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

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DECLARATION

I, Janet Feranmi Amusan, declare this research report is my own work. It is being submitted for the degree of Master of Science (in Nursing) at the University of the Witwatersrand, Johannesburg. It has not previously been submitted for any degree or examination at this or any other university.

Signature …….

……day of …… 2019

Protocol Number: M180525

DEDICATION

I dedicate this work to the Almighty God for granting me the strength to start and complete this study, is not by my might nor by my power but by the grace of God. Therefore, I return all the glory back to him.

I also dedicate my work to my uncles Professor. Oluwole Amusan and Dr. Isaac Amusan for their support, encouragement and for making my Master degree program journey possible.

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ABSTRACT

Background: Ventilated Associated Pneumonia (VAP) is one of the most common nosocomial infections and complication that occur in Intensive Care Units (ICUs) worldwide. It has become a major challenge worldwide and in South Africa where the patient mortality rate is 37.5%. Evidence-based guidelines exist for the prevention of VAP, which is highly effective in the reduction of VAP in ICUs. However, there are inconsistency in practices and different opinions amongst the intensive care nurses regarding the evidence-based VAP prevention guidelines.

Purpose: The purpose of this study was to assess the knowledge of intensive care nurses with regards to current evidence-based guidelines for preventing VAP in five adults ICUs of an Academic Hospital in Johannesburg.

Setting: This research study was conducted in five Adult's ICUs (General ICUs, Trauma ICUs, Neurological ICUs, Cardiothoracic ICUs and Acute Coronary Care Units) at the Academic Hospital, in Johannesburg.

Design and Methods: This study uses a non-experimental, descriptive survey and correlational research design consisting of a questionnaire with multiple questions options and one correct response. This questionnaire has been developed, validated and tested by Labeau et al. (2007) in Belgium. The sample size comprises of 94 (n=94) intensive care nurses respondents from the adult intensive care units (n=5), and a non-probability convenience sampling methods was used to select the study participants. The questionnaire is divided into two sections: the first section comprises a demographic description of participant and second section comprises nine (9) items on preventative interventions on VAP for nurses (Labeau et al., 2007). Descriptive and inferential statistics was used to analyse data collected in this study. The descriptive statistics was reported as percentage and frequency. Statistical testing was done on the 0.05 ($p<0.05$) level of significance.

Results: The intensive care nurses mean score in knowledge test was 44% and there was no significant ($p>0.05$) difference in knowledge based on years of experience in ICUs and different level of nursing qualification.

Conclusion: The intensive care nurses demonstrated poor knowledge of the evidence-based guideline for VAP prevention. In-service training or educational training programme on VAP prevention should be render to the intensive care nurses in this research study setting through continuous education.

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LIST OF ABBREVIATIONS

EBP	Evidence-based Practice
ETT	Endotracheal tube
ICUs	Intensive Care Units
SD	Standard Deviation
VAP	Ventilated Associated Pneumonia

CHAPTER ONE

OVERVIEW OF THE STUDY

1.0 INTRODUCTION

This chapter will provide an overview of the study and the research process, explaining the background of the study, problem statement, purpose, objectives and significance of the study. A short description of the research methodology will be given by briefly explaining the research design, data collection process, data analysis and ethical considerations of the study.

1.1 BACKGROUND OF THE STUDY

Ventilated Associated Pneumonia (VAP) is one of the nosocomial infections that commonly occur in Intensive Care Units (ICUs) worldwide (Righi et al., 2014), and can be defined as hospital-acquired pneumonia (respiratory tract infection) that develops within 48 hours after a patient has been placed on mechanical ventilation (Soh et al., 2012).

Since 1987, VAP has been a significant challenge in ICUs, with reported incidences of 68% and mortality rates of 71% (Torres et al., 1990). The presence of VAP is one of the causes for the delay of extubation from mechanical ventilation, increased days in ICUs, increased use of healthcare resources, high cost of treatment for the patient and the hospital's capacity (Johnson, Domb & Johnson, 2012; Righi et al., 2014). In addition, a study conducted by Parisi et al.

(2016) reported the VAP incidence rate of 11.6 per 1000 ventilator days, the length of stay in ICUs to be 27 days and the duration of mechanical ventilation to be 21days, all of which are prolonged and the cost of treatment high for both the patients and the hospital management. Fees for a critically ill ventilated patient in a hospital in South Africa can cost approximately R22, 870 for a day (Mahomed & Mahomed, 2019). This unquestionably is very costly. However, ICUs are for the stability of the critically ill patient's condition, and the expected duration of stay is considered to be within a period of three to six days, provided there are no contraindications and complications. Therefore, it is essential to reduce complications as much as possible to reduce ICUs' cost of treatment and to make beds available for the next patients. With the above-mentioned shortfall, intensive care nurses and other related healthcare researchers have embarked on a journey to combat and prevent VAP incidence through an innovative solution using a scientific research approach and evidenced-based practice.

Gray, Grove and Sutherland (2017) defined Evidence-Based Practice (EBP) as a conscientious integration of the best research evidence with clinical expertise and patient values, aimed at delivering quality and cost-effective healthcare. In various research findings addressing VAP incidence, Chulay and Gallagher (2017); Klompas et al. (2014) and Muscedere et al. (2008) developed a VAP prevention guideline and a VAP care bundle through an EBP. The EBP utilises the most relevant and current best evidence from research studies conducted on severe cases for VAP prevention. The evidence-based VAP prevention guideline and VAP care bundle aimed to utilise the EBP to improve the quality of care and ensure best patient outcomes (Ali, 2013; Muscedere et al., 2008). It is therefore

essential that EBP becomes a core competency of all healthcare practitioners (Rauen et al., 2008).

Porter-O'Grady (2007) and Rauen et al. (2008) point out that nurses are at the forefront of evidence-based approaches, as they are at the patient's bedside 24 hours using their scientific-based knowledge and skills, which are highly technical, physiological and pharmacological in the field of Critical Care Nursing for the management of the patients (Porter-O'Grady 2007; Rauen et al., 2008). This scientifically-based knowledge and skill would also empower intensive care nurses to use their research and evidence-based knowledge to answer questions, establish protocols, and promote critical thinking and decision making at the patient's bedside (Polit & Beck, 2014).

The evidenced-based process involves five steps that enable a healthcare practitioner to quickly access, evaluate and integrate evidence into clinical practice (Melnyk & Fineout-Overholt, 2015). These five steps include: identifying a clinical practice question or problem; search for the best evidence; critically appraise the evidence; decide to integrate the evidence into practice; evaluate the outcomes.

However, many evidence-based VAP guidelines have been developed for the prevention of VAP since the epidemiology of the disease started and they are updated in concurrent years to adapt to current practices. Labeau et al. (2008) further claimed that evidence-based VAP prevention guidelines are effective to reduce the VAP mortality and morbidity rate, resulting in patient's short stay in the hospital, reducing hospital costs and improving quality of health and safety of the

patient(s). However, many challenges still exist in the implementation of the evidence-based VAP prevention guidelines, as the current incidence rate ranges from 9% to 39% (Safdar et al., 2016).

In South Africa, a study by Behari and Kalafatis (2015), in two major hospitals in Durban metropolitan area over a period of six months, reported a VAP incidence rate of 9.9 per 1,000 ventilator days accompanied by a mortality rate of 37.5%. Poor adherence by healthcare practitioners to the implementation of evidence-based VAP prevention guidelines is the cause of VAP occurrences today, because it is a preventable infection (Gatell et al., 2012; Labeau et al., 2008). Healthcare practitioners are responsible for implementing evidence-based VAP prevention guidelines when caring for a patient under mechanical ventilation.

Internationally, lack of knowledge, lack of familiarity with the EBP VAP prevention guidelines and the inconsistency between local and international guidelines were recently identified as factors for poor adherence to the evidence-based VAP prevention guidelines among intensive care nurses (Jansson et al., 2013; Labeau et al., 2008). In their study, Kiyoshi-Teo et al. (2014) observed that intensive care nurses show positive attitudes towards the guidelines by reading them for specific information they received during nursing training and clinical practice; however, they consider parts of the guideline they are not familiar with as less critical and are reluctant to read them (Kiyoshi-Teo et al., 2014).

In South Africa, the findings from a study conducted by Gomes (2010) illustrated that intensive care nurses lack knowledge of evidence-based VAP prevention

guidelines and also identified lack of resources, lack of staff, inadequate teamwork approach and protocols not being updated as barriers to the implementation of such guidelines. The limitation of this study is that the barriers to the implementation of identifying evidence-based VAP prevention guidelines were self-reported by the nurses, except for knowledge which was assessed. No significant difference ($P>0.05$) was found in the relationship between intensive care nurses with and without a post basic or additional qualification regarding their knowledge and adherence to evidence-based guidelines.

Furthermore, the study was conducted in three hospitals in Gauteng, and included one public and two private hospitals, and the majority of participants were from private hospitals (Gomes, 2010). Therefore, this study intends to compare the latter study's findings with the current study, as Gomes' (2010) study was conducted in 2010, eight years ago. At that time, EBP was still new in the healthcare profession, and recent EBP has been added as part of the curriculum for Nursing Students at the Bachelors and Masters level. Therefore, these newly qualified nurses are expected to be more knowledgeable with regard to EBP, and it is envisaged that the attitude and knowledge of the healthcare practitioner (especially the intensive care nurses) and the health institutions towards the evidence-based guidelines has improved.

1.2 PROBLEM STATEMENT

VAP is one of the most severe complications that occurs in ICUs worldwide, with a mortality rate of 37.5% (Behari & Kalafatis, 2015). Recently, non-adherence of

healthcare professionals to the evidence-based VAP prevention guidelines was identified as the cause of VAP occurrences today. The use of evidence-based guidelines improves the quality of patient care and narrows the gap between the research outcomes and clinical practice. VAP can be prevented if the current evidence-based guidelines are adhered to consistently.

Furthermore, the researcher observed inconsistency in practices amongst intensive care nurses, as some have different opinions regarding intervention on evidence-based VAP prevention guidelines. There are only a few published studies to-date in South Africa on factors that influence intensive care nurses adherence or non-adherence to the current evidence-based VAP prevention guidelines (Behari & Kalafatis, 2015; Gomes, 2010). The causes of non-adherence are however not understood and may be related to lack of knowledge, therefore, this study intends to assess the knowledge of the intensive care nurses regarding the current evidence-based VAP prevention guidelines that must be adhered to in clinical practice to provide and if necessary, make suggestions from the findings of this study.

The research questions were:

- What is the knowledge of intensive care nurses regarding current evidence-based guidelines for the prevention of VAP?
- Do age, training and years of experience in the ICU influence the intensive care nurses' knowledge of current evidence-based guidelines for preventing VAP?

1.3 PURPOSE OF THE STUDY

The purpose of this study was to assess the knowledge of intensive care nurses regarding current evidence-based guidelines for preventing VAP in five adult ICUs of an academic hospital in Johannesburg.

1.4 OBJECTIVES

The objectives of the study were:

- To assess the knowledge of intensive care nurses regarding current evidence-based guidelines for the prevention of VAP in ICUs.

- To determine if there is an association between training, years of experience and knowledge of the intensive care nurses on current evidence-based guidelines for prevention of VAP.

1.5 SIGNIFICANCE OF THE STUDY

This study intends to assess Intensive Care nurse's knowledge of current evidence-based VAP prevention guidelines. The intention is to create awareness among healthcare practitioners, specifically intensive care nurses, of the value of following evidence-based VAP prevention guidelines. The findings from this study will benefit the healthcare institution in developing policy and education programmes for the healthcare practitioner on the implementation of evidence-

based VAP prevention guidelines. In so doing, it will promote adherence amongst the intensive care nurses, which will ultimately benefit patient outcomes by reducing the incidence of VAP and mortality rates, the patient will benefit financially because the cost of their stay in the ICU will decrease, and hospitals will benefit because they are continually faced with the challenge of providing cost-effective services to patients and communities.

1.6 OPERATIONAL DEFINITIONS

Definitions for the purpose of this study are as follows:

- **Academic Hospital**

Academic hospital refers to a healthcare facility that is linked to a medical school or university complex, and is closely affiliated with a degree-granting university (Segen's Medical Dictionary, 2011).

- **Intensive Care Unit (ICU)**

An ICU is a designated ward in a hospital that is staffed with specialised nurses and equipped with highly sophisticated technologies. Its purpose is for monitoring, caring and treating the patient(s) with a life-threatening condition that needs critical care (De Beer, Brysiewicz and Bhengu, 2011; South African Nursing Council, 2014).

- **Intensive Care Nurse**

An Intensive Care nurse in this research includes either Professional Nurse with or without a postgraduate qualification in Critical Care Nursing and registered with the South Africa Nursing Council as a Professional Nurse, and/or an Intensive Care Nurse (De Beer, Brysiewicz and Bhengu, 2011; South African Nursing Council, 2014).

intensive care nurses provide adequate and complex care for critically ill patients, using their well-developed knowledge base and specialist skills in both technologies and the caring dimensions of Critical Care nursing (De Beer, Brysiewicz and Bhengu, 2011; South African Nursing Council, 2014). They also render support and comfort to the patient's family during the stay of the patient in an ICU (De Beer, Brysiewicz and Bhengu, 2011; South African Nursing Council, 2014).

- **Evidence-Based Guidelines**

Evidence-based guidelines can be defined as systematic statements derived from systematic reviews, based on best research evidence of clinical effectiveness, to assist in decision making on specific clinical conditions (Muscedere et al., 2008).

- **Knowledge**

Knowledge is the facts, information and skills acquired through theoretical or practical training to understanding a particular subject. It can also be defined as the awareness of familiarity gained by experience of a fact or situation (Oxford Dictionary, 2018). In this study, nurses' knowledge of evidence-based guidelines for prevention of VAP will be measured using a survey questionnaire (Labeau et al., 2008).

1.7 OVERVIEW OF THE RESEARCH METHODOLOGY

A non-experimental, descriptive survey and correlational research design was used to meet the study objectives. The survey was selected based on the research topic, problem statement and its objective. Descriptive survey was used to describe the intensive care nurses knowledge concerning each item on the questionnaire. Correlational research design was used to identify the relationship between knowledge and years of working experience in the ICU, qualification or training. The study respondents were intensive care nurses working in five adult's ICUs at an Academic hospital in Johannesburg, using a self-administered questionnaire by Labeau et al. (2007). The questionnaire was used for this study based on its effective in assessing the knowledge of intensive care nurses with regarding evidence-based guidelines for preventing VAP (Blot et al., 2007; El-Khatib et al., 2010; Gomes, 2010). The ICUs included Trauma ICU, General ICU, Cardiothoracic ICU, Neurosurgical ICU and Coronary Care Unit.

