KNOWLEDGE OF INTENSIVE CARE NURSES ON EVIDENCE BASED GUIDELINES FOR PREVENTION OF VENTILATOR ASSOCIATED PNEUMONIA

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DECLARATION

I, Viviana Paula Ribeiro Gomes, declare that this research report is my own work. It is being submitted for the Degree of Master of Science in Nursing in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other university.

Signature

Signed at Johannesburg

On Friday, 21st May 2010

ABSTRACT

The purpose of this study was to determine the knowledge of nurses working in ICU with respect to evidence based guidelines for prevention of ventilator associated pneumonia. A non experimental, descriptive, correlational and contextual two phase research design was used. The first phase of the study consisted in validating the data collection instrument for applicability to the South African context. The second phase of the study used the instrument validated in phase one to test the knowledge of nurses working in ICU. Data analysis was done by means of descriptive and inferential statistics using frequency distributions, cross-tables, means, standard deviations and Pearson correlation coefficient.

The knowledge of 83 nurses working in ICU from two hospitals of the private health sector and one hospital of the public health sector in Gauteng was tested using the data collection instrument validated by ICU nursing experts. Knowledge of ICU trained and non ICU trained nurses working in ICUs of the three hospitals was found to be lacking in the evidence based guidelines for prevention of ventilator associated pneumonia. Of the 83 participants, 18 (21.69%; CI 95% 13.4% ; 32.1%) achieved a pass mark of 70% on the multiple choice part of the questionnaire and were considered to have adequate knowledge on the evidence based guidelines for prevention of VAP. The mean score of participants was 4.25 (SD 1.537 CI 95% 3.92; 4.59) on nine questions. The difference in the mean average score of ICU trained nurses and non ICU trained nurses was very similar demonstrating no statistically significant difference in the knowledge of the two groups of nurses. A weak correlation between years working in ICU and knowledge was found, but this correlation may be clinically insignificant.

Recommendations to address this lack of knowledge of ICU nurses were given for clinical nursing practice, nursing education as well as for nursing research.

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CHAPTER ONE

OVERVIEW OF THE STUDY

1.1 INTRODUCTION

This chapter will provide an overview of the study. A description of the background of the study will be given as well as a statement of the problem, purpose and objectives of the study, including its significance. The researcher's assumptions, relevant definitions and an overview of the research process will be discussed.

1.2 BACKGROUND OF THE STUDY

The use of evidence-based practice and guidelines improves the quality of patient care and closes the gap between research outcomes and practice (Dontje, 2007). To discuss the evidence based guidelines for the prevention of ventilator associated pneumonia (VAP) one has to first understand what is Evidence Based Practice (EBP) and how it relates to nursing care. Evidence based practice is the use of current research evidence combined with clinical expertise as well as patient values to formulate sound interventions that ultimately improve the quality of patient care (Dontje, 2007).

According to Dontje (2007), the first step in the evidence based process is to identify a problem in current practice which would represent a trigger for change in practice. The first step is followed by the second step which entails a review and critique of relevant literature. The third step is to identify research evidence that supports the change in clinical practice. The final step is to implement the change in practice and monitor the outcomes.

Evidence based practice and nursing can be embraced and jointly practiced without losing the art and the caring side of nursing while still providing care that is individualized and patient centred.

The process of evidence based practice resembles the components of the nursing process (Collins, Golembeski & Selgas, et al., 2007) which include:

- Identifying the clinical practice question or problem;
- Assessing the clinical appraisal components;
- Planning the implementation;
- Implementing the practice change; and
- Evaluating the practice change.

By looking at the above steps one can link the evidence based practice (EBP) process to the nursing process and easily find the similarities between the two. In other words, the EBP process would not be such an unknown measure for nurses in the management of critically ill patients. The use of evidence based practice can improve the processes, outcomes and costs of clinical care (Muscedere, Dodek & Keenan, et al., 2008).

As a registered nurse working in an intensive care unit in South Africa, I observed that ventilator associated pneumonia is a problem that greatly affects mechanically ventilated patients. It impacts greatly on their illnesses and outcomes leading to death.

Ventilator associated pneumonia is defined as a type of pneumonia in a patient receiving mechanical ventilation that was not present at the time of admission to hospital or that occurs 48 hours after intubation and mechanical ventilation. It is characterized by a new or a progressive pulmonary infiltrate, fever, leukocytosis and purulent tracheobronchial secretions (Hixon, Lou Sole & King, 1998; Munro, Grap, Elswick, et al., 2006)). It accounts for 47% of infections in intensive care unit's patients and complicates the course of 8% to 28% of mechanically ventilated patients

(Cason, Tyner & Saunders, et al., 2007). The mortality rate generally ranges from between 24% and 50% and may be as high as 74% in high risk populations (Grap, Munro & Ashianti, 2003).

Intubation and mechanical ventilation both increase the risk of bacterial pulmonary infection because the invasive endotracheal tube allows direct entry of bacteria into the lower respiratory tract since the tube is located in the trachea. Bacterial colonization in the respiratory tract is further facilitated by the absence of the cough reflex and excessive mucus secretion in the mechanically ventilated patient (Grap, Munro & Hummel, et al., 2003). Prolonged ventilation increases the risk of ventilator associated pneumonia and increases hospital stay, which dramatically increases mortality rates. The frequency of VAP in the intensive care setting is high and VAP's negative impact on patient outcomes and resource utilization is huge (Hugonnet, Uckay & Pittet, 2007).

Evidence based guidelines have been created in an attempt to find a solution to the problem of ventilator associated pneumonia. These guidelines incorporate a number of evidence based strategies proved in the literature to decrease ventilator associated pneumonia and increase positive patient's outcomes. There are 21 strategies for prevention of VAP and these are divided into 10 physical strategies, three positional strategies and eight pharmacological strategies (Muscedere, et al., 2008).

The physical strategies include:

- Route of endotracheal intubation
- Systematic search for maxillary sinusitis
- Frequency of ventilator circuit changes
- Airway humidification: type of humidifier
- Airway humidification: frequency of humidifier changes

- Endotracheal suctioning system: closed vs. open
- Endotracheal suctioning system: frequency of change
- Subglottic secretion drainage
- Timing of tracheostomy
- Use of bacterial filters

The positional strategies include:

- Kinetic bed therapy
- Semi recumbent positioning
- Prone positioning

The pharmacological strategies are:

- Prophylactic aerosolized antibiotics
- Prophylactic nasal antibiotics
- Prophylactic intravenous antibiotics
- Prophylactic topical/ topical plus intravenous antibiotics
- Oral decontamination with chlorhexidine
- Oral decontamination with povidone – iodine
- Oral decontamination with iseganan
- Prevention of maxillary sinusitis

The guidelines which incorporate all the above strategies were created by a multidisciplinary panel composed of intensivists, infectious disease specialists, intensive care nurses, an infection control

nurse, an ICU pharmacist and respiratory therapist as well as a representative from the Canadian Patient Safety Institute.

Intensive care nurses are in the best position to put the evidence based guidelines into practice as they are at the patient's bedside 24 hours a day and therefore they play an important role in the prevention of VAP (Biancofiore, Barsotti & Catalani, 2007). Nevertheless nurses need to have an awareness of the problem as well as knowledge on evidence based guidelines so as to adhere to such practices.

In the South African context where there is shortage of nursing staff , skilled and knowledgeable nurses are extremely important and needed to make appropriate decisions in patient care and minimize risks to patients. Knowledge on evidence based practices should bring confidence to intensive care nurses to make appropriate decisions and prevent poor outcomes in the recovery of mechanically ventilated patients.

Unfortunately little is known about the degree of nursing knowledge on evidence based guidelines for the prevention of ventilator associated pneumonia and about factors that can contribute or represent barriers to their implementation. Understanding the importance of recommended practices increases the likelihood of adherence and may overcome barriers to implementation. If the nurse does not have enough knowledge on measures proven to decrease VAP rates she may not have the necessary confidence to take action and make decisions regarding such practices. Patient recovery may be delayed and other risks of complications from mechanical ventilation can be prevented.

Prevention and control of ventilator associated pneumonia are dependant on education and awareness of ICU staff towards the problem and on the application of evidence based strategies (Biancofiore, et al., 2007). Adherence to the evidence based guidelines on prevention of ventilator

associated pneumonia will occur once staff involved directly with the patient's care has knowledge of such guidelines and can put them into practice.

This study aims at evaluating intensive care nurses' knowledge of evidence based guidelines for VAP so that adherence and implementation of the guidelines becomes a prerogative in intensive care units in South Africa. The same study has been done previously in Belgium and Italy. The researcher replicated the previous study done in Belgium using the same evaluation questionnaire with exception of a few modifications that were done for applicability to the South African context.

1.3 PROBLEM STATEMENT

Ventilator associated pneumonia is a problem in intensive care units worldwide and dramatically increases morbidity and mortality rates on mechanically ventilated patients. It is the most common infectious complication among patients admitted to intensive care units (Cason, et al., 2007). When VAP occurs, it prolongs the ICU length of stay, ultimately increasing hospital stay and the risk of death in critically ill patients. VAP is also associated with an increased duration of mechanical ventilation and increased health care costs due to an increased ICU and hospital length of stay.

However, ventilator associated pneumonia is preventable and evidence based guidelines for prevention of VAP have been shown internationally to reduce its' incidence and burden on patient's outcomes. Knowledge of evidence based guidelines on the prevention of VAP and adherence to them would reduce the risk of occurrence of VAP and decrease morbidity and mortality of mechanically ventilated patients in the ICU.

Critical care in South Africa is growing rapidly in conjunction with technology and it is catching up with developed countries guidelines and standards of care. Nursing shortage, however, is a burden

and intensive care nurses are in huge demand in South Africa. The few intensive care nurses still practicing need to constantly update themselves with current knowledge and scientific evidence on many issues existent in the ICU, including VAP. Little is known regarding intensive care nurses' knowledge of such guidelines and it's application during the provision of patient care in South Africa.

No studies on knowledge of intensive care nurses on evidence based guidelines for VAP has yet been done in South Africa. Therefore it is important to evaluate intensive care nurse's knowledge and to highlight possible contributors and barriers to the implementation of evidence based guidelines on prevention of ventilator associated pneumonia, which is what this study is aiming to achieve.

1.4 RESEARCH QUESTIONS

The following research questions are posed:

- Do intensive care nurses have knowledge on evidence based guidelines for prevention of ventilator associated pneumonia?

- Are the evidence based guidelines for prevention of ventilator associated pneumonia being implemented in the intensive care units and what are the contributors and barriers to the implementation of the evidence based guidelines for prevention of ventilator associated pneumonia?

- Do training, age and years of experience in ICU influence knowledge levels of intensive care nurses on evidence based guidelines for prevention of ventilator associated pneumonia?

1.5 PURPOSE OF THE STUDY

The purpose of the study was:

- To evaluate and describe intensive care nurse's knowledge of evidence based guidelines for the prevention of ventilator associated pneumonia in intensive care units from private and public sectors in Gauteng.

1.6 RESEARCH OBJECTIVES

To meet the purpose of the study, the research was conducted in two phases with the following objectives:

Phase one:

- To validate the instrument "*Evaluation questionnaire concerning intensive care nurses knowledge of interventions for prevention of ventilator associated pneumonia*" to assess ICU nurses' knowledge on evidence based guidelines for prevention of VAP.

Phase two:

- To determine and describe intensive care nurse's knowledge of evidence based guidelines for the prevention of ventilator associated pneumonia in intensive care units from the private and public sectors in Gauteng.
- To determine possible contributors and barriers to the implementation of evidence based guidelines for prevention of ventilator associated pneumonia.

- To establish if there is any correlation between training as well as years of experience and knowledge of intensive care nurses on evidence based guidelines of prevention of ventilator associated pneumonia.

1.7 SIGNIFICANCE OF THE STUDY

Mechanical ventilation is one of the major supportive modalities in the intensive care unit but it carries a lot of risks and complications, the most common one being ventilator associated pneumonia. The lungs are usually amongst the major organs involved in multiple organ failure and thus the challenge of delivering appropriate ventilation with as little complications as possible is extremely important (Hugonnet, et al., 2007).

To ensure the highest standards of nursing care, nursing practice must be based on a strong body of scientific knowledge. This can be achieved through adherence to the evidence based guidelines for prevention of ventilator associated pneumonia, ultimately improving patients outcomes. Improved outcomes will shorten patient's ICU length of stay, hospitalization as well as benefit the patient financially with decreased hospital costs. Hospitals also gain benefits as they are continually faced with the challenge of providing cost effective services to patients and communities.

1.8 RESEARCHER ASSUMPTIONS

This study was based on the following metatheoretical, theoretical and methodological assumptions:

1.8.1 Meta theoretical assumptions

- **The individual**

The ICU patient is a member of a family and therefore the patient and family members are all individuals needing care during hospitalization. The ICU patient is a person in a critical and unstable condition needing specialized care to meet his needs. The patient's family is the patient's support and reference but may be needing support and care themselves at the time of critical illness of one of its members. The patient is a holistic being who has a physical, psychological, social and spiritual aspects which may all be in need of care. The patient is dependant on knowledgeable professionals for safe implementation of all therapeutic interventions.

- **The nurse**

The nurse is central to the context of this study. The nurse is the professional whom the patient is dependant on and who needs to have updated knowledge and skills to provide best nursing practice. Knowledge and caring goes together in the nursing profession and quality of care depends on both components and not only one of them. Intensive care nurses are qualified and specialized nurses who require high levels of decision making. To guide the decision making process, protocols and guidelines are being used more frequently in intensive care units and these instruments provide the reference on which decisions can be based on, but it is essential that intensive care nurses are able to analyze each individual situation and are able to choose what is the best intervention to take at the time. This relates to the holistic care concept in nursing where each patient is an unique individual with unique needs and not only the physical body must be taken into consideration during nursing care, but also the patient's mind and soul.

- **The society**

Society expects quality health care from health professionals, where quality standards are met as well as all patient's needs. It expects care that entails all aspects of health and with no complications during hospitalization. Health care provision is a basic right of all citizens in South Africa but the reality is of limited distribution of resources, especially in the public health sector.

- **Health**

Health is a state of absence of illness, in which physical and psychological stability and balance are maintained. In the ICU setting, restoration of health is aimed at stabilization of patient's condition so that it becomes a manageable disease, however, the results of intensive care interventions cannot always be foreseen. The patient in ICU is usually critically ill and health is restored with the use of complex technological resources and knowledge and skills of intensive care nurses and doctors.

1.8.2 Theoretical assumptions

This refers to the theoretical operational definitions of terms used in this study:

Intensive care unit	A special area in a hospital where critically ill patients who need close observation and frequent ministrations can be cared for by highly qualified, specially trained staff working under the best possible conditions. Abbreviated ICU (Blackwell's Dictionary of Nursing, 2002).
Intensive care nurse	Registered nurse specialized and trained with knowledge and skills in the field of intensive care nursing and critical thinking, able to provide specialized nursing care to critically ill patients (Blackwell's Dictionary of Nursing, 2002).
Ventilator associated pneumonia	A nosocomial pneumonia in a patient on mechanical ventilatory support by endotracheal tube or tracheostomy for more than 48 hours (Cason, et al., 2007).

Evidence based guidelines	Systematically developed statements derived from systematic reviews based on best research evidence of clinical effectiveness which assist in decision making about appropriate healthcare for specific clinical conditions (Muscedere, et al., 2008).
Evidence based nursing practice	Provision of care that uses empirical knowledge with application of available data and research to understand and make better clinical decision making (Pravikoff, Tanner, Pierce et al., 2005).
Knowledge	Awareness or familiarity gained by experience; a theoretical or practical understanding of a subject (The Concise Oxford Dictionary, 1990)
Adherence	Behaviour according to plans/standards, followed in detail. (The Concise Oxford Dictionary, 1990)
Private health sector	Small portion of health sector that provides from primary health care to specialized health services. It is run largely by commercial lines, caters to middle and high income earners who are usually members of medical schemes. (http://www.hst.org.za/uploads/files/sahr05_chapter3.pdf) Accessed 22.09.2009
Public health sector	Largest health sector where health care provided varies

from most basic primary care, offered free by the state to more specialized care, where the state contributes a portion of all expenditure.
(http://www.hst.org.za/publications/410)
Accessed 22.09.2009

1.8.3 Methodological assumptions

The researcher believes in a holistic approach to nursing that includes all aspects of health such as the physical, social and spiritual. In order to provide holistic care, therapeutic interventions are used to promote health in all aspects and the knowledge of such interventions needs to be constantly rechecked and updated. The way to achieve this is through research: a diligent, systematic inquiry to validate and refine existing knowledge and generate new knowledge (Burns & Grove, 2007) which ultimately leads us to evidence based practice. Evidence based practice promotes positive patient outcomes through quality, safe and cost effective care.

The researcher believes that the research process is quite similar to the nursing process, nevertheless it has a broader focus and involve the rigorous application of a variety of research methods. When performing research, the researcher must be knowledgeable about the problem under discussion. According to Burns & Grove (2007), this knowledge is obtained from clinical experience and by conducting a review of the literature.

Each step of the research process was undertaken by the researcher. A problem was identified in the intensive care unit, a purpose for the study was outlined as well as research objectives. A research design was chosen and followed through, population and sample were collected and a instrument

for measurement validated and used for data collection. Data were analysed and research outcomes followed.

In this study, the researcher described evidence based practice and the evidence based process. A valid, ethical and reliable study was done based on previous studies of the same topic, which makes this a replication study.

1.9 METHODOLOGY

The aim of this study was to evaluate and describe intensive care nurses' knowledge of evidence based guidelines for prevention of ventilator associated pneumonia and to highlight possible contributors and barriers to the implementation of the evidence based guidelines. The sample included intensive care nurses from three health care institutions, one from the public health sector and the two from the private health sector in Gauteng.

A replication study was done using a non experimental, descriptive, correlational and contextual two phase research design to evaluate intensive care nurses' knowledge on the evidence based guidelines for prevention of VAP as well as to highlight the possible contributors and barriers to the implementation of the guidelines.

Phase I of the study entailed validation of the researcher's modified *"Evaluation questionnaire concerning intensive care nurses' knowledge on interventions for prevention of ventilator associated pneumonia"*. Validation of the modified instrument was achieved through discussion with ICU nursing experts and specialist nursing educators.

Phase II of the study comprised of the data collection phase. The validated questionnaire was distributed amongst the participants and was collected daily by the researcher. Data were analysed by means of descriptive and inferential statistics. Figure 1.1 presents a flow chart with an overview of the research plan.

Knowledge of ICU Nurses regarding evidence based guidelines on prevention of ventilator associated pneumonia

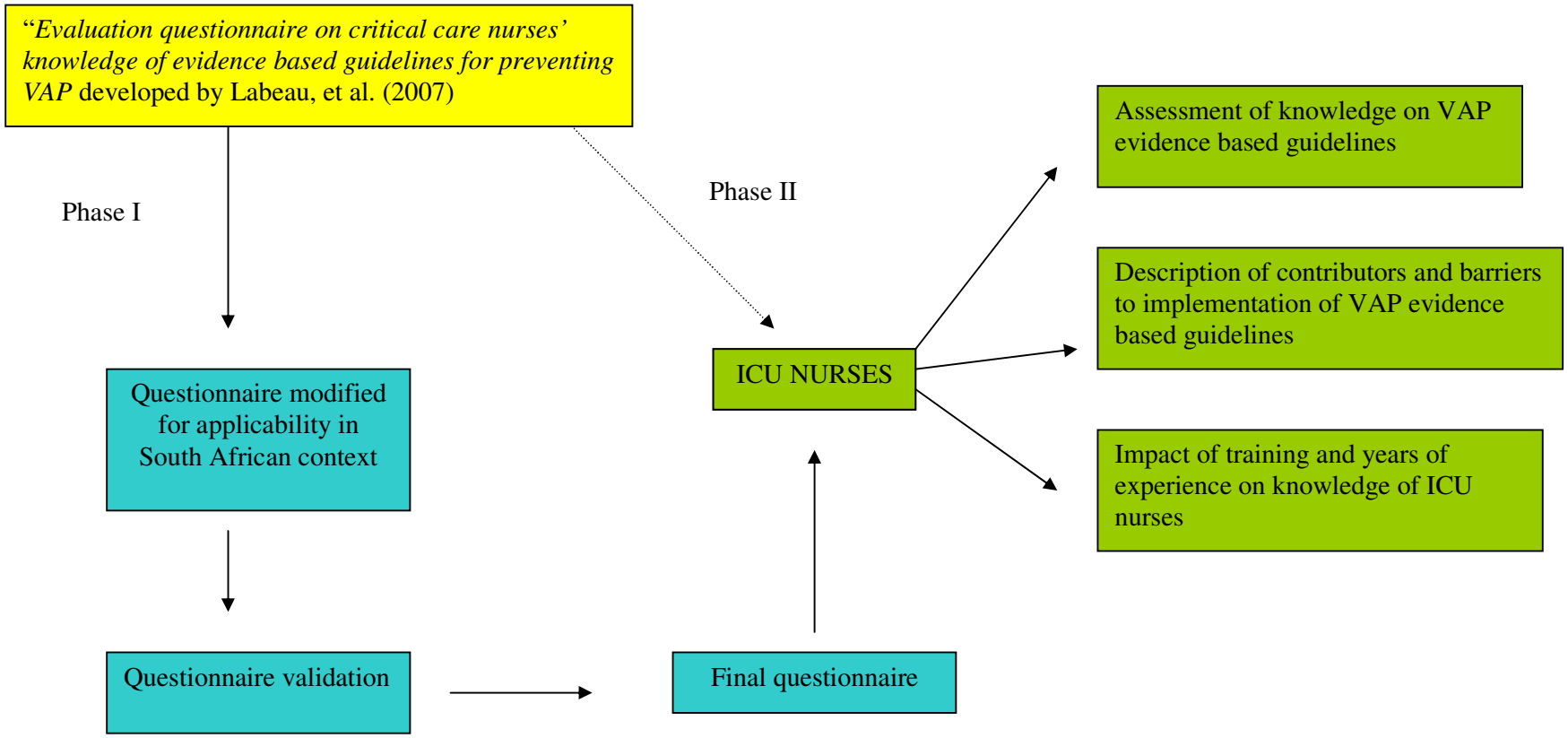


Figure 1.1: Overview of the research plan

1.9.1 Phase I

1.9.1.1 *Research design*

- Phase I of the study involved validation of the modified questionnaire based on the "*Evaluation questionnaire on critical care nurses' knowledge of evidence based guidelines for preventing ventilator associated pneumonia"* by Labeau (2007) and "Q*uestionnaire concerning intensive care nurses knowledge of interventions for prevention of ventilator associated pneumonia*" by Biancofiore (2007).

- Both questionnaires had been validated and used previously in other countries and the researcher combined both questionnaires to compile the data collection tool. A few modifications were made by the researcher for applicability to the South African context.

1.9.1.2 Population

The population of Phase I of the study comprised experts in ICU and nursing education consisting of experienced ICU nurses currently working in intensive care units of private and public sector hospitals and specialist nursing educators from nursing colleges and tertiary institutions and ICU clinical facilitators from a private sector hospital.

1.9.1.3 Sample and sampling method

In this phase, a non probability purposive sampling was used to select experts to validate the data collection instrument to ensure applicability of the instrument to the South African context. Six nurses specialized in ICU as well as specialists in nursing education were invited to participate in a

focus group for the instrument validation process. Of the six experts invited to participate only five took part in the study.

Inclusion criteria for the expert group was:

- Intensive care nurses working in either trauma, cardiothoracic, medical, surgical, neurological or a multidisciplinary ICU of two hospitals in the private and public health sectors.
- Nurses with expert knowledge (with a Master's Degree or Diploma) in ICU or nursing education from nursing colleges and university.

1.9.1.4 Instrument

The instrument is based on two validated and reliable questionnaires that were developed to evaluate nurse's knowledge of VAP prevention evidence based guidelines. The "*Evaluation questionnaire on critical care nurses' knowledge on evidence based guidelines for preventing ventilator associated pneumonia*" by Labeau (2007) had been used previously during an annual congress of the Flemish Society for Critical Care Nurses in November 2005. This questionnaire included demographic data such as gender, years of intensive care experience and whether respondents have a degree or diploma in intensive care nursing.

In the first part of the modified questionnaire, nine strategies with relevance to nursing practice and known in the literature to prevent VAP were listed and participants had 4 response alternatives: the correct response and three other alternatives that are not correct, which includes the option "I don't know" to avoid participant's playing a chance or gambling and other two options with investigated preventive value in VAP. If a participant left any question without being answered it was considered that the participant did not know the answer.

Interventions such as oral hygiene was not included in the questionnaire, despite being relevant to nursing practice, because the evidence based interventions added were from the systematic review by Dodek, et al (2004) and did not include frequency of oral care or describe the best way of providing oral care. Further research is still needed to determine the ideal frequency and timing of oral hygiene practices in patients receiving mechanical ventilation (Grap, et al., 2003).

The second part of the modified questionnaire was based on the questionnaire by Biancofiore (2007) which had been used previously in an Italian study also aiming at evaluating nurses' knowledge and to highlight causes that hinder guidelines' implementation. This part of the modified questionnaire asked respondents to state if they use strategies listed by using YES or NO answers and describe how frequently they use them. In case of strategies not being used seven possible reasons were stated. The respondents were requested to select the most appropriate reasons. Lastly the participant was asked if he/she thinks that he/she is sufficiently informed about the prevention of ventilator associated pneumonia in mechanically ventilated patients. An open ended question at the end of the questionnaire assessed factors that contribute to the implementation of the guidelines.

