (Mehtar, 2005).

1.7.5 Evaluation

"A comparative assessment of the value of the evaluated or intervention, using systematically collected and analysed data, in order to decide how to act" (Ovretveit, 1998).

1.7.6 Compliance

"Checking that established standards, regulations and directives are followed" (Ovretveit, 1998).

CHAPTER 2

LITERATURE REVIEW

2.1 Literature searches

Two literature searches were conducted. The initial search used the key terms "MRSA" and "nosocomial infection" in the CINAHL, MEDLINE (via EBSCOhost), PubMed, ScienceDirect and SA ePublications databases 2004 - 2008 searching for peer reviewed English language articles only. The rationale for using peer reviewed literature only was that the researcher was seeking expert opinion on the current state of knowledge with regard to MRSA and its management in order to identify key components relevant to management within SCICU. The researcher was not attempting to increase knowledge about MRSA *per se*.

A vast quantity of material was found to be available on MRSA and appropriate infection control measures, mostly from developed countries. Relatively little was available from Southern Africa.

The journal material found on MRSA was comprised of major research, case studies and reviews of existing research. The main themes covered were: screening and surveillance for both hospital acquired MRSA and community acquired MRSA; risk factors associated with having or acquiring MRSA colonisation and MRSA infection; evaluations of treatment options, combinations and efficacy. Given the prominence of MRSA in the journal literature, two critical care nursing texts were also consulted for information on

management of MRSA in ICU. No specific information was found but when discussing nursing management of critical care patients these texts emphasised proper hand hygiene, aseptic techniques when dealing with invasive and in-dwelling devices and availability of sufficient sinks with antiseptic scrub, liquid soap and alcohol gel (Adam & Osborne, 2005, Urden, Stacy & Lough, 2006).

The material on MRSA was organised with respect to the significance of MRSA in healthcare, the particular significance of MRSA in CICU for high risk surgical patients, and the importance of infection control policies (ICPs) in dealing with MRSA infection. All identified sources emphasised the importance of hand hygiene as the mainstay of prevention of HAI.

The subsequent main search was for information on "evaluation" of "protocols" or "programmes" or "programs" in the same databases. The researcher was attempting to find an appropriate theoretical framework for the evaluation of the MRSAP. There was little published material found on evaluation of interventions and very little pertaining directly to evaluation of ICPs (as opposed to particular items within those protocols such as hand hygiene or isolation of infected patients). The material found was reviewed with particular reference to designing the study.

Key articles and texts were consulted on the advice of the infection control nurse responsible for the MRSAP. The WHO, CDC and HPA websites were utilised to find information on recommended prevention strategies and guidelines for evaluation. They were utilised because of the lack of literature available in journals, the high profile of these organisations in public health issues and their access to expertise in the field.

2.2 MRSA and its significance for healthcare

In Grundmann et al. (2006) MRSA was reviewed. MRSA first emerged in the 1960s and subsequently acquired resistance to an increasing number of antibiotics, making it progressively more difficult to treat effectively. MRSA was identified as the commonest antibiotic resistant pathogen in Europe, the Americas, North Africa, the Middle East and East Asia. This review stated that comprehensive MRSA control programmes were required, since no single measure on its own had proven to be effective. Thus a programme which incorporates screening cultures (to identify MRSA colonised patients or staff), contact precautions, hand hygiene, decolonisation regimes and tagging of colonised patients records was identified as the most likely to be successful.

The Guideline for the Management of Nosocomial Infections in South Africa (Brink et al. 2006) stated that HAIs were a common and increasing problem due to the widely varying standards for prevention and management, increasing antimicrobial resistance and the particularly vulnerable patients at high risk for infection. However, the guideline also identified the lack of a standardised surveillance system, the under-reporting of HAIs and that data on antimicrobial resistance trends were only available in the private sector microbiology laboratories and academic hospitals. Thus the full extent of the problem in SA is not known. Perovic et al. (2006) in their study on *Staphylococcus aureus* bacteraemia in two academic hospitals in Johannesburg found that MRSA was significantly more likely to cause mortality than non-resistant strains of *Staphylococcus aureus* and that HIV infection further contributed to morbidity, mortality and economic burden due to the young age at which patients become exposed to HAI.

2.2.1 Risk factors associated with MRSA colonisation and infection

Various factors have been identified with respect to how likely it is that a patient will either already be or become colonised or infected with MRSA.

2.2.1.1 Colonisation with MRSA

Colonisation with MRSA describes the situation where a patient is an MRSA carrier but has no symptoms relating to it (Davis et al. 2004), the organism often being carried asymptomatically in the nares. Grundmann et al. (2006) explained that MRSA had evolved over time and now has different strains with differing antibiotic resistance patterns.

Johnson and Saravolatz (2005) reported that factors for colonisation differed between community-acquired MRSA and hospital-acquired MRSA. Those patients colonised with community-acquired MRSA being typically young, poor, minority populations, in the prison system or armed services. The higher prevalence in these groups was thought to be associated with communal living which facilitates cross-transmission e.g. correctional facilities, day-care centres and barracks (Grundmann et al. 2006). Community-acquired MRSA has become epidemic in some settings according to Byers and Decker (2008), now affecting people not previously considered to be at risk.

Colonisation risk factors for hospital-acquired MRSA tended to be older patients, diabetics and those with frequent hospital admissions e.g. haemodialysis and oncology patients (Johnson & Saravolatz 2005).

2.2.1.2 MRSA infection

With regard to MRSA infection (where the patient has symptoms due to the organism) it appeared that prior MRSA colonisation put the patient at increased risk of MRSA infection according to Davis et al. (2004) who investigated the relationship between colonisation with MRSA (at or following admission) and subsequent MRSA infection and found a significant increase in MRSA infection rates ($p<0.01$). Byers and Decker (2008) also reported the association between nasal colonisation with MRSA and subsequent MRSA infection rate of 10-30%, but further advised that patients with MRSA infection do not invariably have nasal colonisation, as some strains of MRSA tend to colonise non-nasal sites.

In the UK and Ireland short bed turnover intervals and high bed percentage occupancy were investigated as possible sources of MRSA and have been identified as being significantly related to MRSA infection rates in studies by Cunningham, Kernohan, and Rush, (2006a & 2006b). Increased length of stay in hospital (and particularly ICU/ burn unit) has been reported as increasing risk of MRSA acquisition (Byers & Decker 2008), as has trauma as a reason for admission (Marshall, Wolfe, Kossmann, Wasselingh, Harrington & Spelman 2004). Talbot (2005) reviewed the association between diabetes mellitus and increased frequency of cardiothoracic surgical site infection, which had implications for rates of MRSA infection where the organism was present.

The results of these studies serve to illustrate Byers and Deckers (2008) assertion that patients, healthcare workers and the inanimate environment are three of the major reservoirs of infection.

2.2.2 The particular significance of MRSA in ICU and CICU

Humphreys et al. (2008) in their four-country survey of HAI prevalence found that the highest rates of HAI were found in ICU and cardiothoracic patients, patients with parenteral nutrition, ventilated patients and patients with central lines. High rates were also found in cardiothoracic units. Writing specifically on MRSA, Byers and Decker (2008), identified previous antimicrobial use, indwelling catheters, postoperative surgical wounds, use of intravenous drugs, use of enteral feeding and dialysis as putting patients at increased risk of MRSA in addition to proximity to MRSA infected or colonised patients. That is, many of the same risk factors are identified. All of these procedures are more prevalent in ICU settings.

2.2.3 Higher rates of HAI in developing countries

The WHO guidelines on hand hygiene in healthcare estimated that worldwide 25% of patients in ICU will acquire an infection during their stay and that this estimate may be doubled in developing countries (WHO, 2006). Duse (2005) writing with respect to developing countries and SA commented on the indiscriminate use of antibiotics in developing countries which contributes to the difficulty of treating and containing infections caused by multi-resistant organisms. Allegranzi and Pittet (2008), reporting on the WHO update on the global burden of disease study, identified a substantial reduction in the prevalence of MRSA bacteraemia in England following hand hygiene promotion and specific MRSA control measures. Given that these authors further identify the 2-20 fold increased risk of acquiring HAI in developing countries, it makes sense to utilise evidence-based solutions already developed to prevent these infections. When developing guidelines for the management of nosocomial

infections in South Africa, the importance of being cognisant of, and dealing with HAI in a targeted fashion within a healthcare facility was indicated (Brink et al. 2006). Further, Duse (2005) commented that the spread of multi-drug resistant organisms within and between institutions in SA was due to inadequate infection control practices.

2.2.4 Infection control measures and ICPs

The literature reviewed thus far highlights both the actual and potential problems associated with HAIs in general and MRSA in particular. It tends to support the following comment - "Estimating the mortality, excess length of stay, and costs attributable to HAIs would be an interesting academic exercise were there not increasing evidence that most, if not all, these infections are preventable" (Zell & Goldmann 2007:261); thus these authors recommended making effective prevention the new focus with respect to HAI. Wernitz, Swidinski, Weist, Sohr, Witte, Franke, Roloff, Ruden and Veit (2005) demonstrated a reduction by 48% of hospital acquired MRSA in their study of the effectiveness of a selective MRSA screening programme. Gould (2006), in his analysis of the costs of hospital acquired MRSA, commented on the perception that infection control measures were expensive, but that there was evidence of control being highly cost-effective, particularly as the societal costs of MRSA were huge, and that future threats were even greater. Byers and Decker (2008), when reviewing the changing epidemiology of MRSA in the USA, identified that hospital acquired MRSA infections in ICU increased by 3.1% annually between 1992 and 2003, but that probably the most effective measure to reduce risk was good hygiene.

2.2.4.1 Screening and surveillance for MRSA

There appeared to be agreement that screening and surveillance programmes were useful in that they allowed identification of patients who were MRSA colonised and thus both at increased risk of MRSA infection and a potential source of infection (Davis et al. 2004). For example, Robotham, Jenkins and Medley (2006) investigated screening strategies with respect to surveillance for MRSA and found random screening to be most effective. However a targeted approach was more usual, such as that used in the study by Shitrit, Gottesman, Katzir, Kilman, Ben-Nissan and Chowers (2006) in which surveillance cultures were performed on all high risk patients in order to identify hidden reservoirs of MRSA and subsequently reduced the mean number of MRSA bacteraemia cases. Teoh et al. (2008) advised that MRSA screening had become a standard preoperative investigation for cardiac surgery patients in the UK, but still emphasised the importance of basic hygiene measures in the prevention of infection. MRSA community surveillance programmes have been undertaken (Johnson & Saravolatz 2005; Parker & Vokoun 2006; Zuger 2006): the infection rates were variable by location; thus from a treatment perspective there must be situation specific knowledge of local strains and resistance pattern if these infections are to be dealt with effectively.

Particular patient groups such as those admitted for cardiothoracic or vascular procedures have been targeted for screening due to their planned procedure carrying an increased risk of poor outcomes. Schelenz et al. (2005) identified a significant reduction in cardiothoracic surgical site infection following introduction of a comprehensive infection control programme which included weekly surveillance screening for MRSA. Thompson (2006) found evidence for

a significant reduction in MRSA infection in a vascular unit following increased use of isolation as a control measure for patients at particular risk from MRSA. A systematic review by Cooper, Stone, Kibbler, Cookson, Roberts, Medley, Duckworth, Lai and Ebrahim, (2004) found evidence to support isolation as a control measure for MRSA and recommended that it should continue to be used, particularly for selected groups of patients identified to be at high risk.

As mentioned previously, prevention and control strategies were generally combined into a comprehensive protocol in order to manage infection and infection risk within a specified area, i.e. it was situation specific, based on local risks. Gleeson (2008) discussed prevention and control of MRSA and described the use of hand hygiene, identification and isolation of MRSA carriers, patient decolonisation and environmental decontamination.

2.2.4.2 The importance of hand hygiene

One of the early hand hygiene studies by Pittet, Hugonnet, Harbarth, Mouraga, Sauvan, Touveneau and Perneger (2000) was aimed at increasing hand hygiene compliance in order to decrease nosocomial infection. Over the period of the study, as hand hygiene compliance was significantly increased ($p<0.001$), nosocomial infection in general decreased ($p=0.04$) and MRSA transmission decreased ($p<0.001$). Fairclough (2006) reviewing measures to address the threat of MRSA commented that, while comprehensive measures were required to address the threat of MRSA, hand hygiene was identified as being of particular importance. Hand hygiene, and particularly the availability of alcohol gel preparations, were emphasised in WHO reports and initiatives such as WHO, 2002; WHO, 2005b; WHO, 2006. Allegranzi and Pittet (2008) reported that hand hygiene monitoring had become an important quality indicator in

advanced accreditation systems in developed countries such as Scotland due to its status as "the single most effective measure to reduce HAIs".

The current hospital MRSAP is comprehensive and is consistent with current evidence, providing for identification of high risk patients, and detailing prevention and treatment measures which are in accordance with this evidence.

2.3 Literature relevant to evaluation of compliance

An evaluation framework was selected on the basis that, in terms of nursing theory, this study was entirely utilitarian. The concepts of person, environment, health and nursing being central to all models of nursing (Fawcett 1995 cited in Polit & Beck 2006). Hence using a particular nursing theory neither enhanced nor detracted from the usefulness of preventing infection in cardiac surgery patients (Polit & Beck, 2006). A nursing process framework may have sufficed on the basis that the situation was assessed and the need for the MRSAP identified, the MRSAP was planned and implemented, but had not as yet been evaluated. However, the nature of the study implied that nurses and nursing care have significant roles to play in prevention and control of infection in the hospital environment and that the patient will benefit from these interventions. There was evidence to support these assumptions in recent literature, particularly the literature relating to the success of increased compliance with hand hygiene at ward level in reducing infection rates reviewed previously such as Pittet et al. (2000). Therefore, this comprised a goal-orientated evaluation, which Bond (1991) stated should, "assess the extent to which the specified goals of an innovation are achieved, i.e. the effectiveness of an innovation."

2.3.1 Evaluation of the effects of ICPs and compliance with ICPs

Studies such as those by Cooper et al. (2004), Wernitz et al. (2005), Gould (2006) and Thompson (2006) among others described previously might be considered to be evaluations of ICPs in that they aim to measure the effects of one or more infection control measures on MRSA rates. However these studies were not explicitly stated to be evaluations, nor were theoretical frameworks described. Polit and Beck (2006) advised that the failure to identify a theoretical framework is not unusual in quantitative studies.