Ethical clearance and permission to conduct the study were obtained from the university's relevant committees, the Gauteng Department of Health and the hospital. Participation in the study was voluntary and respondents were free to withdraw at any point in time.

After permission was achieved from the hospital and unit managers, written consent was obtained from the respondents who agreed to participate. The target sample size comprised of 94 (n=94) intensive care nurses (including trained and non-trained intensive care nurses). Data analysis was done by descriptive and inferential statistic methods, with the help of a biomedical statistician who was consulted to assist with the analysis and interpretation of the data collected.

Reliability of the study was maintained by ensuring the researcher was the sole data collector of the data, the total sample was employed, convenience sampling method was used, and the data verified by a biomedical statistician to ensure accuracy of the findings. Face and content validity of the questionnaire were assessed (Labeau et al., 2007) in the sample of the original study and by Gomes (2010) in South Africa, therefore, it was suitable for this study.

1.8 OUTLINE OF THE STUDY

The outline of the study will be presented as follows:

Chapter One – Outline of the study

Chapter Two – Literature review

Chapter Three- Research design and methods

Chapter Four – Results

Chapter Five – Discussion of findings, conclusions and recommendations.

1.9 SUMMARY

This chapter provided an outline of the research study. The problem statement, the purpose of the study, the research objectives and the significance of the study has been described. Operational terms were described. A brief overview has been given of the research methodology, validity and reliability of the study and the ethical procedures adhered to.

The next chapter will provide a detailed review of the literature.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter reviews different studies conducted on VAP, explaining VAP and its disease process, EBP and nursing process. In addition, different studies done on knowledge and barriers to the implementation on EBP VAP guidelines will be reviewed and the findings will be summarised, and this approach will provide a framework for this study. The electronic and manual literature from reliable, grounded research and sources that are in line with the current EBP were used as sources of the literature review. In this regard, a comprehensive electronic literature search was conducted using databases such as PubMed, Cochrane and Google scholar. Both primary source and secondary source literature were reviewed in order to expand this study and to have more understanding of the research topic. This approach also serves as a leading step towards achieving the study's objective, data collection and analysis.

The inclusion criteria for the electronic literature searched were: articles published in English between the years 2008 to 2018, human objects and key search words, which included *EBP in nursing, pneumonia in ICUs, nursing process in nursing research, knowledge of VAP guidelines, implementation of VAP guidelines, current VAP care bundles, current EBP VAP prevention guidelines*, and lastly the barrier toward the implementation of VAP prevention guidelines and VAP care bundles.

The concept of EBP and the nursing process, VAP and its disease process, barriers to and the implementation of evidence-based VAP prevention guidelines, replication of studies done on knowledge of the healthcare profession regarding evidence-based guidelines for preventing VAP will be discussed in the chapter accordingly.

2.2 CONCEPT OF EVIDENCE-BASED PRACTICE AND THE NURSING PROCESS

The concept EBP is a conscientious integration of the best research evidence with clinical expertise and patient values to deliver quality and cost-effective healthcare (Gray, Grove & Sutherland, 2017). Polit and Beck (2014) pinpoint that the implementation of EBP leads to a higher quality of care, improved patient outcomes, decreased healthcare costs, reduced morbidities and mortality, a decrease in medical errors and the geographic variation of healthcare. The healthcare practice has increasingly shifted from making decisions based on conservative culture to more scientific driven approach and methods (Delaune & Ladner, 2010). The ultimate goal of a healthcare practitioner should be to deliver a quality healthcare and to achieve a better outcome for patients. However, it is important that nurses are familiar and aware of the current evidence-based guidelines, and continuously incorporate these guidelines into their nursing care (Polit & Beck, 2014). Gray, Grove and Sutherland (2017) stated nurses have a responsibility to render holistic nursing care to patients using a scientific approach to decision making and problem solving.

Thus, the scientific approach towards decision making in nursing includes the nursing process that addresses the patient's needs as a whole. This nursing process consists of nursing assessment, nursing diagnosis, plan of care, nursing implementation and evaluation (Delaune & Ladner, 2010). In addition, Melnyk and Fineout-Overholt (2015) claimed that the nursing process is more or less similar to the EBP process, as it enables the healthcare practitioners to quickly access, evaluate and integrate EBP into clinical practice.

The application of the nursing process entails nurses quickly assessing patients by collecting subjective and objective data, whilst identifying the nursing diagnosis from the analysis of the data collected during the assessment, and to proactively provide a plan of care that is measurable and in line with the current EBP (Delaune & Ladner, 2010). The nursing implementation or intervention rendered to the patients should be strongly supported by EBP. Thus, the nursing implementation should work towards achieving the plan of care and best practices. The concept of nursing evaluation is the evaluation of the intervention done towards achieving the patients' plan of care either as effective or non-effective (Melnyk & Fineout-Overholt, 2015). It is important that each unit in the hospital has current evidence-based guidelines that support their nursing practice.

Figure 2.1: Five step of evidence-based process (Melnyk and Fineout-Overholt, 2015).

2.3 THE VENTILATED ASSOCIATED PNEUMONIA DISEASE PROCESS

The majority of patients admitted into the ICU are critically ill or injured with, or at risk of, acute or chronic life-threatening organ or system dysfunction that are either medical or surgical conditions (Marshall et al., 2017). These critically ill patients are mostly immune compromised patients, chronic disease patients (such as diabetes, chronic lung disease, cancer, end stage renal failure, heart failure), on immune suppressive therapy, have altered oropharyngeal flora secondary to antibiotic use, or on bed rest and prolonged immobility, factors which predispose

these patients to be at risk of hospital acquired pneumonia and other related infections (Lewis et al., 2014; Marshall et al., 2017). However, the risk for hospital acquired pneumonia is much higher in critically ill patients who are placed on mechanical ventilation (either orotracheal intubation or nasotracheal intubation) for respiratory support (Gatell et al., 2012) and this makes them easily prone to complications such as VAP (Soh et al., 2012).

VAP is one of the most common nosocomial infections in ICUs (Johnson, Domb & Johnson, 2012). VAP can be defined as pneumonia (acute inflammation of the lung parenchyma caused by microorganisms) in patients who have been on invasive mechanical ventilation for at least 48 hours to assist with ventilation (Soh et al., 2012). The cause of pneumonia in mechanical ventilated patients is due to infection caused by bacteria organisms (Johnson, Domb & Johnson, 2012). The incidence of VAP can be categorised into two types, early and late onsets VAP (Gastmeier et al., 2009; Lewis et al., 2014). Early onset VAP occurs between 48 to 96 hours after intubation and is frequently caused by antibiotic susceptible organisms (Garnacho-Montero et al., 2014; Muscedere et al., 2008). The late onset VAP occurs after 96 hours of mechanical ventilation and frequently caused by antibiotic resistant organisms (Elliott, Aitken & Chaboyer, 2012; Restrepo et al., 2013).

Gastmeier et al. (2009) claim the bacteria organisms frequently associated with VAP at the early onset are staphylococcus aureus, streptococcus pneumonia, haemophilus influenza, proteus species, serratia marcescens, klebsiella pneumonia and escherichia coli. Recently, Acinetobacter baumannii or

Pseudomonas aeruginosa organisms have been identified in both early and late onset VAP (Nair & Niederman, 2015; Restrepo et al., 2013). The multi-drug resistance pathogens frequently associated with VAP include klebsiella-producing carbapanamase strains, methicillin-resistant staphylococcus aureus, acinetobacter species, pseudomonas aeruginosa, and enterobacter species (Gastmeier et al., 2009; Garnacho-Montero et al., 2014; Nair & Niederman, 2015). Thus, late onset VAP prognosis is usually poor due to the high mortality rate it carries when compared to early onset VAP (Kalanuria, Zai & Mirski, 2014; Garnacho-Montero et al., 2014).

2.3.1 The Pathophysiology of Ventilated Associated Pneumonia

VAP disease process can be categorised into two main processes, which are biofilm formation within the tracheal tube and micro-aspiration of secretion (Gunasekera & Gratrix, 2016). The placement of an endotracheal tube (ETT) makes critically ill patients at risk of VAP, because the ETT interferes with the normal protective airway reflexes of the patients, such as cough reflex of the glottis and larynx (Kalanuria, Zai & Mirski, 2014). Furthermore, the placement of an ETT can cause tissue irritation and provides a direct pathway for microorganisms to gain access into the normal sterile lower part of the respiratory tract, via micro-aspiration of secretion, pooling of secretion around the ETT cuff, and biofilm formation within the ETT (Sedwick et al., 2012).

Johnson, Domb and Johnson (2012) claim that the bacterial pathogen pool around the ETT cuff and damage to the cilia response reduces the clearance of secretion from the trachea. The placement of a nasogastric tube in an intubated patient for

enteral feedings, medication administration and gastric decompression increases the risk of micro-aspiration of the oropharnyngeal and gastrointestinal tract, which in turn increases the risks for developing VAP (Gunasekera & Gratrix, 2016). In addition, decreased levels of consciousness, impaired gag reflex and mucocilliary clearance of secretions, which is often noticeable among critically ill patients, causes contaminated secretions to pool into the posterior part of the oropharynx where pathogens get aspirated into the lung and are failed to be cleared by the host defense mechanisms (Sedwick et al., 2012).

2.3.2 Risk Factors for Developing Ventilated Associated Pneumonia

The risk factors for developing VAP are categories into three related factors, which are patient (host)-related risk factors, device-related risk factors and personnel-related risk factors. The host (patient)-related risk factors include age, male gender, immune-suppression, pre-existing pulmonary disease and multiple organ failure, patient's body positioning (supine position), decrease in level of consciousness, re-intubation, frequent aspiration and administration of medications such as sedation and antibiotic agents (Gunasekera & Gratrix, 2016; Kalanuria, Zai & Mirski, 2014). The device-related risk factors include ETT intubation, and the presence of a nasogastric and orogastric tube (Johnson, Domb & Johnson, 2012; Sedwick et al., 2012). The personnel-related risk factors are, non-adherence to the general principle of infection control (such as hand washing, rubbing of hands with alcohol-based hand disinfectant and gloving) and non-adherence to the evidence-based VAP prevention guidelines (Kalanuria, Zai & Mirski, 2014; Sedwick et al., 2012).

2.3.3 Diagnostic of Ventilated Associated Pneumonia

There are two different approaches towards the VAP diagnosis, clinical strategy and bacteriologic strategy.

2.3.3.1 Clinical Strategy

The clinical strategy diagnostic approach for VAP includes one or more radiological criteria, plus at least one clinical criteria and two of the pulmonary criteria (Horan, Andrus & Dudeck, 2008). The radiological criteria include chest X-ray with the presence of a new or progressive infiltrate, consolidation, and cavitation with no other cause in patients receiving mechanical ventilation for more than 48hours in the ICU. The clinical criteria include signs of systemic infection such as temperature greater than 38°C or less than 35°C, leucocytosis (white blood cell counts greater than 12,000/mm^3) or leukopenia (white blood cell count less than 4000/mm^3), adults above 70 years old or altered mental status with no other recognised cause (Centers for Disease Control & Prevention, 2018). In addition, the pulmonary criteria include increased purulent endotracheal or bronchial secretions, increased oxygen requirement, new onset of cough or dyspnoea, and lastly rales or bronchial breath sounds (Eom et al., 2014; Righi et al., 2014).

2.3.3.2 Bacteriologic Strategy

The bacteriologic strategy involves the quantitative cultures of the lower respiratory tract secretions to identify the presence of pathogens (Nair & Neiderman, 2015). These cultures are collected through endotracheal aspirates or sputum, broncho-alveolar lavage (BAL) or protected specimen brush (PSB) with or without a bronchoscopy (Eom et al., 2014; Righi et al., 2014). In addition, the growth of pathogens above a threshold concentration is required to diagnose VAP and to determine the causative microorganisms (Centers for Disease Control and Prevention, 2018; Garnacho-Montero et al., 2014; Gastmeier et al., 2009).

A negative tracheal aspirate indicates the absence of bacteria or inflammatory cells, and positive tracheal aspirate indicates the presence of bacteria or inflammatory cells (Elmansoury & Said, 2017). Patients with suspected VAP, and who meet the clinical criteria for diagnosing VAP, should have a culture and microbiology sample taken before the start of antibiotic therapy (Torres et al., 2017). It is recommended to use a non-invasive respiratory sampling with semi-quantitative cultures, such as endotracheal aspiration for VAP diagnosis, to focus and narrow the initial empiric therapy (Kalil et al., 2016). Moreover, if a respiratory sample cannot be obtained non-invasively, in such an instance an invasive sample may be considered, which includes protected specimen brush, broncho-alveolar lavage and blind bronchial sampling (Kalil et al., 2016).

2.3.4 Medical Therapy for Ventilated Associated Pneumonia

The Infection Disease Society of America and the American Thoracic Society updated their clinical practice guidelines for the diagnostic and medical management of adults with hospital-acquired and ventilator-associated pneumonia in 2016. These recommendations were based on the grading of recommendations, assessment, development and evaluation (GRADE). The aim of these guidelines are to prevent and reduce unnecessary antibiotics in VAP patients and in so doing, reduce the rate and risk of antibiotic resistance (Kalil et al., 2016).

In the years 2017 and 2018, the European Respiratory Society, European Society of Intensive Care Medicine, European Society of Clinical Microbiology and Infectious Diseases and Asociación Latino Americana del Tórax also developed and published guidelines for the management of hospital-acquired pneumonia and ventilator-associated pneumonia, and it is these guidelines that will be used in the discussion of the medical management therapy for VAP.

Firstly, it is important and recommended that the healthcare institution has a local ecology or an antibiogram record of their community and ICUs (Garnacho-Montero et al., 2014); this will serve as a guide toward the selection of antibiotics, drugs for the patients. The local ecology or antibiogram record prevents the unnecessary use of antibiotic drugs and also helps in achieving effective and optimal antibiotic response (Kalil et al., 2016). Therefore, the choice of antibiotic treatment should be based on the local ecology (Garnacho-Montero et al., 2014).

