INTENSIVE CARE NURSES' KNOWLEDGE OF EVIDENCE-BASED GUIDELINES REGARDING ENDOTRACHEAL SUCTIONING IN AN ACADEMIC HOSPITAL IN JOHANNESBURG

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DECLARATION

I, Christine Ncube, 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: M140643

DEDICATION

I dedicate this research study to the loving memory of my dad “Mr Thomas Ncube’’ who passed on during the course of my research study. My intention of doing my Master’s degree was to see you among the masses singing praises on my graduation day and you just being proud of your baby girl. I know you always wished only the best for me and I really wanted to show you that I can be just that ‘The best’.

I so wish you were here

However, I guess God had other plans for you.

You forever in my heart. DAD

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ABSTRACT

Background: An evidence-based approach that encompasses current practice, knowledge and observed outcomes in clinical areas is vital for the purpose of delivering best health care practices to patients (Davies, 2008).

Purpose: The aim of this study was to determine intensive care nurses' knowledge for the current evidence-based guidelines of endotracheal suctioning for adult intensive care units at one university-affiliated public hospital in Johannesburg, in order to make recommendations for clinical practice and education of these nurses.

Method: A non-experimental, descriptive, quantitative and cross sectional design was utilised in this study. The sample size comprised 80 (n=80) nurses working in adult intensive care units. Data was collected using a structured questionnaire developed by Jordan (2011). The data collection was divided into two sections. The first section was the demographic data, the second section comprised 27 questions and nurse respondents were asked to respond to dichotomous questions and rate their responses (agree/disagree) on a 5-point Likert scale. Data analysis was done by means of descriptive and comparative statistics to meet the study objectives. Statistical tests included Pearson's correlation (r) and ANOVA tests and Testing was done on the 0.05 ($p < 0.05$) level of significance.

Results: The knowledge of intensive care nurses (both trained and non-trained) was found to be average, the mean total score was 63.8% (SD 6.6), which was considered below adequate (cut-off 70%). The study found no statistical ($p > 0.05$) difference in knowledge based on age and years of experience of these nurses. Further, the results of the multivariable linear regression shows that there is no significant ($p > 0.05$) association between qualification (trained and non-trained ICU nurses), years of experience and knowledge.

Conclusion: This study concluded that nurses do not have desirable updated knowledge of current evidence based guidelines on ETT suctioning. Concerns were raised about all aspects of endotracheal suctioning and highlighted the need for changes in nursing practice, with clinical guidelines and focused practice-based education.

Keywords: ETT suctioning, knowledge, evidence based practice, intensive care

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LIST OF ABBREVIATIONS

EBP	Evidence Based Practice
ETT	Endotracheal tube
ICU	Intensive care unit
VAP	Ventilator Associated Pneumonia

CHAPTER ONE

OVERVIEW OF THE STUDY

1.0 INTRODUCTION

This chapter provides an outline of the study. The problem statement, the purpose of the study, research objectives and significance of the study will be described. A brief overview, which will be discussed in greater detail in Chapter Three, will be given of the research methodology, validity and reliability and the ethical procedures adhered to.

Evidence-based practice (EBP) is the conscientious integration of the best research evidence with clinical expertise and patient values and needs in the delivery of quality, cost-effective healthcare (Dicenso, Cullum & Ciliska, 1998; Sackett, Strauss, Richardson *et al.,* 2000; Turenne, Heon, Aita *et al.,* 2016). The ultimate goal of evidence-based practice is to improve patient outcomes and quality of care.

Endotracheal tube (ETT) suctioning is one of the necessary invasive procedures carried out to clear airway secretions and maintain its patency for mechanical ventilation. However, if not carried out according to the current evidence-based practice recommendations, it will lead to inconsistent practices among nurses, affecting the health of the patient by causing ventilator-associated pneumonia, bleeding, infection, atelectasis, hypoxemia, cardiovascular instability, elevated intracranial bleeding, and may also cause lesions in the tracheal mucosa (Ansart, Alav, Adib-Hajbagheri *et al.,* 2012).

