OPINIONS OF NURSES IN ICU ON THE IMPORTANCE AND UTILIZATION OF THE CLABSI PREVENTION BUNDLE IN AN ACADEMIC HOSPITAL IN GAUTENG

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DECLARATION

I Dorica Mughogho Ng'ambi declare that this Research Report is my own, unaided work. It is being submitted for the Degree of Master of Science in Nursing at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

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Signed today on

8th day of November 2018 in Johannesburg

Protocol Number M180282

DEDICATION

I dedicate this research report affectionately to my husband John Ng'ambi for his untiring support throughout my study.

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I thank God for the good life, good health and guidance throughout my study.

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- Finally, to my classmates and friends who kept me well-balanced during the study period.

PRESENTATION ARISING FROM THIS STUDY

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ABSTRACT

The central line associated bloodstream infections (CLABSI) prevention bundle has proven to prevent CLABSI when all elements are utilized. While the bundle is evidence based, if nurses do not believe it is important, they are unlikely to use it. The purpose of the study was to describe the nurses' opinions on the importance and utilization of the CLABSI prevention bundle with a view, at a later stage, to inform the infection control unit on what to consider when teaching and implementing the CLABSI prevention bundle. The study used a descriptive research design using a Q Methodology approach. Data was collected using a Q sort technique from thirty nurses in Intensive Care Unit (ICU). The nurses had to sort a set of thirty statements about the CLABSI prevention bundle. Factor analysis was used to interpret data by means of the software PQ Method version 2.35 package.

The results of the study revealed mixed opinions among the nurses in ICU. Some value aseptic technique during insertion of the central line. Some value maintenance of the central line, while some value some elements on both the insertion and maintenance of the central line. The study revealed that those elements that the nurses believe to be important, are the ones that they also utilize.

Nurses opinions differ from one another and judging by their opinions, it is evident that not all CLABSI prevention bundle elements are believed to be important, nor are all bundle elements utilized. Recommendations have been proposed for nursing education, practice, management and research.

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CHAPTER ONE

OVERVIEW OF THE STUDY

1.1. INTRODUCTION

This chapter introduces the research study. It provides the general overview of the study by giving a background, problem statement, purpose of the study and study objectives and operational definitions.

1.2. BACKGROUND OF THE STUDY

Central line associated bloodstream infection (CLABSI) is one of the healthcare associated infections (HCAI) and is defined as a primary bloodstream infection occurring in a patient with a central line in situ or where an infection occurs within 48 hours of the removal of the central line when there is no other source of bloodstream infection identified (Richards et al., 2017). According to the World Health Organization (World Health Organisation, 2011), healthcare associated infections are a major problem for patient safety. The impact of HCAIs includes lengthy hospital stays, long term incapacity, and increased resistance of microorganisms to antimicrobial agents. They also result in a massive additional financial burden for health systems, high costs for patients and their families and excess deaths worldwide.

Central line associated bloodstream infection is mostly associated with insertion and maintenance central venous catheters (CVCs). Central venous catheters (CVC) are being increasingly used in in-patients and out-patient settings to provide long term venous access, for administration of medications, fluids and parenteral feeds (Velasquez Reyes, Bloomer and Morphet, 2017; Atilla et al., 2017). These CVCs disrupt the skin, making infection with bacteria and/fungi possible. Infection may spread to the bloodstream causing haemodynamic changes and organ dysfunction as a result of sepsis and eventually death can occur (Mermel, 2000). Approximately 90% of central line associated bloodstream infections occur with central venous catheters (Best Care Always Campaign, 2009). CLABSI causes up to 25% of deaths resulting from hospital acquired infection (Mer, 2005). Strashein et al. (2015), recorded a prevalence of

10.1 intravenous catheter related infections per every 1000 catheter days in a South African study.

The Centre for Disease Control (CDC) guidelines for the prevention of Intravascular Catheter-Related infections 2011, have recently been revised to accommodate recent research done with regards to the establishment and maintenance of intravenous catheters in order to prevent infections (O'Grady et al., 2011). Previously, it was recommended that CVCs should be routinely replaced to prevent CLABSI every 48 – 72 hours. The new recommendation is that clinical judgement should be used as to when to replace the CVC, and that fever should not be the only indication, but also confirmation that no other cause of the fever exists, whether infectious or non-infectious (CDC 2011:16). In order to prevent CLABSI, the Centre for Disease and Control (CDC) recommends that insertion and maintenance of CVC should include the following; hand hygiene and aseptic technique, maximal sterile barrier precautions, skin preparation, catheter site dressing regimens, patient cleansing and catheter securement devices.

A bundle is a group of evidence based practices put together to guide performance of a procedure (Resar R et al., 2012). The CLABSI prevention bundle comprises of: hand hygiene and aseptic technique, maximal sterile barrier precautions (during insertion of CVC all staff should observe barrier precautions and the patient should be covered), skin preparation, catheter site dressing regimen and catheter securement devices and patient cleansing. The items in the CLABSI bundle each have steps to follow to ensure prevention of central line associated bloodstream infections.

In South Africa, Best Care Always (BCA) was launched in August 2009 with its focus on prevention of hospital associated infections. The aim of the BCA initiative was to prevent HAIs through measuring the incidence of HAIs and implementing evidence based practices grouped in bundles, one bundle for each of the hospital associated infections. These bundles were adopted from the Initiative for Health Improvement (IHI) and Safer Healthcare Now Canada (Kantor et al, 2011). Adhering to each element of the CLABSI prevention bundle has shown a reduction in the incidence of CLABSI (Richards et al., 2017). However, the programme is being underutilized at the hospital where this research was conducted.

There is dearth of information on how nurse's beliefs can affect utilization of the care bundle. According to Chor et al., (2012) healthcare professionals' compliance to a care bundle can be influenced by the way they perceive the severity of the disease or infection. These findings are in

line with the Health Belief Model, which suggests that personal belief or perceptions towards a disease or infection are affected by the perceived seriousness of the disease (Turner et al, 2004). Therefore, the way the nurses perceive the items in the CLABSI prevention bundle will affect the utilization of the bundle – hence the need to describe the opinions of the nurses in ICU in terms of the importance and usefulness of the CLABSI prevention bundle.

1.3. PROBLEM STATEMENT

Despite the potential benefits and gains that BCA promised since its inception in 2009 and its roll out at this particular hospital in 2010, there is evidence of underutilization of the CLABSI bundle arising from lack of understanding by the nurses in the ICU. This has resulted in the persistence of CLABSI. While the bundle is evidence based, if nurses do not believe it is important and useful they are unlikely to use it. The study seeks to determine the opinions of the nurses with a view informing the infection control unit of the hospital on how to encourage nurses to use of the BCA initiated CLABSI prevention bundle so as to reduce the incidence of CLABSI and improve quality of healthcare provision.

1.4. PURPOSE AND SIGNIFICANCE OF THE STUDY

The purpose of this study is to determine whether the CLABSI prevention bundle is important and useful to nurses in ICU. The study results will inform the infection control unit of the hospital on what to consider when teaching and implementing the BCA initiated CLABSI prevention bundle so as to ensure effective utilization in order to reduce the incidence of CLABSI and improve quality of healthcare provision.

1.5. RESEARCH QUESTION

The study was based on finding answers to the following question, "How important and useful do nurses in the ICU believe the CLABSI prevention bundle is in ICU?"

1.6. OBJECTIVES OF THE STUDY

- To describe the opinions of the nurses in ICU of the importance of the CLABSI prevention bundle.
- To describe the opinions of the nurses in ICU of the usefulness of the CLABSI prevention bundle.
- To describe the relationship between the importance and utilization of the CLABSI prevention bundle based on the nurses' opinions.

1.7. OPERATIONAL DEFINITIONS FOR THIS STUDY

Intensive care unit – It is a unit in the hospital where critically ill patients requiring constant observation and life support devices are admitted

Nurse – It is someone who has undergone training in nursing and is competent to provide nursing care to critically ill patients.

Central venous catheters/ central line – it is a device inserted in large blood vessels terminating close to the heart for purposes of haemodynamic monitoring, drug administration and many more.

Central line associated bloodstream infection (CLABSI) – it is a laboratory confirmed bacteraemia or fungemia in a patient with a central venous catheter in-situ for more than 48 hours which was not present at the time of central venous catheter insertion.

Central line associated bloodstream infection prevention bundle – also known as central line bundle is a set of evidence based elements which if implemented can lead to prevention of CLABSI

Opinions – it is the nurses' views or judgement about the central line associated bloodstream infection and is not necessarily based on fact or knowledge.

Importance – the value that the nurses attach to CLABSI prevention bundle

Utilization – the effective use of the CLABSI prevention bundle

1.7.1. Q Methodology operation definitions

Q Methodology – it is a research approach used to study views or opinions of people about something and it takes away the subjectivity of the researcher.

Concourse – it is a group of statements or pictures gathered from literature or guidelines, or interviews from which Q statements are taken.

Q set – it is a set of cards with statements printed on them which the participants are supposed to sort.

P set - also known as person sample is a group of participants sampled out from a particular population for Q sorting of the cards in the Q set.

Q sorting – it is the process of sorting out statements, comparing each statement with each other and ranking them out on a Q diagram under a specific condition of instruction.

Free Q sort – Is when a participant is allowed to place as many Q cards as she/he wants under the distribution markers.

Forced Q sort – Is when a participant is only allowed to place a specific number of Q cards under the distribution markers.

Q sort diagram – it is a large diagram usually a normal distribution where participants place cards after sorting them according to their preference under specific distribution markers

Distribution makers – it is a rating scale for -3 to 3

Condition of instruction – it is a guide given to the participant to help him or her with the sorting process.

Factor analysis – it is a process of data reduction done in Q methodology where various completed Q sorts load on one or more factors

Q sort – it is a completed Q sort diagram done by a participant

Factor – it is a representation of participant who share similar viewpoints.

Defining Q sort – also known as flagged Q sorts, it is a Q sort that significantly (in this study it is a Q sort with a value above 0.35) loads onto a factor.

Z-score – it is an average of scores given by flagged Q sorts to a particular statement.

Eigenvalue – it is a sum of squared factor loading for each factor

Centroid – it is a grand average of the relationships between all Q sorts

1.7. PLAN OF THE STUDY

The study is outlined as follows:

Chapter One	Overview of the study
Chapter Two	Literature review
Chapter Three	Research design and methods
Chapter Four	Data analysis and findings
Chapter Five	Summary, discussion of findings, conclusions and recommendations

1.7. SUMMARY

This chapter has described the study overview. This has included the background, problem statement, purpose and objectives of the study. The next chapter will provide a review of the relevant literature.

CHAPTER TWO

LITERATURE REVIEW

2.1. INTRODUCTION

This literature review will focus on the CLABSI and the CLABSI prevention bundles as this is the subject of the study. It will discuss the compliance of healthcare professionals to the CLABSI bundle in terms of barriers and enablers of compliance. It will also discuss healthcare professionals' beliefs in relation to compliance with guidelines.

2.2. HEALTHCARE ASSOCIATED INFECTIONS

Healthcare associated infections (HCAI), also known as hospital acquired infection (HAI) or nosocomial infections, are infections occurring in a patient in a hospital or any other healthcare facility in whom the infection was not present or incubating at the time of admission (Giri et al., 2016). There are four types of healthcare associated infections namely; Central line associated bloodstream infections (CLABSI), Catheter associated urinary tract infections (CAUTI), Ventilator associated pneumonia (VAP) and Surgical site infections (SSI).

The burden of HCAIs is huge and in most cases lead to increased antimicrobial resistance affecting both developed and developing countries worldwide (Velasquez Reyes, Bloomer and Morphet, 2017). HCAIs can affect patients in any setting where they are receiving care. According to the World Health Organisation (WHO, 2016), 1 in every 10 patients is affected by HCAIs worldwide on average. The incidence is higher in developing countries where 15% of patients will acquire HCAI as compared to 7% in developed countries (WHO 2010; Nejad 2011). Likewise, (Raka and Osmani, 2012) and (Rothe, Schlaich and Thompson, 2013), confirmed the high burden of HCAIs, and found the prevalence rate of HCAIs to be between 25 – 30% in developing countries and 6.7 - 28% in Sub-Saharan Africa respectively. In another study, the burden was found to be higher, i.e. 31.1 per 1000 patient days at a children's hospital in South Africa as compared 9.3 per 1000 patient days in the United States America (USA) (Dramowski,

Whitelaw and Cotton, 2016). There is very scant information on the incidence in adults of HCAIs in South Africa and Africa as a whole.

HCAIs leads to prolonged hospital stays, long term disability and high costs for patients, families and hospitals (WHO, 2011). The length of a hospital stay can be prolonged by anything between 4 to 29 days (Steth et al.,2017; Velasquez Reyes, Bloomer and Morphet, 2017). Patients with HCAIs have a high mortality rate - according to Furuya et al., (2011) about 99,000 HCAI-related deaths occur per year with central line-associated bloodstream infections leading with an estimated 31,000 deaths per year.

The cost of the HCAIs are very high. In Europe the economic burden is estimated to be between €13-24 billion and in the United States of America it is estimated at US$ 6.5 billion in 2004 (WHO 2011) and a decade later it had risen to between $28 and $45 billion (Dick et al., 2015). In Africa there is very scant information on the cost implication of the HCAIs, which can be attributed to a lack of robust HCAIs surveillance systems.

Central line associated bloodstream infections is number 3 on the incidence of HCAIs, but it is the leading cause of HCAI related deaths with a mortality rate of up to 25% in South Africa (Mer 2005).

2.3. CENTRAL LINE ASSOCIATED BLOODSTREAM INFECTIONS

The Center for Disease Control and prevention (CDC), provides the definition of CLABSI for purposes of surveillance. According to the CDC, CLABSI is defined as a primary laboratory confirmed bacteremia or fungemia in a patient with a central line at the time of (or within 48-hours prior to) the onset of symptoms and the infection is not related to an infection from another site (Tang et al., 2014; CDC, 2018). A patient who presents with one of the following symptoms are considered to have a CLABSI: fever (>38°C), chills or hypotension and laboratory identified organisms in the blood not related to an infection at any site in the body (CDC, 2018). Richards et al., (2017) defined CLABSI as " a primary bloodstream infection occurring in a patient with a central line in situ or where an infection occurs within 48 hours of the removal of the central line and where no other source of bloodstream infection was identified". The key things that should be present in a patient to be diagnosed as having a CLABSI are the presence of a central line or

central venous catheter for more than 48 hours, and laboratory confirmed microorganisms not identified in another site of the body.

Approximately, 90% of central line associated bloodstream infections occur with central venous catheters (Best Care Always Campaign, 2009). Central venous catheters (CVCs) are devices or lines that are inserted into the large blood vessels that terminate close to the heart (Institute for Healthcare Improvement (IHI), 2001). These CVCs disrupt the skin, making infection with bacteria and/fungi possible. Infection may spread to the bloodstream causing sepsis which may later lead to hemodynamic changes, organ dysfunction and eventually death (Mermel, 2000). Despite the potential of CVCs causing infection, clinical practice especially caring for critically ill patients, cannot operate without these devices. CVCs are being used increasingly in the inpatients and out-patient settings to provide long term venous access, for administration of medications, high volume of fluids, blood products and parenteral feeds (Velasquez-Reyes, Bloomer and Morphet, 2017; Atilla et al., 2017; Perin et al., 2016).