The patients with suspected VAP, who meet the clinical criteria for diagnosing VAP, should have initial empirical antibiotic therapy started, provided extra pulmonary infection is excluded (Kalil et al., 2016). The initial empirical antibiotic therapy should be started after respiratory culture and microbiology samples have been taken, and also within 45 minutes of suspected VAP in order to reduce the mortality rate and complications that may arise from VAP (Restrepo et al., 2013). It has been acknowledged that the antibiotic therapy selection is based on the absence or presence of risk factors for multidrug-resistant pathogens and Methicillin-Susceptible Staphylococcus Aureus (MSSA) (Torres et al., 2017). Therefore, the assessment of patients at risks for MSSA and Methicillin Resistant Staphylococcus Aureus (MRSA) is important and needed for initial empirical antibiotic therapy.

The patients who are at risk for multidrug-resistance pathogen, which causes VAP, are those being admitted from another healthcare institution with hospitalisation for five days or more, patients older than 65 years of age, patients on a prolonged antibiotic therapy in preceding 90 days, patients on chronic dialysis in preceding 30 days, patient or a family member at home undergoing wound care infected with a multidrug-resistant pathogen, patients with immunosuppressive disease or therapy and patients staying in a high frequency antibiotic resistance community or hospital unit (Restrepo et al., 2013).

The patients with no risk factors for multidrug-resistance organisms, and who are being treated in ICUs where staphylococcus aureus isolates, should be treated with antimicrobial agents that are active against Staphylococcus aureus,

Pseudomonas aeruginosa and other gram-negative bacilli organism (Kalil et al., 2016), such as piperacillin-tazobactam, cefepime, levofloxacin, meropenem or imipenem. An initial broad-spectrum therapy is started immediately for patients at risk of multidrug-resistant pathogens, and those who are treated or being treated in units where Staphylococcus aureus and MRSA are isolated (Torres et al., 2017). The broad spectrum antibiotics coverage recommended for MRSA is either vancomycin or linezolid (Kalil et al., 2016).

Furthermore, the initial empirical therapy can be changed and re-adjusted once the results of respiratory cultures and microbiology culture are available (Garnacho-Montero et al., 2014). This result will identify the pathogens that are responsible for the infection or colonisations and the antimicrobial agents to be used to combat the infection. A Procalcitonin test is recommended to be used for the de-escalation of antibiotic therapy (Torres et al., 2017).

2.4 Evidence-Based Guidelines for Prevention of Ventilated Associated Pneumonia

The American and European Scientific Society developed evidence-based VAP prevention guidelines from the various intervention strategies defined in different research studies done on VAP (Muscedere et al., 2008). In 2014, the Society for Healthcare Epidemiology of America and the Infectious Diseases Society of America developed strategies to prevent Ventilator-Associated Pneumonia. Similarly, in 2016, the American Association of Critical Care Nurses provided recommendations for the prevention of Ventilator-Associated Pneumonia in Adults,

which serves as a practice alert for the intensive care nurses. Chulay and Gallagher (2017), Klompas et al. (2014) and Muscedere et al. (2008) developed a guideline and bundle, and provided recommendations for the prevention of Ventilator-Associated Pneumonia. The recommendations made in this guideline were graded using the American Thoracic Society Grading System, Grades of Recommendation, Assessment, Development and Evaluation (GRADE), American Association of Critical Care Nurses levels of evidence to assess the quality of evidence provided, with regard to the various preventative strategies for VAP.

2.4.1 The Ventilated Associated Pneumonia Preventative Strategies and Recommendations

- Infection Control

The education of ICU healthcare personnel on VAP, and its disease processes on compliance with hand hygiene principles and standard precaution protective principles reduces nosocomial infection (Klompas et al., 2014).

- Avoiding Intubation

The presence of intubation (ETT) is the main risk factor for developing VAP. It is recommended to avoid intubation if possible and consider the use of Non-Invasive Positive Pressure Ventilation (Chulay & Gallagher, 2017), as it lowers VAP incidence rates, decreases the length of stay in ICUs and lowers mortality rates compared to Invasive Positive Pressure Ventilation (Klompas et al., 2014).

- Oral Route For Intubation

In patients where Non-Invasive Positive Pressure Ventilation cannot be effective for their ventilation management, it is recommended to use the oral route for intubation as it lowers the incidence of nosocomial sinusitis and reduces the risk of VAP when compared to the nasal route of intubation (Muscedere et al., 2008).

- Spontaneous Breathing Trials And Spontaneous Awakening Trials

The risk for developing VAP increases with prolonged intubation and re-intubation, as this increases the amount of aspirated pathogens from the oropharynx (Chulay & Gallagher, 2017). The implementations of ventilator weaning protocol prevent VAP, reduces the days on mechanical ventilation and prevents re-intubation (Klompas et al., 2015). Therefore, it is recommended to be used in practice as it prevents accidental removal of the ETT and improves extubation success. The use of early tracheostomy is suggested after seven to eight days of endotracheal intubation to reduce the duration of mechanical ventilation and ICU length of stay.

Furthermore, it is recommend to manage mechanical ventilated patients without sedation and to interrupt sedation once a day (spontaneous awakening trials) for patients without contraindications, as evidence shows that reduced administration of sedation is associated with reduced length of stays in ICUs, a reduction of the days on mechanical ventilation and the VAP rate (Klompas et al., 2015). It is also recommended to assess readiness to extubate daily through combined

spontaneous awakening trials and spontaneous breathing trials when possible (Chulay & Gallagher, 2017).

- Oral Care

Oral antiseptic chlorhexidine mouthwash is recommended to be used for oral hygiene in mechanically ventilated patients (Klompas et al., 2014). The oral antiseptic providence-iodine mouthwash is recommended for patients with severe head injuries as it has been proven to reduce VAP incidence (Chulay & Gallagher, 2017; Khan et al., 2017; Muscedere et al., 2008).

- Airway Care

Airway care is essential in the prevention of VAP. Bacteria organisms reach the distal airway through the draining of secretions surrounding the endotracheal cuff and the inoculation of bacteria through the inner lumen of the tube (Klompas et al., 2014). Therefore, it is recommended that health education on airway management for mechanical ventilation should be done in the healthcare institution. In addition, hand hygiene before airway management is recommended.

- Cuff Care

It is recommended to maintain adequate ETT cuff pressure of at least 20cm H_2O to reduce the drainage of oropharyngeal and gastric secretions around the ETT (Chulay & Gallagher, 2017). An inflated ETT cuff pressure below 20cm H_2O could

result in excessive drainage of oropharyngeal and gastric secretions (Klompas et al., 2014), whilst an inflated ETT cuff pressure of above 30cm H_2O can damage the mucosal.

- Subglottic Secretion Drainage

The use of ETT with subglottic secretion drainage ports for patients expected to be on mechanical ventilation for more than 48hours is recommended in practice (Chulay and Gallagher, 2017; Klompas et al., 2014). This minimises pooling of secretions above the ETT cuff and in so doing, reduces the VAP rates, the days on mechanical ventilation and cost of treatment (Damas et al., 2015).

- The ETT Coating

Silver ions penetrate into the microbial membrane and interfere with DNA synthesis to prevent cell replication (Klompas et al., 2014). The bacteriostatic properties of the silver coated ETT make it biologically compatible and effective in reducing tracheal colonisation and bacterial growth, which reduces the risk for VAP developing (Kollef et al., 2008). Therefore, a silver-coated ETT is recommended for use in patients expected to be on mechanical ventilation for more than 48 hours (Klompas et al., 2014).

- Ultrathin Polyurethane ETT Cuffs

Due to technologic advances, polyurethane ETT cuffs are now recommended for use in practice to reduce aspiration, which in turn reduces the risk of VAP developing (Chulay and Gallagher, 2017; Klompas et al., 2014). Ultrathin polyurethane ETT cuffs protect against early postoperative pneumonia in cardiac surgery patients (Miller et al., 2011).

- Maintaining Ventilator Circuits

New ventilator circuits are recommended for use with each patient and to be changed only when soiled, damaged or malfunctioning (Klompas et al., 2014; Chulay & Gallagher, 2017). The evidence shows that less frequent changes of ventilator circuits are not associated with VAP development (Muscedere et al., 2008).

- Heat And Moisture Exchanger

The use of heat and moisture exchangers is recommended for use in patients who have no contraindications, such as haemoptysis, as it decreases VAP incidence rate compared to heated humidifiers (Muscedere et al., 2008). Furthermore, the heat and moisture exchanger should be changed every five to seven days, as infrequent changing of the heat and moisture exchanger lowers VAP incidence rate.

- Closed or Open Endotracheal Suctioning

Closed or open suctioning systems have no significant impact on VAP rates, duration of mechanical ventilation, ICU length of stay and mortality rate (Klompas et al., 2014), therefore this intervention is neither encouraged nor discouraged. However, to prevent patients and healthcare workers from being exposed to aerosolised secretions, closed suctioning systems are considered safe and are recommended to be used in practice (Muscedere et al., 2008). Furthermore, it is recommended to use a new closed suctioning system for all new patients, which should be changed when clinically indicated as daily changing has no effect on the VAP incidence (Muscedere et al., 2008).

- Semi-recumbent positioning

It is recommended to elevate a mechanically ventilated patient's bed head to an angle of 30 to 45 degrees unless clinically contraindicated; for example, a patient with a spinal cord injury cannot be placed in a semi-recumbent position (Muscedere et al., 2008). The semi-recumbent position reduces aspiration of oral and gastric secretions, which in turn decreases VAP incidences in a mechanically ventilated patient (Alexiou et al., 2009; Chulay & Gallagher, 2017). However, this position does not completely prevent the aspiration of subglottic secretions across the tracheal cuff and does not totally clear the secretions in the lower respiratory tract (Alexiou et al., 2009; Klompas et al., 2014). Recently, the lateral horizontal position has been suggested for use in practice as it is more feasible, decreases

the days of mechanical ventilation and lowers VAP incidence more than semi-recumbent positioning (Klompas et al., 2014).

- Kinetic Therapy

The use of kinetic therapy (also known as Continuous Lateral Rotational Therapy) reduces VAP incidence but has no impact on the duration of mechanical ventilation or the mortality rate (Muscedere et al., 2008). Kinetic therapy can be defined as the mechanical rotation of the patient's bed at an angle of 40 degree. Continuous lateral rotation therapy improves the movement of secretions and avoids the accumulation of mucus in dependent lung zones compared to standard care for positioning changing, which is the turning of the patient every two (2) hours on a standard bed (Klompas et al., 2014).

- Early And Enteral Feeding

It is suggested to use a post-pyloric feeding tube for enteral feeding as it reduces the risk of aspiration and VAP that may occur due to enteral feeding (Klompas et al., 2014). It is recommended to avoid the initiation of parenteral nutrition in critically ill patients within 48 hours of ICU admission and mechanical ventilation, as this increases VAP and the mortality rate compared to the starting of parenteral nutrition on and after eight (8) days.

- Early mobility

It is recommended to promote early exercise and mobilisation in mechanically ventilated patient as this reduces the time period of extubation, decreases the length of ICU stay and reduces the cost of ICU treatment (Chulay & Gallagher, 2017; Klompas et al., 2015).

Jansson et al. (2013) and Labeau et al. (2008) emphasise that an evidence-based VAP prevention guideline is effective in reducing the VAP mortality and morbidity 1rate. However, there are many barriers towards the implementation of an evidence-based VAP prevention guideline, and these are discussed in the following sections (see section 2.4.2).

2.4.2 Barriers to the Implementation of Evidence-Based Ventilated Associated Pneumonia Prevention Guidelines

The implementation of evidence-based VAP prevention guidelines and VAP care bundles reduces the incidence of ventilator-associated pneumonia, as the research findings from Álvarez-Lerma et al. (2018) study showed the VAP rate decreases from 9.83 to 4.34 per 1,000 ventilators day after the implementation of such guidelines. However, the major challenge for the implementation of evidence-based guidelines as a preventative strategy for VAP is the intensive care nurses' poor adherence to the VAP prevention guidelines in the clinical practice. This poor adherence is considered the root cause of VAP occurrences, because VAP is a preventable infection (Jansson et al., 2013; Labeau et al., 2008).

2.4.2.1 Adherence

Adherence is defined as the process in which a person follows rules, guidelines or standards, and it is also an act or quality of sticking to rules and guidelines (Farlex Partner Medical Dictionary, 2012). In the context of this study, adherence is referred to as the process in which an Intensive Care nurse complies with all the processes and recommendations listed in the evidence-based VAP prevention guideline. The research study conducted by Perez-Granda et al. (2013) in Spain, shows that the ICUs health professional's adherences to the VAP prevention guidelines are poor in clinical practice. Aloush (2017A) study conducted in Jordan also confirmed intensive care nurses' poor adherence rates to the VAP prevention guidelines. Gatell et al. (2012) further claimed that some intensive care nurses do not adhere to or implement the recommendations of the evidence-based VAP prevention guideline. However, poor adherence is due to factors such as lack of knowledge and skilled staff, shortage of staff and attitudes of the intensive care nurse toward the evidence-based guidelines for preventing VAP. These factors are discussed below (Jansson et al., 2013; Labeau et al., 2008).

- **Knowledge and skilled staff**

Knowledge is the awareness of familiarity gained by experiences of a fact or situation. The lack of familiarity with the guidelines, inconsistency between local and international guidelines, lack of knowledge of the application of the guidelines and VAP disease process were identified as barriers to the implementation of

evidence-based VAP guidelines amongst intensive care nurses (Gatell et al., 2012; Jansson et al., 2013; Kiyoshi- Toe et al., 2014).

The lack of skilled staff with ICU knowledge, skills and experience makes effective implementation of evidence-based VAP prevention guidelines challenging. The studies by Al-Shameri (2017), Gomes (2010) & Korhan et al. (2013) point out that intensive care nurses have a poor knowledge understanding regarding evidence-based VAP prevention guidelines and its disease process. Melnyk et al. (2012) stated that nurses with a post-graduate qualification in nursing, compared to those without, tend to be more knowledge and skilful with regard to the steps in EBP and are more confident in their implementation.