1.1 BACKGROUND OF THE STUDY

Endotracheal suctioning is an essential activity in reducing the risk of consolidation and atelectasis that may lead to inadequate ventilation (Day, Farnell & Haynes *et al.,* 2002; Pedersen, Rosendahl-Nielsen, Hjermind *et al.,* 2009). Endotracheal suctioning, according to the American Association of Respiratory Care (AARC), is defined as "a component of bronchial hygiene while being mechanically ventilated and it involves the mechanical aspiration of pulmonary secretions from a patient with an artificial airway in place" (AARC, 1993; AARC 2010; 500).

Many critically ill patients receive mechanical ventilation as part of their treatment in ICU. These patients require an artificial airway, most often an endotracheal tube. The tube is usually inserted through the mouth (oral intubation), and its distal tip rest above the carina. It is of importance that nurses have the knowledge and skill of endotracheal suctioning procedure as well as the knowledge of the complications that may arise during the procedure and this can be achieved if suctioning is performed consistently in the manner that meets the standard guidelines (Ozden & Gorgulu, 2011; Sole, Penoyer, Su *et al.,* 2009).

Many earlier studies have looked at the intensive care nurse's knowledge and skills of suctioning technique (Celik & Elbas, 2000; Day, Farnell, Haynes *et al.,* 2002; O'Neal, Grap, Thompson *et al.,* 2001; Wood, 1998). Ozden and Gorgulu (2011) found in a more recent study that nurses training and experience of suctioning was insufficient, and as a result, these nurses tend to rely on their personal experience and specific ward routines as sources of knowledge for suctioning patients in the unit. Hence, it would also suggest ETT suctioning may not based on recent scientific evidence. In another study, by Davies (2011) findings

showed that the intensive care nurses had varying degrees of clinical experience, which play a part in the accurate assessment of the patients' potential need for suctioning (Ozden & Gorgulu, 2011).

In the Australian context, the Intensive Care Coordination and Monitoring Unit (ICCMU) developed guidelines with the aim of setting an outline of the best available evidence related to procedures which will facilitate effective removal of ETT secretions, while preventing complications of artificial airway suctioning (Rolls, Smith, Jones *et al.*, 2010). Similarly, guidelines were developed by the New South Wales (NSW) suction network group comprising of senior clinicians and academics as part of the Intensive Care Monitoring and Coordination Unit (ICCMU, 2014) collaborative project. This guideline contains recommendations relating to the following aspects: frequency of suctioning (routine versus. non-routine), prior and post-assessment of patients, size of the suction catheter, preoxygenation, saline installation, closed vs open suctioning. This guideline is provided as a tool to inform the development of local practice policies in NSW Intensive Care Units. It should be used in conjunction with other processes usually used to develop practice guidelines (Rolls, Smith, Jones *et al.*, 2010).

Despite the importance of practice guidelines, studies have also revealed that the knowledge and skills of nurses are outdated and does not meet the desired standards which could be as a result of the level of training or guidelines which are not regularly updated in line with the latest international evidence (Kelleher & Andrews, 2008; Ozden & Gorgulu 2011; Pederson, Rosendahl-Nielsen, Hjermind *et al.*, 2009). Of which, if it were implemented this could contribute to the improvement of nursing care rendered to patients. In summary, endotracheal suctioning and its associated complications have a significant influence on

patient outcomes. The evidence-based guidelines have been created to prevent unnecessary risks and complications including bleeding, infection, atelectasis, hypoxaemia, cardiovascular instability, elevated intracranial pressure and lesions of the tracheal mucosa. Therefore intensive care nurses' adherence to these practice guidelines is an essential consideration for enhancing positive patient outcomes.

1.2 PROBLEM STATEMENT

Many studies conducted overseas demonstrate that intensive care nurses are not adhering to the evidence-based practices for endotracheal suctioning of intubated patients (Leddy & Wilkinson, 2015; Haghighat & Yazdannik, 2015; Ozden & Gorgulu, 2011). This non-adherence to these practices could lead to a compromise of patients' health and outcomes.. However, it is unclear whether the non- compliance could be related to the lack of intensive care nurses knowledge of the latest guidelines or because of the absence of suctioning guidelines. It is for that reason that it is crucial to assess intensive care nurses' understanding and identify any barriers of evidence-based guidelines on ETT suctioning of the adult intubated patient, which is what this study aims to achieve.