It is impossible to say for certain why there was little published research found which was explicitly aimed at evaluation of ICPs, but it may be speculated that often such evaluations are generated at an organisational level for internal consumption only. The Healthcare Commission (2007) report on HAI in the UK may tend to support this by indicating that compliance audits are expected with respect to prevention of HAI and that the quality of these compliance audits should be assured through registration with the organisation's clinical audit department, but the same report identified that systems were not consistently in place within organisations to allow this to happen. Bryce et al. (2007) was the only publication found which was explicitly focused on infection control audit. These authors had refined a standardised audit appropriate to their institution over the past 13 years and had used the results to identify areas of concern, improve practice and acknowledge that which was well done. Further, it was identified that many organisations do not approach audit in a systematic fashion. Bryce et al. (2007) confirmed that this area has not received much attention.

2.3.2 Evaluation of interventions to improve or promote health

The evaluation literature found typically related to educational or health promotion programmes such as HIV transmission prevention (Mitchell, Perloff, McVicker, Ebbert, Petersen & Oltean, 2005); or a recent South African study describing the implementation and evaluation of a community outreach project by primary healthcare nurses (Dick, Clarke, Van Zyl & Daniels, 2007). These areas of healthcare were different to the area under study and their evaluations reflected the difficulties of measuring change in attitude and value for money, neither of which were particular issues in this study. Programmes for chronic disease prevention or health promotion interventions targeting reduction in obesity, smoking and other risk factors for disease were also reported as being evaluated. These were CDC funded initiatives and both the value of using the proposed framework and advice for doing so has been published (MacDonald, Garcia, Zaza, Schooley, Compton, Bryant, Bagnol, Edgerly & Haverkate, 2006).

2.4 Theoretical framework for the study

A description will be given of the chosen theoretical framework and the standards for evaluation. The logic model of how the MRSAP is used to reduce MRSA infection will be presented. The perspective of the evaluation will be explained and the consequent evaluation foci described. The utility of the chosen framework will be addressed.

2.4.1 A description of the CDC's Program Evaluation Framework

The Program Evaluation Framework (CDC, 1999) was developed by the CDC. The basic framework was comprised of the following steps:

- **Engage stakeholders** (– in the case of the MRSAP the initial engagement of the stakeholders (hospital management and CICU staff) took place with the MRSA outbreak; stakeholder engagement must continue if the MRSAP is to be effective);

- **Describe the program** (– the MRSAP was devised by the infection control nurse, approved by hospital management and has been described here);

- **Focus the evaluation design** (– this study was designed to assess the significance of the decrease in MRSA cases and evaluate the nursing compliance with the MRSAP in order to assess where improvements need to be made);

- **Gather credible evidence** (– the researcher collected data based on the study design and analysed it);

- **Justify conclusions** (– the analysed data forms the basis for the conclusions drawn);

- **Ensure use and share lessons learned** (– feedback to stakeholders both in CICU and at management level was planned on completion of the study).

The framework is represented as an ongoing cycle thus acknowledging the implicit connection between evaluation and planning in long term programmes and is illustrated as Figure 2.1:

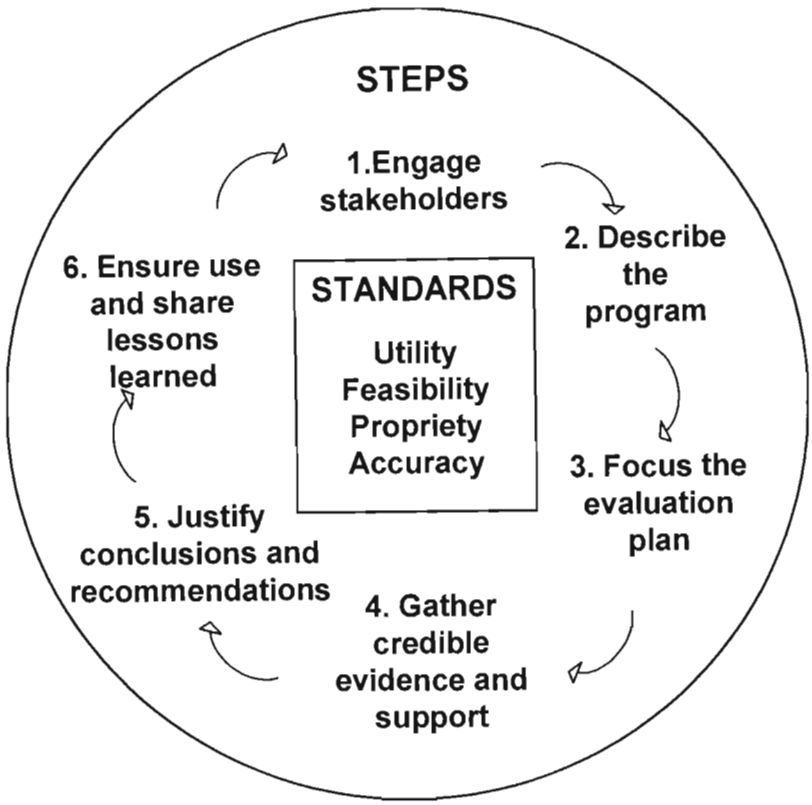

Figure 2.1: Program Evaluation Framework (CDC 1999)

2.4.2 Standards for evaluation

This study was concerned primarily with evaluation of a programme. Programme evaluation does not necessarily follow an academic research model and does not imply a particular type of study design (MacDonald et al. 2006). However, there are standards which guide the evaluation. The CDC standards are the same as those adopted by the American and African Evaluation Association which identified the following criteria for a quality evaluation design (United Nations Fund for Population Activities, 2004):

- **Utility** – it should serve the information needs of the intended users. (In the current study the identified areas for improved implementation of the MRSAP by the nurses in CICU should allow them to improve their quality of care, the evaluation of the decrease in MRSA cases allowed management to decide on future use of the MRSAP);

- **Feasibility** – it should be realistic, prudent, diplomatic and frugal. (The study was designed to accommodate the availability of one researcher only and no budget, feedback was to be conducted sensitively);

- **Propriety** – it should be conducted legally, ethically and with due regard for the welfare of those involved in the evaluation as well as those it affects. (Ethical and hospital management approval was sought and given. Participants were free not to participate without penalty, patient privacy was not compromised.)

- **Accuracy** – it should relay adequate, technically correct information about the worthy or meritorious features of the programme. (The results of the study identified both what was done well and where improvements were required. Feedback was planned following completion of the study.)

Thus the study design took all components of the framework into consideration, gathered data systematically to address the needs of the involved parties (the stakeholders) within the time and budgetary constraints, but with due regard to ethical issues and the potentially sensitive nature of some of the study results.

The evaluation framework described is used primarily for chronic disease prevention programs and health promotion efforts – which, like MRSA screening and infection control, are also on-going rather than discrete processes. Data is

typically collected with regard to both processes and outcomes in order to document processes, determine progress towards outcomes and identify opportunities for on-going programme development and improvement (MacDonald et al. 2006). Thus it is both appropriate and necessary to describe the processes and outcomes relating to the control and prevention of MRSA.

2.4.3 Logic model for the use of the MRSAP to reduce MRSA infection

The logic model below (Figure 2.2) demonstrates the use of the MRSAP to reduce infection risk and consequently infection rates.

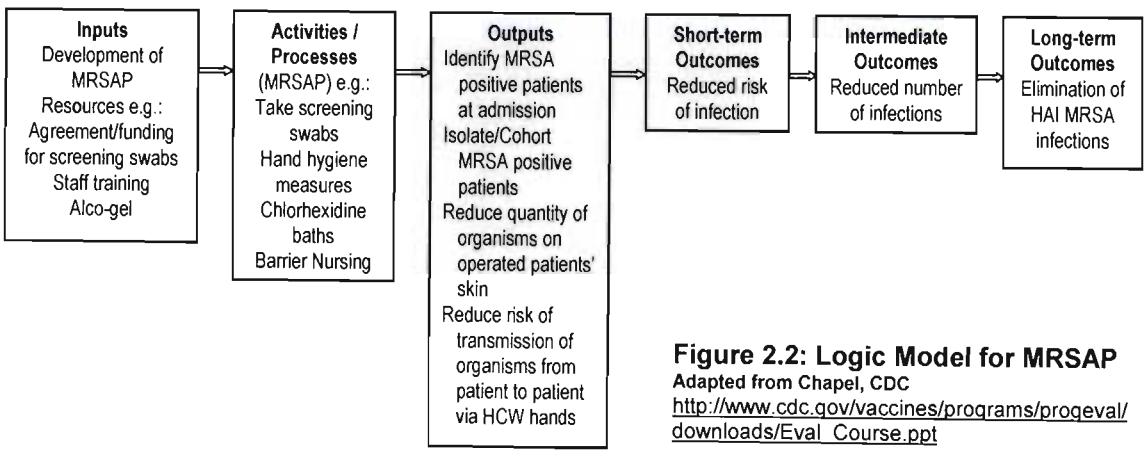

Figure 2.2: Logic Model for MRSAP
Adapted from Chapel, CDC
http://www.cdc.gov/vaccines/programs/proqeval/downloads/Eval_Course.ppt

It illustrates the initial development of the MRSAP in response to increasing MRSA infection, implementation of the MRSAP and what should be happening at CICU level on a daily basis. The model further illustrates the specific desired outputs and the short, intermediate and long-term outcomes for the MRSAP. This study was designed to audit the activities and processes which should be taking place on a daily basis in CICU and to attempt to measure selected outputs and outcomes such as identification of MRSA positive patients and MRSA infection rates.

2.4.4 Evaluation perspectives

As no journal literature was found relating specifically to the proposed study, more general evaluation literature was reviewed to find more guidance on designing the study. Evaluations gather data in order to value an intervention (in this case the MRSAP), which is designed to change the course of events so that health benefit (in this case fewer infections) is accrued (Ovretveit, 1998). Evaluations can be undertaken from different perspectives. Where the focus is mainly on comparing actual activities with standards an evaluation has primarily a managerial perspective and can be described as a compliance evaluation or audit (Ovretveit, 1998). However, evaluation can also be undertaken from a developmental perspective especially where healthcare providers self-evaluate in order to improve performance which can involve quasi-experimental techniques to measure change in outcomes (Ovretveit, 1998).

2.4.5 Focusing the evaluation plan

In order to assess how effective the MRSAP had been in the reduction of patients with MRSA infections over time, it would be necessary to calculate infection rates and test for significant changes. However, in order to attribute those changes in infection rate to the MRSAP, it would also be necessary to demonstrate that the MRSAP had, in practice, been used.

2.4.5.1 Evaluation focus – nursing contribution to infection control

While prevention of nosocomial infection in patients obviously requires a multi-disciplinary approach, it can be described as primarily a nursing responsibility due to the time spent in hands-on care of the patient (Fairclough, 2006). Assessment of compliance with the MRSAP was necessary for two main reasons. Firstly, in order to attribute a decrease in MRSA to the effect of the MRSAP, it was necessary to demonstrate a degree of compliance with the MRSAP. Secondly, on the assumption that compliance with the MRSAP would be less than perfect, it was important to identify which areas required attention in order to improve future compliance and hence improve patient care. Allegranzi and Pittet (2008) identified the importance of performance monitoring being associated with interventions if guidelines are to be implemented effectively in practice.

2.4.5.2 Evaluation focus – MRSA screening and MRSA infection rates

With regard to designing the evaluation of the surveillance (MRSA identification) aspect of the study, there were a number of considerations. Surveillance is, necessarily, an on-going process and the optimal method for implementation of surveillance and the evaluation of its impact on nosocomial infection is dependent on hospital characteristics, desired objectives, resources available and the level of support available (WHO, 2002). Thus the design of the evaluation will be unique to the context in which it is done, unless standardised surveillance and infection control policies/protocols are adopted by other institutions and agreement reached on the stipulated criteria such as objectives and resources. In the USA The National Nosocomial Infections Surveillance System's (NNISS) data is used to evaluate differences between institutions in

terms of HAI, but in order to do this meaningfully, the nosocomial infection rates have to be adjusted for intrinsic patient infection risk which is achieved through use of a risk index comprised of relevant data being collected for each individual patient and entered onto the system (Gaynes, Culver, Horan, Edwards, Richards, Tolson, NNISS, 2001). Institutions in SA could collect such information to facilitate assessment of their performance and thus comparisons with other institutions, but this information is not currently available. Thus, in SA institutions at present, the most meaningful comparison of HAI rates for a specialist unit is with its own historical performance.

2.5 The utility of a programme evaluation framework

Stakeholders were engaged at the stage where the MRSA outbreak occurred. The MRSAP was planned and implemented by the infection control nurse in consultation with hospital management, and has been described. Rationale has been given for the importance of HAI and MRSA in SA and the necessity to evaluate progress in terms of nursing responsibility for safe practice and the need for evidence as to where improvement is required. The study design will be a determinant of how credible the evidence is and to what extent conclusions can be justified.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Design of the study

Evaluation research can involve conducting process and/or outcome analysis and is often descriptive in nature (Polit & Beck, 2006).This evaluation comprises both evaluation of an intervention to a service (implementation of the MRSAP) which aimed to assess the impact on the patients (change in MRSA infection rate) and which also incorporated an audit of nursing compliance with the intervention (MRSAP). Thus both process and outcome data were being collected for evaluation.

3.1.1 Evaluating nursing compliance with the MRSAP

The evaluation of nursing compliance was planned as a descriptive study in three parts as follows.

3.1.1.1 Nurse knowledge and understanding of MRSAP

A survey questionnaire about the MRSAP was administered to all CICU permanent staff, and any other nursing staff present during the observation periods. It was designed, based on the content of the MRSAP, to ascertain the level of knowledge and understanding at CICU level.

3.1.1.2 Nurse compliance with the MRSAP routine hygiene measures

Observations of nursing compliance were conducted, during selected time periods, to ascertain compliance with the routine hygiene measures required by the MRSAP. Haas and Larson (2007) report on the main approaches to assessing compliance with hand hygiene – direct observation, self-report and indirect measurement of product usage. While observation was more time-consuming than questionnaire alone, the observational data was thought to be desirable because it was more likely to be accurate than self-report. This was based on the assumption that nurses do not deliberately breach hand hygiene precautions and other routine infection control measures, but rather that it is inadvertent. However nurses' knowledge of being observed had the potential to improve compliance through heightened awareness of that aspect of care (the "Hawthorne effect") according to Haas and Larson (2007). Some studies, such as Van de Mortel and Murgo (2006), used covert observation in this type of study for that very reason. For the present study, covert observations were not possible, both for ethical reasons and due to the researcher's position in the CICU. Equipment was not available for measurement of product usage.