CVCs are frequently used for monitoring the haemodynamic condition of critically ill patients and infusion of high volume of fluids. CLABSI usually occurs in ICUs as a complication of CVCs. However, the good news is that, according to Jones et al., (2015), CLABSI is approximately 70% preventable when CVCs are well inserted and maintained. On the other hand, CVCs are not always inserted in an antiseptic technique and they are manipulated without aseptic technique - hence the rate of CLABSI remains high.

As with HAIs generally, the worldwide incidence of CLABSI is high, though the rates are better in developed countries than in the developing countries. In the USA, the incidence is between 12-15%, while in the developing countries it is between 20-60% (Atilla et al., 2017). Contrary, this finding Rothe et al (2013), in a systematic review of literature in Sub Saharan Africa found an incidence of 6.7 – 28% which was lower than the 60% reported by Atilla et al. (2017). This difference could be that because of scarcity of data and under reporting of CLABSI in Sub-Saharan Africa. Strashein et al. (2015) recorded a prevalence of 10.1 intravenous catheter related infections per every 1000 catheter days in South Africa.

CLABSI remain among the top three hospital acquired infections with a mortality rate of up to 25% (Mer 2005; Furuya et al., 2012). According to the CDC 2014 report as cited in Steth et al (2017), one out of four patients with CLABSI will die with 30 days. Mortality related to CLABSI can be attributed to antimicrobial resistance, as most of the pathogens causing CLABSI

are increasingly becoming resistant to most of the antibiotics (Furuya et al., 2011). In addition, USA mortality is between 10% to 30% in ICU. This is due to many invasive procedures requiring use of CVCs (Perin et al., 2016). CLABSI mortality rate in the USA is higher than the mortality rate in Australia which is between 4 – 20% (Entesari-Tatafi et al., 2015). The two countries are both developed countries and have been implementing the CLABSI prevention bundle for many years which appears to have resulted in lowering of their mortality rates. South Africa which is a middle income country and is still struggling with the implementation of CLABSI prevention bundles, has a 12 – 28% mortality rate which is similar to the mortality rate in USA (Mer 2005; Lowman, 2016). However, this mortality rate in South Africa could be to underreporting and lack of proper surveillance systems (Pittet et al., 2008).

The cost of CLABSI is very high. CLABSI prolongs a patient's hospital stay thereby interfering with his/her livelihood and quality of life. Acquiring a CLABSI puts a financial burden on the patients' family in terms of transportation costs to and from the hospital to visit their relative. There is also a financial burden on the hospital as, the antimicrobials used to treat the CLABSI are very expensive. It costs between US$12 000 to US$ 54 000 to treat each CLABSI in the United States America (Armstrong et al., 2013). The cost analysis of CLABSI in Africa and South Africa has not yet been established. There is scant information with regard to cost.

2.4. CLABSI BUNDLE

The bundle concept was developed by Institute for Health Improvement (IHI) in 2001. A group of experts working in 13 hospitals met to discuss how to improve patient outcomes in ICUs. The experts studied the actions that caused great harm and high cost, through using an 'IHI ICU Adverse Event Trigger Tool' (Institute for Healthcare Improvment, 2017). Information gathered was analysed and it lead to the development of two bundles namely; a ventilator bundle and central line bundle. According to IHI (2002; 2012) a bundle is "a small set of evidence-based interventions for a defined patient segment/population and care setting that, when implemented together, will result in significantly better outcomes than when implemented individually". Additionally, IHI suggested that a bundle for a specific patient population should have five items or less, which will lead to reduced incidences of CLABSI. McAlearney et al., (2014) agrees with IHI's notion that implementation of evidence-based protocols leads to significant and sustainable

reduction of CLABSI in ICUs. Wern (2017) suggested that though CLABSI is a leading cause of death among the HCAIs, 60 – 75% of CLABSI can be prevented by implementation of evidence-based interventions bundled together. Similarly, Entesari-Tatafi (2015), after implementing a CLABSI prevention bundle, observed a decrease in CLABSI from 2.2 per 1000 central line days pre intervention to 0.5 per 1000 central line days, post intervention. They further observed a reduction in ICU days and hospital stays which lead to a saving of about $210 000. Given the above discussion it is important to use the CLABSI prevention bundle.

The IHI central line bundle comprised of hand hygiene, maximal barrier precautions, Chlorhexidine skin antisepsis, optimal catheter site selection with avoidance of the femoral vein for central venous access in adults and daily review of line necessity, with prompt removal of unnecessary lines. This IHI initiated central line bundle was adopted by Best Care Always (BCA) in 2009 and was implemented with success in private hospitals at first and then rolled out in public hospitals in 2010 (Richards et al., 2017; Kantor et al., 2011). Not much research has been done in public hospitals in South Africa to assess the success or failure of the bundles. A study was done in neonatal intensive unit on CLABSI, the authors identified risk factors that can contribute to CLABSI in neonates such as prolonged hospital stay and poor skin integrity(Geldenhuys et al., 2017). However, these authors observed that the rate of incidence of CLABSI can be reduced by implementing central line insertion and maintenance bundles.

The central line bundle has further been divided into two bundles namely insertion - and maintenance - bundles(Perin et al., 2016; Jones et al., 2015). The item hand hygiene is however found in both bundles because hand hygiene is a cornerstone for infection prevention in every nursing and medical care activity. The central line insertion bundle comprises of hand hygiene, maximal barrier precautions, chlorhexidine skin antisepsis and optimal catheter site selection. The maintenance bundle comprises of hand hygiene and daily review of central line necessity.

2.4.1 Insertion Bundle

The insertion bundle comprises of hand hygiene observing all the nine steps of hand washing and maximal barrier protection. The patient should be well covered with sterile drapes and the medical and nursing staff involved in the procedure should use full personal protective

equipment. The patient should be bathed with chlorhexidine 2 % before insertion of the central line and selection of the central line site while avoiding the femoral vein.

Hand hygiene is very important as it removes microorganisms from hands which can contaminate the CVC insertion site and the CVC itself. There are five moments of hand hygiene as described by WHO (White et al., 2015; Sax et al., 2007). However, IHI modified these moments to suit the CLABSI prevention. Hand hygiene moments for CLABSI prevention are: Before and after palpating the catheter insertion site; before and after inserting, replacing, accessing, repairing or dressing a catheter; when hands are visibly soiled or contamination is suspected; before and after invasive procedures; between patients; before donning and doffing of the gloves and after using the bathroom.

Maximal barrier precautions ensure that skin microorganisms do not transfer from the healthcare professionals to the site of CVC insertion and also prevents the patient from his own skin normal flora from gaining access into the blood stream through the CVC insertion site. Maximal barrier precautions involve wearing a cap, mask, sterile gown and full body drape for the patient, use of sterile gloves. Studies have shown that non-compliance to maximal barrier precautions leads to increased rate of CLABSI (Lee et al., 2018; Valencia et al., 2016). This supports the findings by a study done by Tang et al (2014) which observed that compliance with maximal barrier precautions especially the sterile drape lead to decreased rates of CLABSI. Nurses should be empowered to use the checklist for maximal barrier precautions and be able to stop the procedure if some of the items are not observed by the doctors or anaesthetists. Not only should nurses be empowered, but management should also make the resources for maximal barrier precautions available and easily accessible to promote compliance.

Skin asepsis is one of the bundle elements. It should be done to get rid of the patient's normal skin flora which can become harmful once it enters the blood stream. The skin should be prepared by cleaning it with Chlorhexidine 2% in 70% isopropyl alcohol. Once applied to the skin, Chlorhexidine 2% should be allowed to dry before puncturing the skin. It should be used in all patients with an exception to those patients who are allergic to chlorhexidine. Alternatively, alcohol based povidone can also be used in the absence of chlorhexidine, because it was observed in systematic reviews, that there was no difference between using Chlorhexidine 2% or alcohol based povidone for skin asepsis in the prevention of CLABSI (Velasquez Reyes,

Bloomer and Morphet, 2017; Atilla et al., 2016; Perin et al., 2016). It is therefore important that skin asepsis is observed to prevent CLABSI.

Optimal catheter site selection is a bundle which aims to choose the CVC site very carefully while avoiding the femoral vein whenever possible. The femoral vein as a site of CVC is thought to be a high risk for CLABSI due to the moisture in the inguinal region which provides a conducive environment for microorganism growth. Tang et al (2014), however, observed that there is no difference in CLABSI rates due to catheter site selection provided the other four elements of the CLABSI are followed and complied to. Other authors (Lee et al., 2018; Atilla et al., 2016), however, found the risk of CLABSI to be high when a catheter is inserted in the femoral vein in obese patients and have recommended that such sites should be avoided in obese patients. Similarly, in a systematic review by Rosenthal et al., (2013), it was observed that using the femoral vein as a site for CVC caused 9% of CLABSI and this is in agreement with those studies that suggested that the femoral vein must be avoided as an insertion site for the CVCs.

2.4.2 Maintenance Bundle

The maintenance bundle comprises daily checking for the need for a central line, and using dry dressings for the central line site. The central line ports should also be used sparingly after appropriate aseptic technique. The maintenance bundle recommends that intravenous lines used for giving blood/blood products should be changed immediately and those used for drugs and other clear fluids should be changed after every 48 hours.

Daily review of the CVC is important as it can lead to early recognition of unnecessary CVCs and identify CVCs that have been in-situ for a long time. The risk of CLABSI increases with a long stay of the CVC that is why it is important to review the necessity of the catheter on a daily basis. According to Velasquez-Reyez et al. (2017), the risk of developing a CLABSI increases after the CVC has been in-situ for 8 days and hence recommended that the CVC should be removed before day 7 or it should be re-sited if it is still required. Other authors agree with this finding, as they also observed that the risk for CLABSI increases after use of CVCs for more than 8 days (Atilla et al., 2017; Lin et al., 2017). Routine replacement of a catheter has no impact on the reduction of CLABSI, hence it is no longer recommended that the catheter be routinely

changed (O'Grady et al., 2011). Strategies should be put in place to help nurses and doctors review the CVC site daily.

Initiatives such as a reminder card for a central line, indicating the presence of central line on the medication chart and having a checklist (Jones et al., 2015) are recommended. These initiatives assist in promoting catheter site inspection, which includes checking the need of the CVC on that particular day, the dressing whether soiled or not, redness and warmth around the catheter insertion site as this would indicate a sign of inflammation. In fact, catheter site inspection is very important as observed in a study done by Rosenthal et al. (2013), where the risk of CLABSI was between 12 -32% due lack of CVC site inspection from a pool of studies done in developing countries. Similarly, Melville and Paulus (2014), observed that the CLABSI rates remained poor even after implementation of the other elements of the maintenance bundle due to non-adherence to catheter site inspection in oncology patients. However, the CLABSI rates could also have been affected by the immunosuppression state in oncology patients which makes them susceptible to infection CLABSI inclusive.

Dressing technique is important because microorganisms can colonise the dressing such that when changing the dressings these microorganisms can easily gain access into the blood stream and cause infection. Dressing changes should be minimised as that can also serve as a port of entry for microorganisms (Velasquez-Reyes, Bloomer and Morphet, 2017). Hence, the choice of the type of dressing used for the CVC site is important. Perin et al., (2016) showed in their review that the use of a chlorhexidine impregnated dressing contributed to lower CLABSI rates i.e. 1.51 per 1000 catheter days compared to normal dressing at 5.87 per 1000 catheter days.

Catheter ports access should be adequately disinfected with chlorhexidine 2% before been accessed for medication administration or blood sample collection and after each and every access to the port (Atilla et al., 2016; Perin et al., 2016). Access to CVC port should be restricted, used only when it is very necessary. Frequent access to the CVC using 3-way stopcock was found to be a risk associated with about 88 – 94% of CLABSI (Rosenthal et al., 2013).

Replacement of administration tubing sets should be done every 48 hours if they were used for administering clear, non-viscosity fluids and immediately after use, if used to administer blood or blood products (Jones, Stewart and Roszell, 2015b; Melville and Paulus, 2014). The replacement of giving sets should be done under aseptic technique, as it is also one entry point

for microorganisms which can cause CLABSI. For instance, in a systematic review by Rosenthal et al., (2013), the risk for CLABSI from replacement of giving sets was 18-50%. This risk is very high hence the need for employing antiseptic techniques when replacing giving sets.

2.5. CLABSI BUNDLE UTILIZATION

The CLABSI bundle, when used appropriately, has been found to prevent CLABSI and in some cases has lowered the CLABSI rate to zero as seen in a study done by Richards, et al., (2017), in South African private hospital group. In their 3 year study they recorded some months of zero CLABSI after initiating the CLABSI bundle and this also reduced the costs on the part of the hospital. However, for the bundle to reduce CLABSI, all the elements have to be followed. It is "all or nothing bundle" (IHI, 2012), hence if one element scores zero during a compliance checklist, then the compliance rate is scored as zero compliance. On the contrary, Furuya et al (2016) argued, that even compliance with one or two elements of the bundle reduced CLABSI rates. However, many studies (Arvaniti, 2017; Atilla et al., 2016; Gonzales et al., 2013) agree with IHI, that it is only when all the elements of the bundle are followed that low rates of CLABSI and, in some cases, a zero rate of CLABSI can be reached.

2.5.1. Factors that promote compliance

In many studies done on healthcare professionals compliance to infection control guidelines, some factors that promote and hinder compliance were identified (Powers et al., 2016; Cheung et al., 2015; Gurses et al., 2010; Stein, Makarawo and Ahmad, 2003).

Low nurse- patient ratios can improve CLABSI rates, since if there are enough nurses to care for the patients the chances of complying with all bundle elements are very high (Lee et al. 2018). Another element that influences compliance is availability of resources. When materials needed to perform nursing care for a patient using infection control protocols are present, it becomes easier for the nurses to comply with the protocols.

Training such as monthly seminars as observed by Velasquez et al. (2017) were also associated with reduced rates of CLABSI. Similarly, Atilla et al., (2016) observed that training sessions on

antiseptic technique, catheter insertion procedure and maintenance of the CVCs lead healthcare professionals to be compliant with the CLABSI bundle. For training to have an impact, healthcare professionals should be trained by a qualified infection prevention and control practitioner (IPCP) (Geldenhuys et al., 2017). The availability of IPCPs in hospitals is very important as they have been observed to be one of the key promoters of compliance with the CLABSI bundle (Furuya et al., 2016a). IPCPs can conduct training session on various topics in relation to infection control, they can conduct surveillance and produce monthly reports on the CLABSI rates. Reporting CLABSI rates was found to contribute positively to compliance with the CLABSI prevention bundle (Velasquez Reyes, Bloomer and Morphet, 2017). Since everyone wants to see improvement with care given, if the last reported CLABSI rates were bad, it will lead to compliance with the bundle elements in order to improve the rates in the next report.