This study attempted to answer the following research questions:

- Are intensive care nurses aware of the latest evidence-based guidelines for ETT suctioning of the adult intubated patient?
- Does training and years of experience of intensive care nurses correlate with levels of knowledge?

1.3 PURPOSE OF THE STUDY

The purpose of this study was to describe intensive care nurses' knowledge for the current evidence-based guidelines on ETT suctioning in a university-affiliated public hospital in Johannesburg. The study intended to make recommendations for clinical practice and education and training of intensive care nurses.

1.4 OBJECTIVES

The objectives of the study were:

- To determine and describe intensive care nurses' knowledge for the current evidence-based guidelines on ETT suctioning in intensive care units
- To establish whether there is a relationship between qualification, years of experience and knowledge of nurses (trained and non-trained) for evidence-based guidelines on ETT suctioning

1.5 SIGNIFICANCE OF THE STUDY

Nurses' knowledge of the latest evidence-based ETT suctioning guidelines of the adult intubated patient is vital to ensure consistent implementation of effective/ safe suctioning skills. Thereby preventing any detrimental adverse effects such as Ventilator Associated Pneumonia (VAP). Ventilator-associated pneumonia is a national priority for improving patient care because it is associated with morbidity and mortality risks. Hence the Centre for Disease Control and Prevention (CDC) have established guidelines for preventing nosocomial associated pneumonia (Kjonegaard, Fields & King, 2010). Nosocomial infections can be prevented by monitoring the infection rates in a clinical setting and

adhering to the best healthcare practices set. Development of nosocomial infection can increase patient hospital stay which could cost the government and medical aid unnecessary expenditure, of which could be more effectively used to improve other aspects of the health sector. An American study found that even though their intensive care units had fewer beds (less than 10%) than other units in the hospital premises. Intensive care services cost 22% of the total hospital budget, and in the Netherlands, it was estimated to cost 20% of their hospital budget (Tan, Bakker, Hoogendoorn *et al.*, 2012). Ventilator-associated pneumonia (VAP) needs more extended ventilation, more respiratory support, more extended intensive care unit stay and more extended hospitalisation and this impact on the cost either to medical aid or the state in compared to non-ventilator associated pneumonia (Luckraz, Manga, Senanayake *et al.*, 2018).

1.6 OPERATIONAL DEFINITIONS

The operational definitions consistently used in this study are as follows:

- **Critically ill patient**

The critically ill patient is characterised by the presence of actual and potentially life-threatening health problems, which include the requirement for life-sustaining interventions and continuous observation in an intensive care unit to prevent complications (Schmollgruber, 2015:16).

- **Intensive care unit**

An intensive care unit is a specifically staffed and equipped hospital unit. The management is dedicated to supporting patients with life-threatening illness, injury and complications (Baird, Keen & Swearingen, 2005).

- **Intensive care nurse**

An intensive care nurse is a person who obtains an additional qualification in medical-surgical nursing: Advanced Medical and Surgical Nursing: Critical Care (R212 of 1985, as amended: 119:2) or equivalent alternative intensive care nursing. In this study, this person is a nurse who has received educational training at a South African Nursing Council (SANC) approved learning facility under R212 and informal training through orientation and in-service training.

In this study, the term "*trained nurse*" is synonymously applied to an intensive care nurse.

- **Professional nurse**

A professional nurse is a person registered under section 16 of the Nursing Act (No 33 of 2005). In this study, this person is a nurse who has received educational training at a SANC approved learning facility and has completed the requirements for registration with SANC (R425 of 1985:2, as amended) but has no formal training in intensive care nursing.

In this study, the term professional nurse synonymously referred to as an "*untrained nurse*" meaning that the professional nurse has not obtained a post-basic qualification in intensive care nursing.

- **Endotracheal (ETT) suctioning**

ETT suctioning refers to a process of bronchial hygiene therapy and mechanical ventilation whereby pulmonary secretions are being suctioned via the endotracheal tube by use of an ETT suction catheter connected to a negative pressure vacuum (AARC, 2010).

Evidence-based practice guidelines

Evidence-based practice guidelines are systematic statements that incorporate well-designed studies, patient values and preferences and a clinician's expertise in making decisions about a patient's care (Melnyk, Gallagher-Ford, Long *et al.*,2014; Muscedere, Dodek, Keenan *et al.*, 2008; Sackett, Straus, Richardson *et al.*, 2000).