1.9.1.5 Data collection

- Nursing experts who met the inclusion criteria were sent an information letter (Appendix I) and were invited to participate in the study.

- The data collection tool (Appendix III) was sent to the participants and their feedback with regards to the validity of the instrument and its applicability to the South African context was taken.

- For content validity, nursing relevance of all items in the questionnaire was assessed by scoring items on a scale of 1 to 3: 1 = not relevant; 2 = relevant, but not necessary; 3 = absolute necessary.

- For face validity, participants were asked if the questionnaire was clearly worded, well explained and if it addressed what it was meant to address.

1.9.1.6 Data analysis

Validation of the researcher's modified questionnaire and it's applicability to the South African context was done in this phase of the study. Validation of the modified questionnaire was achieved by individual discussions with five ICU experts. Agreement was based on the importance of each question to clinical practice and what interventions have an impact on nursing practice and the prevention of VAP.

1.9.2 Phase II

1.9.2.1 Research Design

- In Phase II of the study a survey was carried out using the now validated "*Evaluation questionnaire concerning intensive care nurses knowledge of interventions for prevention of ventilator associated pneumonia*" to test intensive care nurses knowledge on evidence based guidelines for prevention of ventilator associated pneumonia (VAP) and to describe contributors and barriers to the implementation of the guidelines for prevention of VAP.

- Intensive care nurses were approached at one public and two private health sector hospitals and the objectives and aim of the study were explained. They were asked to participate in the study and were told that participation was voluntary and would not influence on their jobs. Nurses were also explained that anonymity and confidentiality would be maintained.

- Hospitals from both private and public health sectors were chosen so a larger sample of intensive care nurses would be obtained.

1.9.2.2 Population

The population of phase II of the study involved nurses working in six intensive care units of the two private sector hospitals and of another four intensive care units of the public sector hospital. A total of ten intensive care units in the public and private sectors were the context of this study.

1.9.2.3 Sample and sampling method

The sample comprised of nurses working in the ten intensive care units. A statistician decided on a sample number of 81 participants to provide a representative sample of the population in this phase of the study. A non probability purposive sampling method was used to select nurses provided they were suitable and fitted in the inclusion criteria of the study. Private and public sectors were chosen to be included in the study as a larger number of sample would be achieved by including both sectors.

Inclusion criteria for prospective participants included:

- Registered nurses with an ICU qualification, including permanent and agency staff working in all ten units in public and private sectors. Intensive care nurses from public and private sectors were chosen as they work interchangeably in both sectors.

- Registered nurses with no formal training in ICU working in all ten units. These nurses were included as they are in close contact with mechanically ventilated patients and need to be familiar with ventilator associated pneumonia and the current evidence based guidelines for prevention of VAP.

Exclusion criteria included:

- Enrolled and auxiliary nurses as their category of nursing are not expected to have skills and in depth knowledge of mechanical ventilation and evidence based guidelines on prevention of VAP.

1.9.2.4 Data collection

- Permission was requested from the institutions' management where the study was conducted using a letter of request for research conduction at each institution (Appendices IV, V, VI). Once permission was obtained, the unit managers were approached for permission to conduct the study in their respective units (Appendix VII).

- Nurses working in the chosen intensive care units were told that the purpose of the study was to evaluate and describe nurses' knowledge on evidence based guidelines for prevention of ventilator associated pneumonia and to highlight possible contributors and barriers to the implementation of these evidence based guidelines in order to make recommendations regarding nursing practice, education and further research.

- An information letter (Appendix II) was given to prospective participants and the questionnaire was distributed by the researcher to nurses that had consented in participating in the study. A consent form (Appendix VI) was signed by nurses participating in the study. Completed questionnaires were placed into sealed envelopes and collected by the researcher from each unit weekly.

1.9.2.5 Data analysis

Descriptive and inferentiall statistics were used to evaluate and describe intensive care nurses' knowledge on evidence based guidelines on prevention of VAP.

An appointment with a statistician was made to analyse results obtained after data collection and to assess intensive care nurses' knowledge of evidence based guidelines on prevention of ventilator associated pneumonia.

An overview of the study methodology is provided in chapter 1. Please refer to chapter 3 for details pertaining to methodology.

1.10 RELIABILITY AND VALIDITY

The modified questionnaire was handed out to ICU nurses and nursing educators to assess validity of the modified instrument and its applicability to the South African context. Content validity was achieved by having the modified questionnaire reviewed by the nursing experts. Nursing relevance of all items was assessed by scoring the items on a scale of 1 to 3: 1 = not relevant; 2 = relevant, but not necessary; 3 = absolutely necessary.

To ensure face validity it was discussed if the questionnaire is clearly worded, well explained and if it addresses what it is meant to address: knowledge of ICU nurses on EBG's for prevention of VAP and contributors and barriers to implementation of such guidelines. To evaluate the level of difficulty of the questionnaire, ICU nurse specialists were asked to answer the questionnaire and the proportion of respondents who answered the questions correctly was assessed.

Reliability was maintained by ensuring consistency and accurate recording of data. Data collection was only done by the researcher. The sample size decided by the statistician was achieved and no mention of ICU trained and non ICU trained nurses was made until data was analysed.

A more in depth study with a larger sample size and including a larger number of units and hospitals could be done in future to allow for a more representative sample of the population studied.

An overview of reliability and validity is provided in chapter 1. Please refer to chapter 3 for details pertaining to validity and reliability.

1.11 OUTLINE OF THE STUDY

Chapter one: Overview of the study

This chapter provides an overview of the study and includes the background of the study, the purpose and problem statement, the aim and objectives, the significance of the study, the researcher's assumptions and relevant definitions and concludes with a brief overview of the research process.

Chapter two: Literature Review

In this chapter, a review of the literature relevant to the various aspects of the topic of this study is covered.

Chapter three: Research Methodology

This chapter describes the research methodology used in this study including the research design, setting, inclusion and exclusion criteria, sampling process and data collection procedures. The study is divided into two phases.

- Phase I: validation of the researcher's data collection instrument with ICU nursing experts and specialists in nursing education.
- Phase II: survey amongst intensive care nurses in five intensive care units in two hospitals of the public and private health sectors in Gauteng.

Chapter four: Data analysis and discussion of results

In this chapter the results of phase II of the study are presented and discussed in detail.

Chapter five: Summary, conclusions, limitations and recommendations.

In this chapter, a summary and conclusions of the main findings are presented, followed by a discussion of the limitations of the study as well as recommendations for clinical practice, nursing education and further research in this area.

1.12 CONCLUSION

Ventilator associated pneumonia is a current problem in intensive care units that increases morbidity and mortality amongst critically ill patients. However it is a problem that can be prevented if only intensive care staff, especially ICU nurses, who are next to the patient's bedside 24 hours a day are aware of existent measures to prevent such complication.

Adherence to guidelines that have proven to decrease the incidence of ventilator associated pneumonia is extremely important to allow minimal complications and increase positive outcomes to patients and families. If the knowledge level on evidence based guidelines on prevention of VAP of nurses working in ICU's is known it will facilitate educational strategies to assist nurses in their role of providing safe care to patients as well as for further development in nursing as an evidence based practice.

In this chapter, an overview of the research has been given including the background of the study, the statement of the problem, the purpose, aim and objectives as well as the importance of the study. In addition, the research assumptions were defined.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

Evidence based practice is currently one of the most important ways, if not the most important way, to provide best quality care to patients in the intensive care unit. As technology and research in health care expands, evidence based practice (EBP) is becoming essential in delivering high quality care to critically ill patients (Hockenberry,Wilson & Barrera, 2006).

Evidence based practice has become a very important tool in the prevention of nosocomial infections in the intensive care unit. The most common and frequent nosocomial infection in the critically ill patient – ventilator associated pneumonia – can be prevented by the use of evidence based strategies, which ultimately increases positive outcomes to patients (Ricart, Lorente & Diaz, et al., 2003).

Therefore, it becomes extremely important that intensive care nurses have knowledge of such strategies and are able to implement evidence based nursing in the intensive care units, aiming at achieving high quality care as well as optimal outcomes for their patients.

This chapter begins by providing an insight into the evidence based process and how it relates to nursing practice and the nursing process. Evidence based guidelines for prevention of ventilator associated pneumonia will also be addressed. The problem of ventilator associated pneumonia and its impact on critically ill patients as well as the knowledge levels of nurses on the evidence based guidelines for prevention of VAP will also be discussed.

2.2 EVIDENCE BASED PRACTICE AND THE NURSING PROCESS

There has been a need in the medical and nursing fields to move away from the conservative culture of making decisions according to past practice and opinions to the incorporation of evidence based research into clinical decision making. The use of evidence based practice and guidelines improve the quality of patient care and closes the gap between research outcomes and practice (Dontje, 2007).

With the abundance of information easily accessible through the internet and its use as a knowledge tool, it is important that intensive care nurses become familiar with the available evidence and its application to daily patient care. Intensive care nurses should understand the concepts of EBP and integrate research findings into practice.

Evidence based practice ensures up to date information about best clinical practices in a rapidly changing environment. Health care professionals may have always used personal experience or data from recent articles to make a clinical decision, but evidence based research and practice looks at the evidence in the most systematic and objective way as possible.

The traditional nursing process approach to nursing care can be used to conceptualize the essential components of the evidence based process (Hockenberry, et al., 2006). Both processes are very similar, therefore the familiarity with the nursing process allows nurses to easily apply the evidence based process in the ICU. Both processes start at establishing important questions about the problem and a critical review of existing knowledge to deal with the problem. The clinical question is asked in a concise manner that allows for clear answers. Once the specific questions are identified, an extensive search for the best information to answer the questions begins. The third step in the nursing process is to develop a plan of care. In the evidence based process, the plan of

care is established upon a completion of a critical appraisal of what is known and not known about the identified problem. By integrating evidence with clinical expertise, care is focused on the individual patient. The final step in the evidence based process is consistent with the final phase of the nursing process: evaluation of the effectiveness of the care implemented. Table 1 demonstrates the steps of each process and their similarities can be identified.

Table 2.1: The Nursing Process and Evidence-Based Practice

Nursing process	Actions	Evidence based process	Actions
Assessment	Collects patient data	**Asking the question**	Clearly identifies patient needs/problem
Diagnosis	Analyzes assessment data and determine nursing diagnosis	**Searching for evidence**	Collects information relevant to the problem
Outcome identification	Develop and prioritize patient-centred goals and measurable outcomes	**Summarizing the evidence**	Organizes literature for review
Planning	Develops a plan of care	**Analyzing the evidence**	Critically appraises the published literature
Implementation	Initiates the interventions identified in the plan of care	**Applying the evidence to practice**	Integrates evidence with clinical expertise and patient's individual needs
Evaluation	Evaluates the patient's progress towards attainment of outcomes	**Evaluating the effectiveness**	Evaluates the effectiveness of integration of evidence

When putting evidence into practice, the first step for every health care professional is to identify the practice's related question or problem. This question should particularly identify the target population, outcomes, patient values and possible interventions. The next step is to perform an extensive literature search of published and, when available, unpublished research data that might answer the question. All identified data should then be evaluated for methodological rigor. Finally, analysis of relevant data should provide an answer to the original question (Donald, 2002).

There are various ways to introduce evidence into a practice setting, for example through the development of evidence based protocols or guidelines (Fullbrook & Mooney, 2003). One must bare in mind though that evidence based practice also has limits and despite the use of protocols and guidelines, treatment must nevertheless be individualized for each patient. The limitations to evidence based practice may include the lack of data to answer some clinical questions, difficulty in applying research results to the general population, the need for quick access to resources and time limitations during clinical practice (Donald, 2002).

The intensive care nurse is in a favourable position to promote evidence based practice. The use of guidelines has the potential to expand the role of the nurse and therefore it is important to ensure that nurses working with them are competent and confident to do so. As nurses are accountable for their actions they need to be responsible in using evidence based guidelines correctly and accurately.

In summary, evidence-based practice calls for the practitioner to thoroughly search the peer-reviewed literature that reports scientific studies, critically evaluate these reports for their validity and importance, and convert the data they report into probabilities that can help clinicians, nurses, other health care professionals and patients reduce the uncertainty that surrounds decisions about diagnosis, treatment, and prognosis.

2.3 VENTILATOR ASSOCIATED PNEUMONIA

Ventilator associated pneumonia is defined as a pneumonia in a patient receiving mechanical ventilation that was not present at the time of admission to hospital or that occurs 48 hours after intubation and mechanical ventilation. It is characterized by a new or a progressive pulmonary infiltrate, fever, leukocytosis and purulent tracheobronchial secretions (Cason, et al., 2007).

VAP is the most common nosocomial infection in critically ill patients who require mechanical ventilation (Cason, et al., 2007). It is an important cause of morbidity and mortality in intensive care units. It accounts for 47% of infections in the intensive care unit and it complicates the course of illness of 8% to 28% of mechanically ventilated patients (Cason, et al., 2007). Mortality rates reach 24% to 50% and 74% in high risk patients such as the elderly, immunocompromised patients, patients with chronic obstructive pulmonary disease, burns, neurosurgical conditions, acute respiratory distress syndrome and witnessed aspiration (Grap, et al., 2003). Those who are reintubated and those who receive paralytic agents or enteral nutrition are also at high risk for acquiring VAP.

2.3.1 Etiology

In critically ill patients, several factors associated with intubation and mechanical ventilation alter normal defences against infection. The placement of an artificial airway such as an endotracheal tube or a tracheostomy tube alters the host defences and contributes to the development of pneumonia once colonization occurs (Hixon, et al., 1998; Couchman, Wetzig, Coyer, et al., 2007).

Once a patient is intubated, bacteria have direct access to the lower airways because the endotracheal tube bypasses normal filtration mechanisms and the barrier function of the epiglottis. In addition, the endotracheal tube provides a direct route for inoculation of the lungs with bacteria. Inoculation is caused by inadequate hand washing, using the same gloves from patient to patient and contaminated respiratory devices such as nebulizers, spirometers, bag-valve mask devices and suction catheters (Kaynar, Mathew, Hudlin, et al., 2007).

Endotracheal intubation also interferes with natural host mechanisms by reducing the cough effort, interfering with mucocilliary clearance and injuring the epithelial layer, thereby exposing the

basement membrane (Hixon, et al., 1998; Couchman, et al., 2007). This factor plays a key role in facilitating bacterial adherence and colonization. Mucus is normally produced to trap bacteria, which is then removed by mucocilliary clearance. Endotracheal intubation may result in increased production of mucus and stagnation of mucus in the respiratory tract. These factors combined with an impaired mucocilliary clearance increases the risk of VAP.

The pathogens responsible for VAP originate in the patient's endogenous flora or in the hospital environment: other patients, staff members and invasive devices. Most VAP results from aspiration of bacteria colonizing the oropharynx or gastrointestinal tract. The following pathogens account for more than half the cases of ventilator associated pneumonia: *Staphylococcus aureus, Pseudomonas aeruginosa, Enterobacter spp,* and *Klebsiella pneumoniae* (Hixon, et al., 1998; Couchman, et al., 2007). Gram negative bacteria are implicated in more than 60% of all cases. *P. aeruginosa* and *Acinetobacter spp* have been associated with higher mortality rates from VAP (Hixon, et al., 1998; Couchman, et al., 2007). Pathogens differ according to the onset of VAP. Onset of infection can be divided into early and late phases. Early onset VAP is described as that which occurs 1 to 4 days after endotracheal intubation. Organisms responsible for early onset VAP are usually of oropharyngeal species and include *Streptococcus pneumoniae, S. aureus* and *Haemophilus influezae*. Late onset VAP occurs more than 4 days after endotracheal intubation and is usually associated with gram negative bacteria. Causative agents include *P. aeruginosa, Acinetobacter* spp and *Enterobacter* spp (Hixon, et al., 1998; Couchman, et al., 2007).

2.3.2 Pathophysiology

The lung is colonized by nosocomial pathogens in many ways: microaspiration of oropharyngeal secretions, aspiration of gastric contents, direct inoculation into the airways of intubated patients, inhalation of infected aerosols, hematogenous spread of infection from a distant site, and

potentially, translocation of bacteria from the gastrointestinal tract (GIT). Most VAP is associated with the aspiration of bacteria from the oropharynx and GIT (Cason, et al., 2007).

Oropharyngeal secretions commonly become colonized with pathogens, especially gram negative bacteria. Gram negative bacteria are not part of the normal flora of the oropharyngeal tract and their presence in oropharyngeal secretions is a predictor for the development of VAP. Mechanical ventilation requires intubation with a cuffed endotracheal tube or tracheostomy tube. Despite adequate inflation of the cuff, microaspiration often occurs and bacteria from the oropharynx and the GIT can migrate below the endotracheal tube cuff. The endotracheal tube serves as a reservoir of bacteria with secretions that have pooled above and around the cuff leak and enter the trachea. The tube serves as a safe haven from antibiotics and host defence mechanisms, in that they have no access to destroy bacteria. Bacteria form a biofilm within the tube that may be dislodged when suctioning, coughing or moving the tube, increasing the risk of bacterial contamination of the lower respiratory tract (Hixon, et al., 1998; Kaynar, Mathew, Hudlin, et al., 2007).

Although not directly related to aspiration, nasal placement of endotracheal tubes increases the risk for sinusitis. The sinus provides a reservoir from which organisms seed the tracheobronchial tree and bacteria causing sinusitis can colonize the upper airway, increasing the risk of VAP. Infectious sinusitis occurs in 20% to 30% of patients who have been intubated for at least a week (Hixon, et al., 1998).

Most intubated and mechanically ventilated patients have a decreased level of consciousness from disease, injury or sedatives and therefore they are not able to use protective mechanisms such as cough and gag reflexes. The inability to cough or gag when foreign substances are aspirated increases the likelihood of bacterial colonization and VAP. Most critically ill patients have a nasogastric tube, which increases the risk of aspiration through mechanisms such as reflux and

translocation of bacteria as the gastroeosophageal sphincter is violated (Hixon, et al., 1998; Couchman, et al., 2007).

Medications and enteral feeding can alter the acidity of gastric juices, increasing the likelihood of bacterial growth. The use of antacids and H_2 receptor-antagonists has been identified as contributing factors for the development of VAP (Hixon, et al., 1998; Couchman, et al., 2007). These drugs are prescribed in critically ill patients for stress ulcer prophylaxis and they increase the pH of gastric secretions which affects the normal flora of the gastrointestinal tract allowing pathogens to proliferate. Duodenal reflux and gastric pH higher than 3.5 have been associated with increased bacterial colonization of the lower respiratory tract (Hixon, et al., 1998; Couchman, et al., 2007). There is still controversy as to the use of antacids and H_2 receptor antagonists to prevent stress ulcers in critically ill and mechanically ventilated patients.

2.3.3 Clinical presentation

Ventilator associated pneumonia (VAP) is characterized by (Muscedere, et al., 2008) :

a) a new or a progressive pulmonary infiltrate,
b) fever,
c) leukocytosis and
d) purulent tracheobronchial secretions

Patients with ventilator associated pneumonia have clinical evidence of a new and persistent radiographic infiltrate plus two of the following:

a) a body temperature of > 38 degrees Celsius or < 36 degrees Celsius;

b) white blood cells count > 10.000 or < 4.000;

c) macroscopically purulent tracheal aspirate; and

d) additionally it is required that patients have microbiological confirmation by growth of >10000 colony-forming units/ml of a microorganism on bronchoscopic culture; or

e) the isolation of a potential pathogen from the blood culture (unrelated to another source).

2.3.4 Diagnosis

The diagnosis of VAP is challenging. Bedside evaluation using clinical and radiographic criteria for the presence of VAP is neither specific or sensitive (Muscedere, et al., 2008).

2.3.4.1 Clinical Diagnostic Criteria

Clinical diagnosis for VAP is based on the Center for Disease Control criteria: new or progressive pulmonary infiltrates detectable on chest radiograph, fever higher than 38 degrees Centigrade or less than 36 degrees Centigrade, leukocytosis and purulent tracheal secretions after 48 hours of intubation and mechanical ventilation.

These criteria are often inadequate in confirming a diagnosis of VAP, because infiltrates can occur from atelectasis and other pulmonary conditions and also because in most critically ill patients, fever and leukocytosis will develop.

2.3.4.2 Non invasive/non bronchoscopic methods

These techniques are used by obtaining the specimen via the endotracheal tube, using either a specimen brush or a specially designed suction catheter. These methods take less time to obtain and

the procedure is more cost effective to perform. The sputum is then sent for Gram's stain and/or culture and sensitivity tests, which facilitates the decision of what antibiotic to use (Muscedere, et al., 2008).

2.3.4.3 Bronchoscopic methods

These methods are invasive, have associated risks and thus have not been adopted for the routine clinical diagnosis of VAP. There are two bronchoscopic methods in diagnosing VAP, mainly protected specimen brush and broncoalveolar lavage (Hixon, et al., 1998; Augustyn, 2007).

In protected specimen brush (PSB), a catheter is inserted through the bronchoscope into the area of the lung in which pneumonia is suspected. Using a microbiology specimen brush, a sample is obtained by expressing and retracting the inner cannula and brush. The brush tip is placed in a small amount of sterile, preservative-free saline and is processed. Test results are considered positive if organisms grow at 103 colony-forming unit (CFU)/ml or more.

Disadvantages are that the specimen must be taken from the affected portion of the lung, the sample is not adequate for gram staining and therefore culture results are delayed for 24 to 48 hours.

A bronchoalveolar lavage is similar to PSB, except that a larger amount of sterile, preservative free saline is instilled in the lung area and secretions are aspirated until an adequate specimen is obtained. Cells and secretions lining the lower respiratory tract are obtained and a gram stain can be performed on the specimen. Test results are considered positive if organisms grow at 104 CFU/ml or more.

A recently published meta-analysis suggested that bronchoscopic techniques as compared to endotracheal aspirates have no effect on mortality but are superior for the management of antibiotic therapy for VAP (Muscedere, et al., 2008). In the American Thoracic Society guidelines (2004) for diagnosis and prevention of VAP, invasive quantitative cultures are preferred over endotracheal aspirates.

In the health care institutions were this study was conducted, non bronchoscopic methods are used to diagnose VAP. An endotracheal specimen is collected from the patient with suspicion of VAP and the specimen is sent for micro culture and sensitivity tests. Bronchoalveolar lavage is done if a bronchoscopy procedure is done on a patient in theatre. Then a specimen is collected in the manner mentioned above and Gram's stain is performed.

Routine surveillance is performed in both private health sector hospitals in this study. Blood cultures, sputum and urine are collected for micro culture and sensitivity every Monday and Thursday. This is done for early detection of nosocomial infections and early treatment.

2.3.5 Treatment

Empiric therapy is recommended when there is clinical suspicion of VAP (Muscedere, et al., 2008). Empiric therapy is defined as the initiation of antibiotic therapy at the time of VAP suspicion, even before culture reports are available.

Antibiotics can be stopped safely after 8 days of therapy in patients who have received adequate initial therapy (Muscedere, et al., 2008). A shorter course of antibiotics (8 day course as compared to 15 days course) is associated with a reduction in antibiotic use and a reduction in the emergence

of resistance (Muscedere, et al., 2008). A higher percentage of patients treated with 8 days of antibiotic therapy has developed recurrence of pulmonary infection secondary to non-fermenting gram negative bacteria (eg, *Pseudomonas* or *Acinetobacter* species), but this was not associated with worsened clinical outcomes (Muscedere, et al., 2008). Among patients who developed a recurrent VAP, multiresistant organisms emerged significantly less often in the group who received 8 days of therapy (Muscedere, et al., 2008).The decision to discontinue therapy for non-fermenting gram-negative bacteria at 8 days should be based on clinical factors.

The Canadian Critical Care Trial Group has concluded that no treatment regimen is superior. Methodological limitations of the trials that compared vancomycin to linelozid preclude a recommendation of one drug over the other for empiric treatment of gram-positive VAP (Muscedere, et al., 2008). Linezolid may be considered as a therapeutic option, but further studies are required (Muscedere, et al., 2008). An initial broad spectrum antimicrobial regimen is usually started, but after culture and sensitivity results are obtained, an agent that demonstrates in vitro activity against the microorganism identified on the culture is commenced. The antibiotic treatment should be based on local resistance patterns and patient factors (Muscedere, et al., 2008).

Resolution of VAP can be defined clinically following such features as change in fever, sputum purulence, leukocyte count, oxygenation and radiographic pattern.

2.3.6 Complications

Ventilator associated pneumonia is the most frequent infectious complication amongst patients admitted in the ICU. Negative outcomes associated with VAP includes a prolonged hospital stay, increased mechanical ventilation and increased hospital costs (Cason, et al., 2007). VAP also predisposes patients to other nosocomial infections and is associated with an increased mortality.

According to a Geneva study by Hugonnet, Uckay and Pittet (2007), VAP prolongs the length of stay by up to 50 days, duration of mechanical ventilation by 5 to 7 days and generates substantial extra costs.

Early-onset VAP, occurring within the first 5 days of endotracheal intubation, generally has a better prognosis and is more likely to be caused by antibiotic-sensitive bacteria that colonize the oropharynx, such as *Streptococcus pneumoniae,* and *Haemophilus influenzae.* Late-onset VAP, occurring more than 5 days after intubation, is usually caused by nosocomial or multi-drug resistant pathogens, such as *Pseudomonas aeruginosa, Acinetobacter* spp*, or Klebsiella* spp (Hixon, et al., 1998; Couchman, et al., 2007).