Quality improvement projects can also help reduce CLABSI rates (Velasquez et al., 2017; Jones et al., 2015; Armstrong et al., 2013). For example, this was illustrated in two quality improvement projects namely the John Hopkins hospital project and the Keystone ICU project, which reduced the CLABSI rate from 11.3 per 1000 catheter days to 0 per 1000 catheter days and 7.7 per 1000 catheter days to 1.4 per 1000 catheter days respectively (Armstrong et al., 2013). In addition, the John Hopkins hospital project saved US$1.9 million dollars. The success of the Keystone ICU project was however, also attributed to commitment towards the project from healthcare professionals. Involving the multidisciplinary team in infection control programmes was also observed to be a promoter of compliance with the CLABSI prevention bundle among all the different healthcare professionals (Furuya et al.,2012; Tang et al.,2014).

All the factors that promote healthcare professionals' compliance with infection control practices and in this case CLABSI prevention bundle depend on support from management team. The management team has authority to employ IPCPs and more nurses to reduce workload. They also have authority over procurement of resources to ensure availability of resources which leads to compliance. Given the above, support from the management team is a huge promotor of healthcare professionals' compliance with infection control practices. On the other hand, there are challenges that management teams in most of the Sub Saharan countries have such as lack of funding from government which has led to procurement of cheap not durable supplies and freezing of employment. Sometimes funding is made available but it is directed to other

commitments such as pay offs for legal cases and administrative needs instead of patient care needs.

2.5.2. Factors that hinder compliance

The factors that were observed to hinder compliance with the CLABSI prevention bundle were work overload, understaffing, lack of resources and overcrowding as indicated in a study done in Ghana (Ocran and Tagoe, 2014). Additionally, nurses reported that work overload and understaffing prevented them from following hand hygiene properly. Lack of resources and poor management support was one of the barriers to compliance identified by the healthcare professionals (Cheung et al., 2015). According to the healthcare professionals, management team should make resources available for the CLABSI prevention bundle to encourage compliance. However, this may be possible in private hospitals, in public hospitals management's authority to provide resources is usually rendered null and void due to unavailability of funds.

Lack of training was also one of the barriers that was identified in the studies done on the factors that hinder compliance with infection control practices (Martel et al., 2013; Stein et al, 2003). In support, having policies and guidelines about CLABSI prevention does not bring about reduced rates of CLABSI, but healthcare workers should be trained on the policies and guidelines (Furuya et al., 2016b). This highlights that the absence of the infection prevention and control practitioner (IPCP) is also a barrier, because the IPCP would conduct trainings and do reminder checks for the nurses which would in turn increase compliance to the bundle.

Group conformity was found to be a barrier to compliance, in a way that some nurses felt out of place if only they adhered to infection prevention and control protocols (Cheung et al., 2015). Teamwork is therefore a very important contributor to compliance.

2.5.3. Healthcare workers' beliefs and compliance to guidelines

Healthcare professionals' beliefs can promote compliance but also contribute to non-compliance to infection control practices and health related guidelines. In a study done by Callaghan, (1999), he found that a positive relationship between health beliefs and health related behaviour. In his

study, nurses who rated smoking as an important health risk behaviour to be avoid, were also found to be non-smokers, their desire not to smoke was influenced by their belief that smoking is hazardous to health. In most cases what nurses believe to be important is what they do and advise their patients to do (Price, 2015). White et al., (2015), described such behaviour to be driven by 'behavioural beliefs'. A nurse will perform activities that she/he believes will protect the patient and safe protection, hence, if the nurse believes that certain guidelines will protect a patient and herself from harm, she is likely to comply to guidelines.

In one study, healthcare professionals' compliance to a care bundle was influenced by the way they perceived the severity of the disease or infection (Chor et al., 2012). It was observed that, those healthcare workers who believed that H1N1 influenza virus to be very infectious were able to follow H1N1 prevention guidelines. In addition, these findings are in line with the Health Belief Model, which suggests that personal belief or perceptions or action towards a disease or infection are affected by the perceived seriousness of the disease (Jackson, Lowton, Griffiths., 2013: Turner et al, 2004). Similarly, Martel, et al., (2013), observed that 91% of healthcare professionals would recommend any patient with a cough and fever to wear a mask because they believed that a mask is a preventive measure against infectious respiratory conditions. HCWs compliance to guidelines can be influenced by perceived risk and the perceived benefit of the guidelines. If the HCWs believe that the guidelines will prevent the perceived risks, then they are likely to comply (Jackson, et al 2013).

Sax, et al., (2007) discussed 'outcome beliefs' and 'control beliefs' as some of the beliefs that influences HCWs to comply with guidelines. Outcome beliefs are those beliefs that an individual HCW has about a particular action having positive outcomes for instance, a nurse who believes that hand hygiene will bring about reduced rates of HCAIs is likely to perform hand hygiene. Control beliefs are beliefs that HCWs have of feeling being in control of the activity been performed, these beliefs come as a result of being trained properly about the guidelines. For example, a nurse will do something if she believes that she is competent in and has the necessary resources to do so (White, et al., 2015).

Normative beliefs can influence compliance among HCWs to guidelines, these beliefs are learnt from colleagues, supervisors and management supports and makes one behave in a way that is socially accepted by the group (White, et al., 2015). Normative beliefs can promote compliance

but can also hinder compliance, for example, if the leader is complying with the guidelines everyone will follow, and if he/she does not comply then everyone will follow.

However, healthcare professionals' beliefs can be detrimental, as observed, in a study done by Stein et al (2003). The doctors believed that recapping needles would prevent needle stick injuries, when it actually caused more needle stick injuries. The doctors' belief in the Stein study made them not to be compliant with the infection guideline that requires needles not to be recapped. Similarly, if the healthcare professional does not believe that a guideline will prevent the disease, that person is likely not to comply with that particular guideline (Gurses et al., 2010).

There is dearth of information on how the opinions of nurses on the importance of the CLABSI prevention bundle would influence the utilization of the CLABSI bundle.

2.6. SUMMARY

This chapter has covered some of the information that exists on the subject of CLABSI and CLABSI prevention bundle. There was brief information on the burden and cost of HCAIs and CLABSI. There was a full description and discussion of the CLABSI prevention bundle, healthcare professionals' compliance to the bundle. The chapter closed with a brief discussion on how healthcare professionals' beliefs can influence compliance. The next chapter will describe the methodology used in this study.

CHAPTER THREE

RESEARCH DESIGN AND METHODS

3.1. INTRODUCTION

Research design is a step by step description of how the research study was conducted. It gives an outline of how data was collected, measured, analysed and interpreted (Polit and Beck 2012: Creswell 2007). A descriptive research design using Q methodology was used for this study. This chapter will describe the steps taken during this study, the research design used and will explain why it was chosen. The Q methodology research approach will be described step by step since it is a fairly new method in nursing research. This chapter will cover how data was collected, the validation process, how data analysis was done and the ethical considerations taken into account.

3.2. RESEARCH DESIGN

The Q methodology research approach was developed by Stevenson around the 1930s. Stone et al., (2016) described Q methodology as "an exploratory, interpretation- intensive methodology suitable for small population of respondents". Q methodology is a combination of both qualitative and quantitative research approaches to study subjectivity(Paige, 2015). Subjectivity is an individual's communication of his point of view on any matter of personal or social importance (Sklarwitz, 2017).

Q methodology has five steps namely the development of a concourse, Q set of statements, P set, Q sort and factor analysis (Ha, 2018). Concourse is a group of statements that is gathered from literature, media, or interviews (Pagnussatt et al., 2018; Ha, 2018; Sklarwitz, 2017; Paige, 2015). The Q set is taken from the concourse after removing repeated statements and input from experts. The P set is the sample of the participants that will take part in the study and it can be a small sample size because Q methodology is interested in views or opinions and not numbers(Work, Hensel and Decker, 2015). Q sort is the ranking of the statements by the participants according to their opinions. Factor analysis is the analysis of the Q sorts to be able to

interpret the views by checking for similarities or differences between individuals, since, in Q methodology participants are variables. Concourse development and Q set are part of the qualitative phase while P set, Q sort and factor analysis are in the quantitative phase in Q methodology (Ha, 2018).

Q methodology is a good approach to study individual subjective opinions (Work, Hensel and Decker, 2015; Paige, 2014). Since Q methodology combines both qualitative and quantitative research approaches it provides an excellent way to study opinions in health sciences (Work, Hensel and Decker, 2015). The advantage of Q methodology over the traditional qualitative research methodology is that it studies the individual opinions while removing the researchers' subjectivity (Du Plessis 2005). This research design was chosen due to the fact that this study was studying the subjective opinion of nurses in ICU on the importance and utilization of the CLABSI prevention bundle. The design also has an advantage over the use of Likert scale since the participants are forced to make a choice when ranking the statements instead of just picking things that will put them in the positive light with the researcher i.e. it reduces social desirability bias.

3.3. RESEARCH SETTING

This study was done at an academic hospital in Gauteng. The hospital mainly provides specialist care and treatment. It has five intensive care units namely; general ICU, paediatric ICU, trauma ICU, Cardiothoracic ICU and Neonatal ICU. This study was done in the general ICU which has a bed capacity of 12 beds.

The use of care bundles was introduced at this hospital in 2010. This was part of the "Best Care Always" campaign. It introduced bundles one for each healthcare associated infection. Non utilization and noncompliance lead the hospital infection control unit to repeat training of nurses on the uses of bundles in ICUs in 2017. The findings of the infection control unit included that the nurses thought that the bundles are about ticking the checklist and not in following and utilizing the bundle elements to reduce HCAIs especially the CLABSI.

3.4. POPULATION AND SAMPLE

Population is an entire group of individuals with similar characteristics that the researcher is interested in (Polit and Beck 2012). The accessible study population consisted of nurses working in the general ICU. A total sample of 42 nurses working in general ICU were invited to participate in the study. When using Q sort technique, significant opinions can be obtained with small number of participants with a diverse knowledge and experience (Hensel and Change, 2017; Zabala 2014; Du Plessis 2005).

The study included professional nurses registered with the South African Nursing Council who had worked for not less than six months in general ICU. Nursing auxiliaries and nursing students were not invited to participant in this study. Nurses who did a free Q sort instead of the forced Q sort were also excluded from the study.

3.5. DATA COLLECTION

3.5.1 Concourse Development

The information on the central line bundle found on the Center for Disease Control (CDC), Institute for Healthcare Improvement (IHI) and Best Care Always websites was used to formulate the concourse. There were 40 statements in the concourse then after removing statements with similar meaning and consulting with experts, 30 statements come up as the final Q set. These statements were evidence based practice facts about the prevention of the CLABSI, that the researcher wanted to get the opinions of the nurses in ICU about them (statements).

3.5.2. Q Set

The 30 statements were printed on small cards and numbers were printed on the back of the cards for use when analysing the data. This number of statements was enough for an acceptable range for Q sort which starts from a dozen upwards and it could be sorted out on a normal distribution curve (Sklarwitz 2017: Cross, 2005). Since the statements need to be compared

against each other, 30 statements were manageable for nurses to sort out considering their busy schedules.

3.5.3. P Set

The number of participants was determined using intensive person sample. Intensive person sample is used when participants are required to sort cards under many conditions of instruction (du Plessis, 2005). It is suggested that when employing intensive person sample views can be gathered from one to thirty participants (du Plessis 2005; Cross 2005).

According to du Plessis (2005), a "condition of instruction is a guide to an individual for sorting the Q sort cards from his/her point of view". This study had two conditions of instructions, hence, thirty participants were considered to be significant.

3.5.4. Q Sort

Forced Q sort was used when collecting data. Forced Q sort is when the participants are asked to rank statements against each other on a normal distribution curve. According to Sklarwitz (2017), forced Q sort helps to reduce bias from survey as it brings individual beliefs and experiences into the ranking process. Each participant was allowed to place a specific number of Q cards under the distribution markers.

Participants were given a set of 30 Q cards which had statements (appendix 1) printed on the other side and numbers on the other side. It was explained to the participants that the numbers on the back of the cards were not significant in any way, as they were to be used for data entry only by the researcher. The first condition of instruction was, 'how important are the statements to you with regards to the CLABSI bundle?' The Q diagram with 30 blocks in form of a normal distribution curve was provided with ranges from -3 to 3, where -3 was least important and 3 was important (appendix 1). The participants were advised to first sort the cards into three piles, under the first condition of instruction into 'most important', 'neutral' and 'less important', then later place them on the Q diagram.

The second condition of instruction was, ‘how often do the nurses in ICU use or implement this statement?’ The Q deck was provided with ranges from -3 to 3, where -3 was never and 3 was always (appendix 1). Under the second condition of instruction the participants were asked to sort the cards into three piles; ‘always’, ‘sometimes’ and ‘never’, then place the cards on the Q diagram.

A picture of a completed Q sort was captured by photographing it, both the statements and the numbers side (figure 3.1 and figure 3.2) and it was immediately transcribed on the paper with a Q diagram on it.

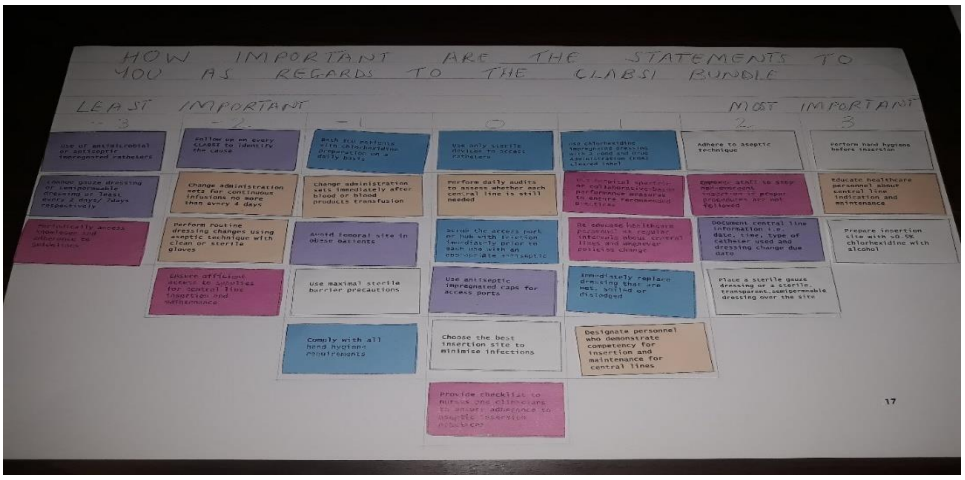

Figure 3.1 - Completed Q sort diagram with statement side

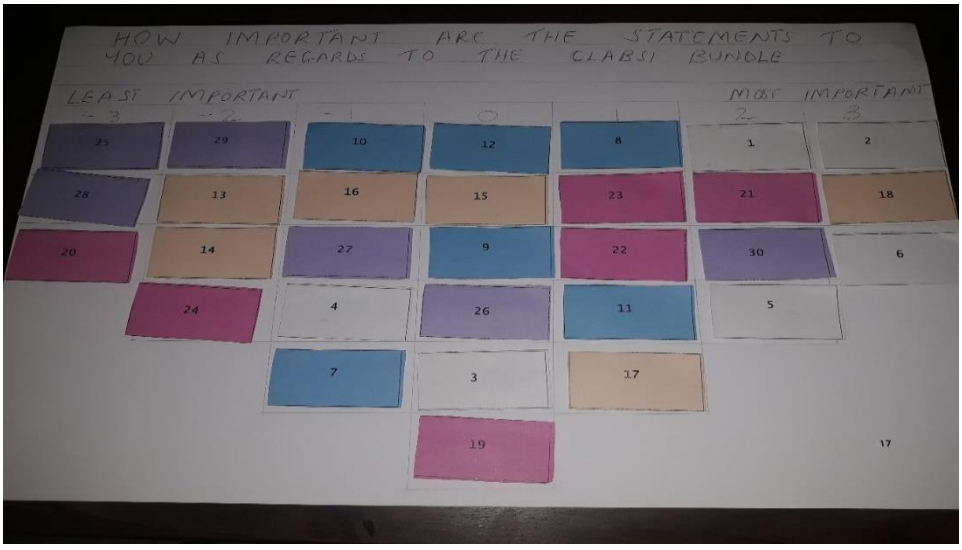

Figure 3.2 – Completed Q sort diagram with numbers side

Verbal comments uttered by some of the participants were captured as field notes and written down on the participant's paper used for transcribing the Q sort diagram. These comments will be highlighted in the findings chapter later in this report.