This statement resonates with the findings of Al-Shameri (2017), as they found the intensive care nurses with a degree or diploma qualification in nursing display poor knowledge regarding the understanding of evidence-based VAP prevention guidelines and the VAP disease process. However, this same study illustrates that intensive care nurses with post-graduate qualifications in ICUs display a better knowledge understanding of the evidence-based VAP prevention guidelines and VAP disease process. Yoo et al. (2012) also confirmed that nurses with post-graduate qualifications in the ICU have a better understanding of the VAP disease process and its preventative intervention. Aloush (2017B) pinpoints that registered nurses with diplomas and degrees in nursing science have no previous specific education on VAP prevention guidelines and on mechanical ventilator management. In addition, lack of skilled staff was identified as another factors for non-adherence to the guidelines, as registered nurses with no ICU experience or

education are employed to nurse critically ill mechanically ventilated patients, and this category of nurses displays poor knowledge of understanding VAP (Al-Shameri, 2017). In this regard, the quality of care and patient outcome has been affected.

The ICU healthcare professional with more than one year of ICU experience, has a better understanding of VAP compared to those with less than one years of experience (Pérez-Granda et al., 2013). The ICU healthcare professional with more than five years of ICU experience displays better knowledge of VAP and adheres more to the VAP prevention guidelines compared to those with less than five years of experience (Jansson et al., 2013; Pérez-Granda et al., 2013). In addition, Aloush et al. (2018) reported that nurses with special VAP education, a post-graduate qualification in ICUs and more than 10 years of experience in ICUs have a high adherence rate compared with those without. In this regard, there is the probability that intensive care nurses with five to10 years or more experience in the ICU to have received more in-service training or education on VAP during their service in the ICU.

Lack of education was a major barrier to the implementation of VAP prevention guidelines, and more so, the knowledge level of nurses regarding VAP preventative intervention correlated with their adherence rate to the VAP prevention guidelines in clinical practice (Pérez-Granda et al., 2013). Similarly, a descriptive exploratory study conducted by Ali (2013), in which 45 critical care nurses' knowledge and compliance with Ventilator Associated Pneumonia care bundle were assessed in an academic hospital in Egypt, showed that intensive

care nurses had poor knowledge of VAP care bundles and displayed poor compliance to the implementation of such. The study conducted by Said (2012) in Tanzania found that intensive care nurses had poor adherence toward VAP prevention guidelines, but displayed adequate knowledge understanding of VAP and its disease process, therefore knowledge does not always influence adherence or other factors, such as attitude and shortage of staff (Ali, 2013).

- **Shortage of Staff**

The shortage of staff is another critical factor affecting adherence to VAP prevention guidelines, and the cause of VAP in the ICU (Blot et al., 2011; Gatell et al., 2012; Kiyoshi-Teo et al., 2014). In addition, the shortage of intensive care nurses in the ICUs is the major cause of burn out amongst staff, and increased workload and poor productivity. The increased workload due to low staffing affects the adherence to the evidence-based VAP prevention guidelines and patient outcomes. Blot et al. (2011) findings show that the ICUs with a 1:2 nurse/patient ratio have an adherence rate that is less than the recommendation on the VAP prevention guidelines, increased ICU length of stay and increased VAP incidence rates. Similarly, Aloush (2017A) confirmed that ICUs with a 1:1 nurse/patient ratio displayed a high compliance rate with regard to the VAP prevention guidelines.

Kiyoshi-Teo et al. (2014) state that due to increased workload in the ICU, the intensive care nurses have limited time to complete their nursing care tasks, which has led to them being unable to comply with some of the recommendations in the evidence-based VAP prevention guidelines that they considered to be time

consuming and more complex. As a consequence of limited time to complete nursing care tasks, intensive care nurses tend to adhere more to the recommendations or practices on the VAP prevention guidelines that they consider easy and not time consuming, such as bedhead elevation (Aloush et al., 2017; Blot et al., 2011; Gatell et al., 2012; Jansson et al., 2013).

Furthermore, Gatell et al. (2012) & Jansson et al. (2013) confirmed that when the intensive care nurses are nursing patients that require extensive care, they prioritise their nursing care and ignore the recommendations of the VAP preventative guidelines that they consider less important, such as narrowest nasogastric tube, correct endotracheal cuff pressure, gastric retention control, oral hygiene and ETT fixation. Kiyoshi-Teo et al. (2014) also identified spontaneous breathing trial and oral hygiene practice as time consuming, less important and more complex for the ICUs nurses. Increased workload may also be considered as the cause of forgetfulness and lack of self-efficacy toward the implementation of the evidence-based VAP prevention guidelines (Jansson et al., 2013).

- **Attitude**

McLeod (2018) describes attitude as a person's feelings or emotions, and beliefs or knowledge regarding a particular object or situation. The Intensive Care nurse has certain beliefs regarding some of the recommendations of the evidence-based VAP prevention guidelines, as they consider some of the preventative measures less important, more important and time consuming (Gatell et al., 2012; Jansson et al., 2013;. Kiyoshi- Toe et al., 2014). Soh et al. (2012) also claim that some of

the nurses did not value the standard methods of risk assessment tools for VAP, because they consider the tool to be too redundant, not important, and burdensome.

It can be argued that some intensive care nurses are resistant and reluctant to change, therefore certain recommendations from the EBP seem difficult for the intensive care nurse to effectively implement (Soh et al., 2012). Kiyoshi-Toe et al. (2014) observed that intensive care nurses show positive attitudes towards a familiar guideline by reading it for specific information they received during education and practice. Therefore, they consider other parts of the guideline that they did not read less important.

2.4.3 Contributor to Evidence-Based Ventilated Associated Pneumonia Prevention Guidelines

Based on the challenging issues identified from above (see section 2.4.2.1), the following are the contributing factors to the implementation of evidence-based VAP prevention guidelines. In order to achieve high quality of care and positive patient outcome, it is important that the hospital's managers, unit managers and the ICUs healthcare practitioner promote the implementation of evidence-based VAP prevention guidelines (Labeau et al., 2008; Soh et al., 2012). However, knowledge is the first key toward promoting adherence, and adherence to the evidence-based VAP prevention guideline reduces VAP incidence rates, reduces the days on mechanical ventilation and ICU length of stay, and the cost of ICU treatment, which results in good patient outcomes. Nurses who are knowledgeable with

regard to evidence-based VAP prevention guidelines have the confidence to apply the guidelines in clinical practice, and in so doing, promote the quality of care rendered to the critically ill patients on mechanical ventilation (Korhan et al., 2013). With this in mind, hospitals and academic institutions need to constantly educate their healthcare practitioners and student counterparts about VAP and its disease process, the impact of VAP in critically ill patients, the evidence-based VAP prevention guidelines and the infection control principle (Al-Hussami and Darawad, 2013; Chulay and Gallagher, 2017; Klompas et al., 2014). Chulay and Gallagher (2017) further said that VAP educational programmes should be included in the orientation programmes for the ICU healthcare professional, and their continuous evaluation of competency on VAP disease process and evidence-based VAP preventative guidelines implementation should be closely monitored. Evidence-based VAP prevention guidelines can be effectively implemented, it just requires time, adequate coaching, and educational training of healthcare practitioners (Soh et al., 2012).

The study by Parisi et al. (2016), in Greece, confirmed that educational training programmes provided to ICU healthcare practitioners decreased the VAP incidence rate, length of stay in ICUs and duration of mechanical ventilation. Their findings showed that the VAP rate decreased from 21.6 to 11.6 per 1000 ventilator days, the length of stay in the ICU decreased from 36 to 27 days, and the duration of mechanical ventilation decreased from 26 to 21 days after the educational training programme. Correspondingly, the study by Gatell et al. (2012) also confirmed that educational training programmes on the VAP disease process improved both knowledge and compliance of the ICUs nurses in regard to the

evidence-based VAP prevention guidelines and the quality of care rendered to patients. In addition, VAP educational training programmes create awareness amongst the intensive care nurses on VAP preventative measures and performance; this approach encourages adherence to the guidelines and reduces the VAP incidence rate (Ban, 2011). Hassan and Wahsheh (2016) also claimed that the knowledge levels of the intensive care nurses improved after attending an educational training programme on VAP.

The EBP have been incorporated into the nursing curriculum at post-graduate, degree and diploma levels (Melnyk et al., 2010; Rauen et al., 2008). Recently, all teaching in nursing institutions is based on evidence-based and best practices in order for the new professional nurse to be aware, familiar and practice in accordance with evidence-based guidelines, and to achieve best care always (Melnyk et al., 2010; Rauen et al., 2008). The nursing students are taught critical thinking and the problem solving approach to analysing and solving health-related conditions or problems to clinically justify their practices and reasons based on tangible and reliable evidence (Gray, Grove & Sutherland, 2017; Polit & Beck, 2014). However, further emphasis is needed on incorporating more detail on VAP prevention guidelines and infection control into the undergraduates' nursing curriculum system in order to improve knowledge and future competency on VAP (Aloush & Qadire, 2017). This is due to a recent study's finding that undergraduate nursing students did not receive special courses on VAP or infection control during their training (Al-Hussami & Darawad, 2013). To justify the abovementioned facts, the knowledge level of the registered nurse with a diploma or degree on the VAP disease process and on evidence-based VAP prevention guidelines, were found to

be poor in study conducted by Al-Shameri (2017), Ali (2013) & Korhan et al. (2013).

The healthcare institutions' productivity hugely depends on their practitioners' skills, knowledge and experiences (Soh et al., 2012). It is important that the levels of skills and knowledge of the healthcare practitioners be renewed and improved on a regular basis, through continuous training and education (Melnyk et al., 2010). Therefore, healthcare institutions must be responsible for providing in-service training, seminars and workshops on a continuous basis for their practitioners on the VAP disease process and evidence-based guidelines for preventing VAP. Furthermore, Gray, Grove and Sutherland (2017) & Polit and Beck (2014) observed that healthcare institutions were also responsible for sending their practitioners on training for continuous professional development and to provide and promote an enabling environment that supports EBP, and to employ adequately skilled staff who are capable and reliable to function effectively in the unit.

The hospital management, unit manager and the quality improvement manager need to ensure the ICUs have policies, procedures or guidelines on evidence-based VAP prevention. They should also ensure there is a poster or pamphlets regarding VAP preventative strategies available at the patient's bedside; this will serve as a reminder toward adherence to the evidence-based VAP prevention guidelines (Ban, 2011). Furthermore, the hospital management, unit manager and the quality improvement manager need to incorporate evidence-based VAP prevention guideline intervention as a standing order and as part of the clinical

documentation in which ICUs healthcare practitioners can chart the recommendation that was or was not done (this can be electronic or manual health records). The documentation will help to record and monitor the patient's outcomes and also healthcare practitioner's compliance rate to the VAP prevention guidelines (Lawrence & Fulbrook, 2010). This approach will improve the compliance to the evidence-based VAP prevention guidelines and in doing so, reduce the VAP incidence rate. The study conducted by Westwell (2008) showed that the daily audit of the VAP care bundle increased the rate of compliance, created awareness and prompted staff to ensure each component on the VAP care bundle had been addressed.

The quality improvement and performance appraiser is essential to promote and motivate the ICUs healthcare practitioner's compliance to the evidence-based VAP prevention guidelines. The quality improvement programmes, which include the regular monitoring and internal reporting of patient outcomes and healthcare practitioner adherence rate to the evidence-based VAP preventative guidelines in the ICUs, should be uplifted in the healthcare institutions as this approach, along with the educational programmes, increases adherence to and helps determine the compliance rate to the evidence-based VAP prevention guidelines, and reduces incidence rates (Parisi et al., 2018). The quality improvement supervisors should present a feedback report weekly or monthly to the ICUs healthcare professional on the overall performance and compliance rate to the evidence-based guidelines for preventing VAP, and also the patient's outcomes, such as length of stay in ICUs, number of days on mechanical ventilation, VAP incidence rates and cost of treatment (Lawrence & Fulbrook, 2010). Rectification through

educational training programmes should be done to emphasise areas where the ICUs healthcare professional scores or receives poor compliance with regard to the VAP guidelines implementation (Westwell, 2008). This approach increases the rate of compliance and improves patient outcomes.

Thus, it should be considered mandatory that all healthcare lecturers engage in continuous professional development, through research, by attending health-related conferences, seminars and workshops for both international and local context, in order to constantly renew their knowledge (Polit & Beck, 2014; Gray, Grove & Sutherland, 2017). Gray, Grove and Sutherland (2017) further explain that healthcare lecturers have the obligation and responsibility to continuously review international articles that are based on EBP. This approach would enable them to identify any changes in and new current health-related evidence-based guidelines (Gray, Grove & Sutherland, 2017).

Lastly, Gatell et al. (2012), Jansson et al. (2013) and Kiyoshi-Toe et al. (2014) state that healthcare professionals and institutions should update their healthcare protocol, guidelines and policies to be in line with current evidence-based guidelines. Healthcare professionals have the obligation and responsibility to engage in continuous professional development to update and enhance their knowledge and practice in accordance with the current EBP and guidelines.

2.5 SUMMARY

It can be said that EBP have helped to improve patient outcomes by reducing mortality and morbidity rates, the length of patient's stay in the ICUs as well as the cost of the healthcare resources. Evidence-based VAP prevention guidelines are important for all healthcare institutions to have and embrace as part of their local policies. The healthcare professional needs to innovatively adhere to the evidence-based VAP prevention guideline, as it is an essential tool to eradicate the incidence of VAP and ultimately, achieve best patient's outcomes.

The next chapter will discuss the research design and methods.

CHAPTER THREE

RESEARCH DESIGN AND METHODS

3.1 INTRODUCTION

This chapter elaborates on the details of the research design and methods used in the data collection process to achieve the purpose and objectives of this study. The study setting, sample process, the inclusion criteria adopted in this study, the data collection process, data analysis, reliability and validity, and the ethical consideration procedures will be discussed accordingly.

3.2 RESEARCH PARADIGM AND RESEARCH DESIGN

A research paradigm can be describe as the researcher world view or assumption in the research field that guide how an inquiry is done to solve an identified research problem. Research paradigm serves as a framework that guide the choice of a research methodology and methods that suit a research. The research paradigms can be divide into two major type which are Positivist Paradigm which is also known as Empiricist; and the second type of research paradigm is called Naturalistic Paradigm which is also known as Interpretative, Post-positivist or Constructivist paradigm(Polit & Beck, 2014).