The failure of initial antibiotic therapy due to resistant pathogens, both at the beginning of treatment and acquired during therapy, is one of the most important causes of clinical failure (Hixon, et al., 1998; Couchman, et al., 2007). Pathogens that cause VAP have become very resistant throughout the years and resistance has become one of the factors associated with VAP mortality. When pathogens become resistant to the antibiotics used in the treatment regimen, there is no response to treatment and there's an increased risk of recurrent infection, sepsis and mortality (Hixon, et al., 1998; Couchman, et al., 2007).

Health care costs associated with VAP have an impact on the economy of the country as well. The main component of direct costs of VAP is the prolongation of ICU and hospital length of stay not including other costs such as ICU bed, antibiotics and doctor's consultation's costs which must also be considered. Increased antibiotics costs are partially driven by the increasing microbial resistance caused by the treatment of nosocomial infections, secondary infections and complications acquired during the increased ICU stay. In Canada, VAP is responsible for 230 deaths per year and accounts for approximately 17000 additional ICU days per year, which represents the equivalent to 3 to 4

ICU's completely occupied for the whole year solely to treat patients with VAP (Muscedere, et al., 2008). From a public safety point of view the number of deaths due to VAP can be compared to HIV related and motor vehicle accident related deaths (Hugonnet, et al., 2007). This has a significant societal impact such as loss of productivity and the psychological and financial impact on the families of patients with VAP.

VAP is preventable and evidence based guidelines have been shown to reduce its incidence and its burden on patient's outcomes. Patient care and outcomes are optimized through decreased nosocomial infection rates, decreased ICU and hospital stay and furthermore decreased hospital costs. Failure to provide care that incorporates evidence based guidelines may result in greater morbidity and health care costs (Ricart, et al,. 2003). As the incidence of mechanical ventilation rises secondary to medicine's improving ability to support critically ill patients, the impact of VAP will also rise. In South Africa, HIV related pulmonary infections are increasing and the amount of patients being mechanically ventilated due to such conditions is also on the increase. It is important to prevent negative outcomes and increase quality of patient care by applying evidence based practice into our daily nursing activities.

2.4 EVIDENCE BASED GUIDELINES FOR PREVENTION OF VENTILATOR ASSOCIATED PNEUMONIA

The literature on VAP is extensive and, in some cases, conflicting and therefore it has become increasingly difficult for critical care practitioners to assimilate and apply best evidence into clinical practice. The synthesis of large bodies of knowledge into clinical practice guidelines is one method of improving accessibility and utility of medical literature to health care professionals (Muscedere, et al., 2008). For the management of critically ill patients, guidelines can improve outcomes and costs of critical care to patients and institutions.

The guidelines for the prevention of VAP were developed in 2004 by the Canadian Critical Care Trials Group to address this problem in the intensive care unit. However, new randomized controlled trials of strategies to prevent VAP have been published and updating of the guidelines was done in 2008 leading to the development of up-to-date and comprehensive evidence-based guidelines for the prevention, diagnosis and treatment of VAP (Muscedere, et al., 2008).

A multidisciplinary and multispecialty panel was created to develop the comprehensive VAP Evidence Based Guidelines. The panel was composed of 20 intensivists from university affiliated and community hospitals, four infectious disease specialists, three intensive care nurses, an infection control nurse, an ICU pharmacist, an ICU respiratory therapist and a representative from the Canadian Patient Safety Institute. The panel members were experts in critical care medicine, infectious diseases, infection control, nursing education, evidence based medicine and guideline development.

To identify relevant evidence, four bibliographic databases were searched (MEDLINE, EMBASE, CINAHL and the Cochrane Database of Systematic Reviews and Register for Controlled Trials) from 1980 to October 2006. Randomized controlled trials (RCT's), systematic reviews or meta-analyses that evaluated interventions for the prevention of VAP were included. The following experimental designs were excluded: intervention crossover, before and after, and interrupted time series. RCT's of ventilator weaning protocols, noninvasive mechanical ventilation and nutritional interventions related to the prevention of VAP were also excluded because guidelines addressing these topics had been published recently. RCT's on stress ulcer prophylaxis were not included either because this strategy is not designed on preventing VAP, although it directly influences the incidence of VAP.

Levels of evidence were graded as:

- Level 1: if they demonstrated concealed randomization, blinded outcome adjudication, an intention to treat analysis and an explicit definition of VAP.
- Level 2: if any of the above characteristics were unfulfilled
- Level 3: if allocation was not strictly randomized. Level 3 trials were excluded from the guidelines.

A pair of panel members critically appraised each trial and systematic review. Differences were resolved by consensus or adjudication by the chair of the panel. Panel members read all circulated documents and evidence tables in advance of an in-person panel meeting. Using levels of evidence and consensus methods a draft recommendation was generated for each intervention reviewed. At the panel meeting, each member then discussed any potential conflicts of interest.

The evidence was first reviewed by a small group and then by the panel due to the large size of the panel and number of RCT's to appraise. The pair of panel members responsible for critical appraisal of each intervention provided a written and oral presentation of the evidence to the group. The members assigned levels of evidence, semi quantitative scores to summarize the evidence and drafted a recommendation statement. Once the evidence summaries and recommendations were drafted, they were presented to a plenary session of the whole panel for discussion and modifications until consensus were reached.

The term *recommend* was used if there were no reservations about endorsing an intervention. The term *consider* was used if the evidence supported an intervention but there were minor uncertainties about the benefits, harms or costs. *No recommendation* was made if evidence regarding an intervention was inadequate or if there were major uncertainties about the benefits, harms and costs. *Do not recommend* was used if there was no evidence of benefit or if there was potential harm or increased healthcare costs from the intervention.

After approval by the panel members, the draft guidelines were externally reviewed by the Boards of the Canadian Critical Care Society, the Canadian Critical Care Trials Group, the Canadian Society of Respiratory Therapists, the Canadian Association of Medical Microbiology and Infectious Disease and the Canadian Thoracic Society. Expert external reviewers were also asked to review the guideline for logic, clarity and practicality as well as to critique the guideline development process. The document was revised based on the feedback given. Each panel member was asked to score his or her level of agreement with the final recommendation statement for each item using a Likert Scale from 1 to 9, that was assigned " disagree completely" at the low end and "agree completely" at the high end. The panel continuously reviews VAP literature and updates the guidelines every 2 years.

There are 21 strategies on the guidelines for prevention of VAP developed by the panel above and these are divided into 10 physical strategies, three positional strategies and eight pharmacological strategies. For the purpose of this study, only strategies under the evidence based guidelines for prevention of VAP that are relevant to nursing practice will be discussed as these were the strategies included in the data collection tool.

2.4.1 Physical strategies

2.4.1.1 Route of endotracheal intubation

Based on a level 2 trial, orotracheal intubation is associated with a trend towards reduction in VAP compared to nasotracheal intubation. Orotracheal intubation is also associated with a decreased incidence of sinusitis and the incidence of VAP is lower in patients who do not develop sinusitis. ***Therefore the orotracheal route of intubation is recommended when intubation is necessary.***

2.4.1.2 Frequency of ventilator circuit changes

Based on two level 2 trials, the frequency of ventilator circuit changes does not influence the incidence of VAP. Cost considerations favour less frequent changes. ***Therefore new circuits for each patient, and changes if the circuit becomes soiled or damaged is recommended, but no scheduled ventilator circuit changes.***

2.4.1.3 Airway humidification: type of humidifier

Based on 12 level 2 trials, it was concluded that there is no difference in the incidence of VAP between patients whose airways are humidified using a heat and moisture exchanger and those whose airways are humidified using a heated humidifier. ***Therefore both types of humidifiers can be recommended.***

2.4.1.4 Airway humidification: frequency of humidifier changes

Based on two level 2 trials where daily humidifier changes and 5 to 7 days changes were compared it was concluded that less frequent humidifiers changes may be associated with a slightly decreased incidence of VAP. Reduction in the frequency of humidifier changes might be considered as a cost reduction measure. ***Therefore changes of humidifiers every 5 to 7 days or as clinically indicated are recommended.***

2.4.1.5 Endotracheal suctioning system: closed vs. open

Based on six level 2 trials it was concluded that the type of suctioning system has no effect on the incidence of VAP. Safety considerations such as patient and health care worker exposure to

aerosolized secretions favour the use of closed systems. ***Therefore, the use of closed endotracheal suctioning system is recommended.***

2.4.1.6 Endotracheal suctioning system: frequency of change

Based on a level 2 trial, scheduled daily changes and unscheduled changes of closed suctioning systems have no effect on VAP. Cost considerations favor less frequent changes. ***Therefore it is recommended that closed suctioning systems be changed for each patient and as clinically indicated.***

2.4.1.7 Subglottic secretion drainage

Based on five level 2 trials, it was concluded that subglottic secretion drainage is associated with a decreased incidence of VAP. The incremental cost of these tubes was considered to be reasonable given the burden of illness associated with VAP. To increase their utility and cost-effectiveness, these tubes should only be placed in patients expected to require prolonged mechanical ventilation. ***Therefore, the use of subglottic secretion drainage is recommended in patients expected to be mechanically ventilated for more than 72 hours.***

2.4.2 Positional strategies

2.4.2.1 Kinetic bed therapy

Based on seven level 2 trials, the use of rotating beds is associated with a decreased incidence of VAP. However, feasibility, safety and cost concerns may be barriers to implementation. ***Therefore the use of rotating kinetic beds should be considered.***

2.4.2.2 Semirecumbent positioning

Based on a level 1 and a level 2 trial, semirecumbent positioning may be associated with a decreased incidence of VAP. ***Therefore it is recommended that the head of the bed be elevated to 45 degrees. When this is not possible, attempts to raise the head of the bed to as near as to 45 degrees as possible should be considered.***

These are the nine strategies that are relevant to nursing practice in the guidelines for prevention of ventilator associated pneumonia. These strategies, if implemented by intensive care nurses, have proven to decrease the risk of VAP and therefore are important steps in increasing positive outcomes to mechanically ventilated patients in the ICU as well as to promote the implementation of evidence based nursing and medicine.

2.5 ICU NURSE'S KNOWLEDGE LEVELS ON PREVENTION OF VAP

Intensive care nurses are in the best position to put evidence based guidelines into practice as they are at the patient's bedside 24 hours daily providing nursing care and therefore play an important role in the prevention of VAP (Biancofiore, et al., 2007). Nevertheless nurses need to have an awareness of the problem as well as knowledge on current research evidence so as to adhere to such practices.

Various measures to prevent VAP have been reported in the literature, however there are very few data concerning nurse's knowledge of VAP prevention strategies and the degree of adherence to them, as well as factors that may influence their application at the bedside. While knowledge may not ensure adherence to evidence based guidelines, a lack of knowledge may be a barrier to adherence (Labeau, et al., 2007). Understanding the importance of recommended practices

increases the likelihood of adherence and overcome barriers such as lack of knowledge (Hockenberry, et al., 2006). If the nurse does not have enough knowledge on measures proven to decrease VAP rates she may not have the necessary confidence to take action and make decisions regarding such practices. Patient recovery may be delayed and not to mention the increased risks of complications from mechanical ventilation such as ventilator associated pneumonia, which are risks that can be prevented.

A large number of nurses have received their basic nursing education before 1990 which was before the availability of electronic information resources and personal computers (Pravikoff, et al., 2005). Most nurses practice nursing according to what they learned in nursing school as well as their experiences in practice. If one takes into consideration the number of changes that occur in nursing practice on a regular basis, it is essential to keep updated and have knowledge of the best current practice. According to Pravikoff, et al. (2005), when decisions must be made quickly, nurses trust a real person – a colleague, clinical specialist or a supervisor – more than they do printed and electronic resources. This demonstrates nurses' lack of value and understanding for research and is of concern that sources of new information, new evidence and research are not used by nurses.

The prevention and control of VAP in intensive care units are dependent on the education and sensitisation of ICU staff members towards the problem and on the application of measures to prevent its occurrence. Critical thinking is needed for appropriate decision making, as one needs to be able to evaluate their actions and their possible outcomes. Data from an Italian study carried out at Cisanello Hospital by Biancofiore, Barsotti & Stefanini, et al. (2007), indicated that nurses tend to apply measures automatically by simply following protocols and instructions given by physicians or colleagues without being fully aware of what and why they actually do. Preventive strategies are widely applied by nurses, but not in a responsible and informed manner. This study demonstrates the importance of education and continuous career development and update so as to be able to

rationale actions taken. As intensive care nurses, we are responsible for lives of critically ill patients and advanced knowledge is needed to prevent complications and for provision of quality patient care. We are responsible and liable for our acts and omissions towards the patient and knowledge is important to ensure responsible nursing practice.

However, education alone is insufficient to ensure compliance with clinical guidelines (Ricart, et al., 2003). Failure of opinion leaders to endorse the guidelines and lack of representation of important stakeholders in the groups that develop guidelines can limit their implementation. It is important that users participate in the development of the guidelines/protocols that will eventually be used by them. Intensive care nurses that occupy leadership roles are essential in motivating staff to follow guidelines as well as in providing reasoning as to the need and the use of guidelines. They are needed to support staff members and empower them with knowledge to provide quality nursing care in the intensive care unit.

Nurses need to be made aware of their important role in preventing morbidity and mortality due to complications and nosocomial infections in their work environment. Empowering nurses with knowledge and skills is very important to increase their decision making ability in the workplace as well as to provide patients with the best standard of care possible. This is needed so that nurses are not viewed as robots available to carry orders and follow protocols but rather seen as health care professionals that have the capability of carrying out their duties in a responsible manner. Nurses can have an active voice in their practice by giving their input regarding patient care and suggestions for improvement in the workplace.

Prevention and control of ventilator associated pneumonia are dependant on education and awareness of ICU staff towards the problem and on the application of evidence based strategies (Biancofiore, et al., 2007). Adherence to the evidence based guidelines on prevention of ventilator

associated pneumonia will only occur once staff involved directly with the patient's care has knowledge of such guidelines and can understand why it is important to put them into practice.

2.6 BARRIERS AND CONTRIBUTORS TO THE IMPLEMENTATION OF EVIDENCE BASED GUIDELINES FOR PREVENTION OF VAP

2.6.1 Barriers to evidence based practice

Evidence based practice is an opportunity for intensive care nurses to become involved in making significant changes in nursing care. It is essential that nurses become empowered to use the knowledge available to implement evidence based nursing practice. Motivation of nurses to get involved in the process is needed and it is important to be aware of barriers preventing this process to occur.

Barriers to effective implementation of evidence based practice exist at both the institutional and individual levels. They may include time factors, limited access to the literature, lack of confidence in the staff's ability to critically evaluate empirical research, limited interest in scientific enquiry, a work environment that does not support or value evidence based nursing, inadequate research resources and limited authority or power to change practice based on research findings (Hockenberry, et al., 2006). Both information and the tools to obtain it are necessary components of evidence based practice, which is the use of the best evidence currently available for clinical decision making. Appropriate resources must be made available for the implementation of evidence based nursing practice. Resources such as computer and internet access should be available in intensive care units for online research and journals access.

Ricart, et al. (2003) identified other barriers to implementation including failure of dissemination strategies, lack of agreement amongst staff with some recommendations, lack of outcome expectancy and lack of self-efficacy. External barriers were also found such as perceptions that guidelines are difficult to use. Patient barriers such as discomfort and potential adverse effects play an important role in nurses' reluctance to apply evidence into practice.

Nurses frequently feel uninformed about research methods and statistical analyses and feel intimidated because of their limited knowledge in the research process. They do not understand or value research and have received little or no training in the use of tools that would help them find evidence on which to base their practice (Pravikoff, et al., 2005). Job satisfaction surveys completed by nurses cite the lack of autonomy, authority, decreased resources for patient care (including support and nursing staff), poor work environment and lack of respect by practicing colleagues as factors in the overall dissatisfaction with the nursing profession (Hockenberry, et al., 2006). Nurses at all levels should be motivated to get involved in the evidence based process and nursing administrators, clinical facilitators, tutors and interested clinical staff must work together to decide on how to best involve the entire nursing staff in the evidence based process.

In a study by Pravikoff, et al. (2005), using a sample of 3000 registered nurses across the USA examining nurses' perception of their access to tools with which to obtain evidence and whether they have the skills needed to do so, the barrier chosen by the greatest number of respondents was a lack of value for research in practice, followed by a lack of understanding of electronic databases as well as difficulty accessing research materials. Lack of skills to critique and synthesize the literature, a lack of search skills and difficulty understanding research articles were also ranked highly. This reveals serious limitations to the implementation of evidence based practice and it demonstrates that nurses are not prepared to appraise research and interpret its usefulness for clinical decision making.

In another study, by Biancofiore, et al. (2007) a lack of human resources such as professionally trained and dedicated personnel was also found to prevent the application of VAP containing strategies, despite the fact that these strategies have been indicated as fundamental means of reducing the rate of pneumonia in mechanically ventilated patients. Strict working rhythms and insufficient staff numbers were identified as reasons for not using the strategies, such as regularly changing the posture of patients in order to allow the drainage of bronchial secretions or the hourly removal of condensation from ventilator circuits. These findings are important because ICU nurse/ patient ratio has been identified as factor potentially affecting the incidence of VAP (Bianofiore, et al., 2007). Lack of human resources may also affect the implementation of prevention strategies in South African hospitals, as the shortage of trained and dedicated intensive care nurses is huge and, as in Biancofiore's (2007) findings, it may be a potential risk in increasing the incidence of VAP.

Another important resource needed is time. The world wide nursing shortage has a toll on issues such as time allocation for patient care, education and training. A lack of time has frequently been identified as an important barrier to applying research into practice (Pravikoff, et al., 2005). At time of universal cost containment policies, there is growing evidence that high workload or low staffing level increases the risk for negative patient outcomes such as ventilator associated infections (Hugonnet, et al., 2007). In the South African context where shortage of nursing staff is a major issue, skilled and knowledgeable nurses are extremely important and needed to make appropriate decisions in patient care and minimize risks to patients. Knowledge on evidence based practices should bring confidence to intensive care nurses to make appropriate decisions and prevent delay in recovery of mechanically ventilated patients.

The intensive care nurse is an important resource for promoting evidence based practice as she is in an appropriate position to promote and implement it. Intensive care nurses can serve as excellent role models in assisting nursing staff to realize the importance of using evidence based practice in

patient care. They could be optimal resources for other nurses to break through the barriers of implementation of EBP as they are perceived as important sources of information to assist with nursing care decisions.

2.6.2 Contributors to evidence based practice

Little is known about the contributors to effective implementation of evidence based practice, but a few factors have emerged in previous studies. Education seems to be the core factor towards application of evidence based practice. Nursing education that motivates young professionals entering the profession to think critically and value research is extremely important. Lack of critical thinking has been pointed out by Biancofiore (2007). Nurses tend to apply measures automatically without thinking about the reason as to why they are doing it. It is also essential to stress the importance of information seeking and information literacy to students along with the professional obligation to career long literature searching, faculty to believe it and live it themselves (Pravikoff, et al., 2005).

Nurses need to be encouraged to search for answers for questions regarding nursing care not only with senior colleagues, but also and rather on electronic resources and recent journal articles. Therefore there is a need that they become familiar with such modern databases and resources. Cason, et al (2007) recommends that all hospitals institute educational training programs for their staff to heighten awareness of VAP prevention and to improve adherence to evidence based guidelines. They also recommend that hospitals encourage staff involvement in educational advancement and performance improvement projects.

Having protocols in place describing interventions related to prevention of VAP may contribute to implementation of evidence based guidelines. In a study by Biancofiore, et al. (2007), nurses apply

interventions in protocols even if they are not fully aware of what and why they actually do so. Ideally, nurses should understand the rationale and reasons as to why certain interventions are needed. Unfortunately, the large number of untrained staff members leads to the use of protocols without using critical thinking. Nevertheless, the presence of protocols in the units allows for a greater possibility of measures being implemented (Cason, et al., 2007). Therefore hospitals should implement protocols for preventing VAP that includes each of the practices recommended. Units implementing prevention protocols should evaluate the effects of nursing actions on VAP rates and disseminate the results.

Cason, et al. (2007) also found a direct relationship between hand washing responses and participation in infection control projects. Increased hand washing frequency was found amongst those participating in such projects, which may stem from heightened awareness about infection control measures. One could predict that if ICU nurses were involved in the development of protocols in the unit aiming at preventing VAP, then frequent use of such measures would occur. As Ricart, et al. (2003) found, guidelines are more likely to be adopted if users have participated in their development.

Years of experience and age may also affect the degree as to which nurses apply prevention measures. In the same study mentioned above by Cason, et al. (2007), which evaluated the extent to which nurses working in ICU's implement best practices when managing adult patients receiving mechanical ventilation, older respondents and those with more years of critical care experience reported that they kept the head of the bed elevated at 30 to 45 degrees from horizontal 75% or more of the time, whereas younger respondents and those with fewer years of critical care experience did not do so.

Patient/nurse ratio is also another important variable that may influence the incidence of nosocomial infection (Ricart, et al., 2003). A well staffed unit allows for time to perform important measures. Increased workloads results in non compliance to basic hygiene measures and infection control recommendations (Hugonnet, et al., 2007).

All the above factors need to be taken into consideration when aiming at implementation of evidence based guidelines, which ultimately leads to increased positive patient outcomes. The starting point for application of guidelines is education and from there stems all other factors.

2.7 REPLICATION STUDY

Various measures to prevent VAP have been reported in the literature, however their overall efficacy, way of application and extent to which they are actually adopted has not yet been defined. In fact, little is known regarding nurse's knowledge on VAP prevention strategies.

A study by Blot, Vandijck and Labeau et al. (2007) was conducted during November 2005 at the annual congress of the Flemish Society for Critical Care Nurses in Belgium.

2.7.1 Materials and Methods

A multiple choice questionnaire was developed following the evidence based VAP prevention guidelines by Dodeck, et al. (2004). Selection of questionnaire items as limited to strategies significant to nursing practice and adapted to a panel of experts for validation comments.

Demographic data included were gender, years of experience in an intensive care unit, number of critical beds in the hospital where respondents worked, and whether they held a degree in emergency and intensive care.

2.7.2 Results of the Belgian study

The questionnaire was distributed to 855 nurses during the annual congress of the Flemish Society for Critical Care Nurses. Of the 855 participants, 638 completed the questionnaire.

Most respondents were females (n = 472; 74.0%); about one quarter 9 (n = 153; 24.0%) had < 1 year of ICU experience, 111 (17.4%) 1 -5 years, 100 (15.7%) 6 – 10 years, and 274 (43.0%) > 10 years. A degree in emergency and critical care was held by 68% (n = 437) of respondents.

The average score was 3.7 on nine questions. No substantial differences were found between males and females. Nurses with < 1 year experience performed worse than nurses with > 1 year experience. Nurses holding the degree had significantly better scores than those not holding it. Linear regression analysis identified years of experience and degree to be independently associated with better knowledge.

2.7.3 Conclusion of the Belgian study

Overall the results were poor. Findings showed that 76% of respondents indicated to change ventilator circuits every week or later; 55% of respondents identified heat and moisture exchangers as the recommended type of airway humidification. Only 12% of respondents were aware that it is

recommended to change airway humidification systems weekly or when clinically indicated, suggesting that in practice, humidification systems are changed too frequently. Only 17% of respondents recognized closed systems as recommended for suctioning. In Belgian ICU's closed suction systems are not commonly used, and thus the results of the survey reflect nurses' unfamiliarity with those systems.

Sixty percent of respondents knew that draining subglottic secretions decreases the risk for pneumonia. The beneficial effect of kinetic beds was recognized by about half of the nurses, however for these two issues, 28% and 31% of nurses, respectively, reported not to know the answer, which suggests that these strategies are seldom used in Flemish ICU's. Finally, semi-recumbent positioning was well acknowledged to prevent VAP.

The findings of the study demonstrate that nurses' awareness about VAP guidelines is low and stress the need for education based on current evidence.

The present study is a replication of the abovementioned Belgian study. The interventions included on the *"Evaluation questionnaire on critical care nurses' knowledge of evidence based guidelines for preventing VAP*" by Labeau (2007) were also included in this study. The questionnaire had a few modifications done for applicability to the South African context and the modified questionnaire was reviewed by experts in ICU and nursing education for validity and reliability.

Permission to use the questionnaire was requested by the researcher and given by the Belgian author S. Blot (Appendix IX).

2.8 CONCLUSION

It seems that lack of resources and a gap in information literacy limits intensive care nurses to put evidence into their practice. There are gaps that need to be addressed if we are to embrace a culture of evidence based practice.

Nursing practice is one based on tradition, intuition and experience. These are important components of our profession, but searching for changes and current literature is essential in maintaining standards of care and ensuring best nursing care to patients.

Integrating evidence based practice into nursing requires an approach from all levels, which includes students, educators, clinicians and nursing administrators to facilitate the change. In this manner, new guidelines would be implemented rapidly and more confidently by nursing staff and complications in the intensive care unit such as VAP would be contained and diminished.

CHAPTER THREE

RESEARCH DESIGN AND RESEARCH METHODS

3.1 INTRODUCTION

This chapter describes the research methodology used in this study including the research design, the study setting, sample criteria, sampling process and data collection procedures as well as the development and validation process of the research instrument used for data collection.

3.2 RESEARCH OBJECTIVES

The objectives of the study were:

Phase one:

- Validation of the instrument "*Evaluation questionnaire concerning intensive care nurses knowledge of interventions for prevention of ventilator associated pneumonia*" to assess ICU nurses' knowledge on evidence based guidelines for prevention of VAP.

Phase two:

- To determine and describe intensive care nurses' knowledge of evidence based guidelines for the prevention of ventilator associated pneumonia in intensive care units from the private and public sectors in Gauteng.