3.1.1.3 Compliance with MRSA screening

Patient records data was required in order to determine whether screening swabs had been obtained appropriately and whether there was documentation of screening results. Data collection sheets were devised on which to record the necessary data.

3.1.2 Comparing MRSA infection rates before and after MRSAP

A comparison was needed between the number of MRSA infections before and after implementation of the MRSAP. However, since this study was planned after the implementation of the MRSAP, data for comparison had to be obtained from existing patient records with no opportunity to elicit more information than already existed. Therefore the study had to use a retrospective design with an appropriate method for matching the current data on MRSA infection with data from before implementation of the MRSAP.

Thus this aspect of the study was a retrospective, non-experimental quantitative study with a quasi-experimental design based on records review. The patient records data was required in order to ascertain the number of patients admitted over the study period and the number of patients with MRSA infections. In order to assess the validity of comparing the two groups for infection rates, limited infection risk stratification data was collected during this phase as well. The limitations related to data available in the hospital records. In order to provide some context for the SCICU infection rates, the hospital rates were also calculated and comparison made. The calculated infection rates from the period before the MRSAP and the period after the MRSAP could then be compared for significant difference. The records data collection tool devised aimed to accommodate the data both from this part of the study and the surveillance screening data.

3.1.3 A summary of the research design

The research design is summarised in the following diagram (Figure 3.1), demonstrating the linking of process and outcome evaluation to provide an evaluation design which is suitable for assessing interventions to a service in terms of its impact on patients (Ovretveit 1998).

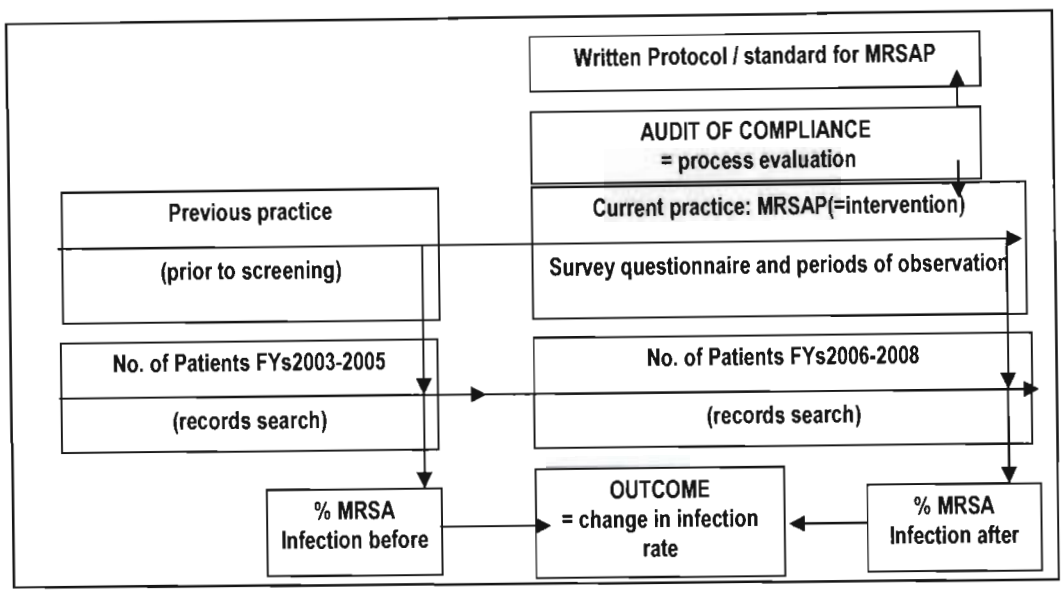

Figure 3.1: Summary of research design (adapted from Ovretveit 1998).

3.2 Population

The patient population with respect to the change in MRSA infection rates was comprised of all patients admitted to the SCICU for Financial Years (FYs) 2003-2008. The patient population with respect to compliance with screening was all the patients admitted after the MRSAP i.e. patients admitted FYs 2006-2008. The staff population comprised all permanent staff (registered nurses, enrolled nurses, unit assistants) who were working in the CICU plus any other nursing staff (e.g. agency) on duty during observational data collection periods.

3.3 Sample and sampling

The two populations which needed to be sampled were the patient care records from the surgical unit for matched periods before and after the introduction of the MRSAP, and the infection control practice of the nurses.

3.3.1 Sample of patient records data

With respect to statistical accuracy, probability sampling was the most accurate method of producing a representative sample from the given population since it would allow for estimation of the magnitude of sampling error (Polit and Beck, 2006). A systematic random sample was planned by taking every nth patient from the list, n being determined by the desired sample size being divided by the population total. The statistician was consulted with respect to adequate sample size

This approach was used wherever a representative sample of the records was required – i.e. when extracting risk stratification data for comparison of the two groups of patients and when attempting to determine compliance with the MRSAP screening protocol.

For aspects related to review of case records both the infection control nurse's records were used and the relevant patient case files were requested via her office in order to maintain security of the records and for purposes of confidentiality.

3.3.2 Sampling staff knowledge and behaviour with respect to MRSAP

Investigating the other aspects of the MRSAP required a convenience sampling approach, since present knowledge and observed practice was the only available indicator of past staff knowledge and practice. Although there has not generally been a high turnover of staff in CICU, the patient population was spread over the previous six years. When collecting patient records data on infection rates, the assumption had to be made that, except for the novel interventions in the MRSAP, the standard of infection control practice was similar over the entire period, despite any changes in staff.

The desirable sample size could not be determined with absolute accuracy, but as a general rule, according to Polit and Beck (2006), the larger the size the better - especially where expected differences are small. Since the researcher was anticipating the likelihood that compliance with the MRSAP was high and therefore that there would be few instances of non-compliance it was particularly desirable to have as large a sample as possible. Also, for non-probability samples a relatively large sample size is required to try and compensate for the non-random nature of the sample: although a large sample cannot correct for poor sample selection, it is preferable to a small sample (Polit and Beck, 2006).

Thus, knowledge of the MRSAP via questionnaire was sought from all eligible permanent CICU staff (i.e. registered nurses, enrolled nurses and unit assistants) and any other staff on-duty during the observation periods (i.e. agency staff all grades). Since ICUs generally are heavily dependent on agency

staff, this maximised the potential sample of staff. Inclusion criteria were all CICU staff on the duty roster who agreed to participate except for the researcher, and the unit manager. The unit manager generally is involved with duties other than direct patient care, besides which she was required to assist with assessing questionnaire responses, both as an expert and a stakeholder.

For observational data, the inclusion criteria were:

All staff members on duty during a planned observation period, provided that

a. they had consented, and

b. they made contact with an observed patient.

Observation periods were carefully selected so that the researcher would be present at times of maximum patient activity e.g. when receiving a cardiac surgery patient from theatre and during the patients' first and second post operative days. Observations of barrier nursed and ventilated medical patients were also included when available thus maximising observation of patient contacts and percentage of staff observed.

3.4 Setting for the study

The setting for the study was the CICU of a private hospital in KwaZulu-Natal, South Africa. The hospital has a maternity unit with neonatal ICU facilities, general, urological, orthopaedic, gynaecological, ENT surgical services, medical and emergency services, general high care and ICU. There is an extensive cardiac unit which consists of a ward, high care, combined medical and surgical ICU with attached facilities for angiography and a cardiac theatre.

Nursing practice was observed mostly in the SCICU since the surgical patients were the main focus of this study. Although it is a combined medical surgical unit there are two distinct areas allocated to the medical and surgical patients. There is a six-bedded surgical side and a seven-bedded medical side. Most patient bays can be observed from the central glassed-in duty station, but not all simultaneously. The staffing is combined for the unit with allocation to patients being made on a daily basis. Figure 3.2 below illustrates the layout.

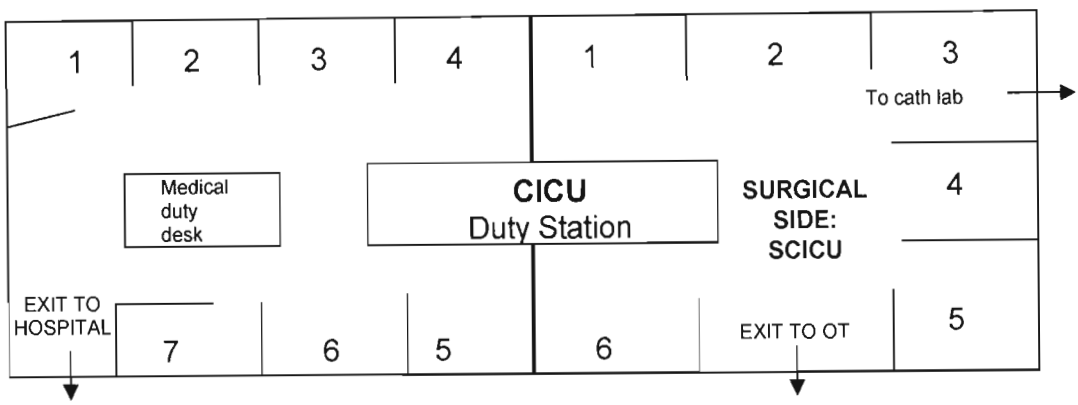

Figure 3.2: CICU floor plan

The medical patients often require only minimal contacts as they are often in the CICU for monitoring and tests. The cardiac surgery patients however are often unstable on return from theatre, requiring multiple interventions in a short period of time to maintain vital parameters within acceptable limits. The other surgical patients tend to be stable on return from theatre, requiring only routine post-operative monitoring for haemodynamic stability and adequate pain control. They, generally, do not have either central or arterial lines, but may have an epidural infusion. Blood loss is usually considerably less than for the cardiac surgery patients. In terms of staff time the cardiac surgery patients often require more than one registered nurse periodically - especially if there are post-operative complications. The other patients generally are cared for two per registered nurse or experienced enrolled nurse.

3.5 Data collection tools for the study

Three types of data were needed in order to address the two major components of the study: a survey questionnaire on the MRSAP; observation of staff compliance with the MRSAP and patient records data in order to assess screening compliance. Records data was also required to assess infection risk pre- and post-MRSAP and the change in infection rates.

3.5.1 Assessing staff knowledge and understanding of MRSAP

A questionnaire was devised, based on the MRSAP, to assess staff knowledge of the aspects of the MRSAP which related to their day-to-day practice. The questionnaire consisted of a single A4 sheet with six questions. Most questions were in a yes, no, don't know, don't understand format with space to expand a response where appropriate. Respondents were assured of anonymity. The full questionnaire is available in Appendix 2.

Q1. Limited biographical data was requested about whether the staff member was permanent CICU or agency. (Grade and qualifications were not requested as the researcher was known to nearly all the potential participants and the small numbers involved meant that anonymity might not be preserved).

Q2. Enquired whether the participant knew of the MRSA policy.

Q3. Asked whether any routine swabs were taken on the unit, if yes, they had to give detail.

Q4. Enquired whether the participant would take any routine precautions when dealing with patients with MRSA, if yes, they had to give detail.

Q5. Asked whether participants ever used chlorhexidine soap to bathe patients in the unit, and if so, to describe the circumstances.

Q6. An opportunity for any comments on infection control practices in the unit.

Thus questions aimed to determine whether staff members were aware of the MRSAP and its contents and if so, how well they knew the policy with respect to routine activities.

It was reviewed by an experienced researcher and a statistician prior to piloting. The main addition at that stage was the section for comments which was not included initially. The rest involved the formatting of response codes and addition of a coding column. The questionnaire was then pilot tested on the General ICU. Eight staff members completed the pilot questionnaire. The questions were answered fully and substantially correctly. Hence no further adjustments were made prior to the main study.

3.5.2 Observation of staff compliance with the MRSAP

Data collection sheets were required on which to enter data on hand hygiene behaviour between patient contacts, use of personal protective equipment (PPE) such as gloves and aprons, observation of barrier precautions and use of chlorhexidine soap for patient bathing. A major limitation of being a lone researcher was being required to watch more than one member of staff. Therefore the data collection tool was designed to be as quick to fill in as possible in order to maximise time spent observing.

All correct contacts were thus recorded simply as "1", and incorrect contacts were recorded by precategorised codes e.g. "0" for unit nurses or by other codes for agency nurses or non-nursing healthcare worker.

There were pre-categorised columns for chlorhexidine washes and barrier nursing contacts so that these aspects could be analysed separately. There was also space to record date, time, the staff members on duty (by code letter to preserve anonymity), and any additional comments. An example is available in Appendix 3.

Initially there were only codes for unit nurses and agency nurses. However, on piloting, codes were allocated for other categories of staff such as doctor, physiotherapist, laboratory nurse (who comes to take bloods). Although these other categories of healthcare worker were not the main focus of the study, they all play a role in protecting patients from transmission of organisms and hence the contacts needed to be recorded. The tool was also reviewed by the statistician facilitating the data analysis for adequacy for purpose. The coding was decided in consultation with her.

3.5.2.1 Indicators which defined patient contacts

The researcher was observing for the routine basic hygiene measures to prevent contamination of lines from transferred micro-organisms. Thus the main focus of observations was appropriate routine hygiene measures such as hand hygiene (whether with hand washing or alcohol gel) and wearing of appropriate PPE such as gloves. While the quality of the hand wash ought to be a consideration in terms of the product used and the length of the wash, this was being assessed separately within the hospital and was therefore not duplicated in this study. Also, where a lone researcher has to observe the practice of more

than one nurse at a time, it is not particularly feasible to focus on this aspect. Other frequent routine activities with the potential for nosocomial infection were: accessing central and arterial lines for administration of medication and ABG sampling respectively, emptying urinary drainage bags attached to urinary catheters; manipulating chest drains and releasing clots from chest drains; physical examination of the patient (whether routine or secondary to a suspected problem); changing dressings among many other activities. The mainstay of infection control during these activities is still appropriate hand hygiene but additionally PPE should be used.

As identified in the questionnaire section, ideally all patients on the unit should have chlorhexidine soap washes, but it is essential that all surgical, bed bound, ventilated or barrier nursed patients have these washes. Lastly, where barrier nursed patients were observed, appropriate use of PPE and contact precautions was observed for in addition to the routine measures appropriate to all patients.