3.6. VALIDITY AND RELIABILITY OF THE INSTRUMENT

Validity is determining whether the study is measuring what it is intended to measure (du Plooy-Cilliers 2014; Burns 2013). The Q set was derived from the mainly from the CDC recommendation for central line bundle for the prevention of the central line associated bloodstream infections (CLABSI) for content validity. Construct validity was addressed through pretesting the Q set using three nurses from cardiothoracic ICU, who were not part of the study, to identify any problems with the statements and to check on the sorting completion time. Data collection took 15 to 20 minutes during the pre-test. The instrument was well understood by the participants, although 1 participant despite having the procedure explained to her, carried out a free Q sort instead of a forced Q sort of the cards. The pre-test results were discussed with the experts, before data collection in the main study commenced.

The Q sort technique has been used in many studies measuring peoples' opinions. The Q sort technique uses a test retest (consistency of yielding the same result if it is administered to the same person on different times) such that administering the instrument to an individual on different occasion yields a correctional coefficient of 0.8 or higher (Watts and Stenner, 2012). Hence using Q sort technique was a reliable tool for this study. To enhance reliability of the results, the same instructions were given to the participants and were visible to them throughout the ranking process. The participants had a chance to sort the cards without disturbances and make changes where they felt it necessary throughout the ranking process.

3.7. DATA ANALYSIS

Data analysis was done in order to make sense of the data by interpreting the completed Q sorts (Polit and Beck, 2012). This was done through Q factor analysis using a statistical program known as PQ Method version 2.35 which is available free of charge from

http://schmolck.org/qmethod. This is the recommended method of analysing data in Q methodology (Simons 2017: Watts and Stenner, 2012). Instead of the traditional factor analysis, this is a person by person factor analysis. There are usually fewer factors than the number of the completed Q sorts because participants load onto factors, and for this reason, factor analysis is also known as a data reduction method (Watts and Stenner, 2012). Participants with similar Q sort grid are indicative of similar perspectives to form a factor (Kelly and Young, 2017). Each completed Q sort was entered in the PQ Method, a statistical program recommended for Q methodology (Simons 2017).

Data was analysed through the following steps as done in Q methodology; correlation matrix, factor extraction, factor rotation and factor interpretation (Paige, 2015; Cochran, 2013). The thirty (30) completed Q sorts for the first condition of instruction 'how important are the statements to you as regards to the CLABSI bundle?' were entered in the PQ Method version 2.35 and Q factor analysis was done. Following this, the completed 30 Q sorts for the second condition of instruction 'how often do the nurses in ICU use or implement this statement?' was entered in PQ Method and Q factor analysis was done. The PQ method has steps which are followed to analyse the Q sorts.

The Q set statements were entered in the PQ Method program (appendix 1). This was done so that the program should be able to analyse the data set in the final step.

The Q sort grid was entered the way it was designed and used by the participants (appendix 1). Then all the 30 completed Q sorts (see figure below of a completed Q sort grid) were entered one by one. Identifying details for each participant was created before the completed Q sort was entered.

3.7.1. Correlation Matrix

The correlation matrix reflects the nature and extent of the relationships that are among the Q sorts in a data set (Watts and Stenner, 2012). In other words, correlation measures the degree of differences or similarity between different Q sorts. A correlation matrix is of less interest in Q methodology, it is only a step where data must pass in order to run factor extraction (Watts and

Stenner, 2012). After entering the Q sorts, a correlation matrix was generated by the PQ method software.

3.7.2. Factor Extraction

A correlation matrix is used to extract factors. Q sorts which highly correlated to each other load on a factor. A factor represents a resemblance or shared meaning among the highly correlated Q sorters (Watts and Stenner, 2012). There are two methods of factor extraction, namely, centroid and principal component analysis (PCA). In this study the researcher used centroid factor analysis, a centroid is a grand average of the relationships between all Q sorts (du Plessis, 2005). Centroid method of factor extraction is highly recommended in Q methodology as it maximizes the total number of loadings both positive and negative z-scores (Watts and Stenner, 2012).

3.7.3. Factor Rotation

Factor rotation is a way of ensuring that each factor is giving the best possible point on which to view our subject matter (Watts and Stenner, 2012). There are two methods of factor rotation, hand rotation and varimax rotation. The researcher chose to use varimax rotation because it maximizes the amount of variance in each factor and it is easy to interpret the factors. Factor extraction leads to factor scores and correlation co-efficients. Factor scores determine how highly a participant or sorter correlates with the factor. Participants with high correlation with a factor were flagged with a letter X against them (table 4.4 and table 4.5).

3.7.4. Factor Interpretation

Factor interpretation is the final step in factor analysis. Interpretation was done using tables displaying the flagged participants, statements' extreme rankings for both top and bottom statements with a z-score >1 for each factor. Tables were also drawn showing distinguishing statements and consensus statements between factors with a P value< 0.05 and $P< 0.01$. Other tables will compare the findings between the two conditions of instructions for this study. This

was done manually to check for the relationship between the nurses' opinions of importance and utilization of the CLABSI prevention bundle.

The results of the Q factor analysis for both conditions of instruction were then analysed manually to check for similarities and differences. This was done manually because the PQ Method statistical program does not analyse different condition of instructions at the same time.

3.8. ETHICAL CONSIDERATIONS

Ethical considerations of a research study refer to the steps that the researcher undertook to protect human participants from harm and to respect their rights, privacy and confidentiality (Guillemin and Gillam, 2004). The research study followed the Health Professions Council of South Africa general ethical guidelines (HPCSA, 2008).

The study obtained ethical clearance from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Ethics Clearance Certificate Number M180282 (appendix 4). The study also was approved to use the site for data collection by the Gauteng Department of Health and the hospital management (appendix 5).

Numbers were used instead of names of the participants to ensure confidentiality and anonymity. Participation in the study was voluntary and the participants were given an information sheet (appendix 2) to read and keep a copy and an informed consent (appendix 3) to sign.

3.9. SUMMARY

This chapter has described the research design and methods used for the study. It has described the Q methodology approach used, how data was collected, analysed and the ethical considerations followed. The next chapter will cover the interpretation of the findings of the study.

CHAPTER FOUR

FINDINGS INTERPRETATION AND DISCUSSION

4.1. INTRODUCTION

This chapter will describe the findings from the study. The presentation of the demographic details of the participants is described and an explanation of how they loaded onto factors. Following this, factor extraction will be presented using tables and an explanation of how they were extracted. The factors will then be presented in tabular form with statements with a z-score of greater than 1. The study had two conditions of instruction, namely, 'how important are the statements to you as regards the CLABSI bundle?' and 'how often do the nurses in ICU use or implement this statement?' The results for both conditions had three factors each, the results will be presented in pairs: factor 1 for importance followed by factor 1 for utilization and so on. The chapter will conclude with interpretation of the findings and discussion.

4.2. DEMOGRAPHICS OF THE PARTICIPANTS

The participants in the study were nurses in the general intensive care unit (ICU). Forty-two (42) nurses were invited to participate in the study and only 30 completed the sorting, representing a 71.4% response rate. The specifics of the participant demographics are presented in the table below.

Table 4.1: Participants' demographics

	Number (n=30)	**Percentage**
Gender		
Male	5	16.7%
Female	25	83.3%
Age range		
20 – 29	3	10%
30 – 39	11	36.7%
40 – 49	10	33.3%
50 – 59	5	16.7%
> 60	1	3.3%
Education		
Degree	4	13.3%

Diploma	26	86.7%
ICU training		
Yes	13	43.3%
No	17	56.7%
CLABSI training		
Yes	17	56.7%
No	13	43.3%

The findings presented in Table 4.1 above are based on the realized sample of 30 nurses who participated in the study. The majority (83.3%) of the nurses in ICU are female with only 16.7% being male nurses. The majority of the nurses (70%) are between the ages 30 and 49 years. It can be observed from the above table that most of the nurses (86.7%) are educated up to diploma level in nursing with less than half 43.3% having formal Intensive Care Nursing. Interestingly, 56.7% of the nurses were trained on CLABSI which was one of the topics included in the Best Care always in service training package.

Table 4.2: Participants' demographics and loadings on factors (**Importance**)

Variable	**Factor 1 (n = 14)**	**Factor 2 (n = 6)**	**Factor 3 (n = 5)**
Eigenvalue (variance %)	5.9870 (19)	1.8600 (8)	2.3720 (7)
Gender			
Male	2	2	0
Female	12	4	5
Age range			
20 – 29	1	0	1
30 – 39	4	2	2
40 – 49	6	4	1
50 – 59	3	0	0
> 60	0	0	1
Education			
Degree	2	2	1
Diploma	12	4	4
ICU training			
Yes	9	2	1
No	5	4	4
CLABSI training			
Yes	9	3	3
No	5	3	2
Loading participants	1, 2, 3, 6, 9, 11, 14, 16, 18, 20, 21, 23, 28, 29	5, 7, 12, 15, 17, 22	4, 10, 13, 26, 27

Table 4.3: Participants' demographics and loadings on factors (**Utilization**)

Variable	**Factor 1 (n = 8)**	**Factor 2 (n = 4)**	**Factor 3 (n = 7)**
Eigenvalue (variance %)	5.6634 (19)	2.0032 (7)	2.0954 (7)
Gender			
Male	1	1	0
Female	7	3	7
Age range			
20 – 29	0	0	2
30 – 39	2	1	4
40 – 49	5	2	0
50 – 59	1	0	1
> 60	0	1	0
Education			
Degree	1	1	1
Diploma	7	3	6
ICU training			
Yes	5	1	2
No	2	3	5
CLABSI training			
Yes	5	1	2
No	2	3	5
Loading participants	1, 2, 6, 10, 14, 17, 20, 24	8, 12, 15, 26	4, 9, 16, 19, 27, 29, 30

Tables 4.2 and 4.3 are showing the traits (age, level of education, ICU training and CLABSI training) of the participants who loaded on which factor. This information will be referred to when interpreting and discussing the factors.

4.3. FACTOR EXTRACTION

In Q methodology, data is analyzed through a process known Q factor analysis, using software known as PQ Method 2.35, which is freely accessible on the internet. This analysis was done through the following steps; factor extraction, factors scores, factor arrays, distinguishing and consensus statements. Interpretation will be done together with the findings.

A factor in Q methodology is a group of persons/participants with similar viewpoints as revealed in their completed Q sorts. A factor was generated by the PQ method software based on persons or participants who have completed their Q sorts in a similar way, hence revealing a certain view of thinking.

PQ Method 2.35 can pull out factors from the q sorts that have been entered into it. Centroid Factor analysis was used to extract these factors. The PQ Method can extract a maximum of 8

factors, but in my study the PQ Method software gave an option of 3 factors to be extracted and these were extracted. Factor extraction is based on the eigenvalue of that factor, only factors with an eigenvalue of >1 are taken to be significant. Eigenvalue is "a sum of squared factor loadings for each factor while the percentage of total variance is the eigenvalue divided by the variates in the matrix" (du Plessis, 2005). The factor eigenvalues and percentage of variance are included in the tables (tables 1 and 3) showing the factor loadings and the flagged Q sorts. Varimax rotation was used to flag the highest loading Q sorts on to factors. Varimax rotation was done to understand the majority of viewpoints and it maximizes the amount of study variance and minimizes subjectivity because it is based on statistics (Watts and Stenner, 2012; Zabala, 2014).

Table 4.4: Factor loadings for the nurses' opinions on the **importance** of CLABSI Prevention bundle with X indicating a defining sort

Participant	**Factor 1**	**Factor 2**	**Factor 3**
1 F33118	**0.6587X**	0.0243	0.2679
2 F331215	**0.5239X**	0.0323	0.1300
3 F33215	**-0.6262X**	0.2716	0.1047
4 F23214	-0.0458	0.0901	**-0.4737X**
5 F23211	0.2951	**0.5011X**	0.1218
6 F23112	**0.3790X**	0.2867	-0.2156
7 M32115	0.2231	**0.4965X**	0.1083
9 F431115	**0.5248X**	0.2031	0.2655
10 F33224	0.2289	0.0330	**0.4263X**
11 F23226	**0.5392X**	-0.0252	-0.0833
12 F33225	-0.1981	**0.3952X**	0.3291
13 F23217	-0.0147	0.3991	**0.6651X**
14 F421129	**0.7469X**	-0.0123	0.0424
15 F22222	0.4185	**0.5021X**	-0.1390
16 F231210	**0.5655X**	-0.0389	-0.1349
18 F431215	**0.6112X**	0.3117	-0.0187
19 F23219	0.2271	**0.3982X**	-0.0319
20 F33212	**0.4667X**	-0.1002	0.0536
21 M23218	**0.7808X**	-0.0957	-0.2293
22 M33129	0.1278	**0.4855X**	0.0545
23 F431217	**0.5431X**	0.3485	-0.3430
26 F531116	-0.0659	0.0137	**0.3608X**
27 F12221	0.0787	0.1524	**-0.4159X**
28 F43119	**0.4504X**	0.3410	-0.0288
29 F13218	**0.5282X**	0.1771	0.2595
Eigen values	**5.9870**	**1.8600**	**2.3720**
% expl.Var.	**19**	**8**	**7**

Key to participant information for Tables 4.4 and 4.5

Number = Participant study number, F = Female, M= Male,

First digit = Age range in years (1 = 20 -29, 2 =30 -39, 3 = 40 -49, 4 = 50 -59, 5 = >60)

Second digit = Level of education (1 = Masters, 2 = Degree, 3 = Diploma)

Third digit = ICU training (1 = Yes, 2 = No)

Fourth digit = Training on CLABSI prevention bundle (1 = Yes, 2 = No)

Table 4.4, shows that 25 participants (83.3%) loaded on a factor while 5participants (16.7%) did not load on any factor. Out of the participants that loaded onto factors, more than half (56%) of the participants had similar viewpoints and loaded onto factor 1, followed by factor 2 with 24% of participants loading on it and then factor three with 20% of the participants.

A significant factor should have at least two participants load on it and as can be construed from table 4.4 above, all the three factors have more than two participants. The values used for factor loading was a number, both positive and negative, above 0.35.