- To determine possible contributors and barriers to the implementation of evidence based guidelines for prevention of ventilator associated pneumonia.

- To establish if there is any correlation between training as well as years of experience and knowledge of intensive care nurses on evidence based guidelines of prevention of ventilator associated pneumonia.

3.3 RESEARCH DESIGN

A non-experimental, descriptive, correlational and contextual two-phase research design was utilised in this study.

3.3.1 Non experimental

In non experimental research, the study is carried out in a natural setting and phenomena are observed as they occur. There is no manipulation of variables and therefore no intervention is made. The main purpose of non experimental research is to describe phenomena and explore and explain relationships between variables (Brink, 2006). A non-experimental design was chosen for this study as it takes place in a natural setting, such as the intensive care units in the selected hospitals and there is no treatment or interventions done.

3.3.2 Descriptive

Descriptive designs are used in studies where more information is required in a particular field through the provision of a picture of the phenomenon as it occurs naturally (Brink, 2006). This study is descriptive because it aims at describing knowledge levels of ICU nurses in a particular field which is evidence based guidelines on prevention of ventilator associated pneumonia.

3.3.3 Correlational

The basic purposes of a correlational study are to describe existing relationships between variables and to determine the relationship between independent and dependent variables (Brink, 2006). This study is aiming to determine if there is a correlation between age, training as well as years of experience and knowledge of intensive care nurses on evidence based guidelines of prevention of VAP.

3.3.4 Research setting

This study is contextual in nature as it is conducted within a specific context, which can be described as a "small scale world" such as an intensive care unit. The setting for this study was intensive care units in one public sector hospital and two private sector hospitals in the Gauteng province in South Africa. The context of the study is discussed in more detail.

South Africa's healthcare system is structured in 4 layers, namely:

- Primary Health care (Clinics)
- District hospitals
- Regional hospitals
- Tertiary (Academic) hospitals.

This structure was developed in order to address the provision of cost effective healthcare to all citizens on the appropriate level and to ensure a better health for all.

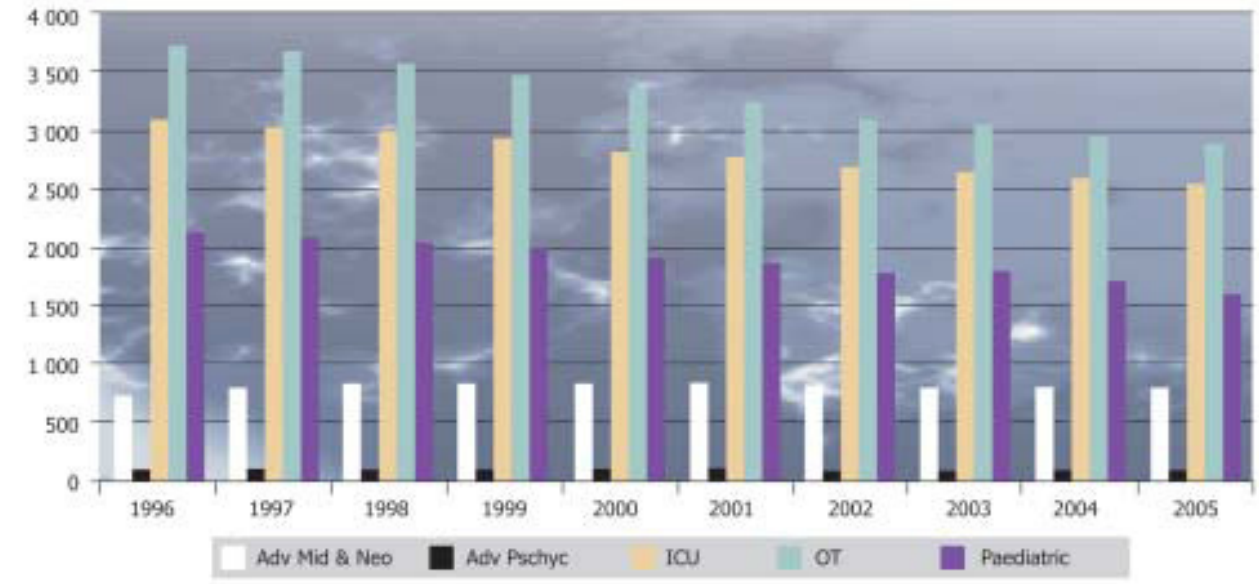
The public and private sectors in South Africa are both affected by the shortage of nursing staff and employment of agency staff is a common practice in the three hospitals included in this study. The geographical population: nurse ratio in South Africa is 466: 1 and specifically in Gauteng is 291:1 (SANC: 2008). Employment of nurses via agencies occurs on a daily basis and some units rely

mainly on agency staff for patient care. Due to this factor, quality of care is ultimately affected as nurses employed in the units for a day or two are not used to the routine as well as policies and protocols that are in place.

There is also a huge shortage of ICU trained nurses in both health sectors in South Africa. The number of ICU trained nurses in the country has decreased in the last 10 years from over 3000 ICU nurses in 1996 to less than 2500 in 2005 (SANC: 2008). Most nurses available via agencies are not qualified intensive care nurses and errors occur more frequently and therefore more need of supervision is needed from shift leaders, increasing their workload and responsibilities. The South African Nursing Council maintains a register of nurses in South Africa, which gathers information pertaining to the qualifications of nurses but does not track whether these nurses are practicing and if so, where they are practicing. It is known, but not documented, that a substantial percentage of ICU registered nurses, often practice in other nursing areas such as nursing management and education, or leave nursing altogether (Scribante & Bhagwanjee, 2007). Table 3.1 demonstrates the decrease in number of specialized nurses according to statistics from the South Africa Nursing Council (2008).

Table 3.1: The training of specialized nurses in South Africa since 1996 - 2005

SPECIALIZED NURSES: 1996 – 2005 (SANC: 2008)



Skills Mix Changes: a nursing reality. Dr. E. Van Niekerk. HASA ANNALS 2008. Pg 29 – 32

The lack of knowledgeable nurses leads to increased risks to patients and may influence patient's outcomes. Nursing shortage also leads to increased workload as nurse: patient ratio decreases and one nurse has to provide care for more than one critically ill patient. Shift leaders in both public and private sectors are working under great pressure and a large number of them are also not trained, but simply have the experience of working in an ICU for a number of years. These nurses have to supervise staff members who are not trained and are very dependent on their input for decision making. Working in an ICU is of great interest to most agency nurses due to the higher wages been paid and what follows is a large number of unskilled nurses caring for critically ill patients, which ultimately increases the risk of errors and complications. Shift leaders therefore need to ensure quality care is rendered with no complications arising.

Many private hospitals train nurses. Private and public partnerships have also been implemented to promote training of nurses. Student nurses work under supervision during their training and are accompanied by clinical tutors. Registered nurses are also trained in intensive care nursing. In an

audit conducted in 2007 by The Hospital Association of South Africa (HASA), 138 nurses were undergoing ICU training in the private hospital industry.

The first private sector hospital to be included in the study is situated in Gauteng and is a member of one of the largest private hospital groups in South Africa. The hospital has 290 beds, a five bed neuro ICU, an 11 bed general ICU and an 18 bed High Care/ ICU combined. The study was conducted with nurses working in the 11 bed and 18 bed ICUs from this hospital. The implementation of the evidence based guidelines for prevention of VAP has commenced in this hospital two years ago. The ventilator strategies are implemented on mechanically ventilated patients via an approach called the FASTHUG, which stands for Feeding, Analgesia, Sedation Vacation, Thrombus prophylaxis, Head of bed elevation, Ulcer prophylaxis and Glucose control. All the FASTHUG measures are listed on the ICU charts and the nurse answers YES or NO if each intervention is being implemented as well as states the reason for implementing it or not. Other strategies are implemented via unit protocols such as frequency in ventilator circuit changes as well as frequency in changes of suction systems. Both units in this hospital are closed units, in other words all ICU patients are managed by the intensivist as well as other disciplines if needed. The intensivist is the main doctor and all decision is made under his supervision.

The second private sector hospital involved in the study belongs to another large South African hospital network with 90 of its 342 beds dedicated to Intensive Care and High Care. The implementation of the evidence based guidelines for VAP prevention has started recently in this hospital. The FASTHUG approach is a new method that the hospital is using for VAP prevention in the ICU and a campaign has been launched for introducing the new guidelines. Other measures have been in place already such as frequency in ventilator circuit changes as well as suction system changes, but the frequency of the changes are not according to the current guidelines. These measures are implemented using unit protocols that state how frequently they should be changed.

The public sector hospital in this study is one of the biggest in the Gauteng province with 1088 beds offering a full range of tertiary, secondary and highly specialized services. It is an academic hospital providing a training base for undergraduate and postgraduate training for all health professional areas. It's clinical departments include: cardiology, neurology, pulmonology, dermatology, family health, nephrology, endocrinology and geriatrics, as well as surgery including neuro surgery, maxillo facial and neuro surgery. The hospital has a dedicated private wing that was opened in 2002 which provides health services such as surgery, oncology, non invasive gastroscopy, specialized radiography investigations, dedicated ICU facilities and medical allied services. The hospital has 5 intensive care units: cardiothoracics, neurology, medical, pulmonology, trauma as well as a paediatric ICU. A few of the evidence based guidelines for prevention of VAP are implemented in the units such as head of bed elevation, thrombus prophylaxis and stress ulcers prophylaxis. Other measures such as frequency of ventilator circuit changes are implemented via protocols, but these changes are done on a weekly basis and not according to the current guidelines.

Doctors from academic institutions do ward rounds in all three hospitals included in the study and therefore there is a sharing of academic knowledge in all units. Thus a total of ten intensive care units from both health sectors were the context of this study.

The implementation of evidence based practice needs advanced nursing practitioners with knowledge of current research and methods of providing best nursing care. Critically ill patients need specialized nursing care and the need for nurses capable of caring for these patients is enormous. Nurses in ICU must be alert to subtle changes in their patients' condition, accurately perform clinical assessments and respond accordingly. It is through vigilance and clinical judgment that a nurse creates a safe and healing environment. A non trained nurse lacks the understanding of disease processes and the clinical judgement to identify potential complications in the ICU. Once again, increased supervision is needed from shift leaders. Critical thinking coupled with nursing

education and skills acquired through integration of education, experience and evidence based guidelines is the cornerstone of good nursing practice (Van Niekerk, 2008).

3.4 RESEARCH METHOD

The study was conducted in two phases. For clarity and consistency each phase will be discussed separately.

3.4.1 Phase I: Validation of researcher's instrument

The questionnaire used in this study was based on a modified version of the "*Evaluation questionnaire on critical care nurses' knowledge of evidence based guidelines for preventing VAP* developed by Labeau, et al. (2007) (Appendix A). For the purpose of this study, the questionnaire by Labeau (2007) was combined to the "*"Questionnaire concerning interventions for preventing ventilator associated pneumonia"* developed by Biancofiore, et al. (2007) (Appendix B).

Biancofiore's, et al. (2007) study aimed at evaluating nurses' knowledge and to highlight the causes that hinder guidelines implementation. Labeau's, et al. (2007) study aimed at developing a reliable and valid questionnaire for evaluating critical care nurses' knowledge of evidence based guidelines for preventing ventilator associated pneumonia. The researcher combined both questionnaires and modification were made for applicability to the South Africa context.

Validation of the researcher's modified questionnaire "*Evaluation questionnaire concerning intensive care nurses' knowledge on interventions for prevention of ventilator associated pneumonia"* (Appendix III) was achieved by individual discussion with five ICU experts. A focus group discussion was planned by the researcher but a date was not agreed amongst all the experts

invited to participate in the study due to different work schedules. Therefore, the researcher met individually with each expert. Telephonic sessions were also held with two of the ICU experts.

3.4.1.1. Population

The population of Phase I of the study comprised of:

- Experienced ICU nurses currently working in intensive care units of two private and one public sector hospitals (N=208)
- Specialist nursing educators from the University of the Witwatersrand (N=10)
- ICU clinical facilitators from a private sector hospital (N=2)

This population was selected as they are nurses with expert knowledge in the field of Intensive Care Nursing as well as Nursing Education. They are involved in research as well as in evidence based practice. Nurses working in the intensive care units were also chosen as they are in close contact with implementation of guidelines and protocols in the units on a daily basis.

3.4.1.2 Sampling and sampling method

In phase I of the study, a non probability purposive sampling was used to select experts to validate the data collection instrument to ensure applicability of the instrument to the South African context. Prospective participants were contacted telephonically to elicit their willingness and availability to take part in the validation process. Six nurses specialized in ICU as well as specialists in nursing education were invited to participate in a group discussion with the purpose to achieve instrument validation: three experienced ICU nurses currently working in ICU; two specialist nursing educators from a university; and one ICU clinical facilitator from a private hospital.. An information letter

was sent via email to each of the prospective participants and five participants replied via email that they were willing to participate in the study. One replied that she was not interested in taking part of the study and no reasons were given. The remaining five nurses participated.

Inclusion criteria for the expert group were:

- Intensive care nurses working in either trauma, cardiothoracic, medical, surgical, and neurological or a multidisciplinary ICU of two hospitals in the private and public health sectors.
- Nurses with expert knowledge (with a Master's Degree or Advanced Diploma) in ICU or nursing education from nursing colleges and university.

The positions held and health sector distribution of the participants in the instrument validation phase is contained in Table 3.2. Of the five participants of Phase I, two were employed in the public sector and three were employed in the private sector. The positions held by the experts were: two ICU lecturers/tutors, one ICU unit manager and two ICU qualified registered nurses working in intensive care units. See Table 3.2 for participants distribution.

Table 3.2: Positions held and sector distribution of Phase I participants

Sector	**Position held**	**No. of participants**
Public	Shift leader	2
Sector	**Position held**	**No. of participants**
Private	ICU lecturer/tutor	2
Private	Unit manager	1

The academic qualifications of the experts participants were: two held a Diploma in Intensive Care Nursing and three held a Masters Degree in Intensive Care Nursing. One participant was enrolled for a Masters Degree in Nursing Administration and another one for the degree of Doctor of Philosophy in Nursing.

3.4.1.3 Data collection

The questionnaire used in this study was derived from two questionnaires used in previous studies. Permission to use both questionnaires was granted from the respective researchers (Appendix IX; Appendix X). The questionnaire by Labeau, et al. (2007) and the one by Biancofiore, et al. (2007) had been validated and used previously in a Belgian and Italian studies respectively but had not been validated yet in the South African setting.

The first part of the researcher's modified questionnaire used in this study was based on the questionnaire developed by Labeau, et al. (2007) in which nine nursing interventions were identified from a review of evidence based guidelines for preventing ventilator associated pneumonia and were then subjected to face and content validation. The nursing interventions used in the researcher's modified questionnaire were the same as the ones chosen by Labeau et al. (2007). These interventions were listed and participants had four response alternatives: the correct response and three other alternatives that are not correct, which includes the option "I don't know" to avoid participant's playing a chance or gambling and other two options with investigated preventive value in VAP. Demographic data such as age, gender and years of experience in ICU were also obtained.

Interventions such as oral hygiene was not included in the questionnaire, despite being relevant to nursing practice, because the evidence based interventions added were from the systematic review

by Dodek, et al. (2008). As yet no evidence based guidelines on oral care have been developed and no studies have yet indicated with confidence the ideal frequency of oral hygiene on mechanically ventilated patients in order to prevent VAP.

The second part of the modified questionnaire used in this study was based on the questionnaire by Biancofiore, et al. (2007). In this part respondents had to state if they use the interventions and how frequently. Reasons for not using strategies were stated as: not foreseen in the department protocol; unavailability of necessary material; the intervention causes patient discomfort; the literature demonstrates its uselessness; it can have harmful side effects on patient; too expensive; or other reasons. Participants were asked to select the most appropriate reason. An open ended question at the end of the questionnaire assessed factors that contribute to the implementation of the guidelines.

The experts independently reviewed each question of the instrument for content validity, face validity and reliability. They were asked to answer the questionnaire themselves so that it's level of difficulty could be assessed.

Each participant was contacted telephonically and electronically by email as a consensus on a date for a focus group discussion was not reached. Therefore an attached questionnaire (Appendix C) assessing if the researcher's modified questionnaire (Appendix III) was clearly worded, well explained and if it addressed what it was meant to address was emailed to each participant. Individual sessions were held with two nursing experts during the validation phase. A telephonic discussion was held between the researcher and a nursing expert and electronic communication (email) was held between the researcher and the other two nursing experts that took part in the validation process. After examining the questionnaire and answering the questions posed agreement was reached on the modified questionnaire's content and clarity by repeatedly consulting each expert when a query would arise from the other participants.

Nursing relevance of all items in the questionnaire was assessed by scoring items on a scale of 1 to 3: 1 = not relevant; 2 = relevant, but not necessary; 3 = absolute necessary. Content validity was determined by the proportion of experts that rated the question as content valid by scoring it as 3 (absolute necessary) on the rating scale. Additionally, the experts were asked if questions about any other preventive interventions should be added to the questionnaire. Data analysis was done by assessment of each item on the questionnaire and a discussion between the researcher and each participant individually.

3.4.1.4 Data analysis

Agreement was based on the importance of each question to clinical practice and what interventions have an impact on nursing practice and the prevention of VAP.

Four of the participants answered that the questionnaire was applicable and thought that it was clearly worded and questions well explained. One participant mentioned that there were two possible answers for question two: Frequency of ventilator circuit changes. The participant did not think the answers for question two were well explained and one could possibly answer that it is recommended to change circuits every week and that it is recommended to change circuits for every new patient, as we cannot use same circuit on two different patients. This participant's comment was posed to the other four participants and they did not agree. The four other participants mentioned that no ventilator circuits should ever be used for two different patients, therefore the circuit on a ventilator has to be changed for every new patient. They also mentioned that current guidelines suggest changes only when circuit is visibly soiled, otherwise change is needed only when a new patient will be using the ventilator. Nevertheless it is standard practice in most ICU's to change circuits every seven days even if circuit is clean and not soiled. It was then decided amongst the researcher and all participants to leave question two unchanged.

The same participant needed clarification if the term "suction systems" in question six referred to the tracheostomy care device, commonly used in South African's ICU's as the suction catheter or if it meant the suction tubing that is connected to the wall suction. Vonberg, Eckmans, Welte, et al., (2006) describes suctioning systems as two types: a) opened suctioning systems that need to become disconnected. These systems require single use catheters and a sterile suctioning technique for prevention of VAP and b) closed suctioning systems: systems that do not become disconnected but rather involve use of multiuse catheters. To assess if changes in the term "suction systems" would be needed, the researcher asked the other four participants what did they understand by "suction systems". The four participants answered that a suction system represents the suctioning device or catheter used for insertion in the patient's airway for removal of secretions from the trachea and lower airway. Three participants added that a suction system consists of a suctioning catheter and that opened and closed suction systems are related to the need for disconnection or not to the ventilator, which correlates to the definition by Vonberg, et al. (2006). It was then agreed amongst the researcher and the other four participants that no rewording of question six was necessary.

On evaluating nursing relevance of items chosen by the researcher, four participants stated that item one: oral vs. nasal route for endotracheal intubation was not relevant to nursing. One participant mentioned that it is not usually nurses' choice which route to perform endotracheal intubation, but it is important that nurses know the risks and complications of each route. Nasal intubation increases the risk of sinusitis and bacteria can colonize the upper airway increasing the risk for VAP (Muscedere, et al., 2007). This is the reason why it is relevant for nurses to know why nasal intubation is not the preferred route so as to monitor for signs and symptoms of sinusitis on nasally intubated patients. When this was discussed with the other participants they did not agree in removing question one from the questionnaire.

Participants were asked if any other intervention should be added to the questionnaire and one participant mentioned oral care as an important measure in preventing VAP. The researcher explained that frequency of oral care as well as a description of how to provide oral care is not added on the evidence based guidelines by Dodek, et al. (2007). No guidelines on frequency of oral care to prevent VAP have yet been developed. The other four participants agreed that no other intervention needed to be added.

One participant did not understand the term "kinetic beds" and did not know their relationship with the prevention of VAP. The researcher explained that kinetic bed therapy is a positional strategy used to prevent VAP and other respiratory complications in critically ill patients. These beds are programmed to rotate intermittently or continuously in their longitudinal axis. The rotation of the patient on a bed is hypothesized to improve drainage of secretions within the lung and lower airways to increase functional residual capacity by providing an increased critical opening pressure to the independent lung, and to reduce the risk of venous thrombosis and associated pulmonary embolism (Goldhill, Imhoff, McLean, et al., 2007).

The other four participants had an understanding on the use of kinetic beds and the prevention of VAP and in fact, were very prone to the use of kinetic beds. One participant mentioned that the public health sector has started investing in these beds, however the researcher did not see the use of such beds while collecting data at a public health sector hospital. Due to the importance of kinetic beds in preventing VAP it was agreed between the researcher and the five participants that the question on kinetic beds should be included on the questionnaire.

After these aspects had been discussed amongst all participants and the researcher and no other concerns or questions were raised by the participants the questionnaire was considered ready for data collection. No changes were made on the modified questionnaire and all the participants agreed

that the questionnaire addressed strategies for prevention of VAP. All participants verbalized that the questionnaire was clearly worded and easy to understand. It was then agreed that the questionnaire was appropriate to address nurses' knowledge on evidence based guidelines for prevention of VAP and the researcher could use it. Please see Table 3.3 for percentage of participants' scores on items' nursing relevance.

Table 3.3: Percentage of scores on nursing relevance of items

Questions	Not relevant		Relevant, but not necessary		Absolutely necessary	
	Freq	**%**	**Freq**	**%**	**Freq**	**%**
Route of intubation	1	20%	1	20%	3	60%
Vent circuit changes	0	0	0	0	5	100%
Type of humidifier	0	0	1	20%	4	80%
Humidifier changes	0	0	0	0	5	100%
Open/closed suction	0	0	0	0	5	100%
Suction system changes	0	0	0	0	5	100%
Endotracheal tubes with subglottic drainage	0	0	1	20%	4	80%
Kinetic beds	1	20%	1	20%	3	60%
Patient positioning	0	0	0	0	5	100%

From Table 3.3 it can be observed that all questions had the majority score of absolutely necessary and therefore all nine questions were included in the questionnaire. The questionnaire was rated as being content valid by the ICU experts and nursing educators.

To evaluate the level of difficulty of the questionnaire, ICU nurse specialists were asked to answer the questionnaire and the proportion of respondents who answered the questions correctly was assessed. Items answered correctly by more than 90% of respondents were considered too easy; and

items answered correctly by less than 10% of respondents were considered too difficult. See Table 3.4 for scores on level of difficulty of data collection instrument.

Table 3.4: Percentage of scores on level of difficulty of data collection instrument

Question	Frequency	Percentage
Oral vs. nasal route	4	80%
Frequency of ventilator circuit changes	3	60%
Type of humidifier	3	60%
Frequency of humidifier changes	3	60%
Open vs. closed suction	5	100%
Frequency of change in suction systems	3	60%
Endotracheal tubes with lumen for subglottic aspiration	5	100%
Kinetic vs. standard beds	5	100%
Patient positioning	5	100%

As can be observed from the Table 3.4 majority of participants answered all questions correctly and therefore level of difficulty of the questionnaire was considered to be easy.

Following data analysis, the statistician determined the Chronbach's alpha coefficient to assess the internal consistency of the items on the questionnaire. According to Burns, et al. (2003), internal consistency examines the extent to which all questions consistently measure the construct. Burns, et al. (2003) also states that when using questionnaires as a data collection tool, individual questions may address different aspects or topics that are associated with the research subject and therefore to determine reliability using tests of internal consistency may not be logical. In this study, the

instrument's Chronbach's alpha coefficient was 0. 5961 which is low and may represent a limitation of the study. Crohnbach's alpha should be in excess of 0.75.

3.4.2 Phase II

In Phase II of the study, the researcher's "*Evaluation questionnaire concerning intensive care nurses knowledge of interventions for prevention of ventilator associated pneumonia*" (Appendix III), now adapted and valid to the South African context, was used to determine and describe intensive care nurses knowledge on evidence based guidelines for prevention of ventilator associated pneumonia (VAP) and to describe contributors and barriers to the implementation of the guidelines for prevention of VAP.

3.4.2.1 Population

The population of phase II comprised of:

- Registered nurses working in the six intensive care units in two private sector hospitals (n = 143)
- Registered nurses working in the four intensive care units in one public sector hospital (n = 65)

3.4.2.2 Sampling and sampling method

The sample comprised of intensive care nurses of ten intensive care units from two hospitals in the private health sector and one hospital from the public health sector. A statistician decided on a sample size of 81 participants taking into consideration that in order to have adequate knowledge

participants were expected to achieve a mark of 70% on the final questionnaire. This sample size would be representative of the population in this phase of the study.

A non probability purposive sampling method was used to select nurses provided they were suitable and fitted in the inclusion criteria of the study. Purposive sampling is a technique based on the judgement of the researcher regarding the subjects that are typical of the study phenomenon, or who are especially knowledgeable about the question at hand (Brink, 2006). Nurses working in ICU's are expected to have specific knowledge about common ICU infections such as VAP and therefore they were part of the sample of this study.

Private and public sectors were chosen to be included in the study as a larger number of sample would be achieved by including both sectors.

Inclusion criteria for prospective participants included:

- Registered nurses with an ICU qualification, including permanent and agency staff working in all ten units in public and private sectors. Intensive care nurses from public and private sectors were chosen as they work interchangeably in both sectors.