In this research study, Positivist research paradigm was used as its focuses on quantitative research. This method involve using a deductive reasoning to generate predictions that can be tested in the real world through a set of orderly isciplined procedures to acquire information about a research problem (Polit &

Beck, 2014). The research paradigm is based on two assumptions, which are ontology and epistemology. Ontology is the researcher belief or assumptions about the nature of reality while epistemology is the researcher ways of knowing or inquiries into knowledge and truth (Polit & Beck, 2014).

Brink, Van Der Walt and Van Rensburg (2012) defined research design as a set of logical steps taken by researchers to answer research questions. The research design, also serves as a blueprint for conducting a research study, such as strategy for collecting data, analyses of data collected and interpretation of the research results (Brink, Van Der Walt & Van Rensburg, 2012). Therefore, research design and methods need to be chosen carefully to best fit the purpose of the study, research questions and the available resource. This study utilised quantitative (non-experimental method), descriptive and correlational research design accordingly, thus a detailed explanation is subsequently given.

3.2.1 Quantitative Research

A quantitative research investigates and measures phenomenon that involves subject or events through a rigorous and controlled design (Polit & Beck, 2014). Quantitative research can be divided into experimental and non-experimental design. In this study, quantitative non-experimental design was used, as this enables the researcher to collect data without introducing treatments or making changes or interventions in any way.

3.2.2 Descriptive Design

Descriptive design will be used in this study, as information is garnered from a representative sample of the targeted population (Brink, Van Der Walt & Van Rensburg, 2012). Consequently, descriptive design was used to describe the intensive care nurses knowledge of evidence-based guidelines for preventing VAP from the data collected in this study. The descriptive statistics will be reported as a percentage and frequency, and this will be described and presented in table and graphic form. This approach was conducted from the data collected from the questionnaires completed between 5th and 30th September, 2018. The selected sample size was drawn from the targeted research population at five Adult ICUs of an academic hospital in Johannesburg.

Each of the items on the preventive intervention of VAP for nurses are adequately described to provide a complete picture of their knowledge with regard to evidence-based guidelines for preventing VAP in ICUs.

3.2.3 Correlational Design

A correlational design is used to describe an existing relationship between independent and dependent variables with no manipulation of the independents variable (Brink, Van Der Walt & Van Rensburg, 2012). In this study, descriptive correlational design was adopted to determine and analyse the significant relationship between the training, years of experience and knowledge of current evidence-based guidelines for preventing ventilator-associated pneumonia among

intensive care nurses, as well as to statistically test and determine its correlation coefficient.

3.3 RESEARCH SETTING

A research setting can be defined as the location or site where a research study is carried out or performed, either in or through a naturally, partially or highly controlled environment (Gray, Grove & Sutherland, 2017). This research study was conducted within five adult ICUs, namely: General ICU, Trauma ICU, Neurological ICU, Cardiothoracic ICU and Acute Coronary Care Unit at an academic hospital in Johannesburg. These specialty areas within the ICUs are where mechanical ventilators are in use to care for different dimensions of critical-ill patients, and where VAP complications are frequently reported.

This study aims to assess the knowledge of intensive care nurses with regard to the evidence-based guidelines for preventing VAP, as it is expected of them to be knowledgeable and to carry their responsibility in accordance with the evidence-based guidelines for preventing VAP. This study also aims to create awareness amongst intensive care nurses on the significant benefits of implementation of evidence-based guidelines for preventing VAP. The study's findings will enhance the institution's education programmes and policy making towards holistic improvement of quality care rendered to patients.

This study is contextual in nature as its purpose was to assess, understand and narrate the knowledge of intensive care nurses with regard to evidence-based

guidelines for preventing VAP (VAP) within the selected five adult ICUs of one academic hospital in Johannesburg, South Africa.

3.4. RESEARCH METHODS

The research methods can be described as a technique used by the researchers to collect information and data relevant to the research question. The research methods include the population, sample and sampling methods, data collection and data analysis and this will be discussed extensively under this heading.

3.4.1 Population

Population can be defined as a group of particular individuals or elements that the research is dealing with (Burns, Grove & Gray, 2011). The total population of intensive care nurses working within the five adult ICUs at the academic hospital, Johannesburg, was 145 (n=145).

Table 3.1: Description of the targeted population at the academic hospital in Johannesburg

Type of Intensive Care Unit	Trained Intensive Care Nurse	Experienced Intensive Care nurse	Total
Cardiothoracic ICU	26	4	30
General ICU	24	11	35
Trauma ICU	15	15	30

Neurological ICU	23	9	32
Coronary Care Unit	10	8	18
Sub-total	98	47	145

The results indicate the total study population included:

- The number of the trained intensive care nurses with either Masters' Degree or Postgraduate Diploma in Intensive Care Nursing, and registered under the South African Nursing Council in this category was 98 (n=98);
- Non-trained Intensive Care Nurses and Professional nurses with more than one years of experience in the ICUs was 47 (n=47).

These research populations were selected as they were working in the ICUs, nursing and caring for patients on mechanical ventilation, and it was expected they (selected intensive care nurses) were knowledgeable and updated with regard to the current evidence-based guidelines for preventing VAP. However, the patients in the ICUs are at risk of VAP as they are being placed on mechanical ventilation. It has been acknowledged that intensive care nurses ought to abide by the policy and guidelines for preventing VAP in accordance with the EBP.

3.4.2 Sample and Sampling Methods

A sample method is used to determine the sample size for a study in order to increase the representativeness and decrease bias in the study (Gray, Grove & Sutherland, 2017). In this study, a non-probability convenience sampling method

was used to select the study participants that met the inclusion criteria in the five Adult ICUs in the study. Thus, according to Burns, Grove and Gray (2011), non-probability sampling methods indicate that not every element of the targeted population would have an opportunity to be selected or included in the samples in the study, as this decreases the representativeness of the targeted population.

The inclusion criteria for the participants in this study included:

- Intensive care nurses with either a Master's Degree or Diploma in Critical Care nursing and registered by the South African Nursing Council in this category.
- Intensive care nurses with no formal training in Critical Care Nursing and registered by the South African Nursing Council as a Professional nurse working in the selected ICUs.
- The intensive care nurses working in either General, Trauma, Neurological and Cardiothoracic ICUs, and Acute Coronary Care Units.
- A minimum of 1 year of experience in ICUs.

Exclusive criteria exclude the Enrolled nurses and Auxiliary nurses as this rank of sub-nurses work under direct supervision of the Registered Nurse, and have less knowledge and skills for caring for the critically ill patient(s) in ICUs.

All the intensive care nurses who met the inclusion criteria and were present in the selected ICUs on the particular day in which the data was to be collected had an equal opportunity to be selected until the desired sample size was reached. The sample size for this study comprised 94 (n=94) intensive care nurses, with or

without post-graduate qualifications in intensive care nursing. A sample size of 94 (n=94) intensive care nurses was used in order to ensure good representation of the population from which the sample was drawn and to reach a saturation level as the research is quantitative in nature. This selected study sample size was based on a non-probability convenience sampling method.

3.4.3 Data Collection

Data collection is the process of gathering data from a participant in a research study, and it depends on both the research design and methods that gears towards achieving the study objectives (Burns, Grove & Gray, 2011). In this study, data was to be collected by means of self-administered questionnaires by the researcher. The data collection instrument and procedures, such as questionnaires, validity and reliability of the instrument, will be explained in detail in the next sections.

3.4.3.1 Questionnaire

A questionnaire, with multiple choice options and one correct response was developed, validated and tested by Labeau et al. (2007) in Belgium, was used to achieve this study's objective.

The questionnaire consisted of two sections (refer to **Appendix A**). The first section comprised the demographic description of each participant, which included age, type of ICUs currently working in, years of experience in ICUs, and degree or postgraduate qualification in ICUs. The second section comprised nine items with

multiple choice options and one correct response to assess the knowledge of the intensive care nurses regarding evidence-based guidelines for preventing VAP (Labeau et al., 2007). These items included: oral vs nasal route for endotracheal intubation, frequency of ventilator circuit changes, type of airway humidifier, frequency of humidifier change, open vs closed suctioning systems, frequency of change in suctioning systems, ETT with extra lumen for drainage of subglottic secretions, kinetic vs standard beds and patients' positioning (Labeau et al., 2007). One open-ended question was added at the end of the questionnaire should the nurses wish to add additional information related to the topic.

3.4.3.2 Validity and Reliability of the Instrument

Face and content validity of the questionnaire was assessed by Labeau et al. (2007) in the sample of the original study and presented to a panel of eight experts for face and content validation in Belgium (Labeau et al., 2007). These experts had 15 to 20 years of experience in ICUs, Master's Degree in Nursing Sciences or Medico-socials Sciences, and a particular interest in ICU-acquired infections. The questionnaire that was presented to the experts consisted of 10 items on VAP preventive interventions for nurses. Face and content validity was obtained for nine items, and one item (on chest physiotherapy) was removed as the experts reported it was irrelevant for the nurses. The instrument was demonstrated to be effective in assessing the knowledge of intensive care nurses with regard to evidence-based guidelines for preventing VAP, in accordance with the study conducted by Blot et al. (2007), El-Khatib et al. (2010) and Gomes (2010) in

Belgium, Lebanon and South Africa. Therefore, it was deemed suitable for the study within the South Africa context.

Gomes' (2010) study was conducted in South Africa and the questionnaires were presented to six nurse experts, and face and content validity and reliability were achieved for each item on the questionnaire. These six nurse experts were specialists in nursing education, experienced intensive care nurses and Intensive Care clinical facilitator.

3.4.3.3 Procedure

Permission to conduct this study was sought from the Chief Executive Officer of the hospital in which the study was to take place. Once the permission was obtained, the Directors for Nursing Services, the Medical Directors and the Nurse Unit Manager of each selected five adult ICUs were approached for permission to conduct the research. The nursing allocation lists in each five adult ICUs was observed for selections of participants. The intensive care nurses who agreed to participate in this research were given an information letter (refer to **Appendix B**) to read.

The hard copy of the questionnaires was given to the participants, and their anonymity and confidentiality were assured. The questionnaires took approximately 15 minutes to complete. A sealed box was placed in a secure area in each ICU for the participants to drop the questionnaires once completed. The box was opened once the data collection period was over.

3.4.4 Data Analysis

The raw data collected was captured onto a Microsoft Excel spreadsheet and checked on a second data capturing sheet (Microsoft Excel spreadsheet) for accuracy, after which it was transferred into a standard software package (STATISTICA version 13.2) for statistical analysis.

In this study, descriptive and inferential statistics were used to analyse the demographic data, as well as to assess the knowledge of the intensive care nurses with regard to the evidence-based guidelines for preventing VAP. The descriptive statistics were reported in percentage and frequency, and this was described and presented in tables and graphic forms. In order to further explore the data, three categories were created, and their cut-off points were: poor (0-50%), average (50%-71%) and good (71% and above) (Ntlhokoe, 2014). The level of training and years of experience were correlated with their knowledge with regard to the evidence-based guidelines for preventing VAP. Statistical tests included the Kruskal Wallis test, Spearman's correlation test and a Multivariable linear regression model. Statistical testing was set at 5% ($p < 0.05$) level of significance.

3.5 ETHICAL CONSIDERATIONS

Ethical considerations are discussed under the following headings: permission to conduct research, informed consent, and measures to ensure confidentiality and anonymity.

3.5.1 Permission to Conduct Research

The research protocol was submitted to the Department of Nursing Education for peer review and to determine the feasibility of the study. Subsequently, approval and clearance to conduct this study was obtained from the Faculty of Health Sciences Postgraduate Committee and the Human Research Ethical Committee (Medical) of the University of the Witwatersrand. Furthermore, permission to conduct field work research was obtained from the Chief Executives Offices, Director of Nursing Services and the Nurse Unit Managers of the selected hospitals **(**refer to **Appendix E**). Approval to utilise the research instrument was sought from the developer of the questionnaire (refer to **Appendix G**).

3.5.2 Informed Consent

It is essential that researchers seek voluntary informed consent from participants when conducting research (Burns, Grove & Gray, 2011). Therefore, the intensive care nurses were adequately and duly informed about the full nature of the research, and that their participation in the study was voluntary. However, since the nature of research is dealing with the participation of human beings, the intensive care nurses were informed of their right to informed decision making, confidentiality, privacy, honesty, dignity, justice and safety, and this was respected and not violated during the study.

3.5.3 Confidentiality and Anonymity

The intensive care nurses were duly informed that their anonymity and confidentiality would be protected in this study and they could withdraw at any point without penalty. The researchers ensured that the confidentiality and anonymity of research participants were highly protected, thus the individual's name was not requested or documented on the questionnaires. The raw data collected in the research will be secured with a lock and key by the researcher for a period of five years. The researcher, the supervisors and the Department of Nursing Science of the Witwatersrand University, Johannesburg, will be the only ones to have access to the raw data collected in the research.

3.6 VALIDITY AND RELIABILITY OF THE STUDY

The validity and reliability measures followed in this study are explained in the subsequent sections.

3.6.1 Validity

Gray, Grove and Sutherland (2017) define validity as the degree to which an instrument used in research study, actually performed, evaluated, measured or represented that which it was supposed to do. The validity of the data collection process was ensured by using an existing validated questionnaire adopted from a previously conducted study. The questionnaire was used in the exact manner as in the original study to ensure validity of the study.

3.6.2 Reliability

Reliability is defined as the extent to which an instrument used in a research study can be depended upon to yield consistent results if used on the same or similar targeted population at different point in times (Brink, Van Der Walt & Van Rensburg, 2012). Thus, only the relevant participants that met the sample inclusion criteria were involved in this research study. The data collected from each participant were examined and harmonised with overall participants' responses to achieve consistency in the research and thereafter, verified by a statistician for accuracy. This study provides clear and adequate information on the data collection procedure followed in this research. The findings from this research study represent the true nature of the assessment of the knowledge of the intensive care nurses with regard to the evidenced-based guidelines for preventing VAP.

3.7 SUMMARY

This chapter provides the detailed strategy of the research design and methods adopted, including the ethical considerations, and validity and reliability of the study.

The next chapter will present the data analysis and the results.

CHAPTER FOUR

RESULTS

4.1 INTRODUCTION

This chapter describes the data analysis and the results of the study. This was achieved within a non-experimental, quantitative, descriptive and correlational design. The population included all nurses working in the ICUs (n = 5) at a university-affiliated public hospital in Johannesburg. A sample size of 94 (n = 94) was obtained by means of convenience sampling. Data was collected by means of a data collection tool (refer to **Appendix A**), Data were analysed by means of descriptive and inferential statistics. Statistical tests included the Kruskal Wallis test, Spearman's correlation test and a Multivariable linear regression model. Testing was done on the $p<0.05$ level of significance.