Table 4.5: Factor loadings for the nurses' opinions on the **utilization** of CLABSI Prevention bundle with X indicating a defining sort

Participant	**Factor 1**	**Factor 2**	**Factor 3**
1 F33118	**0.5138X**	0.0041	0.2742
2 F331215	**0.5694X**	0.0487	0.1150
4 F23214	-0.0445	0.0776	**0.4266X**
6 F23112	**0.5814X**	-0.1491	0.4000
8 M33225	0.1415	**0.4697X**	-0.1684
9 F431115	0.0410	0.1337	**0.8921X**
10 F33224	**0.4764X**	0.0535	0.1745
12 F33225	0.2918	**0.5536X**	0.3226
14 F421129	**0.7504X**	-0.0637	-0.1690
15 F22222	0.3415	**0.4277X**	0.1480
16 F231210	0.4693	0.0661	**0.5086X**
17 M23126	**0.5062X**	0.4559	0.0661
19 F23219	0.4405	0.1431	**0.5269X**
20 F33212	**0.5410X**	-0.1585	0.2438
24 F33215	**0.5816X**	-0.0874	-0.0304
26 F531116	-0.0100	**0.7242X**	-0.0636
27 F12221	0.2757	0.1105	**0.5154X**
29 F13218	0.1317	-0.0195	**0.7143X**
30 F23217	-0.0114	0.2582	**0.5833X**
Eigen values	**5.6634**	**2.0032**	**2.0954**
% expl.var.	**19**	**7**	**7**

Table 4.5 provides the information on how many and who loaded on a particular factor on the opinions of nurses on the utilization of the CLABSI prevention bundle. The majority of the participants (19) 66.3% loaded onto a factor while 36.7% (11) participants did not load on any factor. Out of the 19 participants who loaded onto factors, 42% of the participants loaded onto factor one, 21% of the participants loaded onto factor two while 37% of the participants loaded on factor three.

The rest of the tables in this chapter will be based on Tables 4.4 and 4.5, i.e. will be based on the participants that loaded onto factors.

4.4. FACTOR DESCRIPTION

A factor in Q methodology is a selection of a group of participants who share similar viewpoints. A viewpoint can be described using statements that have z-scores greater than 1, it can be positive or negative > 1 z-score. According to Zabala, (2014), a z-score is an average of the scores given by flagged Q sorts to a particular statement. The factors will be described using the statements z-scores and their position on the Q sort grid. The tables are arranged in such a way, that factor 1 represents opinions on importance of CLABSI prevention bundle, followed by factor 1 on the opinions on the utilization of CLABSI prevention bundle. The same pattern is used for all the other factors.

Table 4.6: Extreme ranking statements for factor 1 on nurses' opinions on importance of CLABSI prevention bundle

Statement No.	Statement	z-score	Grid position
	Most important statements		
2	Perform hand hygiene before insertion	2.203	3
6	Prepare insertion site with >0.5% chlorhexidine with alcohol	1.834	3
4	Use maximal sterile barrier precautions	1.765	3
1	Adhere to aseptic technique	1.728	2
30	Document central line information i.e. date, time, type of catheter used and dressing change due date	1.198	2
3	Choose the best insertion site to minimize infections	1.170	2
	Least important statements		
13	Change administration sets for continuous infusions no more than 4 days	-1.049	-3
21	Empower staff to stop non-emergent insertion if proper procedures are not followed	-1.119	-3
28	Change gauze dressing or semipermeable dressing at least every 2 days/7 days respectively	-1.245	-3

4.4.1. Factor 1(importance) – value aseptic technique during insertion of central line

Out of twenty-five (25) participants who significantly loaded on the three factors, 14 participants loaded on factor one, representing 56% as shown in Table 4.6. Therefore, factor 1 represents viewpoints shared by 56% of the participants who loaded onto the factors in this study. This

group of participants consisted of a majority of ICU trained nurses (9) and those nurses who were trained in CLABSI prevention. Their training could have influenced why they loaded on factor 1.

The participants who loaded onto this factor ranked statements 2, 6, 4 and statements 1, 3 on the most important (grid positions 3, 2) and all these statement have to do with ensuring aseptic insertion of the central line as a way of preventing CLABSI. These nurses also believe documentation of the central line details (statement 30) to be important in prevention of the CLABSI.

These participants ranked three statements (13, 21,28) as least important in the prevention of CLABSI. One participant said infusion sets are changed every day, hence changing them every 4 days is least important. These participants considered empowering staff to stop non-emergent insertion (statement 21) to be less important because doctors don't listen to nurses,

"the doctor will just tell the nurse…. I never saw you in the corridors of medical school, so you can't tell me to do" (Participant 17).

The participants believe that stopping non-emergent central line insertion is least important because of the response doctors usually give.

Table 4.7: Extreme ranking statements for factor 1 on nurses' opinions on the utilization of the CLABSI prevention bundle

Statement No.	Statement	z-score	Grid position
	Most utilized statements		
2	Perform hand hygiene before insertion	2.121	3
1	Adhere to aseptic technique	2.100	3
6	Prepare insertion site with >0.5% chlorhexidine with alcohol	1.611	3
4	Use maximal sterile barrier precautions	1.161	2
5	Place a sterile gauze dressing or a sterile, transparent, semipermeable dressing over the site	1.135	2
7	Comply with all hand hygiene requirements	1.102	2
	Least utilized statements		
15	Perform daily audits to assess whether each central line is still needed	-1.019	-2
20	Periodically assess knowledge and adherence to guidelines	-1.048	-2
22	Re-educate healthcare personnel at regular intervals about central lines and whenever policies change	-1.137	-3
23	Use hospital specific or collaborative-based performance measures to ensure recommended practices	-1.308	-3
21	Empower staff to stop non-emergent insertion if proper procedures are not followed	-1.489	-3

4.4.2. Factor 1 (utilization) – aseptic technique users for insertion of central lines and non-administrative bundle items users

Out of nineteen (19) participants who loaded on the three factors for opinions of nurses on the utilization of the CLABSI prevention bundle, eight (8) loaded on factor 1 representing the viewpoint of 42% of the participants. The majority (5) of these eight participants were ICU trained nurses and they had attended the CLABSI in service training.

The opinion of these participants can be described as those who believe in using aseptic technique and complying with hand hygiene as a means of preventing CLABSI since they ranked statements 2, 1, 6, 4, 5 and 7 as the 'always used' statements in the ICU. A point of interest to note is that four participants (1, 2, 6 and 14) who loaded on factor 1 on the opinions of nurses on the importance of the CLABSI prevention bundle also loaded on factor 1 for opinions on utilization. This finding concurs with the studies that suggest that what nurses believe to be important, that is what they do.

Factor 2 dealt with the, on the participants' opinions on the utilization of the CLABSI prevention bundle. Participants ranked the administrative statements as never or rarely used by the nurses in the ICU. This could be so because these statements should be in a policy or standard operating procedures documents which should be endorsed by hospital management. Another interesting finding is that statement 21 "empower staff to stop non-emergent insertion if proper procedures are not followed" was ranked as least important and it has also been ranked as never used in ICU. It was also believed by this group that daily central line audits are rarely done by the nurses. This is worrying because then high risk central lines that could lead to CLABSI cannot be identified in time.

Table 4.8: Extreme ranking statements for factor 2 on nurses' opinions on the importance of the CLABSI prevention bundle

Statement No.	Statement	z-score	Grid position
	Most important		
2	Perform hand hygiene before insertion	1.852	3
1	Adhere to aseptic technique	1.695	3
7	Comply with all hand hygiene requirements	1.489	3

14	Perform routine dressing changes using aseptic technique with or sterile gloves	1.457	2
12	Use only sterile devices to access catheters	1.261	2
19	Provide checklist to nurses and clinicians to ensure adherence to aseptic insertion practices	1.167	2
	Least important		
21	Empower staff to stop non-emergent insertion if proper procedures are not followed	-1.066	-2
20	Periodically assess knowledge and adherence to guidelines	-1.153	-2
3	Choose the best insertion site to minimize infections	-1.506	-2
29	Follow up on every CLABSI to identify the cause	-1.561	-3
27	Avoid femoral site in obese patients	-1.746	-3
8	Use chlorhexidine impregnated dressing with a FDA cleared label	-1.848	-3

4.4.3. Factor 2 (importance) – Partly value both central line insertion and maintenance bundles

Six participants (24%) loaded on this factor. Only two out of six participants were ICU trained and three of the six were trained in CLABSI prevention bundle and they were aged between 30 - 49 years. Their opinion can be described as those who partly value the central line insertion and maintenance bundle. This can be so because they ranked statements 2, 1 and 19 which are mainly to do with insertion of the central line and statements 7, 14, 12, which mainly deal with maintenance of the central line as most important.

These participants believe that the choice of insertion site is of least importance and this is because the nurses take the choice of insertion site to be a doctors' duty. They also viewed that some of the administrative actions such as empowerment of nurses, following up on a CLABSI event, and assessing knowledge and adherence to be of less importance in prevention of CLABSI. Use of a chlorhexidine-impregnated dressing was viewed to be of less importance. This is worrying because it is one of the bundle elements that can lead to reduction in the rates of CLABSI.

Table 4.9: Extreme ranking statements for Factor 2 on nurses' opinions on the utilization of CLABSI prevention bundle

Statement No.	Statement	z-score	Grid position
	Most utilized		
26	Use antiseptic impregnated caps for access ports	1.861	3
1	Adhere to aseptic technique	1.788	3
3	Choose the best insertion site to minimize infections	1.540	3
12	Use only sterile devices to access catheters	1.512	2

11	Immediately replace dressing that are wet, soiled or dislodged	1.109	2
	Least utilized		
20	Periodically assess knowledge and adherence to guidelines	-1.064	-2
29	Follow up on every CLABSI to identify the cause	-1.450	-3
7	Comply with all hand hygiene requirements	-1.583	-3
28	Change gauze dressing or semipermeable dressing at least every 2 days/7 days respectively	-1.852	-3

4.4.4. Factor 2 (utilization) – central line maintenance bundle elements users

Seven participants loaded onto this factor. Five of these participants were not ICU trained and were also not trained in CLABSI prevention. The participants who loaded on the factor for the opinions of nurses on the utilization of the CLABSI prevention bundle, can be described as those who believe in using aseptic technique in the maintenance of central lines. Despite, being in the same unit, the nurses who loaded on factor 2 contradicted the other nurses who loaded onto factors 1 and 2 by ranking 'choice of site as always being used by nurses'. It is surprising because this was mentioned as a doctors' duty in the other two factors on utilization and the CLABSI prevention and all the three factors on the importance of the CLABSI prevention bundle.

The participants can be described as those with an opinion that adherence to guidelines assessment and follow up of CLABSI cases are never or rarely done in ICU. They also are of the view that hand hygiene requirements are never complied to. This is worrying because hand hygiene is the cornerstone of prevention of any healthcare associated infection including CLABSI.

Table 4.10: Extreme ranking statements for factor 3 on nurses' opinions on the importance of the CLABSI prevention bundle

Statement No.	Statement	z-score	Grid position
	Most important		
10	Bath ICU patients with chlorhexidine preparation on a daily basis	2.266	3
15	Perform daily audits to assess whether each central line is still needed	1.476	3
7	Comply with all hand hygiene requirements	1.043	3
11	Immediately replace dressing that are wet, soiled or dislodged	1.000	2
	Least important		
4	Use maximal sterile barrier precautions	-1.104	-2
17	Designate personnel who demonstrate competency for insertion and maintenance for central lines	-1.244	-2
18	Educate healthcare personnel about central line indication and maintenance	-1.329	-3

23	Use hospital specific or collaborative-based performance measures to ensure recommended practices	-1.798	-3
22	Re-educate healthcare personnel at regular intervals about central lines and whenever policies change	-1.969	-3

4.4.5. Factor 3 (importance) – value central line maintenance but not administrative issues

Five participants loaded on Factor 3. Four out of five had no formal ICU training, and only three had been trained in prevention of CLABSI. These participants' opinion can be described as those nurses consider central line maintenance most important, because they ranked all the statements (10, 15, 7, 11) as most important with a z-score of >1 fall under the maintenance bundle.

These participants, however, do not consider regular training and using hospital specific guidelines to be important in the prevention of CLABSI. This is seen from the way they ranked statements (17, 18, 23, 22) as least important. The worrying thing about these participants' opinions is that "use of maximal sterile barrier precautions" is least important too as regards to the CLABSI bundle. This is worrying because there is strong evidence from literature showing that this element can prevent CLABSI.

Table 4.11: Extreme ranking statements for factor 3 on nurses' opinions on the utilization of the CLABSI prevention bundle

Statement No.	**Statement**	**z-score**	**Grid position**
	Most utilized		
1	Adhere to aseptic technique	1.499	3
14	Perform routine dressing changes using aseptic technique with clean or sterile gloves	1.299	3
30	Document central line information i.e. date, time, type of catheter used and dressing change due date	1.289	3
16	Change administration sets immediately after blood or blood products transfusion	1.150	2
28	Change gauze dressing or semipermeable dressing at least every 2 days/7days respectively	1.035	2
	Least utilized		
3	Choose the best insertion site to minimize infections	-1.083	-2
20	Periodically assess knowledge and adherence to guidelines	-1.535	-3
17	Designate personnel who demonstrate competency for insertion and maintenance for central lines	-1.956	-3
27	Avoid femoral site in obese patients	-2.027	-3

4.4.6. Factor 3 (Utilization) – Central line maintenance bundle users

Seven participants loaded onto factor 3 on the opinions of nurses on the utilization of the CLABSI prevention bundle. There were all female nurses aged between 20 – 39 years (6), five of them did not have formal ICU training and were not trained in the CLABSI prevention bundle.

The viewpoint of Factor 3 participants can be described as those who would use more of the central line maintenance elements of the CLABSI prevention bundle to prevent CLABSI. These participants ranked the following statements (1, 14, 30, 16, 28) as those things that are always done.

These participants can be described as those do not use some of the insertion bundle elements such as selecting the best insertion site. This may be due to the understanding that nurses have when it comes to their role in management of the central line. This was evident from the comment that was made by a participant during sorting of the statements.

"my duty is not to insert the central line, it is the duty of the doctor.., my duty is to maintain the central line". (Participant number 23)

They also ranked statement 20 and 17 as never used by nurses in the ICU.

Two participants (4, 26) loaded on both factor 3 on importance and factor 3 on utilization. Factor 3 on the importance and factor 3 on the utilization of the CLABSI prevention bundle have similarities in the way the statements were ranked. This confirms the findings that nurses do the things they consider to be important.

4.5. FACTOR ARRAYS AND CONSENSUS STATEMENTS

A factor array represents the best estimate of a factor using statements. It shows how someone who loads 100% on a particular factor would have ranked the statements on Q sort grid (Wint, 2013). Samples of how the completed Q sort grids would have looked using the PQ Method generated factor arrays for nurses' opinions on importance and utilization are attached (appendix 6).

Consensus statements between factors will be interpreted based on the following factor arrays while distinguishing statements will be interpreted in a separate section. Consensus statements are those statements which have the same or similar score in the factor arrays. Consensus statements are not very important in Q methodology because the express the similarity in the factors.