- Registered nurses with no formal training in ICU working in all ten units. These nurses were included as they are in close contact with mechanical ventilated patients and need to be familiar with ventilator associated pneumonia and the current evidence based guidelines for prevention of VAP.

Exclusion criteria included:

- Enrolled and auxiliary nurses as their category of nursing are not expected to have skills and in depth knowledge of mechanical ventilation and evidence based guidelines on prevention of VAP.

3.4.2.3 Data collection

Once permission was obtained from each institution, the permission from the nursing services managers was given and the unit managers were approached for permission to conduct research in their respective units.

All nurses meeting inclusion criteria were requested to participate in the study. The questionnaire was taken to the selected ICU's by the researcher. ICU nurses were approached and the purpose of the study outlined as well as its procedures. All participants were told that their participation was voluntary and were assured of anonymity and confidentiality. Prospective participants were encouraged to ask questions they had regarding the study and they were told that nurses could refuse to participate in the study, decline to answer any particular question and discontinue participation at any given time without incurring any penalty.

The questionnaire with an information letter and a consent form attached to it was distributed amongst those nurses who agreed to participate in the study. Participants were told to sign the consent form, detach it from the questionnaire and place it in an envelope by the nurses' station. A few participants refused to sign the consent form and some participants did not want to write their names on the consent form despite the researcher ensuring them that data would only be accessible by the researcher and her supervisor. These participants mentioned that they did not feel comfortable in having their names written anywhere. The researcher then requested that they place a cross (X) on the space provided for their names. Written informed consent was obtained from

most participants. On completion of the questionnaire the participants would place it into an envelope designated by the researcher and would seal the envelope. Completed questionnaires were placed into sealed envelopes and collected by the researcher from each unit weekly.

After the first two weeks of data collection, the researcher observed that some questionnaires had not been fully answered. To prevent that from occurring the researcher decided to remain in the units during data collection, while participants were answering the questionnaire to ensure participants would answer to the questionnaire fully. The researcher remained in the units also to ensure a greater response, as participants wouldn't leave the questionnaire to be answered at a later stage or not answer at all.

3.4.2.4 Data analysis

The raw data were loaded onto an Excel spreadsheet for analysis and were double checked. The same statistician that decided on a sample size for the study was consulted for data analysis.

The researcher met the statistician and presented the Excel spreadsheet for data analysis. Stata Release 10 was the statistical programme used to analyze the data. Descriptive statistics were used to describe the characteristics of the sample using the demographic data available. Descriptive and inferential statistics were used to describe the knowledge levels of ICU nurses working in ICU's from the public and private health sectors on VAP prevention guidelines. Their age and number of years working in ICU as well as training was correlated to their knowledge levels.

A mark of 70% was decided as a pass mark for the questionnaire to test the knowledge of ICU nurses on evidence based guidelines for prevention of VAP in this study. It is generally accepted

that the pass rate for a clinical assessment is 60% and for practical procedures is 80%. The indicator of knowledge of 70% in this study was between the two levels.

3.5 ETHICAL CONSIDERATIONS

The following ethical requirements were taken into consideration during the study:

- The research proposal was submitted to the University Postgraduate Committee for permission to conduct the study and permission was obtained to ensure compliance with ethical standards.
- Application for clearance to conduct research to the Committee for Research on Human Subjects (Medical) of the University of Witwatersrand was made and clearance certificate was issued (Appendix D).
- Application for permission to conduct the study was made to the management of all three hospitals included in the study (Appendices IV, V and VIII). Written permission was granted from all three hospitals (Appendix D). The research proposal was presented to the Ethics Committee of one of the private sector hospitals and a written permission to conduct the research was given (Appendix D).
- To ensure confidentiality and anonymity of the participants no names were recorded during data collection and reporting. Consent forms and questionnaires were separated at the time of data collection to maintain anonymity of participants.
- Confidentiality was maintained by only the researcher and the supervisor having access to the raw data.
- Participants were told that participation in the study is voluntary and participants may decline to answer any particular question as well as to discontinue participation in the study

at any time without incurring any penalty. All participants were allowed to ask questions if not clear.

- Telephonic consent was obtained from the ICU experts involved in the instrument validation phase.
- Informed consent was obtained from most nurse participants. Those participants who did not want to write their names on the consent form were encouraged to place a cross (X) on the space provided for their names.
- The only people who had access to the questionnaires was the researcher and her supervisor.
- Data were kept by the researcher in a locked cupboard and will be discarded once study has been published.

3.6 CONCLUSION

In Chapter three the research methodology of the study was described in detail. The research design, the setting and context of the study, the inclusion and exclusion criteria, population and sample, data collection method as well as validity and reliability were explained in detail. The validation process of the instrument used in the study was also described.

The next chapter will entail data analysis and discussion of the results of the study.

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION OF RESULTS

4.1 INTRODUCTION

In this chapter data analysis is discussed in detail. In phase I the researcher validated the data collection instrument. Phase I was discussed in detail in chapter three. In phase II the researcher tested nurses' knowledge on the evidence based guidelines for prevention of ventilator associated pneumonia using a questionnaire validated by ICU nursing experts. The results of the study were analysed using descriptive and inferential statistics and the research findings and discussion thereof are presented.

4.2 APPROACH TO DATA ANALYSIS

Descriptive statistics were used to interpret the demographic data: age, sex, years working in ICU and training. Stata Release 10 was the statistical programme used to analyze the data. Frequency distributions and cross-tables were used to provide an overall and coherent presentation and description of data. Means and standard deviations were used to summarize the abovementioned demographic characteristics. Pearson correlation coefficient (r) was used to express the magnitude and direction of the association between age, years working in ICU, training and knowledge of evidence based guidelines for prevention of VAP. One way analysis of variance was used to determine the scores and significance of scores on the instrument. Confidence interval was used for continuous variables such as instrument scores and proportion of scores that achieved adequate knowledge. Scattergrams were plotted as a graphic representation of the paired scores between each variable and knowledge and tables were drawn to describe frequencies and percentages. The level of significance was set at a level of $p < 0.05$.

4.3 RESULTS AND ANALYSIS OF PHASE II

4.3.1 Demographic data

In this section the demographic data of phase two are presented followed by the results and analysis of the data.

- **Age**

Of the 83 participants in the study, only 78 answered regarding their age. Of the 78 participants, 20 (25.64%) were aged between 24 and 35 years; 36 (46.15%) were between 36 and 45 years; and 22 (28.21%) were between 46 and 61 years. The mean age was 41 years (SD = 7.38). Figure 4.1 shows the ages of participants.

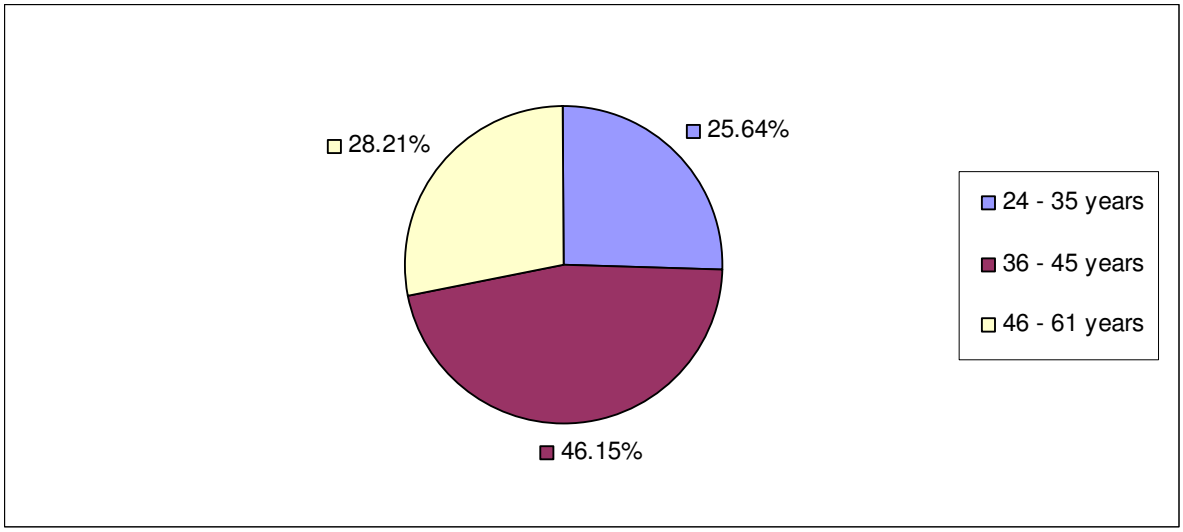


Figure 4.1: Distribution of the ages of all participants (n = 78)

- **Sex**

Of the 83 participants, 8 (9.63%) were male; 72 (86.74%) were female; and 3 (3.61%) did not answer the question. Figure 4.2 shows the sex of participants.

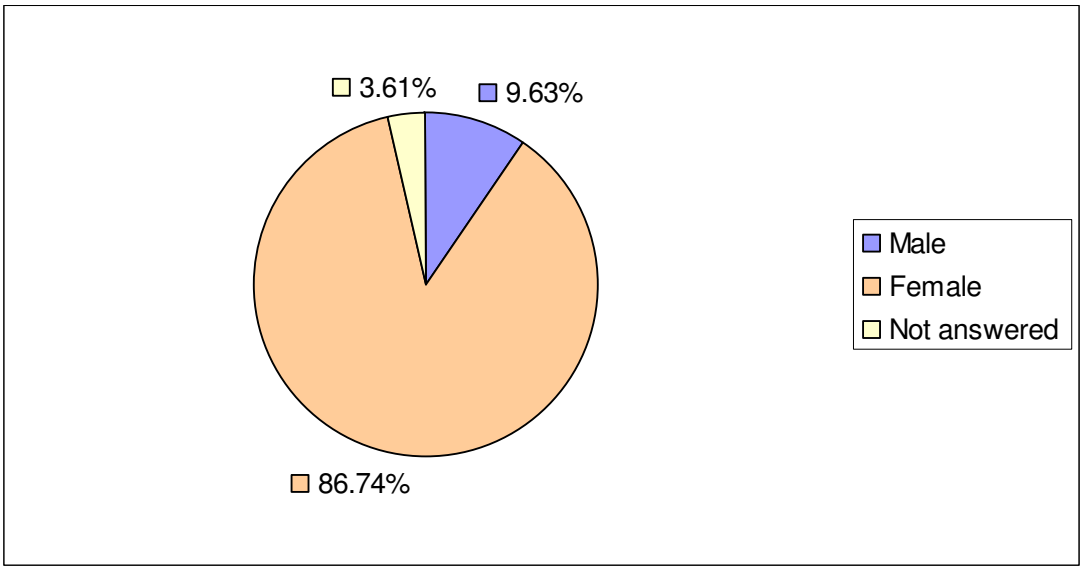


Figure 4.2: Distribution of sex of all participants (n = 83)

- **Years working in ICU**

Of the 83 participants, 76 answered how many years they have been working in ICU. Of the 76 participants that answered, 52 (68.42%) were working in ICU for 1 to 10 years; 18 (23.69%) were working in ICU for 11 to 20 years; and 6 (7.89%) were working in ICU for 21 to 32 years. The mean amount of time worked in ICU was 9.1 years (SD = 7.30). Figure 4.3 shows the distribution of years working in ICU.

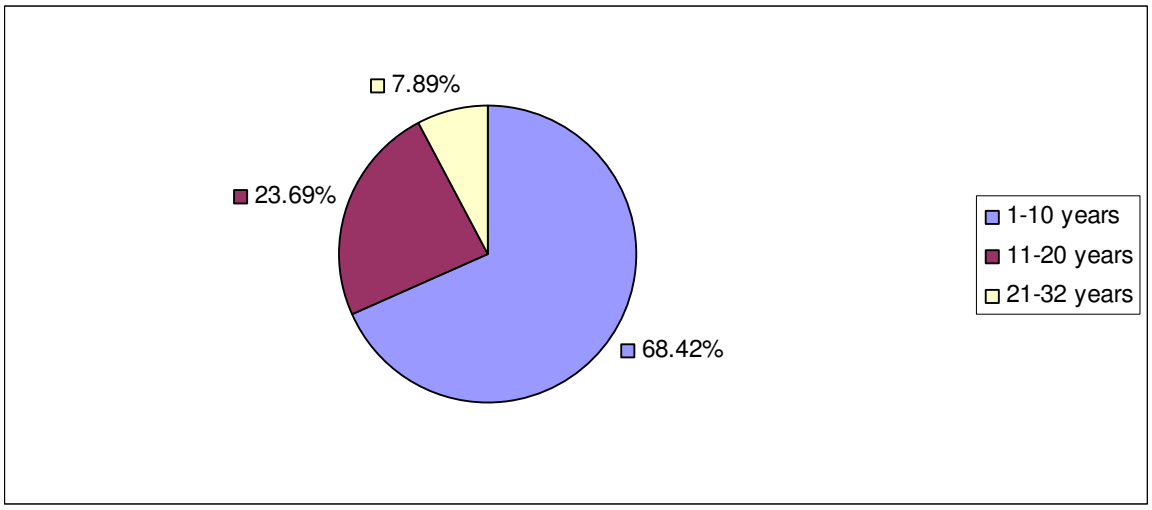


Figure 4.3: Distribution of years working in ICU (n = 76)

- **Training**

Of the 83 participants, 4 (4.82%) had a Degree in Intensive Care Nursing; 50 (60.24%) had a Diploma in Intensive Care Nursing; and 29 (34.93%) had no intensive care training. See Figure 4.4 for the distribution of training of participants.

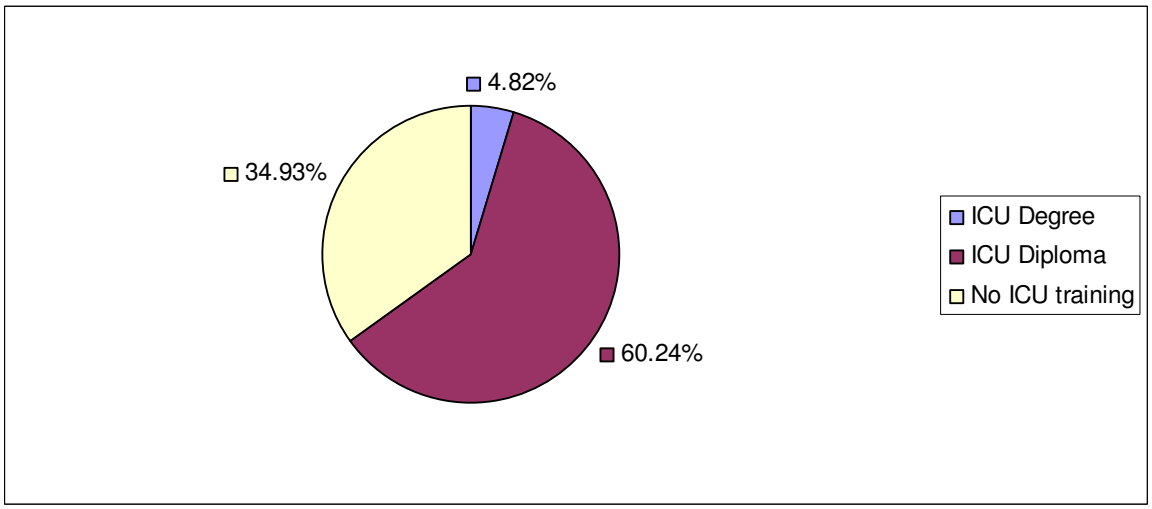


Figure 4.4: Distribution of level of training of participants (n = 83)

4.3.2 Nurses' knowledge levels on evidence based guidelines for prevention of ventilator associated pneumonia

On the multiple choice part of the questionnaire, participants were examined on their knowledge on the evidence based guidelines for prevention of VAP. Participants were asked to mark which interventions listed on the questionnaire were recommended in the evidence based guidelines for prevention of VAP.

- **Question 1: Oral vs. nasal route for endotracheal intubation**

Of the 83 participants, 58 (69.88%) answered that oral intubation is recommended; 7 (8.43%) answered that nasal intubation is recommended; 13 (15.66%) answered that both routes of intubation can be recommended; and 5 (6.02%) participants indicated that they did not know the answer to the question.

According to the evidence based guidelines (EBG's) for prevention of ventilator associated pneumonia (VAP), the oral route is the recommended one. Amongst all participants, 58 (69.88%) answered correctly and 25 (30.12%) answered incorrectly, showing that nurses know that the oral route is preferred for endotracheal intubation. See Table 4.1 for scores on Question 1.

Table 4.1: Summary statistics for Question 1

Question 1 (n = 83)	Frequency	Percentage
Oral route recommended	58	69.88%
Nasal route recommended	7	8.43%
Both routes recommended	13	15.66%
Did not know	5	6.02%
Correct answers	58	69.88%
Incorrect answers	25	30.12%

- **Question 2: Frequency of ventilator circuit changes**

Of the 83 participants, 11 (13.25%) answered that it is recommended to change circuits every 48 hours; 46 (55.42%) answered that it is recommended to change circuits every week; 23 (27.71%) answered that it is recommended to change circuits for every new patient; and 3 (3.61%) indicated that they did not know the answer.

According to the EBG'S on prevention of VAP, it is recommended to change ventilator circuits for every new patient, or when clinically indicated such as when the circuit becomes soiled. Amongst all participants, 23 (27.71%) answered question 2 correctly and 60 (72.29%) answered incorrectly. See Table 4.2 for scores on Question 2.

Table 4.2: Summary statistics for Question 2

Question 2 (n = 83)	Frequency	Percentage
Change circuits every 48hours	11	13.25%
Change circuits every week	46	55.42%
Change circuit for new patient	23	27.71%
Did not know	3	3.61%
Correct answers	23	27.71%
Incorrect answers	60	72.29%

- **Question 3: Type of humidifier**

Of the 83 participants, 11 (13.25%) answered that heated humidifiers are recommended; 45 (54.22%) answered that heat and moisture exchangers are recommended; 16 (19.28%) answered that both types of humidifiers can be recommended; and 11 (13.25%) indicated that they did not know the answer to the question.

According to the EBG's on prevention of VAP both types of humidifiers can be recommended. Amongst all participants, 16 (19.28%) answered correctly and 67 (80.72%) answered incorrectly. See Table 4.3 for scores on Question 3.

Table 4.3: Summary statistics for Question 3

Question 3 (n = 83)	Frequency	Percentage
Heated humidifiers	11	13.25%
Heat and moisture exchangers	45	54.22%
Both types of humidifiers	16	19.28%
Did not know	11	13.25%
Correct answers	16	19.28%
Incorrect answers	67	80.72%

- **Question 4: Frequency of humidifiers changes**

Of the 83 participants, 41 (49.90%) answered it is recommended to change every 48 hours; 9 (10.84%) answered that it is recommended to change every 72 hours; 26 (31.33%) answered that it is recommended to change every week; and 7 (8.43%) indicated that they did not know the answer to the question.

According to the EBG's on prevention of VAP it is recommended to change humidifiers every week or when clinically indicated. Amongst all participants 26 (31.33%) answered correctly and 57 (68.67%) answered incorrectly. See Table 4.4 for scores on Question 4.

Table 4.4: Summary statistics for Question 4

Question 4 (n = 83)	Frequency	Percentage
Changes every 48 hours	41	49.90%
Changes every 72 hours	9	10.84%
Changes every week	26	31.33%
Did not know	7	8.43%
Correct answers	26	31.33%
Incorrect answers	57	68.67%

- **Question 5: Open vs. closed suction systems**

Of the 83 participants, 3 (3.61%) answered that open suction systems are recommended; 61 (73.49%) answered that closed suction systems are recommended; 16 (19.28%) answered that both systems are recommended; and 3 (3.61%) indicated that they did not know the answer to the question.

According to the EBG's on prevention of VAP closed suction systems are recommended. Amongst all participants 61 (73.49%) answered this question correctly and 22 (26.51%) answered incorrectly. See Table 4.5 for scores on Question 5.

Table 4.5: Summary statistics for Question 5

Question 5 (n = 83)	Frequency	Percentage
Open suction recommended	3	3.61%
Closed suction recommended	61	73.49%
Both suctions recommended	16	19.28%
Did not know	3	3.61%
Correct answers	61	73.49%
Incorrect answers	22	26.51%

- **Question 6: Frequency of change in suction systems**

Of the 83 participants, 55 (66.27%) answered that daily changes are recommended; 9 (10.84%) answered that weekly changes are recommended; 16 (19.28%) answered that it is recommended to change systems for every new patient; and 3 (3.61%) indicated that they did not know the answer to the question.

According to the EBG's on prevention of VAP it is recommended to change suction systems for every new patient or when clinically indicated. Amongst all participants 16 (19.28%) answered correctly and 67 (80.72%) answered incorrectly. See Table 4.6 for scores on Question 6.

Table 4.6: Summary statistics for Question 6

Question 6 (n = 83)	Frequency	Percentage
Daily changes	55	66.27%
Weekly changes	9	10.84%
Change for every new patient	16	19.28%
Did not know	3	3.61%
Correct answers	16	19.28%
Incorrect answers	67	80.72%

- **Question 7: Endotracheal tubes with extra lumen for drainage of subglottic secretions**

Of the 83 participants, 50 (60.24%) answered that these endotracheal tubes reduce the risk for VAP; 10 (12.05%) answered that these tubes increase the risk for VAP; 6 (7.23%) answered that these tubes do not influence the risk for VAP; and 17 (20.48%) of participants indicated that they did not know the answer.

According to EBG's on prevention of VAP endotracheal tubes with extra lumen for subglottic secretions aspiration reduce the risk for VAP. Amongst all participants, 50 (60.24%) answered correctly and 33 (39.76) answered incorrectly. See Table 4.7 for scores on Question 7.

Table 4.7: Summary statistics for Question 7

Question 7 (n = 83)	**Frequency**	**Percentage**
These tubes reduce VAP risk	50	60.24%
These tubes increase VAP risk	10	12.05%
These tubes do not influence VAP	6	7.23%
Did not know	17	20.48%
Correct answers	50	60.24%
Incorrect answers	33	39.76%

- **Question 8: Kinetic vs. standard beds**

Of the 83 participants, 2 (2.41%) answered that kinetic beds increase the risk for VAP; 46 (55.42%) answered that kinetic beds reduce the risk for VAP; 18 (21.69%) answered that the use of kinetic beds does not influence the risk for VAP; and 17 (20.48%) indicated that they did not know the answer.

According to the EBG's for prevention of VAP, kinetic beds reduce the risk for VAP. Amongst all participants, 46 (55.42%) answered correctly and 37 (44.58%) answered incorrectly. See Table 4.8 for scores on Question 8.

Table 4.8: Summary statistics for Question 8

Question 8 (n = 83)	**Frequency**	**Percentage**
Kinetic beds increase VAP risk	2	2.41%
Kinetic beds reduce VAP risk	46	55.42%
Kinetic beds do not influence VAP	18	21.69
Did not know	17	20.48%
Correct answers	46	55.42%
Incorrect answers	37	44.58%

- **Question 9: Patient positioning**

Of the 83 participants, 14 (16.87%) answered that supine positioning is recommended to prevent VAP; 57 (68.67%) answered that semirecumbent positioning is recommended; 9 (10.84%) answered that position of the patient does not influence the risk of VAP; and 3 (3.61%) indicated that they did not know the answer.

According to the EBG's on prevention of VAP semirecumbent positioning is recommended to prevent VAP. Amongst all participants; 57 (68.67%) answered correctly and 26 (31.33%) answered incorrectly. See Table 4.9 for scores on Question 9.

Table 4.9: Summary statistics for Question 9

Question 9 (n = 83)	Frequency	Percentage
Supine position is recommended	14	16.87%
Semirecumbent position is recommended	57	68.67%
Patient position does not influence VAP	9	10.84%
Did not know	3	3.61%
Correct answers	57	68.67%
Incorrect answers	26	31.33%

Of the 83 participants, 18 (21.69%; CI 95% 13.4% ; 32.1%) achieved a pass mark of 70% on the multiple choice part of the questionnaire and were considered to have adequate knowledge on the evidence based guidelines for prevention of VAP. The mean score of participants was 4.25 (SD 1.537 CI 95% 3.92; 4.59) on nine questions.

4.3.2.1 Correlation between age and knowledge of nurses

The number of participants included in this part of the study was 78 as 5 of the respondents omitted to fill in their age. A scatter plot has been used to illustrate the dispersion of values on the variable (age). Refer to Figure 4.5 for the scattergram.

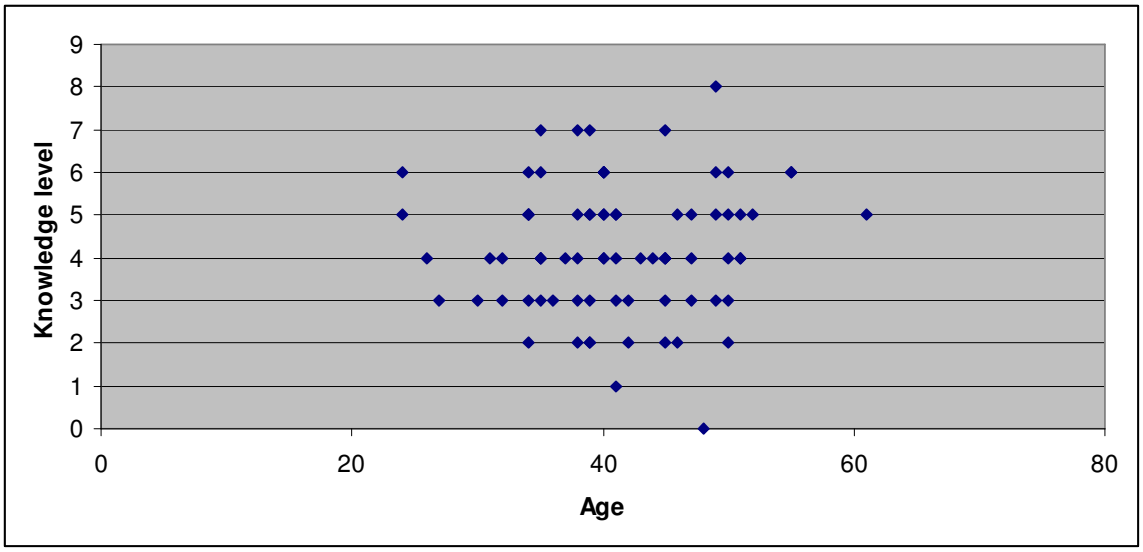


Figure 4.5: Marks obtained for the instrument as whole and age of participants

From the scatter plot in Figure 4.5 it can be observed that there is no correlation (r = 0.051) between age and knowledge of nurses on the evidence based guidelines for prevention of VAP. A correlation coefficient (r) of 0.051 was obtained, confirming the absence of correlation (p = 0.6599).