4.2 APPROACH TO DATA ANALYSIS

Categorical variables such as age were described as frequencies and percentages. Continuous variables such as years of experience' were assessed for normality using the Shapiro Wilk test. Normally distributed continuous variables were described as means and standard deviations (SD) and skewed variables were described as medians and interquartile ranges (IQR).

From the nine (9) questions on knowledge on current evidence-based guidelines for prevention of ventilator-associated pneumonia, a total score was calculated based on the number of correct responses and converted into a percentage. To

compare the total score on knowledge on current evidence-based guidelines for prevention of ventilator-associated pneumonia based on demographic data, a Kruskal Wallis test was used in instances where the demographic variable had three or more categories. In instances where the demographic variable was continuous, a Spearman's correlation test was used.

Lastly to assess the association between training (or qualification), years of experience and knowledge of the intensive care nurses on current evidence-based guidelines for prevention of ventilator-associated pneumonia, a multivariable linear regression model was fitted adjusting for age and type of ICU that the nurses work in. The level of significance was set at the level of 0.05. A biomedical statistician from the Faculty of Health Sciences assisted in the analysis of the data using the statistical software 'STATA' version 14.

Because of the homogeneity of the data the findings may be of interest to other public sector ICUs, clinical practice and education of intensive care nurses.

4.3 RESULTS

4.3.1 Section A: Demographic Characteristics

This section related to the nurse respondents demographic data, which comprised of four items. Included are age, the highest level of qualification, type of ICU where the respondents worked and years of ICU experience. **Table 4.1** displays results obtained.

Table 4.1: Demographic characteristics of the study respondents

Characteristic (n=94)	**Frequency**	**Percentage**
Age		
20 to 29 years	10	10.6%
30 to 39 years	26	27.7%
40 to 49 years	26	27.7%
50 to 59 years	28	**29.8%**
60 and more years	4	4.3%
Highest qualification		
Advanced diploma	63	**67.0%**
Master's degree	5	5.3%
Registered nurse	26	27.7%
Type of ICU		
General ICU	34	**36.2%**
Trauma ICU	17	18.1%
Neurosurgery ICU	16	17.0%
Cardiothoracic ICU	2	2.1%
Acute Coronary Care Unit	7	7.5%
	Median	**IQR**
Years of experience in ICU settings	8	4-15

In this study, the largest group (29.8%; n = 28) of nurse respondents were aged between 50 to 59 years, followed by 27.7% (n = 26) in the 40 to 49 years and 30 to 39 years age categories, respectively.

Regarding highest level of qualification, the majority (67.0%; n = 63) of the nurse respondents had an advanced diploma in ICU nursing, whereas 27.7% (n = 26) had a comprehensive (general) nursing qualification.

The largest (36.2%; n = 34) group of the nurse respondents worked in a general ICU, while 18.1% (n = 17) and 17.0% (n = 16) worked in a trauma ICU and neurosurgical ICU, respectively. Only a small (2.1%; n = 2) number of the nurses worked in a cardiothoracic ICU.

These findings suggest most of the intensive care nurses included in the study were between ages 30 and 59 years, with an advanced diploma and working in general ICU. The median years of experience in ICU settings was 8 years (IQR 4 to 15 years). Table 4.1 displayed results obtained.

4.3.2 Section B: Prevention of Ventilator Association Pneumonia Questionnaire

This section comprised of nine (9) items related to current evidence-based guidelines on the prevention of VAP. Responses were obtained from the respondents by the researcher through a questionnaire (refer to Appendix A). The total sample comprised of 94 (n = 94) respondents who were intensive care nurses working in selected ICUs. Descriptive statistics were used to analyse the interpretation of the data.

An overview of nurses' responses on the multiple-choice questionnaire regarding prevention of VAP are displayed in **table 4.2.**

Table 4.2: Nurses' responses on multiple-choice items regarding prevention of VAP

Item	Frequency	Percentage
Oral v. nasal route for endotracheal intubation		
- **Oral intubation is recommended**	49	**52.1%***
- Nasal intubation is recommended	10	10.6%
- Both routes are recommended	27	28.7%
- I do not know	2	2.1%
Frequency of ventilator circuit changes		
- It is recommended to change circuits every 48h (or when clinically indicated	29	30.9%
- It is recommended to change circuits every week (or when clinically indicated)	33	35.1%
- **It is recommended to change circuits for every new patient (or when clinically indicated**)	31	**33.0%***
- I do not know	-	-
Type of humidifiers		
- Heated humidifiers are recommended	7	7.5%
- **Heat and moisture exchanges are recommended**	46	**48.5%***
- Both types of humidifiers can be recommended	32	34.0%
- I do now know	6	6.4%

Frequency of humidifier changes		
- It is recommended to change humidifiers every 48 h (or when clinically indicated)	50	53.2%
- It is recommended to change humidifiers every 72 hour (or when clinically indicated)	11	11.7%
- **It is recommended to change humidifiers every week (or when clinically indicated)**	27	**28.7%***
- I do not know	4	4.3%
Open vs. closed suction systems		
- Open suction systems are recommended	6	6.4%
- **Closed suction systems are recommended**	58	**61.7%***
- Both systems are recommended	29	30.9%
- I do not know	1	1.1%
Frequency of change in suction systems		
- Daily changes are recommended (or when clinically indicated)	40	42.6%
- Weekly changes are recommended (or when clinically indicated)	24	25.5%
- **It is recommended to change systems for every new patient (or when clinically indicated)**	26	**27.7%***
- I do not know	4	4.0%
ETT with extra lumen for drainage of subglottic secretions		
- **These ETT reduce the risk for VAP**	40	**42.6%***
- These ETT increase the risk for VAP	9	9.6%

- These ETT do not influence the risk for VAP	9	9.6%
- I do now know	33	35.1%
Kinetic vs. standard beds		
- Kinetic beds increase the risk for VAP	4	4.1%
- **Kinetic beds reduce the risk for VAP**	42	**44.7%***
- The use of kinetic beds does not influence the risk for VAP	25	26.6%
- I do not know	20	21.3%
Patient positioning		
- Supine positioning is recommended	22	23.45%
- **Semi-recumbent positioning is recommended**	55	**58.5%***
- The position of the patient does not influence the risk for VAP	14	14.9%
• I do not know	2	2.1%

Key: * = correct response

4.3.3 Summary for Comparison of Correct and Incorrect Responses for Knowledge

Table 4.3 Summary of responses for comparison of nurses' correct and incorrect responses

Statement	Correct response or best practice recommendation		Incorrect response or incorrect best practice recommendation	
	n	%	n	%
"Oral vs. nasal route to endotracheal intubation	49	52.1%	45	47.9%
Frequency of ventilator circuit changes	31	32.9%	63	67.0%
Type of airway humidifier	46	48.9%	48	51.1%
Frequency of humidifier changes	27	28.7%	67	71.3%
Open vs. closed suction systems	58	61.7%	36	38.3%
Frequency of change in suction systems	26	27.7%	68	72.3%
ETT with extra lumen for drainage of subglottic secretions	40	42.6%	54	57.3%
Kinetic vs. standard beds	42	44.6%	52	55.3%
Patient positioning"	55	58.5%	39	41.5%

Table 4.3 shows a comparison of results obtained by correct and incorrect categories of responses. **Figure 4.1** provides a graphical representation of these results.

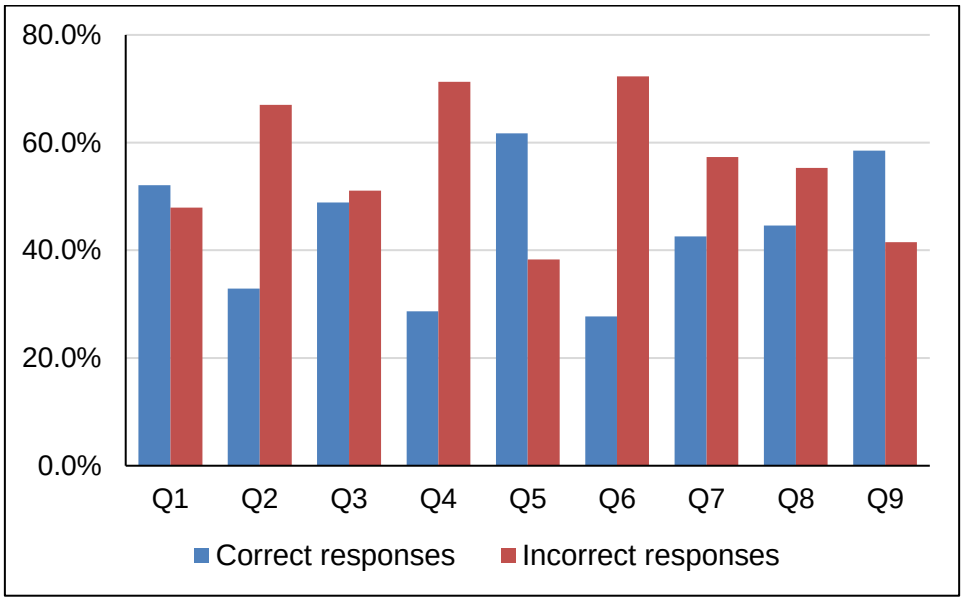

Figure 4.1: Comparison of nurses' correct and incorrect responses

Table 4.4: Total percentage score for knowledge of VAP guidelines by categories

Scores	Frequency	Percentage scores
Less than 50%	61	64.9%
50% to 71%	31	33.0%
More than 71%	2	2.1%
Total	94	100.0%

In this study, out of the sample size of n = 94, 61 respondents scored less than 50%, 31 respondents scored between 50% and 71% and two scored more than 71%; knowledge is classified as poor if less than 50%, the average of 50% to 71% and more than 71% indicates good knowledge. This suggests intensive care

nurses in this study had poor knowledge of the evidence-based guidelines for preventing VAP, as the majority (n=61 out of n=94) scored less than 50%.

4.3.4 Associations between Training, Years of Experience and Knowledge

Table 4.5: Proportion of correct answers by intensive care nurses on knowledge on current evidence-based guidelines for preventing ventilator-associated pneumonia

Item (n=94)	N	%
Oral vs. nasal route for endotracheal intubation	49	52.1%
Frequency of ventilator circuit changes	31	32.9%
Type of airway humidifier	46	48.9%
Frequency of humidifier changes	27	28.7%
Open vs. closed suction systems	58	61.7%
Frequency of change in suction systems	26	27.7%
ETT with extra lumen for drainage of subglottic secretions	40	42.6%
Kinetic vs standard beds	42	44.7%
Patient positioning	55	58.5%

Table 4.5 shows the proportions of correct answers by intensive care nurses on knowledge on current evidence-based guidelines for preventing ventilator-associated pneumonia. About half of the intensive care nurses recommended oral intubation (52.1%; n = 49), 32.9% (n = 31) suggested that changing the circuits at each new case as good practice for frequency of ventilator changes, 48.9% (n = 46) stated that the humidifier type should have a heat and humidity exchanger,

28.7% (n = 27) recommended changing the humidifier every 48 h. The majority (61.7%; n = 58) of the intensive care nurses recommended a closed aspiration system in preventing VAP and 27.7% (n = 26) of them stated that it was sufficient to change the closed aspiration system at each new case, and 42.6% (n = 40) of the intensive care nurses stated that extra-lumen ETT were beneficial in the drainage of subglottic secretions while 44.7% (n = 42) of them believed that kinetic standard beds reduced the risk of VAP. Lastly, 58.5% (n = 55) of the intensive care nurses expressed the opinion that a semi-seated position was recommended to prevent VAP.

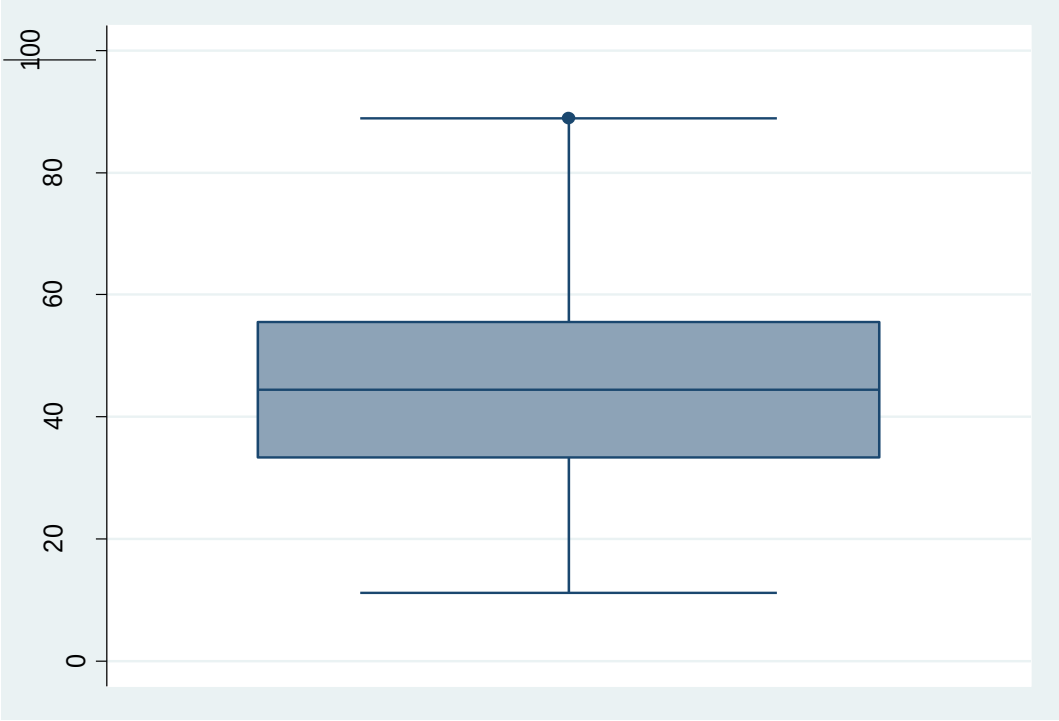

Figure 4.2: Median value of the total scores of nurses on knowledge on guidelines for preventing ventilator associated pneumonia.

Overall, the intensive care nurses had poor knowledge on guidelines for the prevention of VAP (Median: 44% and IQR: 33 -56%).