Table 4.12 follows on next page

Table 4.12: Factor Arrays for the nurses' opinion on the importance of the CLABSI

No. of statement	Statement	Factor 1	Factor 2	Factor 3
1	Adhere to aseptic technique	2	3	2
2	Perform hand hygiene before insertion	3	3	2
3	Choose the best insertion site to minimize infections	2	-2	1
4	Use maximal sterile barrier precautions	3	-1	-2
5	Place a sterile gauze dressing or a sterile, transparent, semipermeable dressing over the site	2	-1	0
6	Prepare insertion site with >0.5% chlorhexidine with alcohol	3	2	-1
7	Comply with all hand hygiene requirements	0	3	3
8	Use chlorhexidine impregnated dressing with a FDA cleared label	0	-3	0
9	Scrub the access port or hub with friction immediately prior to each use with an appropriate antiseptic	0	0	-2
10	Bath ICU patients with chlorhexidine preparation on a daily basis	-1	1	3
11	Immediately replace dressing that are wet, soiled or dislodged	1	-1	2
12	Use only sterile devices to access catheters	1	2	0
13	Change administration sets for continuous infusions no more than every 4 days	-3	1	0
14	Perform routine dressing changes using aseptic technique with clean or sterile gloves	-2	2	0
15	Perform daily audits to assess whether each central line is still needed	0	-1	3
16	Change administration sets immediately after blood or blood products transfusion	-2	1	2
17	Designate personnel who demonstrate competency for insertion and maintenance for central line	1	-1	-2
18	Educate healthcare personnel about central line indication and maintenance	1	1	-3
19	Provide checklist to nurses and clinicians to ensure adherence to aseptic insertion practices	1	2	-1
20	Periodically assess knowledge and adherence to guidelines	-2	-2	-2
21	Empower staff to stop non-emergent insertion if proper procedures are not followed	-3	-2	-1
22	Re-educate healthcare personnel at regular intervals about central lines and whenever policies change	-1	-2	-3
23	Use hospital specific or collaborative-based performance measures to ensure recommended practices	-1	0	-3
24	Ensure efficient access to supplies for central line insertion and maintenance	-2	0	-1
25	Use of antimicrobial/antiseptic impregnated catheters	0	1	-1
26	Use antiseptic impregnated caps for access ports	0	0	1
27	Avoid femoral site in obese patients	-1	-3	1
28	Change gauze dressing or semipermeable dressing at least every 2 days/7 days respectively	-3	0	1
29	Follow up on every CLABSI to identify the cause	-1	-3	1
30	Document central line information i.e. date, time, type of catheter used and dressing change due date	2	0	0

Table 4.12 shows the factor array for nurses' opinions on the importance of the CLABSI prevention bundle.

Consensus statements between factors can be picked up from table 4.12 above. Participants in all the factors agreed on the adhering to aseptic technique and performing hand hygiene before central line insertion is most important in the prevention of CLABSI by ranking them on 3 and 2 on the grid. The participants share the same opinion that periodically assessing the knowledge and adherence to guidelines is least important in the prevention of CLABSI by ranking the statement (20) on -2 on the grid.

Table 4.12 also shows that participants who loaded on factors 1 and 2 share the same opinion on statement 9, "scrub the access port or hub with friction immediately prior to each use with an appropriate antiseptic" (grid position 0), statement 18, "educate healthcare personnel about the central line indication and maintenance" (grid position 1) and statement 26, "use antiseptic impregnated caps for access ports" (grid position 0). The participants viewed the above statements as having some importance in prevention of CLABSI.

Participants who loaded on factors 2 and 3 strongly agreed on statement 7, "comply with all hand hygiene requirements" (grid position 3) as being very important in the prevention of CLABSI. These participants view statement 30 as being neutral in the prevention of CLABSI.

Participants who loaded on factors 1 and 3 shared a viewpoint on statement 8, "use chlorhexidine impregnated dressing with a FDA cleared label" (grid position 0).

Table 4.13. Correlation between factor scores for nurses' opinions on the importance of the CLABSI bundle

	Factor 1	**Factor 2**	**Factor 3**
Factor 1	1.0000	0.3765	0.0262
Factor 2	0.3765	1.0000	0.1847
Factor 3	0.0262	0.1847	1.0000

From table 13, there is a very weak relationship between factors extracted for the nurses' opinions on the importance of the CLABSI prevention bundle, since the correlation is less than 0.5. This is good because it means the factors are completely different from each other and hence, the distinguishing statements can be obtained from these factors.

Table 4.14. Factor arrays for the nurses' opinions on Utilization of the CLABSI bundle

No. of statement	Statement	Factor 1	Factor 2	Factor 3
1	Adhere to aseptic technique	3	3	3
2	Perform hand hygiene before insertion	3	0	-1
3	Choose the best insertion site to minimize infections	1	3	-2
4	Use maximal sterile barrier precautions	2	-2	1
5	Place a sterile gauze dressing or a sterile, transparent, semipermeable dressing over the site	2	-2	1
6	Prepare insertion site with >0.5% chlorhexidine with alcohol	3	1	0
7	Comply with all hand hygiene requirements	2	-3	2
8	Use chlorhexidine impregnated dressing with a FDA cleared label	-1	-1	-1
9	Scrub the access port or hub with friction immediately prior to each use with an appropriate antiseptic	-1	1	1
10	Bath ICU patients with chlorhexidine preparation on a daily basis	0	1	0
11	Immediately replace dressing that are wet, soiled or dislodged	2	2	0
12	Use only sterile devices to access catheters	-1	2	2
13	Change administration sets for continuous infusions no more than every 4 days	-1	0	1
14	Perform routine dressing changes using aseptic technique with clean or sterile gloves	0	0	3
15	Perform daily audits to assess whether each central line is still needed	-2	2	-1
16	Change administration sets immediately after blood or blood products transfusion	-2	2	2
17	Designate personnel who demonstrate competency for insertion and maintenance for central line	0	0	-3
18	Educate healthcare personnel about central line indication and maintenance	-1	-1	0
19	Provide checklist to nurses and clinicians to ensure adherence to aseptic insertion practices	0	-1	0
20	Periodically assess knowledge and adherence to guidelines	-2	-2	-3
21	Empower staff to stop non-emergent insertion if proper procedures are not followed	-3	0	-1
22	Re-educate healthcare personnel at regular intervals about central lines and whenever policies change	-3	-1	0
23	Use hospital specific or collaborative-based performance measures to ensure recommended practices	-3	-1	-1
24	Ensure efficient access to supplies for central line insertion and maintenance	-2	1	-2
25	Use of antimicrobial/antiseptic impregnated catheters	0	-2	-2
26	Use antiseptic impregnated caps for access ports	1	3	1
27	Avoid femoral site in obese patients	1	1	-3
28	Change gauze dressing or semipermeable dressing at least every 2 days/7 days respectively	1	-3	2
29	Follow up on every CLABSI to identify the cause	0	-3	-2
30	Document central line information i.e. date, time, type of catheter used and dressing change due date	1	0	3

The consensus statements between factors on the opinions of nurses on the utilization of the CLABSI prevention bundle can be deduced from table 4.14.

All the participants who loaded on all the three factors, strongly agreed on adhering to aseptic technique as always being used (grid position 3). They also shared the same view on statement 8, "Use chlorhexidine impregnated dressing with a FDA cleared label" (grid position -1), statement 18, "Educate healthcare personnel about central line indication and maintenance" (grid position 0, -1) and statement 20, "Periodically assess knowledge and adherence to guidelines" (grid position -2, -3), that these statements are rarely and never used by nurses in ICU in the prevention of CLABSI.

Participants who loaded onto factors 1 and 2 shared the same viewpoint on the following statements: Statement 11, "Immediately replace dressing that are wet, soiled or dislodged" (grid position 2) as something mostly done by nurses in ICU. They also had a similar view on statement 27, "Avoid femoral site in obese patients" (grid position 1) and statement 14, "Perform routine dressing changes using aseptic technique with clean or sterile gloves" (grid position 0) as things that are sometimes done by the nurses in ICU in prevention of CLABSI.

Participants who loaded on factors 2 and 3 had consensus statements. Statement 12, "Use only sterile devices to access catheters" (grid position 2), statement 16, "Change administration sets immediately after blood or blood products transfusion" (grid position 2) and statement 9, "Scrub the access port or hub with friction immediately prior to each use with an appropriate antiseptic" (grid position 1). Their views on the above statements can be described as things mostly and sometimes done respectively. These participants also shared a view on statement 23, "Use hospital specific or collaborative-based performance measures to ensure recommended practices" (grid position -1) and statement 25, "use of antimicrobial/antiseptic impregnated catheters" (grid position -2) as things rarely done by nurses in ICU in the prevention of CLABSI.

Table 4.15. Correlation between factor scores for nurses' opinions on the utilization of the CLABSI bundle

	Factor 1	**Factor 2**	**Factor 3**
Factor 1	1.0000	0.1580	0.3459
Factor 2	0.1580	1.0000	0.1685
Factor 3	0.3459	0.1685	1.0000

Table 4.15 shows the level of correlation between the factors extracted for the nurses' opinions on the utilization of the CLABSI prevention bundle. The correlation is weak, since the correlation between factors are below 0.5. This is good as then the distinguishing statements between factors can be found from the factor array.

4.6. DISTINGUISHING AND CONSENSUS STATEMENTS

Distinguishing statements can be described as statements that distinguish one factor from the other i.e. what makes a factor to be unique from other factors. These distinguishing factors are obtained from the factor scores in factor arrays.

Distinguishing statements with statistical significance at $p < .05$ and $p < .01$ will be presented in tabular form for all the six factors (three factors on the opinions on the importance and three factors on the utilization of the CLABSI prevention bundle). The interpretation of the distinguishing statements was done beginning with the three factors on the nurses' opinions on the importance of the CLABSI prevention bundle, then followed by the nurses' opinions on the utilization of the CLABSI prevention bundle.

Key for tables 16 to 21

(P < .05; Asterisk (*) Indicates Significance at P < .01)

Both the Factor Q-Sort Value (Q-SV) and the Z-Score (Z-SCR) are Shown.

Table 4.16. Distinguishing Statements for Factor 1 for the nurses' opinions on the importance of the CLABSI prevention bundle

		Factor 1		**Factor 2**		**Factor 3**	
No. of statement	**Statement**	**Q-SV**	**Z-SCR**	**Q-SV**	**Z-SCR**	**Q-SV**	**Z-SCR**
6	Prepare insertion site with >0.5% chlorhexidine with alcohol	3	**1.83***	2	**0.63**	-1	**-0.55**
4	Use maximal sterile barrier precautions	3	**1.76***	-1	**-0.23**	-2	**-1.10**
30	Document central line information i.e. date, time, type of catheter used and dressing change due date	2	**1.20***	0	**0.03**	0	**-0.06**
5	Place a sterile gauze dressing or a sterile, transparent, semipermeable dressing over the site	2	**0.92***	-1	**-0.42**	0	**-0.15**
18	Educate healthcare personnel about central line indication and maintenance	1	**0.05**	1	**0.60**	-3	**-1.33**
7	Comply with all hand hygiene requirements	0	**-0.38***	3	**1.49**	3	**1.04**
23	Use hospital specific or collaborative-based performance measures to ensure recommended practices	-1	**-0.64**	0	**-0.12**	-3	**-1.80**
10	Bath ICU patients with chlorhexidine preparation on a daily basis	-1	**-0.67***	1	**0.24**	3	**2.27**

27	Avoid femoral site in obese patients	-1	**-0.70***	-3	**-1.75**	1	**0.50**
29	Follow up on every CLABSI to identify the cause	-1	**-0.73***	-3	**-1.56**	1	**0.54**
16	Change administration sets immediately after blood or blood products transfusion	-2	**-0.75***	1	**0.22**	2	**0.90**
14	Perform routine dressing changes using aseptic technique with clean or sterile gloves	-2	**-0.91***	2	**1.46**	0	**0.45**
13	Change administration sets for continuous infusions no more than every 4 days	-3	**-1.05***	1	**0.30**	0	**-0.06**
28	Change gauze dressing or semipermeable dressing at least every 2 days/ 7 days respectively	-3	**-1.25***	0	**-0.12**	1	**0.63**

Table 4.16 shows the statements that distinguish factor 1 from the other 2 factors. The distinguishing statements 4, 30, 5 were ranked as important by the participants who loaded on factor 1 than those who loaded on factor 2 and 3.

The two statements 6 and 18 distinguish factor 1 from factor 3. Statement 6 was ranked as being most important (grid position 3) by factor 1 participants and less important (grid position -1) by factor 3 participants. While statement 18 was ranked as important (grid position 1) by factor 1 participants and least important (grid position -3) by factor 3 participants.

The other distinguishing statements are 7, 23, 10, 27, 16, 14, 13 and 28, which were ranked as not important in the prevention of CLABSI by factor 1 participants as compared to participants who loaded onto factors 2 and 3.

Table 4.17. Distinguishing Statements for Factor 2 on the nurses' opinions on the importance of the CLABSI bundle

		Factor 1		**Factor 2**		**Factor 3**	
No. of statement	**Statement**	**Q-SV**	**Z-SCR**	**Q-SV**	**Z-SCR**	**Q-SV**	**Z-SCR**
14	Perform routine dressing changes using aseptic technique with clean or sterile gloves	-2	**-0.91**	2	**1.46***	0	**0.45**
12	Use only sterile devices to access catheters	1	**0.28**	2	**1.26***	0	**0.40**
6	Prepare insertion site with >0.5% chlorhexidine with alcohol	3	**1.83**	2	**0.63***	-1	**-0.55**
18	Educate healthcare personnel about central line indication and maintenance	1	**0.05**	1	**0.60**	-3	**-1.33**
10	Bath ICU patients with chlorhexidine preparation on a daily basis	-1	**-0.67**	1	**0.24***	3	**2.27**
16	Change administration sets immediately after blood or blood products transfusion	-2	**-0.75**	1	**0.22**	2	**0.90**
23	Use hospital specific or collaborative-based performance measures to ensure recommended practices	-1	**-0.64**	0	**-0.12**	-3	**-1.80**
28	Change gauze dressing or semipermeable dressing at least every 2 days/ 7days respectively	-3	**-1.25**	0	**-0.12**	1	**0.63**

4	Use maximal sterile barrier precautions	3	**1.76**	-1	**-0.23***	-2	**-1.10**
3	Choose the best insertion site to minimize infections	2	**1.17**	-2	**-1.51***	1	**0.81**
29	Follow up on every CLABSI to identify the cause	-1	**-0.73**	-3	**-1.56***	1	**0.54**
27	Avoid femoral site in obese patients	-1	**-0.70**	-3	**-1.75***	1	**0.50**
8	Use chlorhexidine impregnated dressing with a FDA cleared label	0	**-0.62**	-3	**-1.85***	0	**-0.23**

Table 4.17 presents the statements that distinguish factor 2 on the nurses' opinions on the importance of the CLABSI prevention bundle from factor 1 and factor 3. The participants who loaded onto factor 2 ranked statements 14, 12, 6, 10 and 16 as important and statements 23 and 28 as neutral. These participants ranked statements 4, 3, 29, 27 and 8 as less important.

The opinion of these factor 2 participants can be described as those who partly value both insertion and maintenance of the central line to be important in the prevention of CLABSI.