Indicators which defined patient contacts were required to facilitate consistency in the observations. Those used were similar to Van de Mortel and Murgo (2006):

1. Any action to clean hands with liquid soap or alcohol rub was considered to be appropriate hand hygiene (unless the nurse was preparing for an aseptic procedure in which case an aseptic wash was necessary).

2. Chlorhexidine soap on the trolley was accepted as evidence of use.

3. Any contact of gloved or ungloved hands with skin, secretions, excretions, blood or any invasive device was considered to be a patient contact.

4. Once a staff member's hands had made contact with the patient or devices (as in 3), repeat hand hygiene was required prior to any further contacts of patient or invasive devices.

5. Accessing invasive lines before cleaning with alcohol swabs was considered a failure of routine hygiene precautions.

6. Failure to use appropriate PPE before contact with body fluids, or equipment used for carriage of body fluids, was considered a failure of routine hygiene precautions.

7. Contacts with bed linen, monitoring equipment or notes were not considered to be a patient contact.

8. Leaving or entering a patient bay without performing hand hygiene was considered to be a failure to perform appropriate hand hygiene.

9. For barrier nursed patients failure to don appropriate PPE prior to entering, and discard PPE prior to exiting, were considered a failure of barrier precautions.

3.5.3 Screening compliance and comparison of MRSA infection rates

Data collection sheets were devised on the basis of the data required. The case number was required for every patient admitted to SCICU over the six year period. This was both so that the total number of patients was known and so that the appropriate records could be requested for sampling purposes.

Infection risk stratification data available in the patient record was required for as many patients as possible from the whole study period FYs 2003-2008.

Where this was not available with the initial listing of patients it was to be obtained on a probability sampling basis. The HAI risk factors reported by Crabtree, Codd, Fraser, Bailey, Olsen, Damiano, (2004) for sternal surgical site infection following coronary artery bypass graft included increasing body mass index, smoking, diabetes and female gender. Humphreys et al. (2008) identify cardiac surgery patients as having particularly high rates of HAI, and also identify: increasing age from 35 years; admission to ICU, diabetes and male sex as independent risk factors for HAI. Thus age, gender, type of surgery, diabetes and smoking were selected as data which would be obtainable from the case notes. Screening data was required on a probability sample of patients from the post MRSAP period FY2006-2008. Examples of the data collection sheets are available in Appendix 4.

3.6 Data collection process

Permission in principle had been obtained both from the unit manager and the infection control nurse in the planning stages of the study. Thus access to staff, the physical area and records was already agreed. Formal permission from the hospital nursing manager was obtained prior to commencing data collection. The unit manager's permission was sought and given for access at the specific times planned for observations. Data collection was carried out over approximately 4 months, July – October 2008. The data was collected in three phases, summarised in Table 3.1 below.

Table 3.1: The three phases of data collection

Questionnaire (Appendix 2)	Observational data (Appendix 3)	Records review data (Appendix 4)
1. Pilot questionnaire in General ICU 2. All cardiac Unit staff to be surveyed, plus any nurses on duty at time of observation.	¾ - 3 hour observation periods over a 2 month period of: • Hand hygiene • Use of PPE • Patient Washing • Barrier precautions (i.e. convenience sample of nurses – whoever was on duty at the time)	1. Total Patients admitted and total MRSA infections FY2003-FY2005, then compare to: 2. Total Patients admitted and total MRSA infections FY2006-FY2008 both for SCICU and hospital 3. Probability sample of SCICU patients to check compliance with screening protocol from FY2006 onwards. Risk stratification data from sampled case files.

3.6.1 Distribution of informed consent and questionnaire

Packs containing the information for participants, the informed consent and the questionnaire (see Appendix 2) were handed out personally to all eligible members of unit staff – only the researcher and the unit manager were excluded as stated previously. The unit manager was excluded since her assistance was desirable as an assessor for co-marking verbatim responses (after they had been transferred to a marking sheet and thus were absolutely devoid of any identifying features) along with the infection control nurse.

Staff members were requested to return the consent and completed questionnaire to the researcher on the same day if they agreed to participate and if they had time to do so. The researcher was present on the unit most days throughout the study period either for normal duties or for data collection thus ensuring that each member of staff received their pack and had the opportunity to return the completed consent and questionnaire if they chose to do so. Returned consents and questionnaires were put in a collection folder by the researcher for coding later. Reminders were also given daily so that any staff

who had forgotten or had been too busy to do so previously had the chance to return their questionnaire. Over a period of one week all staff had received the packs and the majority had returned a signed consent and the anonymous questionnaire.

3.6.2 Observation of patient contacts

Using the contact indicators stated previously, data was recorded on the previously prepared sheets. In order to maximise appropriate observations it was necessary to observe the practice of as many staff members as possible and as many contacts as possible during the study period.

3.6.2.1 Selection of observation periods

The observation periods were carefully selected by the researcher to ensure that she was present during the times of maximum patient activity. These times were during receiving patients from cardiac theatre, and during day 1 and 2 post-operatively (during which these patients remain on the unit) at handover or bathing times. Thus both the significantly at-risk patients would have contacts observed, and also the number of patient contacts observed would be maximised since these patients require the greatest number of high contamination risk interventions involving access to invasive lines (e.g. ABG sampling, insulin bolus' potassium or calcium supplementation, suctioning via ET tube). The exact number or length of observation periods could not be planned in advance as it was dependent on when and how many patients went to theatre and how long they took to stabilise post-operatively. During the observation study period (2 months), it was planned to come in on each day that there was a theatre slate with cardiac surgery patients. The length of the

observation period depended on how long the patient took to stabilise i.e. for the level of activity to decrease. Similarly with the nurses, the researcher had no control over the allocation of staff to patients - so how many and which nurses were observed depended on the number of patients in the unit and which staff happened to be on duty and were allocated to the patients being observed.

3.6.2.2 Staff anonymity and awareness of being observed

The researcher stayed in the central duty station, which is glassed and overlooks the patient bays. The researcher was, mostly, not in uniform. This was to try and avoid distractions such as requests for assistance as far as possible and consequently being able to observe the staff as accurately as possible. Staff who had been requested to participate had been assigned a code, so that when entering the staff on the data sheet anonymity was preserved. Staff members were aware they were being observed, but after the first few sessions appeared not to pay too much attention to the researcher's presence.

3.6.3 Collecting records data

Patient listings for SCICU with case number, age, gender and procedure for SCICU were requested for FYs 2003-2008. This data was entered into Microsoft Excel spreadsheets, on the pre-prepared forms

The number of patient records to be sampled was decided in consultation with the statistician once the total number of patients was known. Every third file was requested, i.e. a systematic random sample. The appropriate records were requested from the off-site central file storage area via the data clerk.

The infection control nurse had computerised records on HAI and MRSA since 1998. With her assistance, the relevant files were located and the MRSA case data was extracted for SCICU. In conjunction with the admission numbers obtained it was possible to calculate MRSA infection rates pre- and post-intervention.

3.7 Data Analysis

The data obtained from the survey questionnaire, the observational data and records data were all entered into Microsoft Excel spreadsheets as coded data. Data analysis depends on the type of data obtained (i.e. nominal, ordinal, interval or ratio) and the sampling method used (Polit & Beck 2006). Therefore the three data sets will be discussed separately.

3.7.1 Analysis of questionnaire data

The responses were coded and entered into a summary spreadsheet for an overview of how each question was answered. See Appendix 5. Descriptive statistics were used to calculate response rates and how accurate the answers were. Where written answers had been requested for a question, the individual respondents' answers were transcribed verbatim into the spreadsheet summarising the responses to that question, thus the data was completely de-identified. Copies of these summarised and de-identified responses were printed ready for assessment by the researcher, the unit manager and the infection control nurse. Each assessor took a sheet and assessed the responses for adequacy in terms of the MRSAP. The marks were then

aggregated and an averaged mark calculated for each question. Having in-house clinical experts as well as the researcher assess the responses served to: reduce any bias; develop evaluation skills; engage the stakeholders in the evaluation process and hence in the results.

3.7.2 Analysis of observational data

Descriptive statistics were used for this analysis. Compliance was measured in terms of percentage compliance. This was done separately for barrier patient contacts, for contacts requiring routine hygiene precautions such as access to central or arterial line ports (including those requiring PPE) and contacts for chlorhexidine baths.

Coded data was again entered into Microsoft Excel spreadsheets (See Appendix 6). Tables were generated demonstrating the percentage of staff members observed, the percentage of correct contacts, the percentage of contacts not observed and the percentage of incorrect contacts differentiated by category of staff involved e.g. unit staff, agency staff, doctor. Limited information on types of error was also given in descriptive form.

3.7.3 Analysis of records data

Data was entered initially into Microsoft Excel spreadsheets, as that software was available on site at the hospital (see Appendix 7). Data was coded and then imported into SPSS version 15.0 at a later stage.

For compliance with the screening protocol, percentages of patients screened were calculated. In theory, every patient should have been screened. So, by comparing the percentage actually screened, with the number which should

have been screened, the degree of compliance with the screening procedure would be demonstrated. Where swab results were available these were entered and percentage MRSA positives were calculated.

Risk factors for infection were then compared for the two groups of patients (before and after the introduction of the MRSAP) using non-parametric tests for the nominal categorical data and parametric tests for interval data as appropriate. This was to try and assess how similar or different the two groups of patients were in terms of intrinsic risk for HAI.

In order to test if there was a significant difference between the number of SCICU patients with MRSA infection pre-MRSAP and post-MRSAP a Chi-Squared test was planned for the collected MRSA infection data. This non-parametric test was suitable because it is used for nominal data from an experimental design where there are two separate groups of subjects (Hicks, 1991).

SCICU MRSA infection rates were compared to hospital MRSA infection rates over the study period to provide context for the results.

3.8 Validity and reliability

Validity is the degree to which an instrument measures what it is supposed to be measuring and reliability refers to the consistency with which an instrument measures an attribute (Polit & Beck, 2006).

3.8.1 Questionnaire

The survey questionnaire was designed, based on the MRSAP, to assess whether staff knew about the MRSAP and/or were aware of and complied with those items specifically relating to daily nursing responsibilities. Thus the questionnaire had face validity through being based on the MRSAP

In order to assess the content validity of the questionnaire it was reviewed by a knowledgeable researcher and was pilot tested as described previously. During the actual study it was less well completed than during the pilot, suggesting that it may need some further improvements to improve reliability.

3.8.2 Observations

For the observational data, similarly, the criteria were generated from the MRSAP. The criteria were then used to generate contact indicators as previously described. The instrument was pilot tested, as described previously, prior to commencing data collection.

3.8.3 Records data

The data collection instrument was designed based on the data required in order to assess if the swabs had been taken per protocol, in order to assess for infection risk (on criteria obtained from published literature on infection risk) and in order to determine the number of MRSA cases. The tools were thus valid in that they were based on the MRSAP. The validity of the records data however was dependent on obtaining the planned probability sample of records from which to extract data, and the certainty with which MRSA cases could be identified. Since the response to each criterion was yes, no, data not available

or not applicable, the main consideration was that the researcher had valid criteria on which to make those decisions. Where there was doubt about any of the screening items or MRSA cases, the advice of the infection control nurse was sought.

3.9 Ethical considerations and ethical approval

Due to the necessity for access to patient records, patient care areas and observation of staff and patients, application to the University of KwaZulu-Natal ethics committee was required as well as to the hospital Nursing Manager in liaison with her senior colleagues. Permission was granted both by the Ethics committee and the Nurse Manager on behalf of hospital management

Written informed consent was obtained from participants (Appendix 2), and from hospital management for access to patient care areas and patient records (Appendix 10).

The participants had the right not to participate and the right to withdraw at any time, which was stated explicitly in the information for participants and the consent document.

Strict confidentiality of individuals' knowledge and opinions was maintained as the questionnaire was anonymous. The only data distributed were de-identified summaries of question responses for assessment by the unit manager and infection control nurse. Confidentiality with respect to staff performance was maintained as individuals were only identified in coded form on the data sheets to enable subsequent analysis. Compiled data reflected qualifications only.

Patient records data was kept confidential as the infection control nurse's office is a secure area and the patient files only left it in order to go back into storage. Data was entered onto the data collection sheets in the infection control nurse's office. The MRSA infection data was also obtained with the assistance of the infection control nurse in her office, the originals remain with her. Original data collected was kept with the infection control nurse and researcher. Only de-identified and collated or coded data was available to anybody else.

Original questionnaire data, observational data and compiled records data will be kept locked and secure for a period of 5 years and will then be destroyed by shredding.

CHAPTER 4

PRESENTATION OF FINDINGS

4.1 Staff participation in the study

Staff participation in the survey and observational component of the study is summarised in Table 4.1 which follows. The total possible number of staff members who could have participated was the population of N=32. Of the twenty CICU registered nurses, 18 were eligible and all agreed to participate. Both CICU enrolled nurses agreed to participate. All four CICU unit assistants agreed to participate. Overall 75% (n=18) of eligible unit staff were observed for at least one observation period. Only one agency nurse, a registered nurse, agreed to participate and was observed. During the period of the study, the cardiac high care was closed for two weeks. Therefore the high care staff members were relocated temporarily to CICU; hence agency staff use was much lower than usual.

For purposes of the study the high care staff members were grouped with agency staff, since they were not permanent CICU staff. Had this been anticipated a separate category would have been included. Students were in CICU throughout the study period and were requested to participate. No consents by students were returned and they were subsequently excluded from the study. Overall 84% (n=27) of staff consented to participate, 81% (n=26) returned questionnaires and 66% (n=21) had their practice observed.

Table 4.1: Summary of staff participation in the study.

Table 4.1	Unit Staff			Unit Staff totals	Agency/HC		Students	Total N=32	%
	RN	EN	U/A		RN	EN			
Unit Staff	20	2	4	26	N/A		Variable	26	
Staff eligible to participate*(= N)	18	2	4	24	1	4	3	32	
Participation requested	18	2	4	24	1	4	3	32	100%
Consent given	18	2	4	24	1	2	0	27	84%
Staff present during observation who had given consent	13	2	3	18	1	2	0	21	78%
Questionnaires returned (= n)	anonymous							26	81%
Practice observed (= n)	13	2	3	18	1	2	0	21	66%
PERCENTAGE	72%	100%	75%	75%	100%	50%	0%	66%	

* Staff eligible to participate comprised all staff except the researcher and the unit manager.