Table 4.6: Average total scores on intensive care nurses on knowledge of current evidence-based guidelines for prevention of VAP based on demographic characteristics

Characteristic	**Median (IQR)**	**p-value**
Age		
20 to 29 years	44 (33-56)	0.8672
30 to 39 years	44 (22-56)	
40 to 49 years	44 (33-56)	
50 to 59 years	44 (39-56)	
60 and more years	44 (39-50)	
Highest qualification		
Advanced diploma	44 (33-56)	0.9257
Master's degree	44 (33-56)	
Registered nurse	44 (33-56)	
Type of ICU		
General ICU	44 (33-56)	
Trauma ICU	44 (33-56)	
Neurosurgery ICU	56 (44-67)	0.0381*
Cardiothoracic ICU	33 (28-44)	
Acute Coronary Care Unit	44 (22-56)	
	Correlation coefficient	**p-value**
Years of experience in ICU settings	0.05	0.6388

Key: *=statistical significance

Table 4.6 shows the average total scores on intensive care nurses on knowledge on current evidence-based guidelines for preventing ventilator-associated pneumonia based on demographic characteristics. The Kruskal Wallis test results show no difference in knowledge based on age and qualification, however, there is a difference in knowledge based on the type of ICU that the intensive care nurses work in (0.0381). Nurses in the Neurosurgery ICU had better knowledge on prevention of VAP (Median score 56%). The Spearman's correlation test shows that there was no correlation between years of experience in ICU and knowledge on preventing ventilator-associated pneumonia.

Table 4.7: Multivariable linear regression results for the association between training (or qualification), years of experience and knowledge of the intensive care nurses on current evidence-based guidelines for prevention of VAP

Characteristic	Coefficient (95% CI)	p-value
Age		
20 to 29 years	-0.39 (-1.81-1.03)	0.592
30 to 39 years	-0.25 (-1.31-0.80)	0.637
40 to 49 years	-0.47 (-1.42-0.49)	0.332
50 to 59 years	1 (base)	1
60 and more years	0.08 (-1.53-1.69)	0.916
Highest qualification		
Advanced diploma	1 (base)	1
Master's degree	0.26 (-1.32-1.83)	0.746
Registered nurse	0.09 (-0.64-0.82)	0.810
Type of ICU		
General ICU	1 (base)	1
Trauma ICU	-0.32 (-1.37-0.73)	0.544
Neurosurgery ICU	0.78 (-0.17-1.73)	0.106
Cardiothoracic ICU	-0.79 (-1.65-0.06)	0.069
Acute Coronary Care Unit	-0.61 (-1.85-0.63)	0.330
Years of experience in ICU settings	-0.00 (-0.06 -0.06)	0.964

Table 4.7 shows that there was no significant association between training (or qualification), years of experience and knowledge of the intensive care nurses on current evidence-based guidelines for preventing ventilator-associated pneumonia when adjusting for demographic data.

4.4 SUMMARY OF THE RESULTS

A total of 94 (n = 94) intensive care nursing staff members participated in the current research of which the largest group were between the ages of 50 to 59 years (29.8%; n = 28). The majority (67.0%; n = 63) held an advanced diploma in intensive care as the highest qualification in nursing, about one-third (36.2%; n = 14) worked in a general ICU. The median years of experience in ICU settings were eight years (IQR 4-15).

When the nurses responses to the nine questions related to current EBP that aimed to prevent VAP, were examined, about half (52.1%; n = 49) of the intensive care nurses recommended *oral intubation*, 32.9% (n = 31) suggested that *changing the circuits* at each new case as good practice for *frequency of ventilator changes*, 48.9% (n = 46) stated that the *humidifier type* should have a heat and humidity exchanger, 28.7% (n = 27) recommended *changing humidifier* every 48h. The majority of the intensive care nurses (61.7%; n = 58) recommend a *closed aspiration system* in preventing VAP, and 27.7% (n = 26) of them stated that it was sufficient to change the closed aspiration system at each new case. Furher, 42.6%; (n = 40) of the intensive care nurses stated that *extra-lumen ETT* were beneficial in the drainage of subglottic secretions, while 44.7% (n = 42) of them

believed that kinetic standard beds reduced the risk of VAP. Lastly, 58.5% (n = 55) of the intensive care nurses expressed the opinion that a *semi-seated position* was recommended to prevent VAP.

Overall, the intensive care nurses had poor knowledge of guidelines for preventing ventilator-associated pneumonia (Median: 44% and IQR: 33-56%). There was no significant ($p>0.05$) difference in knowledge based on age and qualification. However, there is a difference in knowledge based on the type of ICU that the intensive care nurses work in ($p = 0.0381$). Nurses in the neurosurgical unit had better knowledge on preventing VAP (Mean score 56%). There was no significant ($p>0.05$) correlation between years of work experience in ICU and knowledge on the prevention of VAP. In addition, the difference between the nurses' training, duration of work experience and median value of their total scores was found not to be statistically significant ($p>0.05$) when adjustments were made to the demographic data.

Studies that examined evidence-based guidelines for prevention of VAP against nurses that work in ICU of South African healthcare facilities are scarce. However, the findings of this study support the conclusions of the majority of studies conducted overseas that reported and highlighted poor knowledge of guidelines for prevention of VAP as a common problem amongst nurses in ICUs.

4.5 SUMMARY

The chapter discussed the descriptive and inferential statistics that were used to describe and analyse the data collected. The data an interpretation of results were presented. The following chapter will discuss the main findings, limitations of the research results, conclusions and recommendations.

CHAPTER FIVE

DISCUSSION OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter provides a discussion of the findings of the study. The study's justifications are also presented together with limitations. The chapter concludes with recommendations for nursing practice, education, and future research and a final conclusion for the study.

5.2 DISCUSSION OF FINDINGS

The purpose of this study was to describe intensive care nurses' knowledge regarding the current evidence-based guidelines for the prevention of VAP in ICUs (n = 5) at an academic hospital in Johannesburg. This study wished to make recommendations for clinical practice and nursing education of the intensive care nurses.

The age distribution of the sample for this study n=94 respondents were between the ages of 30 and 59 (n = 80) years where the largest group of the respondents were between the aged 50 to 59 years (29.8%; n=28).

The majority (67.0%; n = 63) of the respondents in this research study held a postgraduate qualification in nursing (critical care nursing) 67.0%; n=63. This is similar to study done by Blot et al. (2007) were the majority (68%; n=437) of the

respondents held a postgraduate qualification in nursing (degree in emergency and critical care nursing). In another study, Gomes (2010) reported that the majority (60.24%; n = 50) of the respondents held a postgraduate qualification in nursing (critical care nursing). The rate of continuous educational training among the intensive care nurses has increased by 7% over a period of 10 years in this population as this study reported an increase in the number of trained intensive care nurses (67%) when compared to that of Gomes (2010) study which reported 60% of trained intensive care nurses in her study.

In this study, the next part of the questionnaire related to the intensive care nurses response to the nine (9) items on VAP prevention strategies that assess their knowledge regarding the evidence-based guidelines for prevention of VAP.

This study finding shows that the intensive care nurses as poor knowledge of the evidence-based guideline for preventing VAP as the median total score for the nine (9) items on the questionnaires was 44%. These findings are similar to the finding from Blot et al. (2007) study in Belgium; Labeau et al. (2008) study in Europe and Korhan et al. (2013) in Turkey, in which the knowledge of the intensive care nurses regarding the same nine items that were assessed in this study research was found to be poor with the median total score of 41.2% by Blot et al. (2007); 45.1% by Labeau et al. (2008) and 43.5% by Korhan et al. (2013) respectively. These study research finding is also similar and corresponds to Gomes (2010) study in South Africa that reported the intensive care nurses knowledge of evidence-based guidelines for preventing VAP to be poor with the total mean score of 47%. There is no significant difference between this research

study and that of Gomes (2010) study regarding the total mean percentage score of the overall knowledge level of the intensive care nurses in this population. However, the 47% total mean score in Gomes (2010) may be due to her respondents are from both private hospital and public hospital; while this research study with the mean score of 44% all the respondent are from the public hospital. More so, the 47% total mean score in Gomes (2010) study may also be due to her respondents having a mean of 9.1 years of ICU experience (SD = 7.30) which is more than that of this study as this study median years of experience in the ICU settings is 8 years (IQR 4 to 15 years). In order to support this fact, Labeau et al. (2008), Jansson et al. (2013) & Blot et al. (2007) study finding show that the nurses with more work experience in the ICU had a better knowledge of the evidence-based guidelines for preventing VAP than the nurses with less work experience in ICU. Furthermore, within the period of 10 years only 7% of the ICU - nurses receive an additional qualification in the ICU. Therefore, based on this finding a further research may be conducted to assess the knowledge level of the ICU nurse in private hospital and compare it with that of the public hospital in Johannesburg and to as well assess the factor that contribute to their poor knowledge level on evidence-based guidelines for preventing VAP.

The highest score obtained in this study were for open vs closed suctioning system (61.7%); patient positioning (58.5%); and oral vs nasal route of intubation (52.1%) and the lowest score were “frequency of change in suctioning systems” (27.7%); “frequency of humidifiers changes” (28.7%) and the “frequency of ventilator circuit changes” (33%). This corresponds to Gomes (2010) study in South Africa in which the highest score obtained from the respondent are on open

vs closed suctioning system (73.49%); oral vs nasal route for intubation (69.88%) and patient positioning (68.67%) and the lowest score were on frequency of change in suctioning systems (19.28%); type of humidifier changes (19.28%) and frequency of ventilator circuit changes (27.7%) is the least known aspect of the evidence-based guidelines for preventing VAP, these findings are similar to this current study's findings. In this research study, the knowledge of the intensive care nurses regarding the type of humidifier changes has improved times two from that of Gomes (2010) study. The similarity between this study research and Gomes (2010) is that the frequency of change in suctioning systems and frequency of ventilator circuit changes are still the least known aspect of the evidence-based guideline for preventing VAP.

Blot et al. (2007) reported that the question on patient positioning (90.3%) and ETT with the extra lumen for drainage of subglottic secretions (60.3%) and type of humidifier changes (54.7%) are the most frequent correct answered by the respondents in their study. Labeau et al. (2008) indicate that respondents well-known aspects of the evidence-based guidelines for preventing VAP were patient positioning (85.1%); kinetic bed (57.3%) and oral vs nasal route for intubation (54.7%). Korhan et al. (2013) found that the intensive care nurses are well knowledgeable on the oral vs nasal route for intubation (79%); open vs closed suctioning system (68.8%) and frequency of ventilator circuit changes (62.3%). More so, Jansson et al. (2013) study show that patient positioning (99%) is the most known aspect of the evidence-based guideline for preventing VAP among the intensive care nurses. Whilst, El-Khatib et al. (2010) showed that the question on closed suctioning system and kinetic bed are recommended to reduce the risk

for VAP (92%); and ETT with extra lumen for drainage of subglottic secretions and patient positioning (97%) are the most correctly answered question from their respondents. However, this current study's finding reported a low score of 42.6% for ETT with extra lumen for drainage of subglottic secretions reduces the risk of VAP and this may be because the setting used is a public hospital and the ETT with extra lumen for drainage of subglottic secretions are costly therefore not available for uses in this setting and also not a common nursing practise in the selected ICUs.

Blot et al. (2007) study reported the type of suctioning system (16.9%); the route of endotracheal intubation (18.7%) and frequency of humidifier changes (13.3%) are the least known aspect of the evidence-based guidelines for preventing VAP. Labeau et al. (2008) findings show that frequency of humidifier changes (21.4%); frequency of ventilator circuit changes (35.1%) and frequency of change in suctioning systems (18.2%) as the least correct answers. Korhan et al. (2013) reported the frequency of change in suctioning systems (16.7%); frequency of ventilator circuit changes (17.4%) and ETT with extra lumen for drainage of subglottic secretion (23.9%) as the least correct answers. In all these studies, it is noted that frequency of change in suctioning systems and frequency of ventilator circuit are the least aspect of the evidence-based guidelines for preventing VAP among the intensive care nurses.

This research study finding shows no significant differences ($p>0.05$) between years of work experience in ICU, nurses training and knowledge on the prevention of VAP. This is due to 31.9%; n = 30 of the nurse's respondents in this study has

more than 10 years of experiences in the ICU. This study finding correlates with Gomes (2010) findings where no significant differences were identified between participants of differences level of qualification and work experience in ICUs in the relationship with their knowledge of evidence-based guidelines for preventing VAP; and the 23.69%; n=18 of the respondents has more than 10 years of experiences in the ICU.

However, Blot et al. (2007) study opposite the finding of this studies as there study findings show that intensive care nurses with special qualification in ICU and trauma perform better than does without any qualification in these categories. Labeau et al. (2008), Jansson et al. (2013) & Blot et al. (2007) found that the nurses with more work experience in the ICU had a better knowledge of the evidence-based guidelines for preventing VAP when compared with the nurses with less experience in ICU with the p-value of less than 0.05 ($p<0.05$). The respondents in Blot et al. (2007) 43.0% (n=274), Jansson et al. (2013), 40.6% (n=41) and Labeau et al. (2008) 37% (n=1242) had more than 10 years of experience in the ICU.

Korhan et al. (2013) study reported statistically significant ($p<0{\cdot}05$) in nurses' education levels, qualifications in intensive care nursing and participation in in-service training on intensive care nurses knowledge on VAP prevention while no significant differences were found in years of work experience in ICUs in relationship with their knowledge of evidence-based guidelines for preventing VAP. However, the 2.2% of the respondents in the Korhan et al. (2013) study had more than 10 years of experience in the ICU.

The study done by Gatell et al. (2012); Hassan and Wahsheh (2016) confirmed that educational training programmed on VAP disease process improved knowledge of the intensive care nurses in regards to the evidence-based VAP prevention guidelines and its disease process. In Gatell et al. (2012) study on the assessment of a training programme for the prevention of VAP, the overall correct response on the assessment of the intensive care nurses knowledge level on VAP was higher in the post-intervention phase (after an educational training programme on VAP) than in pre-intervention phase (17.89±2.69 versus 15.91±2.68; p=0.002). The study conducted by Hassan and Wahsheh (2016) also confirmed that there was a significant improvement in the knowledge level of the intensive care nurses after attending an educational training programme on VAP ($p<0.05$).