Table 4.18. Distinguishing Statements for Factor 3 for the nurses' opinions on importance of the CLABSI bundle

		Factor 1		**Factor 2**		**Factor 3**	
No. of statement	**Statement**	**Q-SV**	**Z-SCR**	**Q-SV**	**Z-SCR**	**Q-SV**	**Z-SCR**
10	Bath ICU patients with chlorhexidine preparation on a daily basis	-1	**-0.67**	1	**0.24**	3	**2.27***
15	Perform daily audits to assess whether each central line is still need	0	**-0.40**	-1	**-0.23**	3	**1.48***
11	Immediately replace dressing that are wet, soiled or dislodged	1	**0.13**	-1	**-0.22**	2	**1.00***
16	Change administration sets immediately after blood or blood products transfusion	-2	**-0.75**	1	**0.22**	2	**0.90**
28	Change gauze dressing or semipermeable dressing at least every 2 days/ 7 days respectively	-3	**-1.25**	0	**-0.12**	1	**0.63**
29	Follow up on every CLABSI to identify the cause	-1	**-0.73**	-3	**-1.56**	1	**0.54***
27	Avoid femoral site in obese patients	-1	**-0.70**	-3	**-1.75**	1	**0.50***
14	Perform routine dressing changes using aseptic technique with clean or sterile gloves	-2	**-0.91**	2	**1.46**	0	**0.45***
19	Provide checklist to nurses and clinicians to ensure adherence to aseptic insertion practices	1	**0.80**	2	**1.17**	-1	**-0.26***
6	Prepare insertion site with >0.5% chlorhexidine with alcohol	3	**1.83**	2	**0.63**	-1	**-0.55***
25	Use of antimicrobial/antiseptic impregnated catheters	0	**-0.13**	1	**0.27**	-1	**-0.76**
9	Scrub the access port or hub with friction immediately prior to each use with an appropriate antiseptic	0	**0.04**	0	**-0.08**	-2	**-0.95***
4	Use maximal sterile barrier precautions	3	**1.76**	-1	**-0.23**	-2	**-1.10***
17	Designate personnel who demonstrate competency for insertion	1	**0.07**	-1	**-0.33**	-2	**-1.24***
18	Educate healthcare personnel about central line indication and maintenance	1	**0.05**	1	**0.60**	-3	**-1.33***

23	Use hospital specific or collaborative-based performance measures to ensure recommended practices	-1	**-0.64**	0	**-0.12**	-3	**-1.80***
22	Re-educate healthcare personnel at regular intervals about central lines and whenever policies change	-1	**-0.75**	-2	**-0.50**	-3	**-1.97***

Table 4.18 has highlighted the following statements (10, 15, 11, 29, 27, 14, 19, 6, 9, 4, 17, 18, 23, 22) which have distinguished factor 3 from factors 1 and 2. This distinction is at a significant level of $p < 0.01$. The participants who loaded onto factor's opinions can be distinguished by the way they ranked the above statements. These participants ranked statements 10, 15, 11, 16, 28, 29 and 27 to be most and fairly important than the participants who loaded onto factors 1 and 2. It is interesting to note that statements 19, 6, 25, 9, 4, 17, 18, 23 and 24 were ranked to be least important by the participants who loaded on factor 3 unlike their colleagues who loaded on factors 1 and 2. The significant finding is that these are the participants who value central line maintenance to be very important in the prevention of CLABSI.

Table 4.19. Distinguishing Statements for Factor 1 on the nurses' opinions on utilization of the CLABSI bundle

		Factor 1		**Factor 2**		**Factor 3**	
No. of statement	**Statement**	**Q-SV**	**Z-SCR**	**Q-SV**	**Z-SCR**	**Q-SV**	**Z-SCR**
2	Perform hand hygiene before insertion	3	**2.12***	0	**-0.33**	-1	**-0.55**
6	Prepare insertion site with >0.5% chlorhexidine with alcohol	3	**1.61***	1	**0.58**	0	**0.30**
3	Choose the best insertion site to minimize infections	1	**0.86**	3	**1.54**	-2	**-1.08**
29	Follow up on every CLABSI to identify the cause	0	**-0.15***	-3	**-1.45**	-2	**-0.92**
10	Bath ICU patients with chlorhexidine preparation on a daily basis	0	**-0.39***	1	**0.55**	0	**0.55**
12	Use only sterile devices to access catheters	-1	**-0.49***	2	**1.51**	2	**0.88**
9	Scrub the access port or hub with friction immediately prior to each use with an appropriate antiseptic	-1	**-0.68***	1	**0.68**	1	**0.62**
16	Change administration sets immediately after blood or blood products transfusion	-2	**-0.77***	2	**0.77**	2	**1.15**
23	Use hospital specific or collaborative-based performance measures to ensure recommended practices	-3	**-1.31**	-1	**-0.65**	-1	**-0.58**
21	Empower staff to stop non-emergent insertion if proper procedures are not followed	-3	**-1.49***	0	**-0.43**	-1	**-0.31**

Table 4.19 shows that factor 1 on the nurses' opinions on the utilization of the CLABSI prevention bundle is distinguished from factors 2 and 3 by eight statements (2, 6, 29, 10, 12, 9, 16, 21). The distinction is at a significant level of $p < 0.01$. These participants ranked statements

2, 6 as things mostly done by nurses in ICU and statements 3, 29, 10 as things nurses do sometimes as regards to prevention of CLABSI. Statements 12, 9, 16, 23 and 21 were ranked as things nurses rarely and never do in ICU by factor 1 participants as compared to those participants who loaded on factors 2 and 3.

Table 4.20. Distinguishing Statements for Factor 2 on the nurses' opinions on the utilization of the CLABSI bundle

		Factor 1		**Factor 2**		**Factor 3**	
No. of statement	**Statement**	**Q-SV**	**Z-SCR**	**Q-SV**	**Z-SCR**	**Q-SV**	**Z-SCR**
26	Use antiseptic impregnated caps for access ports	1	**0.49**	3	**1.86***	1	**0.77**
3	Choose the best insertion site to minimize infections	1	**0.86**	3	**1.54**	-2	**-1.08**
12	Use only sterile devices to access catheters	-1	**-0.49**	2	**1.51**	2	**0.88**
15	Perform daily audits to assess whether each central line is still needed	-2	**-1.02**	2	**0.69***	-1	**-0.82**
24	Ensure efficient access to supplies for central line insertion and maintenance	-2	**-0.94**	1	**0.66***	-2	**-1.00**
19	Provide checklist to nurses and clinicians to ensure adherence to aseptic insertion practices	0	**-0.04**	-1	**-0.65**	0	**0.13**
4	Use maximal sterile barrier precautions	2	**1.16**	-2	**-0.65***	1	**0.67**
5	Place a sterile gauze dressing or a sterile, transparent, semipermeable dressing over the site	2	**1.13**	-2	**-0.71***	1	**0.76**
7	Comply with all hand hygiene requirements	2	**1.10**	-3	**-1.58***	2	**0.92**
28	Change gauze dressing or semipermeable dressing at least every 2 days/ 7 days respectively	1	**0.59**	-3	**-1.85***	2	**1.04**

From Table 4.20, it can be deduced that factor 2 is distinguished from factor 1 and factor 3 on the nurses' opinions on the utilization of the CLABSI prevention bundle by these statements (26, 15, 24, 4, 5,7,28). The level of significance for all these mentioned factor 2 statements is at $p < 0.01$. Participants who loaded onto factor 2 ranked these statements 26, 3, 12, 15, 24, as things nurses always do in ICU to prevent CLABSI. They ranked the statements 19, 4, 7, 28 as the things nurses rarely and never do in ICU to prevent CLABSI. Factor 2 participants can be described as those share an opinion of users of the central line maintenance bundle elements to prevent CLABSI.

Table 4.21 follows on next page.

Table 4.21. Distinguishing Statements for Factor 3 on the nurses' opinions on the utilization of the CLABSI bundle

		Factor 1		Factor 2		Factor 3	
No. of statement	**Statement**	**Q-SV**	**Z-SCR**	**Q-SV**	**Z-SCR**	**Q-SV**	**Z-SCR**
14	Perform routine dressing changes using aseptic technique with clean or sterile gloves	0	**0.01**	0	**-0.27**	3	**1.30***
30	Document central line information i.e. date, time, type of catheter used and dressing change due date	1	**0.04**	0	**0.53**	3	**1.29**
12	Use only sterile devices to access catheters	-1	**-0.49**	2	**1.51**	2	**0.88**
13	Change administration sets for continuous infusions no more than every 4 days	-1	**-0.57**	0	**-0.39**	1	**0.73***
11	Immediately replace dressing that are wet, soiled or dislodged	2	**0.98**	2	**1.11**	0	**0.39**
3	Choose the best insertion site to minimize infections	1	**0.86**	3	**1.54**	-2	**-1.08***
17	Designate personnel who demonstrate competency for insertion and maintenance for central lines	0	**-0.43**	0	**-0.22**	-3	**-1.96***
27	Avoid femoral site in obese patients	1	**0.05**	1	**0.57**	-3	**-2.03***

Table 4.21 presents the statements that distinguish factor 3 from factors 1 and 2 on the nurses' opinions on the utilization of the CLABSI bundle with significance level of $p < 0.01$. These participants ranked statements 14, 30, 12, 13 as things always done by the nurses in ICU to prevent CLABSI and statement 11 as neutral. They ranked statements 3, 17, 27 as rarely and never done by nurses in ICU unlike factors 1 and 2 participants who ranked the same statements as sometimes done by nurses in ICU.

4.7. DISCUSSION OF FINDINGS

4.7.1. The value of aseptic technique during insertion of a central line

Adhering to aseptic technique and performing hand hygiene was viewed as very important by the nurses. It is interesting to note that when it came to utilization, most of the nurses ranked aseptic technique and hand hygiene as always done by nurses in ICU. This finding is in agreement with the finding by Price, (2015) and White et al., (2015) that what nurses consider to be important they will do. The opposite is also true. This study found that what nurses view to be less important they will not do. For instance, 'periodic assessment of knowledge and adherence to guidelines' was viewed as less important in the prevention of CLABSI and when it came to

utilization it was rarely done by the nurses. Something must be done to ensure that nurses view assessment to adherence positively and be enabled to do it.

4.7.2. The value of central line handling and maintenance elements of the bundle

Another finding from this study was that there were nurses who valued some elements of the CLABSI prevention bundle as important. The elements these nurses value are to do with maintenance of the central line such as bathing patients with chlorhexidine on a daily basis, complying with hand hygiene, performing daily audits to assess the necessity of the central line and immediately replacing a dressing that is soiled or dislodged. These nurses performed the above activities except for performing daily audits to assess the necessity of the central line. The nurses might not perform the daily audits due to lack of expertise in doing them or lack of knowledge. This study did not find the reason for this which should be explored further. This finding is in line with what Sax, et al., (2007) and White et al., (2015) discussed about "control beliefs." If a nurse feels incompetent, even if she/he may believe something is important, she/he will not do because she will not feel in control.

4.7.3. The value of both central line insertion and maintenance elements of the bundle

The study revealed that some of the nurses in ICU have mixed opinions. They valued some of the bundle elements in both the insertion and maintenance of a central line that prevent CLABSI. The unique thing to this group of nurses was they valued using a checklist to ensure adherence of nurses and clinicians to aseptic insertion techniques as very important. However, when it came to utilization, this checklist was rarely or never used. This could be because the management does not provide the checklist for the nurses to use. (O'Gardy, et al., 2011).

This group of nurses also view complying with hand hygiene, aseptic technique while changing dressing on site of central line and use of sterile devices to access the central line ports as very important. Velasquez-Reyes et al., 2017 found that proper procedures when doing change of dressings on the insertion site of the central line, and limiting access ports manipulations while

using only sterile devices to access the central line ports reduce CLABSI incidences. These elements were also ranked as been utilized always by the nurses in ICU.

4.7.4. Least important and less used CLABSI bundle elements

Assessment of nurses' knowledge and adherence to practice needs to be done periodically which will allow gaps to be identified and addressed timely to ensure prevention of CLABSI. For instance, the study found that nurses cannot stop non-emergent insertion of the central line even if proper procedures are not followed. If there is no periodic assessment this cannot be identified and hence, it cannot be addressed and this can lead to increase in the incidence of CLABSI. This finding might be due lack of sensitization of the healthcare professionals by the management of the health facility. According to the CDC guidelines for central line management, this is the responsibility of the management.

The nurses rated using chlorhexidine impregnated dressing and scrubbing ports with proper antiseptic with equal importance. However, when it comes to utilization it was found that they are rarely used, yet according to studies done elsewhere chlorhexidine impregnated dressing and scrubbing the access ports with chlorhexidine 2% were found to reduce CLABSI rates when used (Atilla et al., 2016; Perin et al., 2016). This finding of underutilization of the use of chlorhexidine is worrying, because it could lead to an increase in the incidence of CLABSI. One has to find out why they underutilized. It is possible that the nurses are not provided with adequate supplies.

4.8. SUMMARY

This chapter has described the findings and their interpretation. The study findings have been discussed. The next chapter will give a summary of the study, the limitations, recommendations and conclusion.

CHAPTER FIVE

SUMMARY, RECOMMENDATIONS AND CONCLUSION

5.1. INTRODUCTION

This is a final chapter, it will summarize the study, and provide the main findings of the study. The study strengths and limitations and recommendations for nursing practice, education, research and management will be discussed. A conclusion of the study will be described.

5.2. SUMMARY

The purpose of the study was to determine whether the CLABSI prevention bundle is important and useful to nurses in ICU, with the aim of informing the infection control unit of the hospital on considerations to be put in place when teaching and implementing the CLABSI prevention bundle.

The objectives of the study were;

- To describe the opinions of the nurses in ICU of the importance of the CLABSI prevention bundle.
- To describe the opinions of the nurses in the ICU of the usefulness of the CLABSI prevention bundle.
- To describe the relationship between the importance and utilization of the CLABSI prevention bundle based on the nurses' opinions.

This study used a descriptive research design using Q methodology approach. Q methodology is one of the methods used to study opinions. The study was done one of the public academic hospitals in Gauteng. Thirty nurses sorted a set of thirty cards with statements about CLABSI prevention bundle derived from CDC, BCA and IHI central line guidelines. The sorting (Q sort) was done on a Q diagram under specific conditions of instruction. Pictures of completed Q sorts were taken and transcribed on a smaller Q diagram and that was used for data analysis. Factor analysis was done using a software PQ Method version 2.35. Factor analysis revealed the

following opinions of nurses in ICU on the importance and utilization of the CLABSI prevention bundle.

5.3. MAIN FINDINGS

The overall finding is that opinions are related to human behaviour. What nurses believe to be important is what they do. However, three categories of nurses having different opinions emerged from this study. First, those nurses who value aseptic technique during insertion of the central line to be important and use the aseptic technique frequently. Second, those nurses value central line maintenance and use some of the maintenance bundle element frequently. Third, those nurses who have value part of the central line insertion bundle elements and maintenance bundle elements.

The study also noted that some statements that were valued as important were not being done by nurses in ICU and other bundle elements which were least important and were never done by nurses in ICU. The point with the CLABSI prevention bundle is that it is an “all or none” approach. The reason why there is no decrease in the rate of CLABSI could be because not all elements of the bundle are utilized.