Key: RN – Registered Nurse; EN – Enrolled Nurse; U/A – Unit Assistant

4.2 Staff awareness of and understanding of MRSAP

The return rate for the questionnaire was 81%. A copy of the questionnaire appears in Appendix 2, a summary response data sheet in Appendix 5 and the analyses of the questions requiring written responses in Appendix 8.

4.2.1 Demographic data

Question 1, "To which group of staff do you belong?" was intended to ascertain whether the respondents belonged to the CICU, or were agency staff who worked regularly or only infrequently in the CICU. It was thought that this latter category might not know the hospital policies and was included so that the responses to the other questions could be evaluated accordingly.

Only one agency registered nurse was on duty during the study period (who had worked on the unit for many years). Of the agency enrolled nurses approached, none agreed to participate. Thus the non-unit staff members present were mostly high care staff amalgamated into the unit temporarily.

4.2.1.1 Mostly permanent staff responded

Most respondents, 96% (n=25), identified themselves as being employed by the unit on a permanent basis either full or part time.

The responses are summarised in Table 4.2 below: the full details, including the original verbatim responses with analyses, are available in Appendix 8

Table 4.2: Summary of questionnaire responses

Table 4.2	Q1 Staff		Q2 MRSAP?		Q3 swabs?		Q4 Routine care for MRSAP?			Q5 Chlor hex?	Q6 Comments
	Perm-anent	Agency	Yes	Don't know	No	Yes	Don't know	Don't Under-stand	Yes	Yes	
TOTALS	25	1	23	3	1	25	2	2	22	26	10
	26		26		26		26			26	26
PERCENT	96%	4%	88%	12%	4%	96%	8%	4%	88%	100%	38%

4.2.2 Awareness of MRSAP

Question 2 "Is there an infection control policy in this unit for dealing with MRSA?" was intended to ascertain whether staff were aware of the MRSAP or not. 88% (n=23) indicated that they were aware of the policy. 12% (n=3) chose the "don't know" response.

4.2.3 Knowledge of the need for routine screening swabs

Question 3, "Do you take any routine swabs from the patients on admission to this unit?" was intended to ascertain whether staff were generally aware of the need for routine swabs to be taken, and if so, what for. The MRSAP states, "ALL admissions to CICU must be screened for MRSA carriage (i.e. high nasal and groin swabs)".

4.2.3.1 Staff knew that swabs need to be taken

Only 4% of respondents (n=1) chose "NO", the other 96% (n=25) indicated that they would take swabs, however, the precision of the answers varied.

4.2.3.2 Inconsistent knowledge of what the swabs are for

Answers were evaluated as correct, partially correct or incorrect (no response or totally inadequate e.g. "new admissions" – since this did not identify either where was being swabbed or what for). There was some variability between the assessors when interpreting the respondents' answers, the lowest being 79% correct and the highest being 96% correct; the average was 88%.

4.2.4 Knowledge of precautions for nursing MRSA patients

Question 4, "If you are nursing a patient with MRSA will you take any routine precautions?" was intended to ascertain the degree to which staff were conversant with the MRSAP in relation to management of MRSA positive patients. None of the respondents answered "NO", 8% (n=2) responded "don't know", 4% (n=1) responded "don't understand" and 88% (n=23) responded "yes" and gave their explanation of what precautions they would take. These responses were rated by the researcher, by the infection control nurse and by the unit manager as to what degree of understanding of the policy was demonstrated. The responses were rated as compliant with the policy (i.e. all major practical nursing points are addressed: hand washing; contact precautions of gloves and aprons; isolation or cohorting of patients), partially compliant (where some, but not all of the above measures were identified) or non-compliant if there were major omissions or an incorrect response. Other recommendations are the use of signage (this is often not feasible in ICU if

there is no door), visitor restriction and surgical masks for staff and visitors to prevent nasal colonisation.

4.2.4.1 Lack of knowledge about nursing MRSA patients

In general, despite most of the staff being aware of the need for special precautions when nursing MRSA positive patients, this question was not well answered with an averaged result of 66%. There was better agreement on the assessors' marks for this question with the range being 64% - 69%. Only ~30% (n=7) of respondents gave answers which all 3 assessors agreed were complete.

4.2.5 Understanding of the use of chlorhexidine soap in CICU

Question 5, "Do you ever use chlorhexidine soap (bioscrub/hibiscrub) to bathe patients?" was intended to ascertain staff familiarity with this aspect of the MRSAP.

4.2.5.1 All staff used chlorhexidine scrub

All respondents (100%, n=26) indicated that they used chlorhexidine soap/scrub. There was however variation in their written answers as to how they used it. According to the MRSAP, "the routine use of chlorhexidine based antiseptic soap for patient hygiene in the ICU/CICU setting is recommended to reduce bacterial loading and shedding" and this is the standard of care at unit level. However the occasional patient who is allowed bathroom privileges will use their own toiletries. As the staff did not wash these patients, and, due to the patient's level of independence, were providing minimal physical care, the risk of organism transfer was much reduced. Therefore answers which identified the most at-risk patients were deemed acceptable. For example the answer "all

surgical, ventilated, infected patients twice daily" was deemed safe as was any answer indicating all patients. However an answer such as "post surgical patients" was deemed unsafe since it fails to identify ventilated and other bed bound patients at serious risk of nosocomial infection.

4.2.5.2 Staff described use of chlorhexidine scrub poorly

Scoring on this basis, the response assessment varied from 54% to 62% with an averaged mark of 58%. However this time ~54% (n=14) of responses were regarded by all assessors to suggest full compliance with the policy.

4.2.6 Staff comments on infection control practice in CICU

Question 6 was an opportunity to provide any comments or suggestions about the infection control practices on the unit. After all the responses had been examined, it was decided that the responses could be categorised as follows: "no comment" – as evidenced by the section left blank or "no", "nil" or similar; "satisfied" as evidenced by a comment indicating that the standard is good or that they cannot identify improvements; "constructive criticism" as evidenced by comments which suggest improvements to facilitate or improve compliance with the MRSAP.

4.2.6.1 Most staff had no comment or were satisfied

The "no comment" category was used most frequently with 61.5% (n=16) respondents failing to comment. 23.1% (n=6) respondents indicated satisfaction with the current MRSAP and infection control practice on the unit. Thus 84.6% (n=22) of respondents appear to be satisfied with the status quo.

4.2.6.2 Constructive criticism of infection control practice

Only 15.4% of staff (n=4) offered suggestions for improvement. These suggestions were that more vigilance was required, specifically: gloves to be used for IV insertion, carrying bedpans and urinals, and drawing ABGs; aprons to be used appropriately; acquisition of better pedal bins for disposal of infectious waste; awareness of infection control and the MRSAP to be increased among all staff, especially new staff.

4.3 Staff compliance with MRSAP

In order to observe staffs infection control practice, consent had to be obtained from the nurses actually caring for the patients on the unit at the time of the study.

4.3.1 Obtaining consent from agency and high care staff

Where staff were present that had not already given consent (either because they were agency or high care staff and thus not part of the establishment) they were given the same pack as the unit staff as described previously. The staff members helping on the unit were usually not greatly involved in nursing the cardiac surgery patients on receipt from theatre as that normally falls to unit staff members, but they would be nursing other patients located in the surgical section of the unit for convenience. High Care staff members usually help when high care is closed and are normally allocated to high care or ward patients.

4.3.2 Patients in SCICU and time spent observing

Over the period of the study there were 15 observation periods varying in length from 45 minutes to 3 hours. The total time spent observing was 30 hours 30 minutes. The total number of observations was 225.

In addition to the cardiothoracic surgery patients, there were also cardiology patients e.g. post angiography/myocardial infarction (MI) or clean surgical high care patients e.g. hip or knee arthroplasty who needed a monitored bed not available elsewhere. The rationale for observing these patient contacts was that some of the procedures on the high risk cardiac surgery patients require more than one nurse, thus the routine hygiene practice of all the nurses working in the area was important. For conclusions to be drawn about compliance with routine hygiene measures, as many nurses as possible needed to be observed.

4.3.3 Increasing the numbers of staff observed

Towards the end of the study period, when it became apparent that the same nurses were having their practice observed on many occasions and others not at all (due to allocation to medical/surgical side), some alternate observation periods were planned on the medical side. This included observation of long-term ventilated patients nursed on the medical side which are another group of patients at high risk of HAI, since these patients also have an endotracheal / tracheostomy tube requiring suctioning and both central and arterial lines.

4.3.4 Difficulties experienced during observations

The difficulties involved in achieving accurate observations varied over the course of the study. Initially the novelty of having somebody watching the staff triggered questions; however after a few observation periods, staff knew what the researcher was there for and proceeded with their routine duties. On some of the busier days it was difficult to keep track of all the staff's activities, and, it would have been preferable to have another researcher to observe some of the patient contacts. It is possible that some correct contacts and/or some incorrect contacts were not observed.

4.3.4.1 Contacts which could not be observed

Some procedures took place behind curtains when visitors were on the unit or when other patients would have witnessed potentially distressing procedures such as suctioning. These contacts could not be fully observed, only whether the correct equipment was on the trolley or whether hand hygiene was performed appropriately prior to going behind the curtains. These contacts were recorded as not observed with the reason e.g. suctioning, bed bath as appropriate.

4.3.5 Making and recording observations

An example observational data sheet is available in Appendix 3. On this sheet the date and times of observation were noted. The allocated staff (by code for anonymity) and the diagnoses of the patients in the SCICU were also recorded. Thereafter the correct contacts, incorrect contacts coded by the type of staff performing the contact errors i.e. unit nurse, agency nurse, doctor,

physiotherapist, laboratory staff and paramedics were observed for and recorded. Where errors were identified, other than hand hygiene errors, a note was made of the type e.g. failure to wear PPE appropriately. However if the same error was made again no further note was made. The contact indicators described previously were used to determine whether patient contacts were correct or not.

4.3.6 Staff participation in the observational study

Observational data was categorised and entered into Microsoft Excel spreadsheets for analysis (Appendix 9). As mentioned previously, no students were actually involved in this part of the study; hence participation was recalculated to reflect this. Of the N=29 staff who could potentially have been observed, 72% (n=21) were observed, during at least one observation period. 74% of the registered nurses were observed (14 out of a possible 19), 67% of the enrolled nurses (4 of 6) and 75% of the unit assistants (3 of 4). Eight staff members were observed three or more times and, and of those, two members of staff were observed six and eight times respectively. This was not planned, but reflects the fact that some senior staff members are always required for supervision and assistance and consequently have greater presence in the CICU - they both nurse patients and assist less experienced staff.

4.3.6.1 Adjusting to reflect contacts by staff grade

When the observation periods were adjusted to reflect qualification, by totalling the number of times a staff member was observed, and grouping by grade, then 73% (n=38) of the observed contacts were by registered nurses, 10% (n=5) were by enrolled nurses and 17% (n=9) were by unit assistants (assisting

registered nurses or enrolled nurses). This emphasised the qualified input to cardiothoracic surgery patients' care. Table 4.3 summarises this information.

Table 4.3: Summary of staff patient contacts by grade and frequency.

Table 4					
Grade	No. of Staff	Staff observed during at least one observation period	Percentage of total staff observed	Observation periods by frequency	Percent
RN Subtotal	19	14	74%	38	73%
EN Subtotal	6	4	67%	5	10%
UA Subtotal	4	3	75%	9	17%
TOTALS	29	21	72%	52	100%

4.3.7 Compliance with the MRSAP

After the observation sessions, the information was aggregated and entered into a Microsoft Excel spreadsheet, where totals and percentages were calculated (see Appendix 9); a summary appears in Table 4.4 below:

Table 4.4: Summary of staff contacts by speciality and error type.

TABLE 4.4													
OBSERVATION BY SPECIALITY	Total correct contacts observed (all staff)		Error unit nurse	Error agency nurse	Error doctor	Error physio	Error lab	Error para-medic	Total errors	% Error	closed curtains	Chlohex ?	Barrier ?
CARDIAC SURGERY	142	63%	64%	0%	100%	0%	100%	0%	42	30%	50%	2	1
OTHER SURGICAL	16	7%	8%	0%	0%	0%	0%	0%	5	31%	0%	1	0
MEDICAL	67	30%	28%	0%	0%	0%	0%	100%	18	27%	50%	3	2
TYPES OF ERROR	Other than failure to wash hands or use alcohol rub appropriately the following were noted: failure to use PPE e.g. gloves for ABG; failure to swab IV ports prior to access; failure to clean a stethoscope prior to use on a different patient, failure to remove apron prior to leaving barrier nursed patient.												
TOTAL OBS	225	144	61	0	2	0	1	1	65		16	6	5
PERCENT	100%	64.0%	27.1%	0.0%	0.9%	0.0%	0.4%	0.4%	28.8%		7.2%	100%	60%

4.3.7.1 Correct patient contacts and patient contact errors

A total of 64% (n=144) correct contacts were observed out of a total of N=225 contacts recorded. Given the importance of infection control measures such as those described, this is not initially very reassuring especially when the impact of nosocomial post-operative infection is considered with respect to cardiac surgery patients. However, 7.2% (n=16) of contacts could not be fully observed, thus the actual rate of errors observed was 28.8% (n=65). Barrier precautions were used appropriately on 60% (n=5) of observations. Chlorhexidine washes were used appropriately for 100% (n=6) of observations, which is better than the responses to the questionnaire which indicated that only 58% of staff had adequate knowledge of this component of the MRSAP.

4.3.7.2 Errors observed

Those errors which were observed, other than simple failure to use appropriate hand hygiene measures included: failure to use PPE e.g. gloves for ABG; failure to swab ports prior to access; failure to clean a stethoscope prior to transfer between patients and failure to remove aprons when leaving a barrier nursed patient. All of these are simple measures, but vital to the prevention of transmission of micro-organisms between staff and patients. Some of the constructive criticisms made by staff in the survey questionnaire also mentioned issues such as staff not wearing PPE appropriately, showing that there is some awareness among the nurses on the floor that improvements are needed.