Thus, the result of this research study can be said to explain an inconsistencies in practices as different respondents as different opinion regarding each items on the VAP preventative strategies on the questionnaires. Therefore, education and training programmes need to be rendered to the intensive care nurses in this research setting on the VAP preventative strategies; with a specific emphasis on the least correct respond in this research study such as frequency of change in suctioning systems; frequency of humidifiers changing and frequency of ventilator circuit changes in order to improve their knowledge level in regard to VAP preventative strategies. Due to the lack of a VAP guideline in the research setting, a poster of Ventilated Associated Pneumonia preventative strategies and recommendations will be placed in each five adult ICUs that will promote awareness, improve knowledge and close the gap in inconsistencies in practices.

The contextual factors such as lack of skilled staff with ICU knowledge, skills and experience, lack of guidelines in the ICU, lack of knowledge of VAP disease process are factors that hinder the implementation of VAP Prevention strategies amongst the intensive care nurses (Gatell et al., 2012; Jansson et al., 2013; Kiyoshi- Toe et al., 2014). In addition, the shortage of the intensive care nurses causes burn out amongst staff, increased workload and poor productivity in the ICU, which in turn hinder the implementation of VAP Prevention strategies (Blot et al., 2011; Gatell et al., 2012; Kiyoshi-Teo et al., 2014). More so, the attitude of the Intensive Care nurse toward VAP guidelines can affect its implementation as some intensive care nurses consider some of the preventative measures on the guideline less or more important, too redundant, burdensome and time consuming (Gatell et al., 2012; Jansson et al., 2013; Kiyoshi- Toe et al., 2014; Soh et al., 2012).

5.3 SUMMARY OF THE STUDY

This study intended to describe the knowledge of intensive care nurses regarding current EBP guidelines for the prevention of VAP in five adult ICUs of an Academic hospital in Johannesburg. The main objectives of the study were to assess the knowledge of intensive care nurses regarding current evidence-based guidelines for prevention of VAP, and to determine whether there was an association between training, years of experience and knowledge of the intensive care nurses.

Before commencement of the study, ethical approval was granted by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand and

approval from the School of Therapeutics Postgraduate Research Committee, and the Chief Executive Officer and Director of Nursing Services at the hospital.

A positivist research paradigm was used for this study. Ontology and epistemology assumption were followed. All ethic and value assumption for a quantitative research were adhere to. The research method and design were based on the positive paradigm since the research is quantitative in nature. This study was a quantitative cross-sectional research design consisting of a questionnaire, with nine multiple choice questions and one correct response, that was developed, validated and tested by Labeau et al. (2007) in Belgium. This questionnaire was used to assess the knowledge of the intensive care nurses regarding evidence-based guidelines for preventing VAP in General ICUs, Trauma ICUs, Neurological ICUs, Cardiothoracic ICUs and Coronary Care Units at an Academic hospital in Johannesburg. The sample size for this study was 94 (n=94) intensive care nurses, with or without formal training in Intensive Care nursing. Face and content validity of the questionnaire was assessed by Labeau et al. (2007) in the sample of the original study in Belgium, and also by Gomes (2010) in South Africa. Descriptive and inferential statistics were used to analyse the collected data. The ethical principle related to the research was adhered to. The result of this study show that Intensive Care Nurses had poor knowledge of evidence-based guidelines for preventing Ventilated Associated Pneumonia. This finding resonate with Gomes (2010) finding as her research finding show that the Intensive Care Nurses has a poor knowledge of evidence-based guideline for preventing VAP. There was no significant association between training or qualification; years of work experience in ICU with regard to the ICU nurses knowledge of the

evidence-based guidelines for preventing VAP with the p value of more than 0.05 ($p>0.05$) in this study and Gomes (2010) research finding.

5.4 LIMITATIONS

The researcher acknowledges the following limitations in this study.

- The investigation of evidence-based guidelines for the prevention of VAP by looking at the knowledge of the intensive care nurses (trained and non-trained) without comparing same with medical doctor's opinions.
- The use of non-probability, convenience sampling and a relatively small sample.
- The knowledge of the intensive care nurses (trained and non-trained) may not be representative of actual patient care.

In consideration of these limitations, the findings of this study cannot be generalised unless replication of the study is carried out on a larger scale including adult ICUs in other public hospitals and other provinces.

5.5 RECOMMENDATIONS ARISING FROM THE STUDY

The findings from this study placed a significant concern on the importance of EBP in the hospital. EBP aim to achieve a high quality of care and positive patient outcomes. Therefore, it is crucial to promote and support EBP in all healthcare institutions in order to reduce avoidable medical complication and risks in the ICUs, thus promoting best patient outcome. In this regard, this study made recommendations for nursing education, clinical practice and nursing research on

possible ways to improve the knowledge of the intensive care nurses regarding VAP and its preventive measure, and to promote quality healthcare rendered to patients.

5.5.1 Nursing Education

The following are the recommendations suggested from this study for the nursing educational institution**:**

- To incorporate more details and special training courses on VAP into the undergraduates' nursing curriculum in order to improve the knowledge and competency of the Registered Nurse on VAP.
- To encourage students to engage in continuous professional development, research and to promote best practices by practicing in accordance with the current evidence-based guidelines.

5.5.2 Clinical Practice

The following recommendations are suggested for clinical practice:

- To constantly educate intensive care nurses about the VAP disease process and infection control principle in order to renew and improve their skills and knowledge. The inclusion of VAP educational programmes as part of the induction programme for the newly selected intensive care nurses is recommended for the healthcare institution to embrace.
- The continuous evaluation of intensive care nurse competency in VAP disease process and its preventive measure, and to provide constant

educational training for the intensive care nurses in the ICUs is recommended to provide good quality healthcare.

- To provide and promote an environment that supports the implementation of EBP by providing policies and guidelines on evidence-based VAP prevention. The provision of posters or pamphlets regarding VAP preventative strategies in the ICUs will create awareness and improve their knowledge on VAP preventative measures.

5.4.3 Nursing Research

The following recommendations are suggested for future nursing research:

- The knowledge of the intensive care nurses regarding the evidence-based guidelines for preventing VAP to be assessed in different provinces in South Africa and with a larger sample size of intensive care nurses. To compare the knowledge difference between the private and public hospital's intensive care nurses' knowledge with regard to the VAP prevention guidelines,
- Further research is suggested to be done to assess the factors that influence the intensive care nurses with regard to their knowledge of VAP prevention guidelines in order to make a recommendation for improvement. It is also suggested that a post-educational training programme be done on VAP for this targeted population and to assess their knowledge post-educational training programme.

5.5 CONCLUSION

This study assessed the knowledge of the intensive care nurses in one academic hospital in Johannesburg. The knowledge of the respondents was found to be poor in this study. The respondents had adequate knowledge regarding the questions on the closed suctioning system, patient position, semi-recumbent positioning and oral route of endotracheal intubation. In addition, the respondents with more years of experience in the ICU had better knowledge regarding the evidence-based guidelines for preventing VAP than those with fewer years. There was no statistical significance found amongst the different levels of nursing qualification with regard to their knowledge of the evidence-based guidelines for preventing VAP.

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APPENDIX A

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

DATA COLLECTION TOOL

SECTION A: DEMOGRAPHIC DATA

PARTICIPANTS DETAILS

Research Code Number: | |

1. What is your Age?

20 to 29 years	
30 to 39years	
40 to 49 years	
50 to 59years	
60 and more years	

2. What is yours highest nursing qualification

Advanced Diploma	Master's degree	Registered professional nurse

3. How many years have you worked in an ICU settings?

4. Which type of ICU do you currently work in?

General ICU	
Trauma ICU	
Neurosurgery ICU	
Cardiothoracic ICU	
Acute Coronary Care Unit	

SECTION B: PREVENTION OF VAP QUESTIONNAIRE

Some of the internationally proposed strategies for preventing VAP are listed below: Please mark one correct choice, which recommendations are recommended in the evidence-based guidelines for prevention of ventilator-associated pneumonia.

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 don't know

2. Frequency of ventilator circuit changes
    a. Recommended to change circuits every 48 h (or when clinically indicated)
    b. Recommended to change circuits every week (or when clinically indicated)
    c. Recommended to change circuits for every new patient (or when clinically indicated)
    d. I don't know

3. Type of airway humidifier
    a. Heated humidifiers are recommended
    b. Heat and moisture exchangers are recommended
    c. Both types of humidifiers can be recommended
    d. I don't know

4. Frequency of humidifier changes
    a. Recommended to change humidifiers every 48 h (or when clinically indicated)
    b. Recommended to change humidifiers every 72 h (or when clinically indicated)
    c. Recommended to change humidifiers every week (or when clinically indicated)
    d. I don't know

5. Open vs. closed suction systems
    a. Open suction systems are recommended
    b. Closed suction systems are recommended
    c. Both systems can be recommended
    d. I don't 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. Recommended to change systems for every new patient (or when clinically indicated)
    d. I don't 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 don't 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 don't know

9. Patient positioning
    a. Supine positioning is recommended
    b. Semi recumbent positioning is recommended
    c. The position of the patient does not influence the risk for VAP
    d. I don't know

Is there anything else you would like to add or comment on this topic? Please use the space below.

Thank you for your response to these questions.

APPENDIX B

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

Participant Information Letter

Dear Colleague,

My name is Janet Amusan, a master candidate (intensive care nursing) in the Department of Nursing Science at the University of Witwatersrand, Johannesburg, South Africa. I hope to conduct a research project and would therefore like to invite you to consent to being included in my sample of intensive care nurses. The aim of this study is to assess the knowledge of intensive care nurses regarding evidence-based guidelines for preventing ventilator associated pneumonia.

Participation in this study is voluntary and should you agree to participant in this study you will be ask to sign a consent form to confirm your willingness to participate in the study. You can choose to withdraw from the study at any time without any penalties. The questionnaire will take approximately 15minutes to complete; and your anonymity and confidentiality with be assured in this study by using a research code number instead of real name. Result of this 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 Charlotte Maxeke Johannesburg Academic Hospital have approved the study and its procedures.

Thank you for taking time to read this information letter. Should you wish to contact me or require further information, please do not hesitate to contact me in the department of nursing education or on the following cell phone 073 1532 921.

Yours sincerely,
Janet Amusan,
(MSc Nursing Student)

APPENDIX C

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

Participant Consent Form

I……. .(Full name) give permission to be included in the research study. I have read the information letter and understand the content of the research; and I have been given the opportunity to ask questions I might have regarding the procedure and my consents to being included in the study. Therefore, I give the consent of participating in the research.

……..

……

Date Signature

APPENDIX D

Ethical Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

R14/49 Ms JF Amusan

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M180525

NAME: (Principal Investigator)	Ms JF Amusan
DEPARTMENT:	School of Therapeutic Sciences Department of Nursing Education Medical School University
PROJECT TITLE:	Intensive Care nurses knowledge of evidence-based guidelines for preventing ventilator-associated pneumonia
DATE CONSIDERED:	25/05/2018
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Professor S Schmollgruber and Ms V Herbert
APPROVED BY:	Professor CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	07/08/2018

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

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on 3rd floor, Phillip V Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/We fully understand the conditions under which I am/we are authorised to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to resubmit to the Committee. **I agree to submit a yearly progress report.** The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **May** and will therefore be due in the month of **May** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature _____ Date _____

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX E

Approval Letter from Hospital

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

CHARLOTTE MAXEKE JOHANNESBURG ACADEMIC HOSPITAL

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

Ms. Janet Amusan
Department of Nursing Education
Faculty of Health Sciences
University of Witwatersrand
NHRD REF: GP_201807_009

Dear. Janet Amusan

RE: **"Intensive care nurse knowledge of evidence based guidelines for preventing ventilator associated pneumonia"**

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

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

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

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

Supported / ~~not supported~~
Ms. M.M Pule
Nursing Director
Date: 20/8/2018

Approved / not approved
Ms. G. Bogoshi
Chief Executive Officer
21.08.2018

APPENDIX F

Postgraduate Committee Approval of Study

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

Private Bag 3 Wits, 2050
Fax: 027117172119
Tel: 02711 7172076

Reference: Mrs Sandra Benn
E-mail: sandra.benn@wits.ac.za

16 May 2018
Person No: 1699230
PAG

Miss JF Amusan
91 Rosewood, Berger Road
Vorna Valley
Midrand
1682
South Africa

Dear Miss Amusan

Master of Science in Nursing: Approval of Title

We have pleasure in advising that your proposal entitled *Intensive care nurses knowledge of evidence-based guidelines for preventing ventilators 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

APPENDIX G

Permission to use Research Instrument

From: Sonia Labeau [mailto:sonia.labeau@hogent.be]
Sent: 12 January 2019 20:20
To: Shelley Schmollgruber <schmoll@iafrica.com>
Cc: shelley.schmollgruber@wits.ac.za; Stijn Blot <stijn.blot@ugent.be>
Subject: RE: request for permission to use questionnaire

Dear Professor Schmollgruber
Dear Shelley

Thank you very much for your and your student's interest in our research. It is my pleasure to grant permission to use the questionnaire and to change it according to your student's requirements (it has been developed in 2006, so it might need updating to meet the current evidence based recommendations).

In attach, please find a copy of the questionnaire as well as some other related publications that might be useful to the student's project. If any further questions might come up, please feel free to contact me at any time.

I wish your student the very best with the research project and thank you and her/him sincerely for the interest in our study.
Kind regards
Sonia

Sonia LABEAU, RN, MA, MNSc, PhD
Ghent University & University College Ghent, Ghent, Belgium
Mail: sonia.labeau@hogent.be
Skype: DecubICUs study

APPENDIX H

Language Editing and Proofing

Gill Smithies

Proofreading & Language Editing Services

59, Lewis Drive, Amanzimtoti, 4126, Kwazulu Natal

Cell: 071 352 5410 Email: moramist@vodamail.co.za

Work Certificate

To	Prof. Shelley Schmollgruber
Address	Wits Dept of Nursing Education
Date	08/01/2019
Subject	Intensive Care nurse knowledge of evidence-based guidelines for preventing ventilator-associated pneumonia
Ref	SS/GS/25

I certify that I have edited the following thesis for language, grammar and style,

Chapters 1 to 5 and Appendices: Intensive Care nurse knowledge of evidence-based guidelines for preventing ventilator-associated pneumonia, by J. Amusan,

to the standard as required by Wits Dept. of Nursing Education.

Gill Smithies