4.3.2.2 Correlation between years working in ICU and knowledge of nurses

The number of participants included in this part of the study was 76 (n = 76) as seven of the respondents omitted to fill in the amount of years they were working in ICU. A scatter plot has been used to illustrate the dispersion values on the variable (years working in ICU). Refer to figure 4.6.

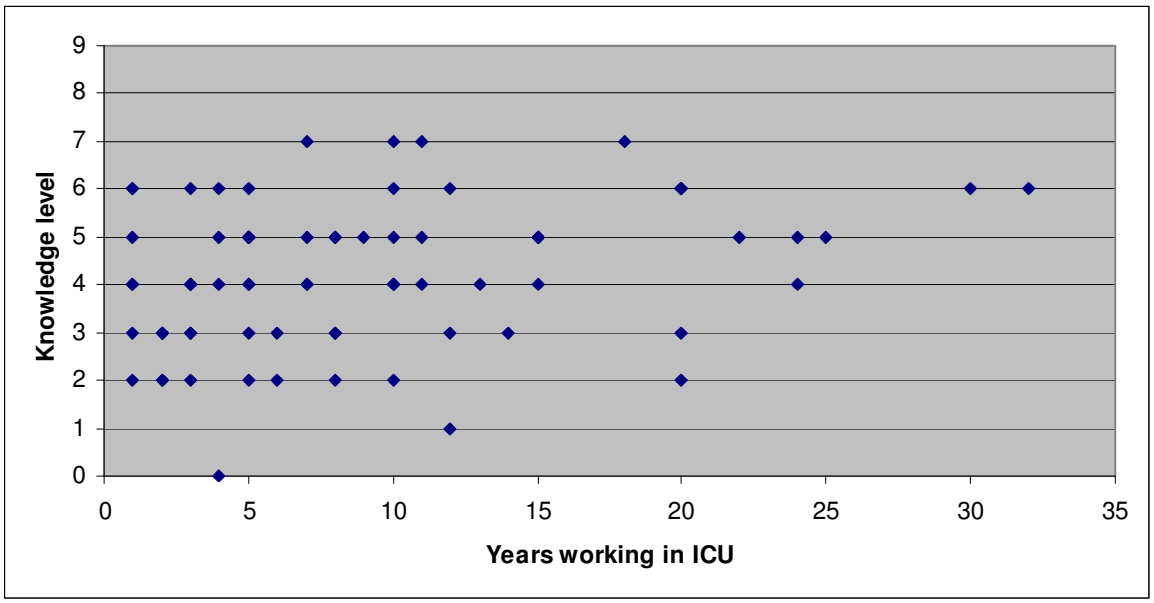


Figure 4.6: Marks obtained for the instrument as a whole and years of ICU experience

From scatter plot in Figure 4.6 it can be observed a very slight curve. A correlation coefficient (r) of 0.2951 (p = 0.0097) was obtained indicating a weak correlation between years of experience and knowledge levels of nurses on evidence based guidelines for prevention of VAP.

4.3.2.3 Correlation between level of training and knowledge of nurses

The number of participants in this part of the study was 83 (n = 83). No significant difference in knowledge between participants with different levels of training (Degree, Diploma or no ICU training) as found (p = 0.7244). Table 4.10 refers to the mean scores between participants of different level of training.

Table 4.10: Mean scores between participants of different level of ICU training (n = 83)

Level of training	Frequency	Mean scores	Standard deviation
Degree	4	4.250	0.957
Diploma	50	4.360	1.626
No training	29	4.069	1.462

p = 0.7244

4.3.3 Implementation of the evidence based guideline for prevention of VAP

The second part of the questionnaire evaluated if participants implemented each of the recommended interventions mentioned in the first part of the questionnaire as part of the evidence based guidelines for prevention of VAP. If an intervention was used participants were asked to state how frequently and in case of interventions not been used, participants were asked to give a reason by writing the corresponding number from a list of reasons stated by the researcher, which included: not foreseen in department protocol; unavailability of necessary material; intervention causes patient discomfort; the literature demonstrates its uselessness; it can have harmful side effects on patient; too expensive; or specify other reasons. From the answers, contributors and barriers to the implementation of the EBG's on prevention of VAP were identified. Findings will be discussed in detail as well as contributors and barriers to the implementation of the guidelines.

- **Oral intubation**

Of the 83 participants, only 81 answered this question and amongst these, 79 (97.53%) answered that they use the oral route for endotracheal intubation; and 2 (2.47%) answered that they do not use the oral route for endotracheal intubation. Refer to Table 4.11.

Amongst those who use the oral route, 26 answered how frequently. Of these 26 participants, 20 (76.92%) said they always use the oral route; and 6 (23.08%) said they mostly use the oral route for intubation. Amongst the 2 participants who do not use the oral route for intubation, 1 stated "possible harmful side effects to the patient" as a reason for not using this route.

Table 4.11: Summary statistics on implementation of oral intubation (n = 81)

Use of oral intubation	Frequency	Percentage
YES	79	97.53%
NO	2	2.47%
TOTAL	81	

- **Nasal intubation**

Of the 83 participants, 78 answered this question and amongst these, 14 (17.95%) answered that they use the nasal route for endotracheal intubation; and 64 (82.05%) answered that they do not use the nasal route. Refer to Table 4.12.

Amongst those who use the nasal route, 8 answered how frequently. Of these 8 participants, one (12.50%) said that it is often used in the unit where this participant works; 2 (25%) said that it is used when necessary; 3 (37.50%) said that it is seldom used; and two (25%) said that it is used in children.

Amongst the 64 participants who do not use the nasal route for endotracheal intubation, 53 provided reasons as to why they do not use it. Of these 53 participants, 25 (47.17%) answered that the nasal route is not used because it has harmful side effects to the patients; 10 (18.87%) answered that it is not foreseen in their Department protocol; 7 (13.21%) answered that it causes patient's discomfort; and the remainder 11 (20.75%) participants answered that nasal route was not chosen because of unavailability of necessary material and because the literature demonstrates its uselessness.

Table 4.12: Summary statistics for implementation of nasal intubation (n = 78)

Use of nasal intubation	Frequency	Percentage
YES	14	17.95%
NO	64	82.05%
TOTAL	78	

- **Closed suctioning**

Of the 83 participants, 82 answered the question. Amongst these 76 (92.68%) answered that they use closed suctioning and 6 (7.32%) answered that they do not use closed suctioning. Refer to Table 4.13.

Amongst those who use closed suctioning, 38 stated how frequently this suction method is used and amongst these, 8 (21.05%) said they always use closed suctioning and 10 (26.32%) said they use closed suctioning when necessary. Seventeen participants (44.73%) stated they use closed suctioning between every hour to 8 hourly. One (2.63%) participant said it is often used in the unit; and 2 (5.26%) said it is mostly used.

Amongst the 6 participants who said they do not use closed suctioning, 5 (83.33%) stated unavailability of necessary material as the reason for not using it; and 1 (16.67%) stated "being too expensive" as reason for not using closed suctioning.

Table 4.13: Summary statistics for use of closed suctioning (n = 82)

Use of closed suctioning	Frequency	Percentage
YES	76	92.68%
NO	6	7.32%
TOTAL	82	

- **Open suctioning**

Of the 83 participants, 44 (53.01%) said they use open suctioning and 39 (46.99%) said they do not use open suctioning. Refer to Table 4.14.

Amongst the 44 participants that use this method of suctioning, 26 stated how frequently they use it. Of these 26 participants, 9 (34.62%) answered that they use open suctioning when necessary; 13 (50%) answered that they always or mostly use open suctioning; and 4 (15.38%) said they seldom use open suctioning.

Amongst the 39 participants who do not use open suctioning, 29 provided reasons for not using it. Of these 29 participants, 19 (65.52%) stated harmful side effects on patients as a reason for not using it; the other 10 (34.48%) stated amongst their reasons: not foreseen in the Department protocol, patient discomfort, unavailability of necessary material and literature demonstrates its uselessness.

Table 4.14: Summary statistics for use of open suctioning (n = 83)

Use of opened suctioning	Frequency	Percentage
YES	44	53.01%
NO	39	46.99%
TOTAL	83	

- **Replacement of suction systems**

Of the 83 participants, 82 answered the questions. Of these 82 participants, 78 (95.12%) replace suction systems and 4 (4.88%) answered that they do not replace suction systems. Refer to Table 4.15.

Amongst the 78 participants who replace suction systems, 56 stated how frequently it is done. Amongst these 56 participants, 25 (44.64%) change suction systems daily, 13 (23.21%) change when necessary or for a new patient only; 17 (32.07%) change between 24 to 72 hours; and 1 (1.79%) changes weekly. Amongst the 4 participants who do not replace suction systems, no reasons were specified.

Table 4.15: Summary statistics for replacement of suction systems (n = 82)

Replacement of suction systems	Frequency	Percentage
YES	78	95.12%
NO	4	4.88%
TOTAL	82	

- **Replacement of ventilator circuits**

Of the 83 participants, 82 answered this question. Amongst these 82 participants, 79 (96.34%) said that ventilator circuits are replaced in their units and 3 (3.66%) participants said that ventilator circuits are not replaced in their units. Refer to Table 4.16.

Amongst the 79 participants, 58 participants stated how frequently it is done. Of these 58 participants 43 (74.14%) replace ventilator circuits weekly; 11 (18.97%) replaces ventilator circuits when necessary and for every new patient; 2 (3.45%) replaces these circuits every 48 hours; and 2 (3.45%) replaces it daily.

Table 4.16: Summary statistics for ventilator circuit changes (n = 82)

Replacement of ventilator circuits	Frequency	Percentage
YES	79	96.34%
NO	3	3.66%
TOTAL	82	

- **Replacement of humidifiers**

Of the 83 participants, 82 answered this question. Of the 82 participants, 73 (89.02%) answered that humidifiers are replaced and 9 (10.98%) do not replace humidifiers in the units they work in. Refer to Table 4.17.

Amongst the 73 participants that have humidifiers replaced in their units, 51 indicated how frequently. Amongst these 51 participants, 23 (45.09%) replace humidifiers daily; 9 (17.65%) replace humidifiers weekly; 12 (23.52%) replace humidifiers when necessary only; and the remainder 7 (13.72%) replace humidifiers between 48 to 72 hours.

Amongst the nine participants who do not replace humidifiers, five provided reasons for not replacing. Amongst these six participants, four mentioned that humidifiers are not replaced due to unavailability of necessary material; and one mentioned that it is too expensive to change humidifiers.

Table 4.17: Summary statistics for replacement of humidifiers (n= 82)

Replacement of humidifiers	**Frequency**	**Percentage**
YES	73	89.02%
NO	9	10.98%
TOTAL	82	

- **Patient positioning**

Of the 83 participants, 79 answered this question. Of these 79 participants, 78 (98.73%) uses patient positioning and 1 (1.27%) answered that patient positioning is not used. Refer to Table 4.18.

Amongst the 78 participants that use patient positioning, 40 stated how frequently it is used. Amongst these 40 participants, 31 (77.50%) answered that they turn patients every 2 to 4 hours; 5 (12.50%) participants answered that they always turn patients; and 4 (10%) answered that they turn patients when necessary. The participant that answered not using patient positioning did not specify any reasons for not using.

Table 4.18: Summary statistics on patient positioning (n= 79)

Use of patient positioning	Frequency	Percentage
YES	78	98.73%
NO	1	1.27%
TOTAL	79	

- **Use of endotracheal tubes with subglottic aspiration**

Of the 83 participants, 77 answered this question. Of these 77 participants, 26 (33.77%) use endotracheal tubes with subglottic aspiration and 51 (66.23%) do not make use of these endotracheal tubes. Refer to Table 4.19.

Amongst the 26 participants that use these tubes, 12 stated the frequency of their use. Of these 12 participants, 4 (33.33%) seldom use these tubes; 1 (8.33%) uses these tubes most of the times; 3 (25%) uses these tubes on all patients; and 4 (33.33%) uses these tubes when available.

Amongst the 51 participants who do not make use of these endotracheal tubes 40 provided reasons for not using them. Of these 40 participants, 25 (62.50%) do not make use of these tubes due to their unavailability; 8 (32%) do not use them because these tubes are too expensive; and 5 (20%) stated not using them because it is not foreseen in their department protocol.

Table 4.19: Summary statistics for use of endotracheal tubes with subglottic aspiration (n= 77)

Use of ETT with subglottic aspiration	Frequency	Percentage
YES	26	33.77%
NO	51	66.23%
TOTAL	77	

- **Use of special beds (Rotational beds)**

Of the 83 participants, 81 answered this question. Of these 81 participants, 31 (38.27%) answered that they make use of rotational beds and 50 (61.73%) participants answered that they do not make use of these beds. Refer to Table 4.20.

Amongst the 50 participants who answered that they do not make use of these beds, 46 provided reasons for not using it. Amongst these 46 participants, 21 (45.65%) answered that these beds are not available in the units; 19 (41.30%) answered that these beds are too expensive; and 6 (13.04%) answered that the use of these beds are not foreseen in the departmental protocol.

Table 4.20: Summary statistics for use of special (rotational) beds (n= 81)

Use of special rotational beds	Frequency	Percentage
YES	31	38.27%
NO	50	61.73%
TOTAL	81	

4.3.4 Contributors to the implementation of the evidence based guidelines for prevention of VAP

The last part of the questionnaire consisted of an open ended question that assessed factors that contribute to the implementation of the EBG's for prevention of VAP. Themes that arose from this question are listed below and will be discussed in detail under discussion of the results.

- **Availability of resources**

This theme was continuously brought up by participants. Availability of resources such as journals and articles as well as internet access for staff members would highly contribute in staff updating themselves. Availability of articles on best current practice would lead to staff increasing their knowledge levels.

- **Training of staff members**

With the extreme shortage of staff in South Africa, including the three hospitals where this study was conducted and the high numbers of less experienced nurses in the ICUs, education of staff on prevention of VAP is essential.

- **Staff motivation and compliance**

Participants feel that they need motivation to raise compliance and adherence to measures in preventing VAP.

- **Team work**

Leaders such as unit managers, clinical facilitators, shift leaders and doctors are needed to endorse VAP prevention measures in the units.

- **Updated protocols**

Unit protocols on frequency of ventilator circuit changes as well as humidifiers and suction systems changes in the three hospitals where the study was conducted were not according to the current evidence based guidelines on prevention of VAP.

4.3.5 Barriers to the implementation of the evidence based guidelines for prevention of VAP

Barriers to the implementation of the evidence based guidelines for prevention of VAP were identified from participants reasons for not implementing certain interventions listed on the questionnaire. These are listed below and discussed in detail under the discussion section.

- **Lack of knowledge**

A few participants demonstrated a lack of knowledge in measures such as route of endotracheal intubation as reasons for not using the oral route were listed as due to possible harmful side effects on patients. Oral intubation is preferred to nasal intubation in the evidence based guidelines for VAP prevention, as nasal intubation leads to sinusitis which may lead to VAP.

Lack of knowledge was also considered a barrier to replacement of suction systems, as nurses were following manufacturer's instructions to replace these systems rather than following the recommendations on the evidence based guidelines.

Unavailability of material and cost were considered by nurses as reasons for not replacing humidifiers as well as ventilator circuits, which also indicates a lack of knowledge since humidifiers and ventilator circuits are readily available in all hospitals and units where the study was conducted. This could represent a barrier to replacement of humidifiers as well as of ventilator circuits if nurses are not aware that these are in place and available to use.

Thirty one (38.27%) nurses stated that they make use of special rotational beds whereas these beds are not available in any of the hospitals included in the study. This also indicates nurses' lack of knowledge on measures for VAP prevention, which could lead to non implementation.

- **Unavailability of necessary material**

Unavailability of material was considered a reason for not using closed suction systems, which are recommended in the evidence based guidelines for prevention of VAP. These systems were not available in one hospital included in the study.

Unavailability of endotracheal tubes with an extra lumen for subglottic secretions aspiration was also noted in two hospitals included in the study, as well as rotational beds. These beds are not available in any of the hospitals.

- **Cost restraints**

A few measures were considered expensive and not used due to cost factors, such as the use of endotracheal tubes with an extra lumen for subglottic secretions aspiration as well as rotational beds and closed suctioning systems.

- **Unforeseen in departmental protocol**

Certain measures such as ventilator circuit changes and replacement of suction systems and humidifiers were not done according to the evidence based guidelines for prevention of VAP because certain unit's protocols were not updated according to the current evidence based guidelines for VAP prevention, which is a barrier to implementation.

4.3.6 Participant's subjective opinion on their level of knowledge on the evidence based guidelines for prevention of VAP

Lastly, participants were asked if they think they are sufficiently informed about the prevention of ventilator associated pneumonia in mechanically ventilated patients. Only 79 participants answered this question. Of these 79 participants, 54 (68.35%) answered that they are sufficiently informed about VAP prevention and only 25 (31.65%) of participants answered that they are not sufficiently informed.

Some of the main reasons that were identified amongst the 25 participants who answered that they are not sufficiently informed about prevention of VAP ranged from not being ICU trained; need to have more in-service training on the topic; no research done in the units; participant not frequently working in ICU; and being an agency staff member. One participant mentioned that there is always a need to update, therefore one is never fully informed in a specific topic.

Most participants in this study mentioned that information on prevention of VAP is gained from clinical facilitators and from the literature; as well as by attending ICU congresses and in-service training in their hospitals. Doctors and other colleagues are also sources of information for nurses.

4.4 DISCUSSION OF RESULTS

4.4.1 Knowledge levels of nurses on evidence based guidelines for prevention of VAP

- **Oral vs. nasal route for endotracheal intubation**

According to the evidence based guidelines (EBG's) for prevention of ventilator associated pneumonia (VAP), the oral route is the recommended one. Amongst all participants, 58 (69.88%) answered correctly and 25 (30.12%) answered incorrectly, showing that nurses know that the oral route is preferred for endotracheal intubation.

Nasal placement of the endotracheal tube increases the risk for sinusitis (Couchman, et al. 2007). The sinus provides a reservoir from which organisms seed the tracheobronchial tree. Bacteria causing sinusitis can colonize the upper airway, increasing the risk for VAP. Incidence

of VAP and sinusitis are significantly reduced when tubes are placed orally and discontinued as soon as possible (Couchman, et al. 2007).

The oral route for endotracheal intubation is mostly used in the three hospitals included in this study. All patients intubated and mechanically ventilated have an oral endotracheal tube in place and therefore this may have lead to nurses being aware of the lower risk for VAP associated with this route.

- **Frequency of ventilator circuits changes**

According to the EBG'S on prevention of VAP, it is recommended to change ventilator circuits for every new patient, or when clinically indicated such as when the circuit becomes soiled. Amongst all participants, 23 (27.71%) answered question 2 correctly and 60 (72.29%) answered incorrectly.

It was noted by the researcher that majority of participants considered that it is recommended to change the ventilator circuits every week. This could be due to the fact that unit protocols in all three hospitals where the study was conducted state that these circuits must be changed every week, usually on a Sunday. During validation of the instrument for data collection, one of the participants was of the opinion that the answers for question 2 were not clear as two answers could possibly be the correct ones: circuit changes every week, which is the commonly practiced; and change for every new patient as the same circuit should not be used on two different patients. The other participants mentioned that current guidelines suggest changes only for new patients or when circuits are soiled, therefore it is clear that ventilator circuits should be changed when clinically indicated and not every week. The question then remained unchanged.

- **Type of humidifier**

According to the EBG's on prevention of VAP both types of humidifiers can be recommended. Amongst all participants, 16 (19.28%) answered correctly and 67 (80.72%) answered incorrectly.

Both types of humidifiers can be recommended as there is no difference in the incidence of VAP between patients whose airways are humidified using a heat and moisture exchanger and those whose airways are humidified using a heated humidifier (Muscedere, et al., 2008). According to Siempos, Vardakas & Kopterides, et al. (2007), heat and moisture humidifiers could be considered a cost saving method of providing humidification for patients undergoing mechanical ventilation.

In two of the three hospitals where the study was conducted heat and moisture exchangers are available for use and therefore this could be the reason why majority of respondents answered that these humidifiers are the recommended ones. Only one of the hospitals in the study use heated humidifiers.

- **Frequency of humidifiers changes**

According to the EBG's on prevention of VAP it is recommended to change humidifiers every week or when clinically indicated. Amongst all participants 26 (31.33%) answered correctly and 57 (68.67%) answered incorrectly.

Amongst the three hospitals where the study was conducted, heated humidifiers are used in one hospital. These humidifiers provide active humidification of air in which the inspired gases pass

across or over a heated water bath. Heated humidifiers may also contain heated wired circuit to avoid formation of ventilator tubing condensate (Siempos, et al., 2007). These humidifiers need their water bath to be constantly refilled when the water solution is finished.

The two other hospitals, one from the public sector and the other from the private health sector use heat and moisture exchangers on mechanically ventilated patients. These humidifiers allow condensation of patient's expired air to be evaporated during inspiration. There are different protocols for humidifiers changes in each of these two hospitals. In one hospital, protocol state humidifiers must be changed every week. The other hospital's ICU protocol states that humidifiers must be changed every 24 hours. There was not an option of 24 hours on the questionnaire which may explain majority of respondents answering that changes are recommended every 48 hours, which is the closest answer to 24 hours.

- **Open vs. closed suction systems**

According to the EBG's on prevention of VAP closed suction systems are recommended. Amongst all participants 61 (73.49%) answered this question correctly and 22 (26.51%) answered incorrectly.

Closed suction systems are used in both private health sector hospitals where the study was conducted and open suction systems are used in the public health sector hospital. Nurses work interchangeably between public and private sector hospitals and most of them are exposed to both types of suction systems. Therefore nurses may be aware of the advantage of the closed suction system in preventing the healthcare worker from being exposed to aerosolized secretions, despite it not having any different effect on the incident of VAP if compared to the

open suction system (Muscedere, et al., 2008) which may have lead nurses to answer closed suction as the recommended suction system in prevention of VAP.

- **Frequency of change in suction systems**

According to the EBG's on prevention of VAP it is recommended to change suction systems for every new patient or when clinically indicated. Amongst all participants 16 (19.28%) answered correctly and 67 (80.72%) answered incorrectly.

In one hospital in the study, units' protocols stated that frequency of changes of suction systems should be every 24 hours. In the other hospital the protocol stated changes every 72 hours as per manufacturer's instructions. These suction systems were previously recommended for use for only 24 hours. According to the manufacturer of the closed suction catheters in South Africa these systems have reduced the incidence of VAP without demonstrating any side effects and therefore the product has been redesigned for 72 hours use.

- **Endotracheal tubes with extra lumen for drainage of subglottic secretions**

According to EBG's on prevention of VAP endotracheal tubes with extra lumen for subglottic secretions aspiration reduce the risk for VAP. Amongst all participants, 50 (60.24%) answered correctly and 33 (39.76) answered incorrectly.

Endotracheal tubes for drainage of subglottic secretions are specialized tubes with a separate dorsal lumen which suctioning through the lumen removes oral and gastric secretions from the subglottic space, preventing micro aspiration that could lead to VAP. Subglottic secretion drainage is associated with a decrease in VAP incidence and the incremental cost of these tubes

is considered to be reasonable given the burden of illness associated with VAP (Muscedere, et al., 2008).

- **Kinetic vs. standard beds**

According to the EBG's on prevention of VAP kinetic beds reduce the risk for VAP. Amongst all participants, 46 (55.42%) answered the question correctly and 37 (44.58%) answered incorrectly.

The use of kinetic beds should be considered as it is associated with a decreased incidence of VAP (Muscedere, et al, 2008), however these beds are not readily available in South Africa as cost, feasibility and safety are issues encountered in their use. Kinetic beds are not available in any of the hospitals where the study was conducted.

- **Patient positioning**

According to the EBG's on prevention of VAP semirecumbent positioning is recommended to prevent VAP. Amongst all participants; 57 (68.67%) answered correctly and 26 (31.33%) answered incorrectly.

Semirecumbent positioning is associated with a decrease in incidence of VAP (Muscedere, et al., 2008). However there are contraindications to elevating the head of the bed to 45 degrees such as spinal injury patients, prone patients as well as head injury patients as it may be unsafe for these patients. However, attempts should be made to raise the head of the bed as near to 45 degrees as possible when not contraindicated (Muscedere, et al., 2008). Nurses demonstrated having knowledge on this measure to prevent VAP according to the scores on this question.