4.3.7.3 Analysis of errors by category of staff

The majority of errors were performed by unit nurses – 27.1% (n=61); this however simply reflects the fact that the vast majority of the contacts were by unit nurses. Due to the constraints of being a lone researcher it was too difficult to code correct contacts by staff type as well as the errors and thus it was considered that documenting the errors more fully would be most productive in terms of identifying where efforts to improve could be made. No agency nurse errors were observed, however this nurse, as well as being experienced, was only observed for 1 observation period while working with medical patients, who mostly have fewer nurse contacts anyway. Hence this performance cannot be considered generalisable to any other agency nurses who may work on the unit. Two doctor errors were observed, one laboratory nurse error and one paramedic error. The errors by non-CICU healthcare worker identified were thus 0.02% (n=4).

4.3.7.4 Categorisation of patients by procedure

The diagnosis for each patient observed was recorded. For purposes of analysis, these diagnoses were categorised into cardiac surgery (e.g. CABG or valve replacement), other surgery (e.g. lobectomy or total joint replacement) and medical (e.g. post angiography with sheath in situ or MI). Although the CICU is designed to separate the medical and surgical patients, in practice, "clean medical" such as MI patients are accommodated on the surgical side if cardiac beds are required. The rationale for the categories was that they require rather different levels of nursing contact intensity.

4.3.7.5 Comparison of patient contact requirements

As described in the setting for the study (p.38), the patients cared for on the unit have varied levels of need for hands on nursing interventions and were therefore at different levels of risk for HAI. The grouping of the observed patients into categories which reflected their dependency, and consequent risk for HAI, allowed subsequent analysis of this factor.

4.3.7.6 Analysis of frequency of contacts by procedure

The study was focused on the most at-risk patients requiring the greatest number of contacts and interventions. Consequently the majority of the contacts, 63% (n=142), were observed on those patients. 7% (n=16) of contacts were observed on the other surgical patients and 30% (n=67) contact observations were on medical patients. The medical numbers were skewed by the last two observation periods where the observations were conducted on the medical section of the CICU in order to include a larger sample of staff in the study. At that time the medical side had at least one long term ventilated patient who was barrier nursed, thus the number of contacts for this patient was much higher than for the usual cardiac medical patients cared for in the CICU. However, this is another category of patient where infection risk is high, both for the patient being at risk of nosocomial infection and for the risk of spread of infection to other patients.

4.3.7.7 Similarity of error rate for all patients

As mentioned previously the global error rate was approximately 29% (n=65). The error rate was similar across all categories of patients with the observed rate being 30% (n=42) for the cardiac surgery patients, 31% (n=5) for the other surgery patients and 27% (n=18) for the medical patients.

4.3.8 Difficulties obtaining adequate records data

The required patient listings were, in theory, available via the hospital admission system. Due to the amount of retrospective data required for this part of the study, the request had to be referred to head office. However, repeated requests failed to generate the necessary listings. It is unclear why there was a difficulty in this regard. The patient listings were therefore compiled manually from the SCICU admission books and entered into Microsoft Excel spreadsheets along with any of the required information which was available, such as age, gender, procedure.

4.3.8.1 Inadequacies of sample for adequate data collection

A further problem encountered was requested files failing to arrive. From the total number of patients (N=759) in the transition and MRSAP period (FY2006 - FY2008), a 34.3% (n=260) probability sample of the files was requested on the advice of the statistician. Over the 3 months only 14.6% (n=38) of the requested records arrived i.e. a 5% sample was ultimately obtained. Those that did arrive were very unevenly distributed. The following bar chart (Figure 4.1) shows the distribution of all sampled patient files by financial year. It can clearly be seen that the majority of data obtained was from the pre MRSAP period (FY2003 - FY2005). Those files obtained from the MRSAP period were particularly

unevenly distributed with n=12 from FY2006, n=0 from FY2007 and n=26 from FY2008.

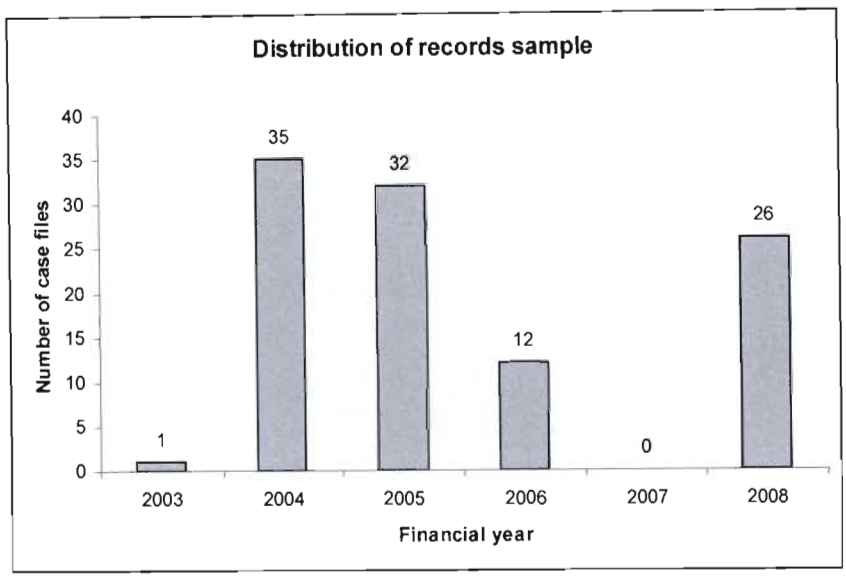

Figure 4.1: Comparison by Financial Year of sample cases obtained

4.3.8.2 Concerns regarding the availability of necessary data

With regard to collecting screening data it transpired that patients for CABG or valve replacement were quite often discharged after the initial diagnosis and stabilisation in order to come back at a later date for surgery. The patient admission system used by the hospital generates a new admission number for each visit and thus it can be difficult or impossible to check on an individual patient's progress through multiple admissions for the same problem. If the patients went to pre-admission, their swab results would go to the doctor and never be put in the hospital case notes.

4.3.8.3 Attempts to improve quantity and quality of screening data

In order to try and improve the amount of data, the medical admission books were cross-referenced against the surgical admissions to try to assess for screening compliance (as some patients progress straight from medical admission to diagnosis to surgery within the same admission). However this cannot be regarded as a probability sample (as originally planned), but rather a convenience sample i.e. results which were available. Bouwer and Lancet laboratories were also approached to investigate the possibility of accessing the hospital's screening results. Both laboratories were very helpful in providing screening data, but unfortunately it was not possible to link the data they had available to individual patients.

4.3.9 Staff compliance with MRSAP screening protocol

The data obtained was entered into Microsoft Excel spreadsheets and subsequently coded and imported into SPSS version 15.0 for further analysis. If all data obtained is considered, then from the total number of patient cases (N=759) there was no data for 73.6% (n=559). There was no evidence that swabs had been taken appropriately for 3.6% (n=27) of cases. In 2.5% (n=19) of cases swabs were definitely taken appropriately. For 15.4% (n=117) there was some evidence that swabs had been taken. Screening swabs were recorded as not applicable if the cases fell into the transition period i.e. 4.9% (n=37). Table 4.5 below summarises these results.

Table 4.5: Compliance with screening – full data set

Table 4.5		Frequency	Percent
Valid	No evidence that MRSA swabs were taken	27	3.6%
	MRSA swabs were taken	19	2.5%
	Some evidence that MRSA swabs were taken	117	15.4%
	N/A	37	4.9%
	Total	**200**	**26.4%**
Missing	System	559	73.6%
Total		**759**	**100.0%**

So, even where evidence could be found that swabs had been taken, there were usually no results available.

4.3.9.1 Sampled screening data

If only the sample data is considered, then the consistency of the data is improved but the amount of data is substantially reduced. From the 38 case files obtained 42.1% (n=16) of swabs were taken; there was no evidence as to whether swabs were taken for 42.1% (n=16) and 5.3% (n=2) had some evidence that swabs had been taken. From the transition period 10.5% (n=4) of cases were recorded as not applicable. Table 4.6 which follows summarises these results.

Table 4.6: Compliance with screening – sample data set

Table 4.6		Frequency	Percent
Valid	No evidence that MRSA swabs were taken	16	42.1%
	MRSA swabs were taken	16	42.1%
	Some evidence that MRSA swabs were taken	2	5.3%
	N/A	4	10.5%
Total		**38**	**100.0%**

4.3.9.2 Availability of swab results

Finally, the data was analysed for the availability of swab results. Where results were found, 34.2% (n=13) were MRSA negative, 2.6% (n=1) were positive and no result was found in 50% (n=19) cases. The remaining 2.6% (n=1) had a result of "no growth" which may mean an inadequate sample or delays in transit occurred, but could also mean that no pathogens (i.e. MRSA) were isolated. The 10.5% (n=4) cases which fell into the transition period were recorded as not applicable. The results are summarised in Table 4.7 below. Although a rate of MRSA positive screens can be calculated as 1 positive out of 38 possible (2.6%), it is not helpful because of the large quantity of missing or inconclusive data i.e. it cannot be considered an accurate reflection of patient colonisation/ infection.

Table 4.7: Screening swab results

Table 4.7		Frequency	Percent
Valid	MRSA negative	13	34.2%
	MRSA positive	1	2.6%
	No growth	1	2.6%
	No result found	19	50.0%
	N/A	4	10.5%
Total		38	100.0%

4.4 MRSA infection rate pre- and post-MRSAP

This component of the study entailed access to the infection control nurse's MRSA statistics which have been kept since 1998. The infection control nurse's records, while comprehensive, had changed format several times over the six years under investigation. This was partly due to changing operational needs and partly due to changes in company requirements. While every effort was made to assist the researcher in obtaining the required MRSA infection data, it was not always possible to extract SCICU data with absolute certainty. The discrepancies between alternative data sources were resolved in consultation with the infection control nurse. Where possible, cases were cross referenced against the patient listings and against the original hospital record.

4.4.1 Infection risk stratification data

Since the aim of this part of the study was to compare for significant difference in MRSA infection rate before and after introduction of the MRSAP, it was necessary to assess the comparability of the two patient groups with respect to infection risk. Since some of the required data was available from the admission books it was available for nearly all patients and hence no sampling was required. These aspects were procedure (i.e. type of surgery), age and gender. The required data which could only be obtained reliably by sampling was on smoking and diabetes since this data was not consistently available except in the case records.

4.4.1.1 Comparability of patients before and after MRSAP

Where sampling was required, exactly the same problems applied as described for the screening data i.e. small convenience samples only were actually obtained. The total number of patients was N=1461 patients admitted to SCICU for FY2003 - FY2008. A probability sample of 35% (n=506) of case files was requested. Ultimately a sample of only 7% (n=106) files was received, unevenly distributed. Therefore a 7% convenience sample was obtained. This seriously limits the possibility of these results being generalisable. Thus it is not possible to be as confident about the results for diabetic and smoker as for the other risk stratification data.

4.4.1.2 Patient groups are comparable for procedure, gender, diabetes and smoking

Data was analysed in SPSS version 15.0 using Chi-Square tests for each non-parametric risk (procedure, gender, diabetic and smoker). For each non-parametric factor the level of significance was $p>0.1$ indicating that any variation between the two groups was not likely to be significant and thus that the groups can be considered to be essentially the same.

4.4.1.3 Differences are noted between patient groups for age

The parametric data for age was analysed in two ways. Frequencies were run and histograms generated in order to assess the distribution of the data. While the data approximated to a normal distribution with similar means (59.48 years before and 57.98 years after) and standard deviations for both periods (13.605 before and 13.936 after), it was slightly skew (-0.843). An independent t-Test was calculated in order to compare the group means. Levene's Test for equality

of variance indicated that equal variances could not be assumed, but was still significant ($p<0.05$) indicating that there was a possibly genuine difference between the two groups with respect to age. That is, patients were tending to be younger. However, as the data was not quite normally distributed, a Mann-Whitney U test was also run which is a non-parametric test suitable for use with data which is not normally distributed. This test also indicated that there was a significant decrease in age between the pre- and post-MRSAP period ($p<0.05$).

4.4.1.4 Female cardiac surgery patients are getting younger

Hence further tests were run, in order to try and identify the source of this difference, as the two data sets appeared by distribution to be very similar. The data was split by gender and procedure and the t-Tests and Mann-Whitney U tests re-run. This further analysis revealed that the main source of significant differences between the periods for age was the female cardiac surgery patients (t-Test, $p<0.01$; Mann-Whitney U test, $p<0.05$). On average this group of patients appears to be getting younger.

4.4.1.5 Male thoracic surgery patients may be getting younger

A borderline result was found for the male thoracic surgery patients with the t-Test indicating a non-significant difference ($p>0.1$), but the Mann-Whitney U test was significant ($p<0.05$). Thus there is a possibility that, on average, male thoracic surgery patients are also getting younger. A summary of the results described above appears in Table 4.8 below.

Table 4.8: Significance of infection risk stratification factors

Data Set	Risk factor	Data type		Test	Significance level			
					Probably Significant		Probably not significant	
					p<0.01	p<0.05	p>0.05	p>0.1
Sample	Diabetic	Non Parametric		Chi-Square				0.231
	Smoker	Non Parametric		Chi-Square				0.354
Full	Procedure	Non Parametric		Chi-Square				0.715
	Gender	Non Parametric		Chi-Square				0.904
	Age	Undifferentiated parametric data		t-Test		0.039		
				Mann-Whitney U		0.02		
		Parametric data split by gender & procedure	Male Thoracic surgery	t-Test				0.107
				Mann-Whitney U		0.036		
			Female Cardiac Surgery	t-Test	0.008			
				Mann-Whitney U		0.012		

As previously described the non-parametric infection risk factors of diabetic, smoker, procedure and gender do not appear to differ significantly between the two groups of patients compared. The age factor however did show a difference between the two groups, with further analysis demonstrating that this difference was substantially due to female cardiac surgery patients being significantly younger in the post–intervention period. There is also some evidence to support male thoracic surgery patients being slightly younger.

4.4.2 MRSA infection rates

Evidence had been obtained to support the pre- and post-MRSAP groups being comparable, except possibly with respect to the age of some groups of patients. The MRSA infection statistics for the two groups were then compared. The number of actual cases of MRSA found was only three from the pre-MRSAP period - all in 2005. One case was found in the post-MRSAP period in February 2006. However, this did represent a relatively high ***rate*** of infection especially when compared to the hospital statistics for the same periods.