Although this study did not look at the resources in relation to prevention of CLABSI, there is weak evidence from the comments made by nurses during sorting of the statements that there is lack of some resources. This needs to be investigated further.

The other finding of this study was that, Q methodology was suitable for this study as it reduced the bias on the part of the researcher especially when doing the factor analysis. It is one of the few studies to use two conditions of instruction and comparing the relationship between factors extracted from the two conditions of instructions. Participants were actively engaged through Q sorting and some of the participants commented that the process had being educational and it stimulated critically thinking.

5.4. LIMITATIONS

The study had some limitations. Data was not collected from the different categories of nurses – only from professional nurses - which would have been helpful. Since, some sub-categories are not involved in continuous professional development training, results from these groups could have been different. If this study is to be replicated, the data on different categories of nurses should be included. However, this limitation was partly addressed as the nurses who participated were asked whether they were ICU trained or not. This, in itself revealed differences so those from the lower categories of nurses may differ even further. Those with formal ICU training were found to value aseptic technique more during insertion while the nurses with formal ICU training view aseptic technique to be more important during the maintenance of the central line.

The study did not check if the nurses really do what they ranked as always done. There is a possibility that they do not. This was beyond the objectives of this study but warrants further research.

The study used a small sample size, hence the results cannot be generalized to a wider population. An issue worth noting, however, is that in Q methodology results are not meant to be generalized but to be used to understand the particular study population, which in this study was the nurses in general ICU.

5.5. RECOMMENDATIONS

Based on the findings of the study, the following recommendations should be taken into consideration by nursing education, nursing practice, nursing management and nursing research.

5.5.1. Nursing education

- Nursing educators should pay attention to behavioural issues and what to include in their teaching methods, on how to encourage nurses to comply with practices.
- Nursing students should also be taught the importance of keeping oneself up to date with current information and innovations happening in nursing even after qualification. This

will enable them have enquiring minds and be able to implement evidenced based practice, conduct audits and assess performance of the recommended practices.

- The findings showed lack of teamwork among different professions in the health care. It is therefore recommended that inter professional learning (IPL) already happening in the faculty of health sciences should continue and if possible include scenarios on how to work as a team in infection prevention and control.

5.5.2. Nursing practice

- The findings identified gaps in the practice of nurses related to the CLABSI prevention bundle. The infection prevention and control unit should conduct ongoing in-service trainings the CLABSI and emphasis should be put on why each element is included in the bundle. The importance of using all the bundle elements should also be stressed.
- The nurses did not view conducting daily central line audits to assess if the central line is still needed as most important. The infection prevention and control unit should train the nurses on the importance of conducting daily audits and how it can be done

5.5.3. Nursing management

- Nurses are not empowered to stop non emergent central line insertion if proper procedures were not followed. This could be due to fear of doctors on the part of nurses. Policies regarding this practice should be visible in the units for all health professionals to see and management needs to facilitate compliance to the policy.
- The nursing management should work together with the hospital management and champion inter professional in service training. This will provide a platform for learning how to work as a team and understand each other's role in patient care.
- Nursing management should also motivate for procuring chlorhexidine impregnated dressings and have the nurses and doctors trained on the importance of using the in the prevention of CLABSI.

5.5.4. Nursing research

- The study was done for nurses in ICU only, the findings revealed some issues with doctors such as their attitude towards nurses and that some elements in the CLABSI prevention bundle are for doctors and not nurses. Therefore, a similar study should be done with the doctors to find out their opinions on the CLABSI prevention bundle. This will inform practice and help management on where to start as regards to doctors' in-service training.
- It would be useful to conduct research on the CLABSI bundle elements ranked as not important, to find out why they were ranked in such a way and what can be done to improve that.
- An observational study should be done to cross check if the nurses really do the tasks they stated they do.

5.6. CONCLUSION

Nurses' opinions in ICU on the importance and utilization of the CLABSI prevention bundle are quite different. There are nurses who value aseptic technique during insertion of central line, others value aseptic technique during handling and maintenance of the central line and the third group of nurses who value some elements of the insertion bundle and some of the maintenance bundle. The nurses did not view as important and rarely used most of the administrative elements in the CLABSI prevention bundle. Most of the CLABSI bundle elements that were valued as being important by the nurses those elements were also utilized by the nurses. However, it was evident that not all elements of the CLABSI prevention were utilised as there are supposed to be.

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APPENDIX 1

DATA COLLECTION TOOL

Opinions of nurses in ICU on the importance and utilization of the CLABSI prevention bundle at an academic hospital in Gauteng

Demographic data

1. Identification number

2. Gender

Male	
Female	

3. Age (Years)

20 - 29	
30 – 39	
40 – 49	
50 – 59	
>60	

4. Educational level

Masters	
Degree	
Diploma	

5. Do you have formal ICU training

Yes	
No	

If yes, at what level?.....

6. Were you trained on CLABSI prevention bundle?

Year	Yes	No
2010		
2017		

7. Work experience in ICU (in years) ……

Q set statements

1. Perform hand hygiene before insertion
2. Adhere to aseptic technique
3. Use maximal sterile barrier precautions
4. Choose the best insertion site to minimise infections
5. Prepare insertion site with >0.5% chlorhexidine with alcohol
6. Place a sterile gauze dressing or a sterile, transparent, semipermeable dressing over the site
7. Use chlorhexidine impregnated dressing with a FDA cleared label
8. Comply with all hand hygiene requirements
9. Bath ICU patients with chlorhexidine preparation on a daily basis
10. Scrub the access port or hub with friction immediately prior to each use with an appropriate antiseptic
11. Use only sterile devices to access catheters
12. Immediately replace dressing that are wet, soiled or dislodged
13. Perform routine dressing changes using aseptic technique with clean or sterile gloves
14. Change administration sets for continuous infusions no more than every 4 days
15. Change administration sets immediately after blood or blood products transfusion
16. Perform daily audits to assess whether each central line is still needed
17. Educate healthcare personnel about central line indication and maintenance
18. Designate personnel who demonstrate competency for insertion and maintenance for central lines
19. Periodically assess knowledge and adherence to guidelines
20. Provide checklist to nurses and clinicians to ensure adherence to aseptic insertion practices
21. Re-educate healthcare personnel at regular intervals about central lines and whenever policies change
22. Empower staff to stop non-emergent insertion if proper procedures are not followed
23. Ensure efficient access to supplies for central line insertion and maintenance
24. Use hospital specific or collaborative-based performance measures to ensure recommended practices
25. Use antiseptic impregnated caps for access ports
26. Use of antimicrobial/antiseptic impregnated catheters
27. Change gauze dressing or semipermeable dressing at least every 2 days/ 7days respectively
28. Avoid femoral site in obese patients
29. Document central line information i.e. date, time, type of catheter used and dressing change due date
30. Follow up on every CLABSI to identify the cause

Q sort 1

"How important are the statements to you as regards to CLABSI bundle"

Least Important Most important

-3	-2	-1	0	1	2	3

Q sort 2

How often do the nurses in ICU use or implement this statement?

Never Always

-3	-2	-1	0	1	2	3

APPENDIX 2

INFORMATION SHEET

Title of study: Opinions of the nurses in ICU on the importance and utilization of the central line associated bloodstream infections prevention bundle in an academic hospital in Gauteng

Introduction

Good day, my name is Dorica Ng'ambi, I would like to invite you to take part in this study which I am required to conduct as part of my studies towards a Master of Science in Nursing degree at the University of the Witwatersrand, Faculty of Health Sciences in the Department of Nursing Education. It is important for you to understand the information below regarding the purpose of the study, the risks, benefits and your rights before you agree to participate in the study. If you have any questions, please feel free to ask me. You should only accept to participate if you comfortable with the procedures involved in the study. You will be given a copy of this information sheet to keep.

Purpose

You have been asked to participate to in this study as a nurse who uses the Central line associated bloodstream infection prevention bundle. The purpose of this study is to describe how useful and important the central line associated bloodstream infections prevention bundle is to the nurses in the Intensive Care Unit. The results will inform the infection prevention and control unit of this hospital on how best to implement the Best Care Always initiated central line associated bloodstream infections prevention bundle to ensure effective utilization to reduce the incidence of central line associated bloodstream infections.

Procedure

If you agree to participate in this study, you will be given a deck of cards which you will be asked to sort under two specific conditions i.e. in relation to how important you believe each statement to be, and the second time in relation to how often nurses implement or use each of the statements while caring for a patient with a central line, by arranging them on a Q sort diagram. When you finish sorting them, your completed Q sort grids will be photographed for the purpose of analysis. Your name will not appear on the grid. This sorting will take you approximately 30 minutes and will be done in a private room.

Risks

In my view, there should be no risks to you in participating in this study.

Benefits

There are no direct benefits to you as a participant. The information gathered will help improved patient care.

Reimbursement

You will not be paid for participating in this study, but you will be given a cold drink and a snack.

Your Rights

Your participation in this study is completely voluntary, your decision not to participate will not attract any penalty or denial of any privileges. If you decide to participate, you will be given this Information Sheet to keep and you will be asked to sign an informed consent form. Should you wish to discontinue participation, you may do so freely at any time and without giving a reason.

Confidentiality

All information obtained during this study will be kept confidential. You will be assigned a number which will be used during the study and in the report in order to maintain your privacy and confidentiality. Data will be kept for 2 years if published and 6 years if not published, after this period it will be destroyed.

Funding

This study is self-funded and will not be used for commercial gain.

Contact

If you would like more information, have any problems, concerns or questions about the study, please contact me (Dorica Mughogho Ng'ambi) on tel: 0610814853 or email: 858238@students.wits.ac.za or alternatively my supervisor Dr. Sue Armstrong on tel: 011 488 4272 or email: Sue.Armstrong@wits.ac.za. You can also contact Human Research Ethics Committee (Medical), University of Witwatersrand. Contact details: Prof. C. Penny, Tel: 011 717 2301, email: Clement.Penny@wits.ac.za., Ms Z Ndlovu and Mr Rhulani Mkansi Administrative Officers, 011 717 1234/1252/2656/2700, email: zanele.ndlovu@wits.ac.za; Rhulani.mkansi@wits.ac.za

APPENDIX 3

INFORMED CONSENT FORM

I confirm that I have been informed by the researcher……. …… (name of researcher) about the nature, conduct, benefits and risks of the study entitled, 'Opinions of nurses in ICU on the importance and utilization of CLABSI prevention bundle in an academic hospital in Gauteng'.

I have received, read and understood the information sheet for the above study and the researcher has answered any queries to my satisfaction.

I understand that my participation is voluntary and that I am free to withdraw from the study at any time of the interview without giving any reason and without any consequences. If I withdraw and I do not want my data to be used, any data collected from me will be destroyed. I understand that I can withdraw from the study any personal data that identifies me at any time. I also understand that anonymised data once collected cannot be withdrawn once they have been included in the study.

I understand that any information collected during the study will remain confidential and no information that identifies me will be made publicly available. I agree that data collected from me will be accessed by supervisors and other authorities.

I consent to being a participant in this study

……..
……. ……..

Participant's Name Signature Date

……..
…… ……..

Researcher's Name Signature Date

APPENDIX 4

ETHICS CLEARANCE CERTIFICATE

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

R14/49 Ms D Ng'ambi

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M180282

NAME: (Principal Investigator)	Ms D Ng'ambi
DEPARTMENT:	School of Therapeutic Sciences Department of Nursing Education Medical School University
PROJECT TITLE:	Opinions of nurses in ICU on the importance and utilization of the central line associated blood stream infections prevention bundle in an academic hospital in Gauteng
DATE CONSIDERED:	23/02/2018
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr S Armstrong
APPROVED BY:	Professor CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	30/05/2018

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on 3rd floor, Phillip V Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.
I/We fully understand the conditions under which I am/we are authorised to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to resubmit to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **February** and will therefore be due in the month of **February** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature — Date: 30/5/2018

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX 5

SITE APPROVAL

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

CHARLOTTE MAXEKE JOHANNESBURG ACADEMIC HOSPITAL

Enquiries:
Ms. G. Ngwenya
Office of the Nursing Director
Tell: (011): 488-4558
Fax: (011): 488-3786
01 June 2018

Mrs. Dorica Ng'ambi
Department of Nursing Education
Faculty of Health Sciences
University of Witwatersrand
NHRD REF: GP_201804_009

Dear. Mrs Dorica Ng'ambi

RE: **"Opinions of nurses in ICU on the importance and utilization of the CLABSI prevention bundle in an Academic Hospital in Gauteng"**

Permission is granted for you to conduct the above recruitment activities as described in your request provided:

1. Charlotte Maxeke Johannesburg Academic hospital will not in anyway incur or inherit costs as a result of the said study.
2. Your study shall not disrupt services at the study sites.
3. Strict confidentiality shall be observed at all times.
4. Informed consent shall be solicited from patients participating in your study.

Please liaise with the Head of Department and Unit Manager or Sister in Charge to agree on the dates and time that would suit all parties.

Kindly forward this office with the results of your study on completion of the research.

Supported / ~~not supported~~
Ms. M.M Pule
Nursing Director
Date: 31/05/2018

Approved / not approved
Ms. G. Bogoshi
Chief Executive Officer
05.06.2018

APPENDIX 6

COMPLETED Q SORTS BASED ON FACTOR ARRAYS

Q sort factor 1 (importance)

"How important are the statements to you as regards to CLABSI bundle"

Least Important Most important

-3	-2	-1	0	1	2	3
13	14	10	7	11	1	2
21	16	22	8	12	3	4
28	20	23	9	17	5	6
	24	27	15	18	30	
		29	25	19		
			26			

Q sort factor 2 (Importance)

"How important are the statements to you as regards to CLABSI bundle"

Least Important Most important

-3	-2	-1	0	1	2	3
8	3	4	9	10	6	1
27	20	5	23	13	12	2
29	21	11	24	16	14	7
	22	15	26	18	19	
		17	28	25		
			30			

Q sort factor 3 (Importance)

"How important are the statements to you as regards to CLABSI bundle"

Least Important Most important

-3	-2	-1	0	1	2	3
18	4	6	5	3	1	7
22	9	19	8	26	2	10
23	17	21	12	27	11	15
	20	24	13	28	16	
		25	14	29		
			30			

Q sort factor 1 (Utilization)

How often do the nurses in ICU use or implement this statement?

Never Always

-3	-2	-1	0	1	2	3
21	15	8	10	3	4	1
22	16	9	14	26	5	2
23	20	12	17	27	7	6
	24	13	19	28	11	
		18	25	30		
			29			

Q sort factor 2 (Utilization)

"How often do the nurses in ICU use or implement this statement?

Never Always

-3	-2	-1	0	1	2	3
7	4	8	2	6	11	1
28	5	18	13	9	12	3
29	20	19	14	10	15	26
	25	22	17	24	16	
		23	21	27		
			30			

Q sort factor 3 (Utilization)

How often do the nurses in ICU use or implement this statement?

Never Always

-3	-2	-1	0	1	2	3
17	3	2	6	4	7	1
20	24	8	10	5	12	14
27	25	15	11	9	16	30
	29	21	18	13	28	
		23	19	26		
			22			