- **Knowledge levels of participants**

A pass mark of 70% was decided by the researcher as adequate knowledge, therefore respondents had to mark a minimum of 6 answers correctly to be considered having adequate knowledge on the evidence based guidelines for prevention of VAP.

Given that 18 (21.6%) of nurses achieved a pass mark of 70%, the results were poor. These findings demonstrate that nurses' awareness about VAP prevention guidelines is low and stress the need for education based on the current recommendations.

These results can be compared to the original study done at the annual congress of the Flemish Society of Critical Care Nurses, from which the current study was replicated, which also found a low awareness of nurses about VAP guidelines. The average score on the Flemish study was 3.7 on nine questions compared with 4.25 achieved in this study.

In a study by Labeau, et al. (2008) on knowledge levels on the evidence based guidelines for prevention of VAP among European intensive care nurses, low scores were found amongst European ICU nurses' knowledge of the evidence based guidelines for prevention of VAP. The average score in the European study was 4.06 on nine questions (45.1%).

Failure to provide care that incorporates EBG's may result in greater morbidity rates and costs (Ricart, et al., 2003). One cannot stress the importance and need for education based on current evidence based practice if one is to increase the degree of implementation to guidelines in preventing VAP in ICU. Increasing the average level of knowledge has been the first step in successful multifaceted educational programmes (Labeau, et al., 2007).

To increase nurses' knowledge in current best practice to prevent VAP it is essential to provide them with resources to gain such knowledge. Although evidence based practice has been widely discussed in the literature over the last years, in a study by Pravikoff, et al. (2005), fewer than half (46%) of nurses said they were familiar with the term. When asked whether they had identified a researchable problem in their units within the last year most nurses said they hadn't. Most nurses in the study rarely or never use libraries for information seeking; and even fewer make use of electronic resources (Pravikoff, et al., 2005).

Nurses' lack of interest and lack of knowledge in research reveals how limited they are in implementing evidence based practice. It is worrisome that nurses are not aware of current recommended practices and one may question if the care that they are providing are in fact best nursing care. Creativity must be used to create programmes that encourage nurses to seek knowledge and update their skills.

This need to update knowledge and skills needs to be addressed from the beginning of their professional careers by stressing the importance of information seeking along with professional obligation of literature searching and increasing their knowledge levels throughout their careers. Integrating evidence based practice into nursing requires the involvement of nursing students, educators, clinicians and administrators.

4.4.2 Barriers to the implementation of evidence based guidelines for prevention of VAP

From the second part of the questionnaire, where reasons were given by the participants for not implementing strategies recommended in the evidence based guidelines for VAP prevention, a few barriers to the implementation of the EBG's for VAP prevention were identified and they are discussed in detail below.

- **Lack of knowledge**

Sixty nine percent of participants are aware that oral intubation is recommended and preferred to prevent harmful side effects on patients, such as sinusitis and eventually VAP. According to respondents, oral route is the mostly used for intubation (97.53%), which is the recommended route on the EBG'S for prevention of VAP.

According to the meta-analysis by Muscedere, et al. (2008), the orotracheal intubation is associated with lower incidence of VAP. Orotracheal intubation is associated with a decrease in sinusitis and the incidence of VAP is lower in patients who do not develop sinusitis (Muscedere, et al., 2008).

As seen from the findings, the oral route is the mostly used route for endotracheal intubation in the three hospitals included in this study and majority of nurses who participated in the study is aware of its advantage over nasal intubation.

Most participants seem to be aware that the nasal route should be avoided during endotracheal intubation due to its negative outcomes to patients such as sinusitis which increases the risk for VAP. If nurses are aware that sinusitis is a possible complication of nasal intubation they could be more likely to observe and monitor for patient's signs and symptoms that would indicate sinusitis.

Amongst the three participants who answered that replacement of ventilator circuits is not done in their units, two provided reasons for not replacing the circuits. One participant mentioned it is not foreseen in the department protocol and the other participant mentioned unavailability of necessary material as a reason for not replacing these circuits. Protocols are available in all three

hospitals included in this study indicating that ventilator circuits should be changed weekly, preferably on a Sunday. No other material is needed to change these circuits except for a new, clean and sterile circuit that replaces the one on the mechanical ventilator. These circuits are readily available in all units included in this study. Therefore the two reasons supplied by the two participants for not replacing these circuits cannot be considered valid and a lack of knowledge is identified in their responses.

Participants' knowledge on type of humidifiers recommended in the guidelines for VAP prevention is low. Only 19.28% answered that both types of humidifiers are recommended, which is the correct answer. The majority of respondents (54.22%) answered that heat and moisture humidifiers are recommended, which correlates to what they use in practice since two of the hospitals included in the study make use of heat and moisture humidifiers.

The six participants who indicated that humidifiers are not changed on the units also demonstrated lack knowledge. In the three hospitals where the study was conducted humidifiers are changed. Only when heated humidifiers were used these were not changed except for the vacolitre used to humidify the inspired air. This indicates lack of knowledge from the six participants who indicated that humidifiers are not changed. The reasons provided such as unavailability of material as well as cost cannot be identified as a barrier to replacement of humidifiers as new heat and moisture humidifiers were available in stock at all three hospitals.

Participants who answered that they make use of these beds most certainly did not understand the question or did not understand what the researcher meant by rotational or kinetic beds which may represent a limitation of this study.

Rotational beds are programmed to rotate intermittently or continuously in their longitudinal axis. The rotation of the patient on a bed is hypothesized to improve drainage of secretions within the lung and lower airways, to increase functional residual capacity by providing an increased critical opening pressure to the independent lung, and to reduce the risk of venous thrombosis and associated pulmonary embolism (Goldhill, Imhoff, McLean & Waldmann, 2007). In two hospitals where this study was conducted electronic beds are available in which the head of bed as well as the foot and the whole bed can be elevated or lowered by using remote controls, however these are not rotational beds.

Most participants (68.67%) are aware that semirecumbent positioning of patients is recommended to prevent VAP. Ninety eight percent of participants indicated that they use patient positioning as means to prevent VAP, but did not indicate what position type is used. In all intensive care units where the study was conducted semirecumbent positioning is reinforced by the head of department, doctors and clinical facilitators due to its impact on decreasing VAP rates. This question only assessed how often mechanically ventilated patients are repositioned but not what position type they were put into, which could represent a limitation of the study.

- **Unavailability of material and cost constraints**

Participants are aware that closed suction systems are recommended rather than open suction systems which correlate to practice, as 92.68% of participants indicated using the closed systems despite these systems not being available in one hospital included in this study. Closed suction systems are not available in the public health sector hospital included in this study most certainly because of the cost constraint. These systems are nevertheless available in both private health sector hospitals. Open suctioning is the method of choice for suctioning in the public health sector hospital and is also used in the other two private health sector hospitals in patients

who have a tracheostomy in situ and are not mechanically ventilated, but receive supplemental oxygen via a tracheostomy mask.

According to the pharmacy prices of one of the hospitals included in this study, closed suctioning devices costs R359.00 and open suction devices costs R2.00. In the other hospital, closed suction devices costs R351.00 and open suction catheters R5.54. As noted by the researcher there is a huge increase in cost when using the closed suction system and therefore cost is one factor that could represent a barrier and lead to the unavailability of closed suction systems despite most participants having said that they make use of these systems.

Participants are also aware that endotracheal tubes with extra lumen for drainage of subglottic secretions are recommended to prevent VAP, but in practice these tubes are not used due to their unavailability in two of hospitals where the study was conducted. Endotracheal tubes with extra lumen for subglottic aspiration are available in only one hospital where the study was conducted. The other two hospitals do not have these endotracheal tubes available due to their high cost. According to one of the suppliers of these endotracheal tubes their cost ranges from R280.00 compared to R70.00 of the endotracheal tubes without an extra lumen. Therefore unavailability of resources due to an increased cost is a barrier to the use of these endotracheal tubes.

Fifty five percent of participants answered that kinetic beds reduce the risk for VAP, but when evaluating implementation of this measure the researcher concluded that most participants do not know what kinetic beds are or how they function since these beds are not available in South Africa, but 38.27% of participants responded that they make use of these beds. Reasons provided by those participants who indicated not making use of these beds included: unavailability of rotational beds and cost constraints as these beds are too expensive. These beds

are not available in South African hospitals as they are expensive and therefore cost is a barrier to the use of these beds. Nurses may simply not be aware of possibilities such as kinetic beds because they are not available locally.

- **Unforeseen in departmental protocol**

Most participants answered that it is recommended to replace ventilator circuits every week most certainly because that is what the unit protocol indicates. The evidence based guidelines for prevention of VAP recommends new circuits for each patient and changes if the circuit becomes soiled or damaged, but no scheduled ventilator circuit changes.

In one of the hospitals included in this study closed suction systems are changed on a daily basis as per unit's protocol. On the other hospital these systems are changed every 72 hours as per manufacturer's instructions. This is probably the reason why most participants answered between 24 to 72 hours to be the recommended frequency to change these suction systems. According to Muscedere, et al. (2008), scheduled daily changes and unscheduled changes of closed suction systems have no effect on VAP. Cost considerations favour less frequent changes and therefore it is recommended to change these systems for every new patient or when clinically indicated.

The protocol on changing heat and moisture humidifiers in two of the hospitals included in the study refers to daily changes. In the hospital where heated humidifiers are used the water for irrigation vacolitre is replaced when empty. The evidence based guidelines for prevention of VAP recommends humidifiers to be changed every week as less frequent changes in humidifiers may be associated with a slight decrease in incidence of VAP (Muscedere, et al., 2008).

Reduction in the frequency of humidifiers changes might also be considered as a cost reduction measure.

From the above it can be concluded that participants' knowledge in certain measures is limited to the protocols used in the units. Measures such as ventilator circuit changes as well as humidifiers and suction systems changes are done mostly according to protocols in the units and not as per the guidelines on VAP.

This is in accordance with the study done by Biancofiore, et al. (2007) which aimed at evaluating nurses' knowledge on prevention of VAP and to highlight the causes that hinder guidelines implementation. The results of Biancofiore's (2007) study highlighted lack of training among the participants with only 22.6% declaring that their knowledge of VAP prevention strategies was satisfactory. Although the majority of nurses declared their lack of knowledge of VAP and the strategies for preventing it, the percentage of those actually implementing it was high (80.9%). Their knowledge background did not seem to affect the implementation rate as this was similar among those who declared they were sufficiently informed about VAP and those who declared themselves not informed. This data indicates that the participants tend to apply such measures by following protocols or instructions given by doctors or colleagues without being fully aware of what and why they actually do so.

In a study by Ricart, et al. (2003), which reviewed barriers to nursing adherence to nonpharmacologic evidence based guidelines for prevention of VAP, overall adherence was 22.3%. The most important reasons for nonadherence were unavailability of resources (37.0%); patient discomfort (8.2%); disagreement with reported trial results (7.8%); fear of potential adverse effects (5.8%); and costs (3.4%).

Factors preventing the application of VAP prevention strategies in the study by Biancofiore et al. (2007) were: lack of resources, as endotracheal tubes with lumen for subglottic secretions aspiration were not available in the department; lack of ICU trained personnel; and stringent working rhythms and shortage of staff.

- **Shortage of staff**

Finally, the shortage of staff in intensive care units was also identified as a barrier to implementation of the guidelines for VAP prevention. Shortage of staff may lead to complications and negative outcomes to patients. There is growing evidence that high workload or low staffing level increases the risk for negative patient outcomes (Hugonnet, et al., 2007). According to Augustyn (2007), the occurrence of nosocomial infections in the intensive care unit is directly related to the adequacy of staff.

Insufficient staff numbers leads to nurses reprioritizing patient care and strategies that are required to be done repeatedly such as posture of patients and removal of condensate from the ventilator circuits may not be considered priorities. Decreasing nurse staffing levels can lead to suboptimal care, which can raise costs far above the expense of employing more nurses (Hugonnet, et al., 2007).

From the above, it is evident that knowledge of guidelines does not necessarily imply compliance as the latter depends on availability of material and human resources and on cost implications. Financial constraints can have negative implications on VAP. The cost of closed suction catheters is extremely high as compared to open suction catheters as well as the cost for endotracheal tubes with an extra lumen for subglottic secretions aspiration. Staff shortage also leads to reprioritization of nursing care which may not include interventions to prevent VAP.

Therefore measures recommended to prevent ventilator associated pneumonia may not be implemented due to unavailability of the appropriate resources. Failure to provide care that incorporates EBG's may result in high morbidity rates and costs (Ricart, et al., 2003).

4.4.3 Contributors to the implementation of evidence based guidelines for prevention of VAP

- **Availability of resources**

Professional literature was the most important source cited for changes in practice in a study by Pravikoff, et al. (2007), which examined nurses' perceptions of their access to tools with which to obtain evidence and whether they have the skills to do so. In the same study, nurses also found that professional literature is not readily available to them at the workplace.

Nurses need to become familiarized to the tools and resources available in accessing evidence for best practice. This is achieved by having these resources available at the workplace and allowing them to make use of it. Activities and programmes could be created in which nurses take turns on a weekly basis in researching a topic and discussing with all colleagues on an allocated time period in the units.

- **Training of staff members**

Nurses need to understand the pathophysiology of VAP, risk factors and measures that prevent the disease. Training in the units is needed so as to make staff members aware of the problem and empower them with knowledge to diminish it. Education of staff on current evidence based

practice is essential to keep them updated and skilled, especially in the ICU environment which is constantly developing.

- **Staff motivation and compliance**

According to Ricart, et al. (2003), guidelines are more likely to be adopted if users have participated in their development. Therefore it is important to take into consideration all stakeholders when developing guidelines to prevent limiting its implementation and increase compliance on measures listed in the guidelines. Staff may also become motivated when empowered with education and knowledge. Motivation of staff is also recognizing their work which leads them to want to make a difference.

- **Team work**

If every staff member including management becomes involved in driving the process of implementation of guidelines, staff members may feel motivated by the team input and more collaboration may occur.

Team work is essential to make one feel involved and supported by other staff members. If one staff member is implementing a certain measure to prevent VAP that person should be set as an example to others and support from all is needed for continuous improvement in the units.

- **Updated protocols**

According to the study by Labeau, et al. (2008) on knowledge levels on the evidence based guidelines for prevention of VAP among European intensive care nurses, marked differences

are noted between local and international guidelines. These differences may lead one to conclude that non implementation of guidelines may not be due to lack of knowledge but rather because protocols differ from the current international best practice. If better scores are obtained after judging the participants against local guidelines, this would suggest that the problem is lack of consistent policy, rather than poor training.

It is essential that those involved in developing standards and protocols have knowledge of current evidence so as to develop updated standards.

4.4.4 Participants' subjective opinion on their level of knowledge on the evidence based guidelines for prevention of VAP

The subjective opinion of nurses on their own knowledge levels contrasts with the scores on the questionnaire. Only 21.69% had adequate knowledge on measures for prevention of VAP as mentioned previously. This low score may be due to nurses not seeking further knowledge and updating themselves, which can pose risks to critically ill patients.

In a study by Pravikoff, et al. (2005) in the United States, it was found that nurses don't understand or value research and have received little or no training in the use of tools that would help them find evidence in which to base their practice. Thirty nine percent of nurses stated that they need information only occasionally or seldom, which goes in accordance to the findings of this current study where majority of nurses found that they had sufficient information on VAP. This is alarming when one considers the number of changes in practice that are recommended on a regular basis.

The same study by Pravikoff, et al. (2005) found that nurses practice according to what they learned in nursing school as well as their experience in practice, which is relevant. Nevertheless, nursing and medicine are evolving in such a fast pace that updating of knowledge and skills are essential for quality patient care. Nurses' assumption that they have sufficient knowledge in VAP prevention may lead to them not seeking further knowledge and having no interest in updating themselves. With current practices changing rapidly due to new evidences it is essential that one continues developing oneself throughout their career.

4.5 CONCLUSION

This chapter discussed the results obtained from the study and the descriptive and correlational statistics employed to describe and analyse the data. The research findings are discussed and integrated with findings from the literature.

Although the instrument was validated by ICU nursing experts, the Cronbach's alpha coefficient obtained for internal consistency was lower than expected (Cronbach's alpha = 0. 5961).

Overall the knowledge levels of nurses demonstrated in this study were poor with only 18 participants (21.69%) achieving a score at or above the pass mark of 70%. Mean score achieved was 4.25 in nine questions.

The final chapter of this study will present conclusions, limitations and recommendations for nursing practice, education and research.

CHAPTER FIVE

SUMMARY, LIMITATIONS, RECOMMENDATIONS AND CONCLUSIONS

5.1 INTRODUCTION

In the final chapter of this study a summary and conclusions from the main findings are presented. This is followed by a discussion on the limitations of the study and recommendations for nursing education, practice and research in the area.

5.2 SUMMARY OF THE STUDY

5.2.1 Purpose of the study

The purpose of this study was to determine intensive care nurse's knowledge of evidence based guidelines for the prevention of ventilator associated pneumonia in intensive care units from the private and public sectors in Gauteng and to highlight possible contributors and barriers to the implementation of these evidence based guidelines in order to make recommendations for nursing practice, education and further research.

5.2.2 Objectives of the study

To meet the purpose of the study, the research was conducted in two phases with the following objectives:

Phase one:

- To validate the instrument "*Evaluation questionnaire concerning intensive care nurses knowledge of interventions for prevention of ventilator associated pneumonia*" to assess ICU nurses' knowledge on evidence based guidelines for prevention of VAP.

Phase two:

- To determine and describe intensive care nurses' knowledge of evidence based guidelines for prevention of VAP.
- To describe contributors and barriers to the implementation of the evidence based guidelines on prevention of VAP.
- To establish if there is any correlation between age, training as well as years of experience and knowledge of intensive care nurses on evidence based guidelines of prevention of VAP.

5.2.3 Methodology

In phase one of the study the data collection instrument was validated by five ICU nursing experts. Following validation, the researcher took the instrument to two private hospitals and one public sector hospital in Gauteng. Prior to the commencement of the study, ethical clearance and permission to conduct the study was obtained from the relevant authorities. A non experimental, descriptive, correlational and contextual two phase design was utilised in order to meet the objectives of the study. Following a consultation with a statistician a sample of 81 subjects was decided to constitute an adequate and representative sample size but a total sample of 83 subjects were collected. Data collection took place during November and December 2009. Following a second consultation with the statistician, descriptive and inferential statistics were used for data analysis.

5.3 CONCLUSIONS

In general, the nurses performed poorly in the test, with only 18 (21.69%) participants obtaining a mark at or above the competency indicator of 70%. The average score obtained by the participants was 4.25 on nine questions (47.22%) as compared to an average score of 3.7 on nine questions (41.11%) on a Flemish study and 4.06 on nine questions (45.11%) on an European study, both also aiming at evaluating nurses' knowledge on evidence based guidelines for prevention of VAP. This stresses the need of ongoing development of nurses working in ICUs. This lack of knowledge may directly affect the quality of care that critically ill patients receive. Although there was a statistically significant correlation between years working in ICU and knowledge level the correlation was small and its clinical significance is not clear.

Lack of knowledge is a huge barrier to implementation of evidence based guidelines for VAP prevention as resources are available at times but nurses are not aware of the importance of such interventions and its implementation.

In some topics, such as what are the recommended endotracheal suction systems, nurses are aware that closed suction systems are preferred over open suction systems but in practice they are not making use of such systems due to their unavailability. Therefore unavailability of resources as well as cost constraints are barriers to the implementation of certain measures recommended to prevent VAP.

The researcher also found that nurses practice according to protocols in the units and that these protocols are not updated or in accordance with the current evidence based guidelines for prevention of ventilator associated pneumonia.

The main findings of this study show:

- There is a lack of knowledge of nurses working in ICUs with regards to interventions recommended in the evidence based guidelines for prevention of VAP.
- There is no correlation between age and knowledge of nurses on the evidence based guidelines for prevention of VAP.
- There is no correlation between level of training and knowledge of nurses on the evidence based guidelines for prevention of VAP.
- There is no correlation between years working in ICU and knowledge of nurses on the evidence based guidelines for prevention of VAP.
- According to participants, availability of resources, training of staff members, staff motivation and compliance, team work, updated protocols and more nursing staff would contribute in the implementing the evidence based guidelines for prevention of VAP.
- Unavailability of resources as well as cost represents a barrier to the implementation of evidence based guidelines on prevention of VAP

The above findings have implications for patient safety and quality of care as well as on nursing education and training of ICU nurses.

5.4 RECOMMENDATIONS FROM THE STUDY

The results of this study stresses the concern on evidence based practice and quality of care delivered to the critically ill patient. The following recommendations are made relating to nursing practice, education and further research.

5.4.1 Clinical Nursing Practice

With increasing advances in health sciences, including nursing science and there is a rising need for constant updating of new information to develop new skills in order to provide best care to patients. To fulfil this need, ICU nurses need ongoing development in their careers in order to remain updated with current knowledge and skills.

In order to reach this objective, the following recommendations for clinical practice are made:

- Ongoing in-service training must be introduced into hospitals and ICUs to improve knowledge on prevention of VAP, which is a common nosocomial infection in the intensive care units.
- Orientation of new staff members in ICU's should include education on strategies for prevention of VAP.
- Unit protocols should be reviewed regularly as updates and new evidence for best practice are constantly emerging and staff should be educated on the updated protocols.
- Motivate opinion leaders amongst nurses in the units to motivate their colleagues in putting guidelines for prevention of VAP into practice.
- Resources such as articles, journals and electronic resources such as computers and internet should be made accessible in the units for staff members. Articles on prevention of VAP should be discussed in unit meetings as part of staff education.
- Staff members should be motivated to develop their careers by studying further and gaining more knowledge and skills in the ICU field.

5.4.2 Nursing education

The following recommendations are made for nursing education:

- Raise nursing student's interest in research so as to keep themselves updated with current practice.
- ICU training programmes should include evidence based guidelines for prevention of VAP.
- Nursing lecturers and clinical facilitators should incorporate evidence based measures to prevent VAP daily in ICU's and use learning opportunities in the units to raise the topic
- Continuing professional development programmes should be made compulsory for nurses so as to motivate nurses to participate in lectures, congresses and other programmes in order to increase their knowledge levels.

5.4.3 Nursing research

The following recommendations are made for nursing research:

- This study should be extended to include other hospitals and possibly other provinces in South Africa with a larger population and sample.
- Further research should be conducted to test knowledge levels of nurses prior to and after educational programmes on evidence based guidelines for prevention of VAP to assess if nurses gained knowledge after exposure to educational programmes.
- A study on protocols used nationally and their inclusion of evidence based guidelines on prevention of VAP should be carried out in order to evaluate South African hospitals adherence to the guidelines.

5.5 LIMITATIONS OF THE STUDY

The following were identified as limitations to the study:

- The item that referred to positioning of mechanically ventilated patients on semirecumbent position only assessed how often mechanically ventilated patients are repositioned but not what position type they were put into. The guidelines recommend a position type (semirecumbent) and not a frequency for positioning of patients to prevent VAP.
- The item that referred to the use of special (rotational) beds may not have been understood by most participants, as participants indicated that they make use of these beds but in practice these beds are not available.
- The findings of the study cannot be generalized to other populations as the study was contextual and conducted on only three hospitals in one province.
- Despite the final data collection instrument been considered valid by a group of ICU nursing experts, there is a possible lack of reliability as measured by the Cronbach's alpha coefficient which would require refinement and additional testing of the instrument before further use.
- Another limitation of the study is that the degree of use of VAP prevention measures was self reported and therefore may be different from that really observed.

5.6 CONCLUSION

Nurses lack knowledge on evidence based guidelines for prevention of VAP and in order to implement measures to prevent VAP, it is necessary to be aware of such measures. Without this knowledge, nursing practice and patient care are not of high standards. Nurses also need knowledge

on the topic so as to question measures that are being used in their units and their usefulness in preventing VAP.

From this study it can be concluded that both ICU trained and non ICU trained nurses working in ICUs of the three hospitals included in the study do not have adequate knowledge in the evidence based guidelines for prevention of VAP. The study also indicated that there is no difference between the knowledge levels of ICU trained and non ICU trained nurses on the guidelines. ICU trained nurses are expected to have better knowledge than those who have not undergone ICU training as they become shift leaders and supervisors of nursing care. The correlation between ICU experience and knowledge levels was clinically not significant and therefore this indicates that working for longer periods in ICU does not necessarily mean that one gains knowledge.

This chapter provided a summary of the study, a presentation of the main findings, limitations of the study as well as recommendations for nursing practice, education and research.

This study was successful in achieving its aims and objectives as well as in using the research process appropriately. The researcher plans to publish the study in an accredited nursing journal.

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Appendices

APPENDIX A

Knowledge of Evidence-Based Guidelines for Preventing Ventilator-Associated Pneumonia

Gender: □ Female □ Male

How many years of work experience do you have as a critical care nurse? □ <1year □ 1-5 years □ 6-10 years □ >10 years

Have you obtained/Do you have a post-graduate degree in intensive care, provided by a Higher Education institution or similarly professionally accredited organisation? □ Yes □ No

How many bed positions does your intensive care unit have? . . . . .