4.4.2.1 SCICU and hospital MRSA infection rates

The comparison of hospital and SCICU infection rates had to accommodate the existing format of the hospital statistics and a best approximation to the desired dates was achieved. The hospital and SCICU MRSA statistics for the period FY2003 - FY2005 were compared to the period FY2006 - FY2008. Rates were calculated using the hospital and SCICU admission numbers. This information is presented as Table 4.9 below:

Table 4.9: Comparison of Hospital and SCICU MRSA rates

FYs 2003-2008

TABLE 4.9	YEAR	HOSPITAL ADMITS	HOSPITAL MRSA INFECTION	HOSPITAL MRSA RATE	SCICU ADMITS	SCICU MRSA INFECTION	SCICU MRSA RATE
PRE-MRSAP	FY2003	21219	12	0.06%	213	0	0.00%
	FY2004	21699	17	0.08%	234	0	0.00%
	FY2005**	**22833**	**19**	**0.08%**	**255**	**3**	**1.18%**
	SUB TOTALS	**65751**	**48**	**0.07%**	**702**	**3**	**0.43%**
POST-MRSAP	**FY2006****	**22757**	**11**	**0.05%**	**283**	**1**	**0.35%**
	FY2007	22421	5	0.02%	257	0	0.00%
	FY2008	22038	3	0.01%	219	0	0.00%
	SUB TOTAL	**67216**	**19**	**0.03%**	**759**	**1**	**0.13%**
TOTALS		**132967**	**67**	**0.05%**	**1461**	**4**	**0.27%**

** Years in which SCICU MRSA cases found.

This table shows an increasing hospital MRSA rate which peaks in FY2005 at 0.08%, thereafter declining. For the same period, the SCICU rate shows the advent of MRSA in FY2005 at 1.18% of patients admitted followed by a dramatic decline in rate to 0.35% in FY2006 and thereafter no further cases.

The information is depicted graphically as figure 4.2 below in order to better illustrate the change in rates presented in the table:

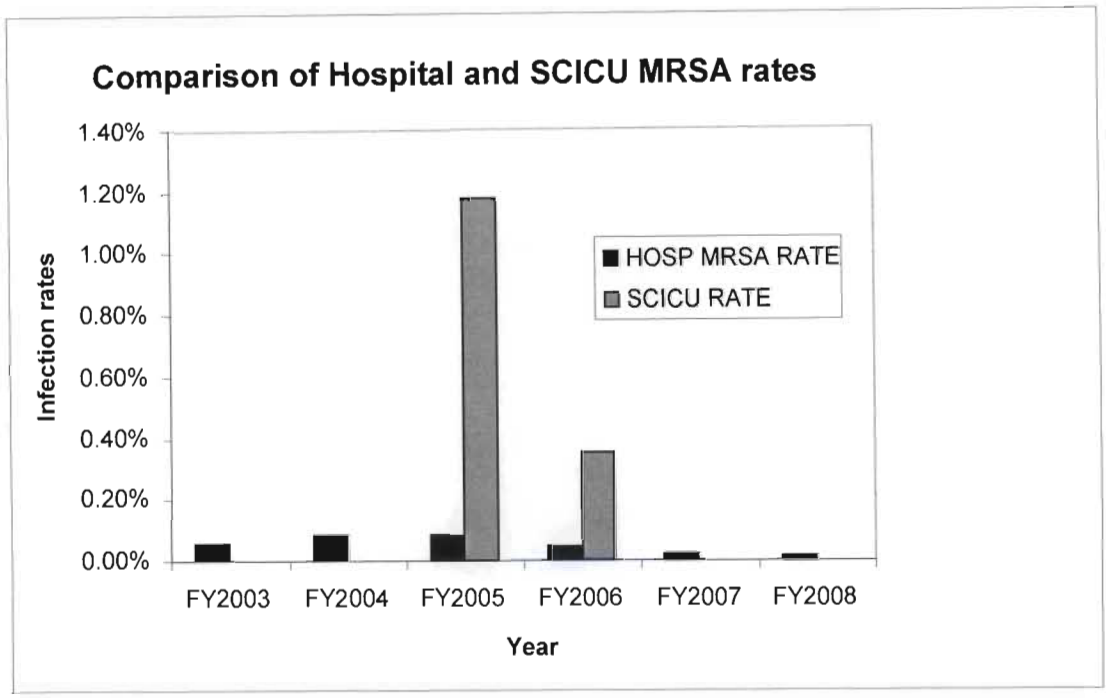

Figure 4.2: Comparison of Hospital and SCICU MRSA rates FYs2003-2008

4.4.3 Analysis of the change in infection rates

Since the actual number of cases found in the SCICU was insufficient to allow more than descriptive statistics, the planned Chi-Squared tests were calculated on the hospital statistics only. However, since the survey, observation of compliance and assessment of screening compliance was only conducted in SCICU, and not in the whole hospital, it was not possible to *assume* that this decrease was due to the MRSAP. A further study would be required to attempt to demonstrate this.

4.4.3.1 Significant reduction in hospital infection rates

Table 4.10, below was compiled from the records data obtained in order to test for significant reduction in MRSA infection rate:

Table 4.10: Calculation of Chi-Squared test for hospital MRSA infection

TABLE 4.10	YEAR	HOSP ADMITS	HOSP MRSA INFECT'N	NO HOSP MRSA INFECT'N
PRE MRSAP	FY 2003	21219	12	21207.00
	FY 2004	21699	17	21682.00
	FY 2005	22833	19	22814.00
	SUB TOTALS	**65751**	**48**	**65703.00**
POST MRSAP	FY 2006	22757	11	22746.00
	FY 2007	22421	5	22416.00
	FY 2008	22038	3	22035.00
	SUB TOTAL	**67216**	**19**	**67197.00**
CHI-SQUARED TEST			**6.20585E-41**	

At hospital level, a significant difference Chi-Squared $=6.20585 \times 10^{-41}$ ($p<0.0001$), was demonstrated between the comparison periods (pre- and post-MRSAP). Thus the figures reported probably represented a real decrease in MRSA infections since the implementation of the MRSAP at hospital level.

4.4.3.2 Reduction in SCICU MRSA infection rates observed

There was a marked decrease in the MRSA infection rate in the SCICU following introduction of the MRSAP from 1.18% in FY2005 to 0.35% in FY2006. There were no cases of MRSA infection identified in SCICU patients in either FY2007 or FY2008.

CHAPTER 5

SUMMARY OF FINDINGS, DISCUSSION AND CONCLUSIONS

5.1 Summary of findings and discussion

This study was comprised of an evaluation, using a program evaluation framework, of the utilisation of an infection control protocol for MRSA in a surgical cardiac ICU. Stakeholders were engaged in management of MRSA at the stage where the MRSA outbreak occurred. The MRSAP was planned and implemented by the infection control nurse in consultation with hospital management. It has been described and is available in appendix 1. The evaluation plan was focused as the stated objectives of this study which were to evaluate the MRSAP in the SCICU with respect to nursing compliance and change in MRSA infection rates over time and to identify any areas for improvement in utilisation of the MRSAP by nurses. Evidence was gathered with respect to staff's knowledge of the MRSAP using a survey questionnaire and on their infection control practice through periods of observation on the unit. Screening compliance and reduction in infection rates were investigated using a retrospective records review. Chapter 5 now presents a summary of the findings, discussion of the findings and conclusions. The results of this study have been given to hospital management and CICU staff so that necessary changes can be implemented to improve nursing practice.

5.1.1 Staff participation in the study

All eligible CICU staff and some of the agency and high care staff approached agreed to participate, thus staff participation was good at 84% (n=27). The questionnaire return rate was 81% (n=26) and practice was observed for 72% (n=21). It became apparent that the high care staff must have included themselves as permanent staff since only one respondent identified themselves as an agency nurse. This was reasonable since the other options they were given pertained to being agency nurses. Due to high care staff being an unanticipated addition to the staffing complement and the resultant decrease in utilisation of agency staff, there were difficulties in fully analysing data and making focused recommendations. This unanticipated category of staff would be catered for in any future studies.

5.1.2 Awareness and understanding of MRSAP in CICU

The rationale for the questionnaire was twofold. It would provide information about how well the content of the MRSAP had been disseminated and consequently it would provide a context for the subsequent observational data i.e. whether any observed deficits were due to lack of knowledge / understanding rather than other factors. The analysed questionnaire data would then permit more focused or targeted feedback to staff about any areas for improvement identified in the observational study.

There was an 81% (n=26) return rate for the questionnaire. This return rate compared favourably with, for example, Quiros, Lin and Larson's (2007) survey of staff attitudes to guidelines in which he also handed out the questionnaires in person and collected in person achieving a return rate of 68.2%. A relatively

good awareness of the MRSAP was demonstrated with 88% (n=23) of respondents indicating that they knew there was a policy specifically for dealing with MRSA. This is also similar to the results from Quiros et al.'s (2007) study which found that only 10.2% of surveyed staff members were not familiar with the practice guidelines in their field (which presumably translated into 89.8% of staff being aware of these guidelines).

5.1.2.1 Poor categorisation of nursing staff

The questionnaire had been designed on the basis of the typical staffing of the CICU (i.e. permanent CICU staff supported by agency staff as required). However, due to the unusual confluence of new staff members after a period of relative staffing stability and the temporary closure of cardiac high care the demographic data requested failed to adequately discriminate between respondents in terms of how their knowledge or lack thereof would impact on implementation of the MRSAP. Thus the lack of a question pertaining to the nursing qualifications or lack thereof e.g. registered nurse, ICU student, unit assistant created some difficulties during the rest of the questionnaire analysis. As the unit assistants have no nursing qualifications, they have no formal responsibility for direct patient care, and consequently their responses may well have been less accurate than those of the trained nurses. However, these staff members are invaluable in assisting the trained nurses and their diligent compliance with routine hygiene measures including PPE is very important to infection control in SCICU and therefore their inclusion in the study was important. Possibly they could have been included only in the observational component of the study.

Due to recent staff movements there were four new staff on the unit after a lengthy period of having a stable complement of staff. Therefore some response options regarding length of time working in the CICU would have been helpful. Given that the respondents probably included at least some of the unit assistants and new enrolled nurses an 88% awareness of the MRSAP probably indicates an acceptable degree of awareness. However, ultimately it is the decision of hospital management what is an acceptable level of awareness in any particular area. As indicated previously, collecting more data pertaining to level of qualification and length of time on the unit would have enabled more focused recommendations on completion of the analysis; however, since preservation of anonymity was a factor in designing the questionnaire the small number of subjects (particularly enrolled nurses and unit assistants) necessarily meant that there were limitations on how much could be asked.

5.1.2.2 Staff knew that care was required, but not always what or why

As with awareness of the policy, nearly all staff (96%, n=25) knew that routine screening swabs were required. However, on average, only 88% were rated as responding correctly as to exactly what swabs were taken. Amending the format of this question to include more focused questions on site of swab and organism might improve the accuracy of responses.

With regard to nursing MRSA positive patients an average of 88% of the knowledge of the care required by these patients was demonstrated. However, only seven staff had their responses rated as completely accurate. Had the seniority of these staff in the unit been known, then the implications of this would have been easier to assess. If these were all senior staff supervising, then there may not, in practice, be a problem.

All staff (n=26) responded that they used chlorhexidine soap/scrub on the unit, but on average only 58% were rated as using it correctly. Therefore it would seem that this area of practice needs to be addressed.

Most staff, 84.6% (n=22), appeared to be satisfied with the current standard of infection control in CICU with 61.5% (n=16) of staff having no specific comment to make and 23.1% (n=6) of staff being positively satisfied. Only 15.4% (n=4) had comments to make which identified improvements to be made. These comments, such as the failure to use PPE appropriately, were largely supported by the observational study. Thus, knowledge deficits have been identified with respect to the content of the MRSAP, which will hopefully be remedied following appropriate feedback.

5.1.3 Staff compliance with the MRSAP

To provide context for the CICU staff compliance with MRSAP routine hygiene measures, the results of other studies were used for comparison. Errors were identified and methods to improve compliance discussed.

5.1.3.1 Staff demonstrated better than average hygiene compliance

Compliance with the MRSAP was assessed by observation of staff's infection control practice – mostly while caring for patients post cardiac surgery (63%) or medical patients requiring ventilatory support (30%). The majority of the time, 73%, registered nurse practice was observed. Correct patient contacts were observed for 64% (n=142) of all the contacts.

Barrier precautions were used appropriately on 60% (n=3) of occasions, which needs to be improved given the risks associated with transmission of infection. Chlorhexidine wash compliance was 100% (n=6). This may demonstrate that while the general level of knowledge 58% was not good the senior staff were supervising effectively and ensuring compliance with the MRSAP in practice. However for both barrier nursing and chlorhexidine washes the number of observations was small and may not be representative.

Given the identified importance of routine hygiene measures in ICUs generally, the compliance rate is not initially very encouraging. However, comparison with other studies on hand hygiene report much lower compliance rates than were observed during this study. For example the WHO (2005a) indicated that doctors and nurses clean their hands appropriately less than 50% of the time. They further suggest that at busy times, in critical care situations, this may fall to 10% or less. This is not meant to encourage complacency, but rather to suggest that staff should be encouraged that their performance is above par and perhaps they could strive to achieve even better routine hygiene measures and infection control performance. Pittet et al. (2000) measured hand hygiene compliance at 47.6% at baseline in their study to promote hand hygiene through the use of alcohol-based hand disinfection for all categories of staff. During the three years of the study, compliance improved significantly to 66.2% ($p<0.001$). As alcohol-based hand disinfection is now an accepted hand hygiene measure in CICU, Van de Mortel, Bourke, Fillipi, McLoughlin, Molihan, Nonu and Reis' (2000) study may be more relevant. These authors assessed hand hygiene compliance among registered nurses at 71% at baseline in their study on performance feedback as a method to improve compliance. Following the intervention phase, where feedback was given to staff, registered nurse

compliance rose significantly to 86% (p=0.0433). It should be noted that in the current study measures other than solely hand hygiene were being observed for and therefore the results will not be strictly comparable. McAteer, Stone, Fuller, Charlett, Cookson, Slade, Michie and the NOSEC/FIT group (2008) developed a standardised hand hygiene observation tool precisely in order to address the issue of comparability of data between institutions. These authors had found that the existing standardised tools either lacked sufficient clarity in their standard operating procedures or were too complex to allow good inter-rater agreement. Wherever researchers are aiming to compare different institutions or use more than one researcher such issues become very important to the reliability of the results.

5.1.3.2 Errors observed and implications for practice

Some contacts could not be observed as they were behind closed screens on 7.2% of occasions (n=16). Errors were observed for, on average, 28.8% (n=65) of contacts, of which very few 0.02% (n=4) were by non-CICU healthcare worker. It may be supposed that, when comparing the observational results with the survey results, the more or less standard error rate across all categories of patients (30% (n=42) for Cardiac Surgery patients, 31% (n=5) for other surgical patients and 27% (n=18) for medical patients) reflects the results pertaining to staff comments on infection control in the unit, where only 4 staff members had any apparent dissatisfaction with the status quo and the rest had either no comment or were positively satisfied with this aspect of nursing care on the unit. It also perhaps suggests that this error rate is in some way intrinsic to staff practice and would merit further study. Cole (2006) specifically identifies motivation, rather than knowledge, as being one of the most challenging factors

to overcome in improving compliance with hand hygiene. Quiros et al.'s. (2007) survey of hospital staff found that staff attitude to guidelines in general and the content of the specific guideline, the CDC hand hygiene guideline, affected their acceptance and self-reported implementation of this guideline.

Those errors which were observed, other than simple failure to use appropriate hand hygiene measures included: failure to use PPE e.g. gloves for ABG; failure to swab ports prior to access; failure to clean a stethoscope prior to transfer between patients and failure to remove aprons when leaving a barrier nursed patient. All of these are simple measures, but vital to the prevention of transmission of micro-organisms between staff and patients. Thus, awareness of the consequences of inadequate infection control needs to be heightened. However, some of the constructive criticisms made by staff in the survey questionnaire also mentioned issues such as staff not wearing PPE appropriately, showing that there is a degree of awareness among the nurses on the floor that improvements are needed.

Unfortunately no major procedures such as central line insertions occurred during any observation period. However these are relatively infrequent in the CICU – lines are, generally, initially placed in theatre and not replaced, as the patients tend to go to cardiac high care on day two or three post-operatively prior to which the lines are removed. However, while assisting with these procedures, nursing staff have the opportunity and obligation to facilitate correct patient contact hygiene measures.

5.1.3.3 Feedback to staff may improve performance

In keeping with the programme evaluation framework which underpins this study, feedback to the staff involved is necessary in order to share the knowledge obtained from the study and use it to improve the standard of nursing. Van de Mortel et al. (2000) demonstrated improved compliance with hand hygiene from baseline measures following feedback on performance at three months which subsequently deteriorated to near baseline. However the registered nurse subgroup did maintain their performance better than most other staff groups observed. The authors recommended repeating performance review and feedback at yearly intervals in order to maintain improved performance. Within the hospital currently (but subsequent to the observation phase of this study) there was a hand hygiene initiative aimed at improving the quality of hand hygiene performance amongst the nursing staff. This indicated that there was awareness of the need for performance monitoring when effective implementation of practice initiatives is expected, as described by Allegranzi and Pittet (2008). Clinical practice education, which could further improve nursing care would be that directed specifically at care of invasive lines. It was necessary to consider the results from the questionnaire as well as the previously identified issues of motivational factors (Cole 2006) and attitudinal issues (Quiros et al. 2007) when considering how to feedback as effectively as possible.

5.1.3.4 Inadequate data for assessment of screening compliance

Although as much data as possible was collected in order to assess compliance with MRSA screening, the combined problems of inadequate sample (5% (n=38) convenience sample) and inadequate data from the obtained sample

meant that this aspect of the study must be regarded as inconclusive. While there was evidence that swabs were taken, there was mostly no documented result. Corriere and Decker (2008) described the proposed legislature in various states in the USA to mandate screening of all hospitalised patients and public reporting of MRSA infections. Allegranzi and Pittet (2008) identified the already mandatory reporting of MRSA bacteraemia in England. As the growing threat of MRSA contributes to increasing costs of health care, it is important to be vigilant in all aspects of control and prevention measures. This must obviously include following up on laboratory results when it is an accepted fact that proximity to patients colonised or infected with MRSA is a significant risk factor for MRSA acquisition (Byers and Decker 2008). The mechanisms in place at present appear to be inadequate and require review.

5.1.4 Comparison of MRSA infection rates pre and post MRSAP

When considering comparison of infection rates pre and post intervention it was necessary both to obtain adequate samples and to ensure that the patient groups were comparable.

5.1.4.1 Impact of inadequate sample on infection risk stratification

To reliably compare infection rates pre and post MRSAP it was necessary to demonstrate that the two groups of patients were similar with respect to infection risk. The inadequate quantity and distribution of case files obtained (7% (n=106) convenience sample) impacted on the quality of data available for the infection risk stratification, with respect to diabetic and smoker which was consistently available only in the case files. The other risk factors of procedure, gender and age were available for all patients and hence were reliable.

5.1.4.2 Comparability of patient groups pre and post MRSAP

The data obtained indicated that there was no significant difference between the patient groups ($p>0.1$) with respect to procedure, gender, diabetic and smoker status.

The results for age initially suggested that the two groups were not comparable with both t-Test and Mann Whitney U test indicating significant differences ($p<0.05$). However as the mean ages and standard deviations appeared to be very similar further analysis on sub-categories of patients were run in order to identify specific sources of this difference. These analyses revealed that female cardiac surgery patients in SCICU in the post intervention period were significantly younger ($p<0.01$). It is postulated that this may be due to heightened awareness in recent years of the atypical ischaemic symptoms often demonstrated by female cardiac patients, described by Berger, Bairey-Merz, Redberg and Douglas (2008). If women are being diagnosed earlier in the disease process, then they have more treatment options than previously. This decrease in age of female cardiac surgery patients may merit further study.

The only other possible source of age difference was male thoracic surgery patients, who may be getting younger; however these latter results were of equivocal significance. A possible explanation may be the combined increase locally of the related problems of Human Immunodeficiency Virus (HIV), Pulmonary Tuberculosis and other lung disease secondary to HIV – especially infection and malignancies (Mohamed 2007) causing an increase in the use of open lung biopsy and wedge resections to facilitate diagnosis or management of pulmonary infiltrates of unknown aetiology. This has been shown to be a valuable diagnostic technique (Coutinho, Pancas, Magalhaes, Bernardo,

Eugenio & Antunes, 2008) where there are difficulties in diagnosis. The above conditions tend to affect a younger segment of the population than, for example, lung cancer due to smoking (Mohamed, 2007; Kahl, 2007). This could be explored in depth if the trend continued.

5.1.4.3 Reduction in SCICU and hospital MRSA infection rates

Having established that the pre and post MRSAP groups of patients were broadly comparable, the MRSA infection rates were analysed. The data collected on MRSA infection in SCICU patients revealed that there had been very few actual cases of MRSA infection during the study period. Three cases were identified pre MRSAP (1.08%) and one post MRSAP (0.35%). This however translated into much higher infection rates than in the hospital as a whole for matched periods. Due to the small number of cases it was not possible to test for the significance of this difference at SCICU level, but a Chi-Squared test on the hospital MRSA cases for the same period demonstrated a highly significant reduction ($p<0.0001$). Haas and Larson (2007) in their review of methods of measurement of compliance with hand hygiene identified that the three major methods used are direct observation, self-report and indirect measures such as hand hygiene product usage or change in infection rates or transmission rates. Thus it was tempting to attribute the statistically significant decrease in infections at hospital level and the observed decrease in SCICU to the MRSAP on the basis that it was in place. However the logic of this might be considered dubious without making some attempt to demonstrate compliance with the MRSAP, which this study has attempted to do.

5.1.4.4 Evidence to support efficacy of the MRSAP

There was evidence from the staff survey and observational study that the identified reduction in MRSA infections was due to the introduction of the MRSAP i.e. good knowledge of the MRSAP and better than average compliance with infection control measures, particularly routine hygiene measures, in the SCICU. The major limitation however was that there could be no direct assessment of past infection control practice. The previously described problems encountered in collecting screening data mean that no conclusions could be drawn about this particular aspect of the MRSAP.

Haas and Larson (2007) when assessing indirect measures which have been used to measure improved hand hygiene compliance, such as change in infection rates, commented that demonstrated improved hand hygiene compliance does not always correlate with decreased HAI rates. This might suggest that a set of comprehensive and targeted measures such as the MRSAP described and evaluated in this study is the best approach to reduction of HAI in general and MRSA in particular. Other authors such as Pittet and Donaldson (2005) and Allegranzi and Pittet (2008) supported the need for multi-faceted interventions to tackle the world-wide burden of HAI.

It is possible that some of the decrease in infection rate in this study was simply due to the identified younger age of female cardiac surgery patients with the consequent decreased infection risk, rather than to the MRSAP.

5.2 Recommendations for improving efficacy of the MRSAP

The knowledge and practice deficits identified in the study were planned to be used for targeted feedback to improve compliance with the MRSAP.

5.2.1 Improving knowledge of the MRSAP

The staff members in CICU needed to improve knowledge of the MRSAP before improved compliance could be achieved. Particular areas of concern were the adequacy of knowledge with respect to obtaining MRSA screening swabs, barrier nursing, the use of chlorhexidine soap in CICU and complacency regarding infection control practice on CICU.

5.2.2 Improving compliance with the MRSAP

It is hoped that the feedback from this study combined with the hand hygiene performance initiative will promote increased awareness of this vital infection prevention measure. Re-assessment should be conducted on an approximately annual basis. Other areas which could be targeted are appropriate accessing of invasive lines (particularly central and arterial lines) and wearing PPE appropriately.

5.2.3 System for taking swabs and reviewing swab results

It is recommended that the current system for documenting the taking of screening swabs and following up results is reviewed. Proof of swabs being taken and documented results need to be available to the infection control nurse for her to be able to manage this aspect of the MRSAP effectively.

5.3 Recommendations regarding hospital records

It is recommended that the system for access to patient records and preservation of patient records be reviewed. Difficulty obtaining adequate documentation of patient care poses a medico-legal hazard.

5.4 Limitations of the study

The questionnaire did not collect adequate data on staff qualifications and length of time working in the unit to enable recommendations to be as focused as was desirable. This needs consideration prior to using it again, but as anonymity was assured in this study it was not possible to request the necessary detail. Some questions could be made more specific or updated to a multiple choice format to facilitate optimum response from the respondents.

Due to having only a single researcher, time for writing during observations was severely limited. Ideally, it would have been possible to either have another researcher to share the observations or to be able to film for periods and extract data afterwards which would also have reduced the possible Hawthorne effect. Thus more accurate observations and correlation of observations with other researchers would have been possible (Haas & Larson 2007). However, the ethical and budgetary constraints of such undertakings were insurmountable for a study of this nature.

The SCICU is a relatively small and highly specialised unit with highly trained staff. Thus the results are not necessarily generalisable to the hospital as a whole. The results may be of relevance to the other ICU and high care areas in the hospital which apply the same MRSAP.

The failure to obtain adequate samples with respect to screening swabs meant that the nursing compliance with the MRSAP could not be adequately assessed. The inadequate samples of patient files also impacted on the reliability of the infection risk assessment, specifically with respect to the patient's categorisation as a diabetic and/or smoker. The small number of MRSA cases found severely limited the extent of analysis of this data.

5.5 Recommendations for research and education

5.5.1 Factors affecting staff compliance with MRSAP

Investigating staff understanding and perceptions of the importance of infection control measures may allow instruction and education in this important component of high quality patient care to be delivered more effectively. Particularly the consistency of the error rate between the differing categories of patient may suggest that there is little discrimination used in how infection control practice has more impact on some high risk patient groups. Coles' (2006) assessment of motivation being a particularly important factor to consider when planning educational strategies to improve compliance with hand hygiene suggests the need for further investigation. The study by Quiros et al. (2007) investigating the attitudes of ICU staff to the CDC hand hygiene guideline found that staff were familiar with the guideline, but that there was a variable attitude to it. Staff members in adult ICUs were much less positive about it than staff in paediatrics and were less likely to implement it in practice.

Thus there is support for the idea of improving compliance being dependent on more than simply making sure that staff members know the details of the MRSAP. Investigating how to engage staff in improving their performance with respect to evidence based guidelines in general and routine hygiene measures in particular is recommended.

5.5.2 Improving generalisability of results

It is recommended that other areas in the hospital be assessed for understanding of, and compliance with, the MRSAP, using improved data collection tools and methods. Particularly, if the other ICU and High Care settings were investigated, the number of MRSA cases pre and post MRSAP might be sufficient to test for a statistically significant reduction as was demonstrated with the hospital MRSA statistics. If such a study was conducted with a greater range of patients and units, using larger sample sizes, the results might become generalisable. Other institutions should also consider evaluating the infection control behaviours of their staff, particularly hand hygiene. Consideration should be given to using a standardised observation tool such as that described by McAteer et al. (2008) to facilitate comparison of results between units and institutions.

5.5.3 Study of patient demographics

The incidental findings of the female cardiac surgery patients getting younger (and possibly the male thoracic surgery patients also getting younger) may merit further study as the change in intrinsic infection risk may have implications for appropriate infection control measures.

5.6 Implications for professional practice

5.6.1 Feedback to staff to improve performance

In accordance with the programme evaluation framework and further to Van de Mortel et al. (2000), it is recommended that staff receive feedback from this study, and also that knowledge and practice are reviewed on a yearly basis, to facilitate maintenance and improvement of performance. Infection control audit as a tool for change as described by Bryce et al. (2007) may also be worth consideration as it could incorporate measurement of hand hygiene compliance.

5.6.2 Make results available to other institutions

Results from this study should be made available so that nurses in SA can benefit from the work already done in this private hospital and improve the standard of infection control practice in SA, particularly with respect to MRSA and other multi-drug resistant organisms. O'Rourke (2006) reminds us of the professional role of the nurse encompassing authority, responsibility and accountability. Thus there is a professional obligation to seek the best possible quality of care, especially when dealing with vulnerable patient groups such as those in CICU.

5.7 Conclusions

This study highlights the importance of good infection control practice, particularly routine hygiene measures such as adequate hand hygiene and appropriate use of PPE. The MRSAP was found to be effective for reducing MRSA infection rates in a Surgical Cardiac Intensive Care Unit despite the inadequate screening data. Efficacy of the MRSAP was demonstrated through adequate staff understanding and compliance, and elimination of MRSA infection from the SCICU. While infection rate results could not be statistically compared for significance due to the small numbers obtained, a larger study comprising all the ICUs would probably provide sufficient data to test for statistically significant difference. Further research with respect to implementation of and compliance with infection control measures could both improve quality of patient care and decrease the burden of preventable infectious disease such as HAI due to MRSA in SA.

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