1. Oral vs. nasal route for endotracheal intubation
□ Oral intubation is recommended
□ Nasal intubation is recommended
□ Both routes of intubation can be recommended
□ I do not know

2. Frequency of ventilator circuits changes
□ It is recommended to change circuits every 48 hrs (or when clinically indicated)
□ It is recommended to change circuits every week (or when clinically indicated)
□ It is recommended to change circuits for every new patient (or when clinically indicated)
□ I do not know

3. Type of airway humidifier
□ Heated humidifiers are recommended
□ Heat and moisture exchangers are recommended
□ Both types of humidifiers can be recommended
□ I do not know

4. Frequency of humidifier changes
□ It is recommended to change humidifiers every 48 hrs (or when clinically indicated)
□ It is recommended to change humidifiers every 72 hrs (or when clinically indicated)
□ It is recommended to change humidifiers every week (or when clinically indicated)
□ I do not know

5. Open vs. closed suction systems
□ Open suction systems are recommended
□ Closed suction systems are recommended
□ Both systems can be recommended
□ I do not know

6. Frequency of change in suction systems
□ Daily changes are recommended (or when clinically indicated)
□ Weekly changes are recommended (or when clinically indicated)
□ It is recommended to change systems for every new patient (or when clinically indicated)
□ I do not know

7. Endotracheal tubes with extra lumen for drainage of subglottic secretions
□ These endotracheal tubes reduce the risk of VAP
□ These endotracheal tubes increase the risk of VAP
□ These endotracheal tubes do not influence the risk of VAP
□ I do not know

8. Kinetic vs. standard beds
□ Kinetic beds increase the risk of VAP
□ Kinetic beds reduce the risk of VAP
□ The use of kinetic beds does not influence the risk of VAP
□ I do not know

9. Patient positioning
□ Supine positioning is recommended
□ Semi-recumbent positioning is recommended
□ The position of the patient does not influence the risk of VAP
□ I do not know

APPENDIX B

Appendix

Questionnaire concerning interventions for preventing ventilator-associated pneumonia (VAP)

This questionnaire is anonymous; we only ask you to indicate the following data:.....

Age .....; Sex M ❑ F ❑; Years working in Reanimation/ICU.....
During your duty periods, do you deal with a certain number of patients or share the care of all patients with your colleagues?
.....

Some of the internationally proposed strategies for preventing VAP are listed below. Indicate those you normally use by putting a cross in the column YES. In the cas eof a negative reply, give the reason by writing the corresponding nomber shown in the list in Table A.

Intervention	Yes	No
Use of protective gloves at every approach to a patient	❑	❑
Hand-washing with soap and water after every approach to a patient	❑	❑
Hand-washing with alcoholic antiseptic solution after every approach to a patient	❑	❑
Adequate nutritional intake	❑	❑
Sterile bronchoaspiration	❑	❑
Use of closed-circuit aspiration systems	❑	❑
Maintenance and control of adequate endotracheal cuff pressure	❑	❑
Respiratory physiotherapy	❑	❑
Avoidance of gastric over-distension	❑	❑
Rimoval of nasogastric tube as soon as clinical conditions allow	❑	❑
Humidification of respiratory circuit using humidity and heat exchange filter	❑	❑
Routine replacement of ventilator circuit	❑	❑
Periodic changes in patient bed posture	❑	❑
Use of antibacterial filters in ventilator circuit	❑	❑
Patient in semi-seated position	❑	❑
Oral hygiene with antiseptic mouthwash	❑	❑
Use of a nosocomial infection control programme	❑	❑
Hourly removal of condensation from ventilator circuits	❑	❑
Use of tubes with sub-glottic aspiration	❑	❑
Use of heated ventilator circuits	❑	❑
Use of special beds (*e.g.* Respicare)	❑	❑

TABLE A.—*Reasons why given manoeuvres or strategies are not used.*

1	Not foreseen in Departmental protocol
2	Unavailability of the necessary material
3	It causes patient discomfort
4	The literature demonstrates its uselessness
5	It can have harmful side effects on patient
6	Too expensive
7	Other reasons (specify)

Do you think you are sufficiently informed about the prevention of pneumonia in artificially ventilated patients?
Yes ❑ No ❑ If yes, by whom? .....

Thank you for your collaboration.

APPENDIX C

QUESTIONNAIRE FOR VALIDATION OF DATA COLLECTION INSTRUMENT

Please have a look at the attached questionnaire and answer the following questions:

Face Validity

- Is the questionnaire clearly worded?
- Are the questions well explained?
- Does the questionnaire address the issues that it is meant to address?

Content Validity

- Please evaluate nursing relevance of items 1 to 9 on the multiple choice part of the questionnaire using a scale of 1 to 3:
    - 1 = not relevant
    - 2 = relevant, but not necessary
    - 3 = absolutely necessary

Item 1:

Item 2:

Item 3:

Item 4:

Item 5:

Item 6:

Item 7:

Item 8:

Item 9:

- To evaluate the level of difficulty of the instrument could you please answer the questionnaire and send it back to me.You may answer the mutiple choice part by allocating a star next to the correct answer

APPENDIX D

Ethics Approval and Letters of Permission

Faculty of Health Sciences
Medical School, 7 York Road, Parktown, 2193
Fax: (011) 717-2119
Tel: (011) 717-2745

Reference: Ms Tania Van Leeve
E-mail: tania.vanleeve@wits.ac.za
23 September 2008
Person No: 0208311T
PAG

Ms VP Gomes
24 Fruli Court
123 Princess Ave
Benoni
1501
South Africa

Dear Ms Gomes

Master of Science in Nursing: Approval of Title

We have pleasure in advising that your proposal entitled "*Knowledge of intesive care nurses on evidence-based guidelines for prevention of ventilator-associated pneumonia*" has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

Nursing Education

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Ms. Viviana Gomez
24 Fruili Court
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Benoni
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29 January 2009

Dear Ms. Gomez

RE: MASTER OF SCIENCE IN NURSING

This letter serves to inform you that you have been allocated to Dr Candice Harris for research supervision commencing 1 February 2009 until completion of your degree.

Please confirm an appointment with Dr Candice Harris at maharris@wol.co.za or 0828796528 for consultation regarding your research.

Yours sincerely

Bruce

Professor J Bruce
Head. Department of Nursing Education

cc. Dr C Harris

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Gomes

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER M081015**
PROJECT	Knowledge of Intensive Care Nurses on Evidence Based Guidelines for Prevention of Ventilator Associated Pneumonia
INVESTIGATORS	Miss VPR Gomes
DEPARTMENT	Dept of Nursing Education
DATE CONSIDERED	08.10.31
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 09.01.15 **CHAIRPERSON** .....
(Professor P E Cleaton Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Dr S Schmollgruber

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

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15TH June 2009

Ms Viviana Paula Gomes
Department of Nursing Education
Faculty of Health Sciences
University of Witwatersrand

Dear Ms Gomes

RE: Permission To do research entitled " Knowledge of intensive care nurses on evidence-based guidelines for prevention of ventilator associated pneumonia"

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

1. The 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.

Yours sincerely

Dr. S. B. Mfenyana
Acting Chief Executive Officer

APPENDIX IV

Viviana Paula Gomes
Department of Nursing Education
Faculty of Health Sciences
University of the Witwatersrand
7 York Road
Parktown 2193

The Chief Executive Officer
The Glynwood Hospital
33 Harrison Street
Benoni 1501

Dear Mr. Scholtemeyer,

Re: REQUEST TO CONDUCT RESEARCH AT THE GLYNWOOD HOSPITAL

I am employed at the High Care Unit of The Glynwood Hospital and am currently a registered Masters student at the University of the Witwatersrand in the Department of Nursing. I am hereby asking for permission to undertake research at The Glynwood Hospital. The title of my research is: ***"Knowledge of intensive care nurses on evidence-based guidelines for prevention of ventilator associated pneumonia".***

Evidence based nursing is a current practice worldwide and evidence based guidelines have been created in order to prevent and minimize ventilator associated pneumonia, which is a nosocomial infection that complicates the course of illness of mechanically ventilated patients. The evidence based guidelines have been proved to increase positive outcomes to mechanically ventilated patients and prevent ventilator associated pneumonia. Intensive care nurses are in the best position to put evidence based guidelines into practice as they are in contact with the patient providing care 24 hours a day. Therefore its important that intensive care nurses have knowledge of such guidelines to be able to put them into practice.

The aim of my study is to evaluate and describe intensive care nurses' knowledge of evidence based guidelines for prevention of ventilator associated pneumonia and to highlight possible contributors and barriers to the implementation of these evidence based guidelines in order to make reccommendations for nursing practice, education and further research.

I want to assure you that the institution's name and personnel involved in the study will not be divulged in the research report. Informed consent will be obtained from all participants and a copy of the research report will be available to you if so requested. I am hoping to conduct my research at the intensive and high care units of your hospital.

My proposed study has been approved by the Committee for Research on Human Subjects of the University of Witwatersrand (please see attached clearance certificate) and I will be waiting for your approval prior to commence my study.

Yours sincerely,

Viviana Gomes
MSc Nursing student

all liaison + publication to be approved by NSM
27/3/2009
Date 25 March 2009

Milpark Hospital

9 Guild Road
Parktown West 2193

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Toll Free: 0800116618
E-mail: milparkhospital@netcare.co.za
website: www.netcare.co.za

11 December 2009

Sr V Gomes
Netcare Milpark Hospital

Dear Viviana

RE: Knowledge of Intensive Care Nurses on evidence-based guidelinesfor prevention of Ventilator Associated Pneumonia

The Netcare Milpark Hospital Ethics Committee has reviewed the above Protocol and Informed Consent

Approval has been granted to conduct the research at Milpark Hospital.

We wish you every success in your recruitment. It is extremely important that the hospital review your findings, once available, to assess deficiencies, if any, in our current guidelines.

Yours sincerely

Dr P Obel- Chairperson Netcare Milpark Hospital Ethics Committee

APPENDIX I

KNOWLEDGE OF INTENSIVE CARE NURSES ON EVIDENCE-BASED GUIDELINES FOR PREVENTION OF VENTILATOR- ASSOCIATED PNEUMONIA

PANEL OF EXPERTS INFORMATION LETTER

Dear colleague,

My name is Viviana Paula Gomes. I am currently registered as a student at the University of the Witwatersrand, in the Department of Nursing Education for the degree of Master of Science in Nursing (Intensive Care Nursing). I am hoping to conduct a research project to evaluate and describe intensive care nurses's knowledge of evidence-based guidelines for prevention of ventilator associated pneumonia.

I hereby invite you as an expert in the field to be part of an expert group in assisting me to validate the data collection instrument. A focus group will be held to discuss instrument content validity and appropriateness to the South African context.

Participation in the validation process is entirely voluntary. Due to the need to contact you, I would kindly request that you provide your personal details on the check list that will be provided. No identification of your personal information will be given when reporting your opinions so as to ensure anonymity and confidentiality. If you consent to be part of the expert group, please complete the attached consent form and return it to me in the addressed and stamped envelope enclosed.

No benefit will be derived by you from participation in this study, however I hope that the results of the study will provide valuable information regarding intensive care nurses' knowledge on current evidence based nursing practice and help direct nursing education and training as well as continuing development of intensive care nurses.

The research committees of the University of Witwatersrand, Gauteng Health Department and relevant health institutions have approved the study and its procedures.

Thank you for taking time reading this information letter. Please don't hesitate to contact me in case you require any further information regarding the study on the following number **082 9543069** or email me on the following address: *vivien_leigh22@hotmail.com*

Yours faithfully,

Viviana Gomes

APPENDIX II

KNOWLEDGE OF INTENSIVE CARE NURSES ON EVIDENCE-BASED GUIDELINES FOR PREVENTION OF VENTILATOR- ASSOCIATED PNEUMONIA

PARTICIPANT INFORMATION LETTER

Dear colleague,

My name is Viviana Paula Gomes. I am currently registered as a student at the University of the Witwatersrand, in the Department of Nursing Education for the degree of Master of Science in Nursing (Intensive Care Nursing). I hope to conduct a research project and would therefore like to invite you to be included in my sample of intensive care nurses.

The purpose of this study is to evaluate and describe intensive care nurses' knowledge on evidence based guidelines for prevention of ventilator associated pneumonia and to highlight possible contributors and barriers that prevent the implementation of these evidence based guidelines in order to make recommendations regarding nursing practice, education and further research.

Participation in the study is entirely voluntary. You may choose not to participate or to withdraw from the study at any time, without any penalties whatsoever. Anonymity and confidentiality will be ensured and your identification will not be disclosed or reported in the study. You will derive no direct benefit from participating in the study, however I hope that the results of the study will provide valuable information regarding intensive care nurses' knowledge on current evidence based nursing practice and help direct nursing education and training as well as continuing development of intensive care nurses. Results of the study will be available to you should you so wish.

The appropriate people and research committees of the University of the Witwatersrand, Gauteng Department of Health and this health institution have approved the study and its procedures.

Thank you for taking time to read this information letter. Should you require any further information regarding the study or your rights as a study participant you are free to contact me in the Department of Nursing Education or on the following telephone number: **082 9543069**.

Viviana Gomes

APPENDIX III

Evaluation questionnaire concerning intensive care nurses' knowledge of interventions for prevention of ventilator-associated pneumonia (VAP)

This questionnaire is anonymous. Please do not write your name.

Please indicate the following:

Age: _____ Sex: Male ☐ Female ☐

Years working in ICU: _____

Do you have a Degree or Diploma in Intensive Care Nursing? _____

Some of the internationally proposed strategies for preventing VAP are listed below.
Please mark which interventions are recommended in the evidence-based guidelines for prevention of VAP.

1. Oral vs nasal route for endotracheal intubation
a) Oral intubation is recommended
b) Nasal intubation is recommended
c) Both routes of intubation can be recommended
d) I do not know

2. Frequency of ventilator circuit changes
a) It is recommended to change circuits every 48 hours (or when clinically indicated)
b) It is recommended to change circuits every week (or when clinically indicated)
c) It is recommended to change circuits for every new patient (or when clinically indicated)
d) I do not know

3. Type of humidifier
a) Heated humidifiers are recommended
b) Heat and moisture exchangers are recommended
c) Both types of humidifiers can be recommended
d) I do not know

4. Frequency of humidifiers changes
a) It is recommended to change humidifiers every 48 hours (or when clinically indicated)
b) It is recommended to change humidifiers every 72 hours (or when clinically indicated)
c) It is recommended to change humidifiers every week (or when clinically indicated)
d) I do not know

5. Open vs closed suction systems
a) Open suction systems are recommended
b) Closed suctions systems are recommended
c) Both systems can be recommended
d) I do not know

6. Frequency of change in suction systems
a) Daily changes are recommended (or when clinically indicated)
b) Weekly changes are recommended (or when clinically indicated)
c) It is recommended to change systems for every new patient (or when clinically indicated)
d) I do not know

7. Endotracheal tubes with extra lumen for drainage of subglottic secretions
a) These endotracheal tubes reduce the risk for VAP
b) These endotracheal tubes increase the risk for VAP
c) These endotracheal tubes do not influence the risk for VAP
d) I do not know

8. Kinetic vs standard beds

a) Kinetic beds increase the risk for VAP
b) Kinetic beds reduce the risk for VAP
c) The use of kinetic beds does not influence the risk for VAP
d) I do not know

9. Patient positioning

a) Supine positioning is recommended
b) Semirecumbent positioning is recommended
c) The position of the patient does not influence the risk for VAP
d) I do not know

Please indicate those strategies you normally use by putting a cross in the column YES and state how frequently used. In the case of a negative reply, give the reason by writing the corresponding number shown in the list in Table A on the corresponding column below.

Intervention	Yes	No	How many times a day or how frequent	Reason not used
1. Oral intubation				
2. Nasal intubation				
3. Closed suctioning				
4. Open suctioning				
5. Replacement of suction systems				
6. Replacement of ventilator circuit				
7. Replacement of humidifiers				
8. Patient positioning				
9. Use of endotracheal tubes with sub-glottic aspiration				
10. Use of special beds (e.g Rotational beds)				

TABLE A – ***Reasons why given interventions or strategies are not used.***

1 Not foreseen in Department protocol
2 Unavailability of necessary material
3 It causes patient discomfort
4 The literature demonstrates its uselessness
5 It can have harmful side effects on patient
6 Too expensive
7 Other reasons (specify)

_____

In your opinion, what would contribute for the implementation of the evidence based guidelines in your unit?

_____
_____
_____
_____

_____
_____
_____
_____

Do you think you are sufficiently informed about the prevention of ventilator associated pneumonia in mechanically ventilated patients?

Yes ☐ No ☐

If **YES**, informed by whom? _____

If **NO**, why? _____

Thank you for your collaboration

APPENDIX IV

Viviana Paula Gomes
Department of Nursing Education
Faculty of Health Sciences
University of the Witwatersrand
7 York Road
Parktown 2193

The Chief Executive Officer
The Glynwood Hospital
33 Harrison Street
Benoni 1501

Dear Mr. Scholtemeyer,

Re: REQUEST TO CONDUCT RESEARCH AT THE GLYNWOOD HOSPITAL

I am currently a registered student at the University of the Witwatersrand in the Department of Nursing. I am hereby asking for permission to undertake research at The Glynwood Hospital. The title of my research is: "*Knowledge of intensive care nurses on evidence-based guidelines for prevention of ventilator associated pneumonia"*.

Evidence based nursing is a current practice worldwide and evidence based guidelines have been created in order to prevent and minimize ventilator associated pneumonia, which is a nosocomial infection that complicates the course of illness of mechanically ventilated patients. The evidence based guidelines have been proved to increase positive outcomes to mechanically ventilated patients and prevent ventilator associated pneumonia. Intensive care nurses are in the best position to put evidence based guidelines into practice as they are in contact with the patient, providing nursing care 24 hours a day. Therefore intensive care nurses need to have knowledge of such guidelines to be able to put them into practice.

The aim of this study is to evaluate and describe intensive care nurses' knowledge of evidence based guidelines for prevention of ventilator associated pneumonia and to highlight possible causes that prevents the implementation of these evidence based guidelines in order to make recommendations regarding nursing practice, education and further research.

I want to assure you that the institution's name and personnel involved in the study will not be divulged in the research report. Informed consent will be obtained from all participants and a copy of the research report will be available to you if so requested.

I hope to conduct my research at the ICU and High Care units once my proposed study has been approved by the Committee for Research on Human Subjects of the University of Witwatersrand.

Yours sincerely,

Viviana Gomes
MSc Nursing student

APPENDIX V

Viviana Paula Gomes
Department of Nursing Education
Faculty of Health Sciences
University of the Witwatersrand
7 York Road
Parktown 2193

The Chief Executive Officer
Charlotte Maxeke Hospital
5 Jubilee Road
Parktown 2193

Dear Dr. S. B. Mfenyana,

Re: REQUEST TO CONDUCT RESEARCH AT THE CHARLOTTE MAXEKE HOSPITAL

I am currently a registered student at the University of the Witwatersrand in the Department of Nursing. I am hereby asking for permission to undertake research at Charlotte Maxeke Hospital. The title of my research is: "*Knowledge of intensive care nurses on evidence-based guidelines for prevention of ventilator associated pneumonia"*.

Evidence based nursing is a current practice worldwide and evidence based guidelines have been created in order to prevent and minimize ventilator associated pneumonia, which is a nosocomial infection that complicates the course of illness of mechanically ventilated patients. The evidence based guidelines have been proved to inrease positive outcomes to mechanically ventilated patients and prevent ventilator associated pneumonia. Intensive care nurses are in the best position to put evidence based guidelines into practice as they are in contact with the patient, providing nursing care 24 hours a day. Therefore intensive care nurses need to have knowledge of such guidelines to be able to put them into practice.

The aim of this study is to evaluate and describe intensive care nurses' knowledge of evidence based guidelines for prevention of ventilator associated pneumonia and to highlight possible causes that prevents the implementation of these evidence based guidelines in order to make recommendations regarding nursing practice, education and further research.

I want to assure you that the institution's name and personnel involved in the study will not be divulged in the research report. Informed consent will be obtained from all participants and a copy of the research report will be available to you if so requested.

I hope to conduct my research at the trauma, cardiothoracic and multidisciplinary intensive care units once my proposed study has been approved by the Committee for Research on Human Subjects of the University of Witwatersrand.

Yours sincerely,

Viviana Gomes
MSc Nursing student

APPENDIX VI

KNOWLEDGE OF INTENSIVE CARE NURSES ON EVIDENCE-BASED GUIDELINES FOR PREVENTION OF VENTILATOR- ASSOCIATED PNEUMONIA

PARTICIPANT CONSENT FORM

I _____ (name) give permission to be included in the study. I read and understood the content of the information and I have been given the opportunity to ask questions I might have regarding the questionnaire and the study.

_____ _____

Date Signature

APPENDIX VII

Viviana Paula Gomes
Department of Nursing Education
Faculty of Health Sciences
University of the Witwatersrand
7 York Road
Parktown 2193

Dear Unit Manager,

Re: REQUEST TO CONDUCT RESEARCH AT YOUR UNIT

I am currently a registered Masters student at the University of the Witwatersrand in the Department of Nursing. I am hereby asking for permission to undertake research at your intensive care unit. The title of my research is**: "*Knowledge of intensive care nurses on evidence-based guidelines for prevention of ventilator associated pneumonia".***

Evidence based nursing is a current practice worldwide and evidence based guidelines have been created in order to prevent and minimize ventilator associated pneumonia, which is a nosocomial infection that complicates the course of illness of mechanically ventilated patients. The evidence based guidelines have been proved to inrease positive outcomes to mechanically ventilated patients and prevent ventilator associated pneumonia. Intensive care nurses are in the best position to put evidence based guidelines into practice as they are in contact with the patient providing nursing care 24 hours a day. Therefore it is important that intensive care nurses have knowledge of such guidelines to be able to put them into practice.

The aim of this study is to evaluate and describe intensive care nurses' knowledge of evidence based guidelines for prevention of ventilator associated pneumonia and to highlight possible contributors and barriers to the implementation of these evidence based guidelines in order to make recommendations for nursing practice, education and further research.

I want to assure you that the institution's name and personnel involved in the study will not be divulged in the research report. Informed consent will be obtained from all participants and a questionnaire handed in to them for completion. A copy of the research report will be available to you if so requested.

My proposed study has been approved by the Committee for Research on Human Subjects of the University of Witwatersrand and by the Hospital Management.

Yours sincerely,

Viviana Gomes
MSc Nursing student

APPENDIX VIII

Viviana Paula Gomes
Netcare Milpark Hospital
Clinical Department
9 Guild Road
Parktown West
2193

Ethics Committee Chairperson
Netcare Milpark Hospital
9 Guild Road
Parktown West
2193

Dear Dr. P. Obel,

REQUEST TO CONDUCT RESEARCH AT THE NETCARE MILPARK HOSPITAL

I am a Milpark staff member, currently employed as ICU Clinical Facilitator at the Trauma and Burns Units. I am hereby asking for permission to undertake research at Milpark Hospital. The title of my research is: ***"Knowledge of intensive care nurses on evidence- based guidelines for prevention of ventilator associated pneumonia".***

Evidence based nursing is a current practice worldwide and evidence based guidelines have been created in order to prevent and minimize ventilator associated pneumonia, which is a hospital acquired infection that complicates the course of illness of mechanically ventilated patients. The evidence based guidelines have been proven to increase positive outcomes to mechanically ventilated patients and prevent ventilator associated pneumonia. Intensive care nurses are in the best position to put evidence based guidelines into practice as they are in contact with the patient providing nursing care 24 hours a day. Therefore it is important that intensive care nurses have knowledge of such guidelines in order to be able to put them into practice.

The aim of my study is to evaluate and describe intensive care nurses' knowledge of evidence based guidelines for prevention of ventilator associated pneumonia and to highlight possible contributors and barriers to the implementation of these evidence based guidelines in order to make recommendations for nursing practice, education and further research.

I want to assure you that the institution's name and personnel involved in the study will not be divulged in the research report. Informed consent will be obtained from all participants and a copy of the research report will be available to you if so requested. I am hoping to conduct my research at the Trauma, Burns, Surgical and Cardiac Intensive Care Units of Milpark Hospital.

My proposed study has been approved by the Committee for Research on Human Subjects of the University of the Witwatersrand (please see attached clearance certificate) and I will be waiting for your approval, if granted, to commence the study.

Yours sincerely,

Viviana Gomes
MSc Nursing student

APPENDIX IX

From: Sonia Labeau [sonia.labeau@hogent.be]
Sent: 25 January 2010 08:34 AM
To: vivianagomes@vodamail.co.za
Cc: 'Stijn BLOT'
Subject: RE: Permission for use of questionnaire

Attachments: Labeau et al_2008_EUVAP_JHI.pdf; Blot & Labeau et al_VAP Knowledge_ICM.pdf; EUQuestionnaireVAPEnglish.pdf; EUQuestionnaireVAPEnglish.doc

Dear Ms. Gomes,

It is our pleasure to grant you permission to use our VAP questionnaire and to make the adaptations required for your study. Thank you in advance for referencing it appropriately.
Please find in attach a Word- and pdf-copy of the questionnaire for your use, as well as two publications that report on the results of surveys using the questionnaire among both a sample of Flemish and European ICU nurses. Also, if you would need any additional information, please feel free to contact us.

We wish you lots of success with your study and thank you for your interest in our research. We would be delighted to be kept informed about the progress or results of your most interesting study!

Best regards,
Sonia Labeau
PhD-student with prof. dr. S. Blot
sonia.labeau@hogent.be
sonia.labeau@ugent.be

APPENDIX X

From: Gianni Biancofiore, MD [g.biancofiore@med.unipi.it]
Sent: 22 June 2009 04:46 PM
To: vivianagomes@vodamail.co.za
Subject: questionnaire

sorry for the delay in my reply but i was abroad.
please feel free to use our questionnaire and let me know if you need any assistance. I'll be happy to give any support
bestregards
gianni biancofiore, md
.,
Gianni Biancofiore, MD
Anestesia e Rianimazione SSN
Ospedale Cisanello
56100 Pisa, Italia
.,