In this study, the evidence-based guidelines of ETT suctioning referred to were derived from current literature and recommendations based on the questionnaire developed by Jordan (2011).

- **Knowledge**

Knowledge refer to what the person knows, as well as the information acquired through learning (O'Neal, Grap, Thompson *et al.*, 2001).

In this study, intensive care nurses knowledge of evidence-based practice guidelines on ETT suctioning is explored and assessed in respect of a questionnaire developed by Jordan (2011), which incorporates the evidence-based guidelines based on current literature and best practice recommendations. Knowledge will be considered to be adequate with a score of at least 70% (Perrie, Schmollgruber, Bruce, *et al.* 2014).

1.7 OVERVIEW OF THE METHODOLOGY

A non-experimental, descriptive, quantitative and cross-sectional design was utilised to achieve the objectives of the study. The study respondents were intensive care nurses affiliated to the adult intensive care units at a 1,200-bed capacity hospital in Johannesburg, using a self-administered questionnaire by Jordan (2011). These intensive care units included the General (Medical and Surgical) ICU, Neurosurgical ICU, Cardiothoracic ICU, Coronary care unit and Trauma ICU.

Ethical clearance and permission to conduct the study was obtained from the relevant University Research Committees, the Department of Health and the hospital. Participation in the study was voluntary, and respondents were free to withdraw at any time.

After permission was obtained from the hospital, consent was obtained from the nurses working in the adult intensive care units who agreed to participate in the study. Descriptive and comparative statistics were used to analyse the data, with STATISTICA^{TM} version 13.2 used for analysis purposes. Reliability of the study was maintained by ensuring the researcher was the sole collector of the data, the sample size was achieved by convenience sampling, and the data was verified by a biomedical statistician to ensure research integrity.

The validity of the research was achieved by ensuring the data collection instrument was verified by ICU clinical and education experts, to fit into the local study context.

1.8 OUTLINE OF THE STUDY

The outline of the study will be presented as follows:

Chapter one:	Overview of the Study
Chapter two:	Literature review
Chapter three:	Research Methods
Chapter four:	Results and Findings of the Study
Chapter five:	Summary of the study, main findings, recommendations and conclusion

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 presents the literature reviewed about the topic under study. The purpose of undertaking a literature review was to scrutinise past research studies, both locally and internationally, to show how the current study linked to it. The literature review provides a framework of enquiry and identifies the area of knowledge that the study intended to expand on (De Vos *et al.*, 2011:135).

The search was conducted using electronic databases available through the University of the Witwatersrand Academic Library – CINAHL (Cumulative Index to Nursing and Allied Health Literature) with SCOPUS, EBSCO HOST and MEDLINE (Medical Literature on Line Accessed through PUBMED). To search PUBMED, the MeSH (Medical Subject Headings) were used. Journal articles were hand searched in respected national journals and books. The keywords which were used are "*ETT suctioning*", "*frequency of suctioning", "hyper-oxygenation in suctioning" , "hyperinflation in suction", "knowledge and skills", "suctioning guidelines", "normal saline instillation", "ETT suctioning guidelines and protocols, "mechanical ventilation", "critical care nursing",* and *"ventilation associated pneumonia"*.

The next section provides an overview of evidence-based practice, ETT suctioning, current ETT suctioning guidelines and recommendations, nurses' knowledge and barriers that hinder ETT suctioning best practices.

2.2 EVIDENCE-BASED PRACTICE

Evidence-based practice (EBP) is the conscientious integration of the best research evidence with clinical expertise and patient values and needs in the delivery of quality, cost-effective health care (Dicenso, Cullum & Cilisla, 1998; Sackett, Strauss *et al.*, 2000; Turenne, Heon, Aita *et al*., 2016).

The ultimate goal of evidence-based practice is to improve patient outcomes and quality of care. EBP unifies research evidence with clinical practice and encourages individualisation of care through the inclusion of patient preferences. According to Dontje (2007), Professor Archibald Leman Cochrane (1909 -1988) was the founder of EBP in 1972, after seeing a gap between current practice and evidence-based guidelines (Dontje, 2007; Turenne, Heon, Aita *et al*., 2016).

The EBP plays a vital role in the future nursing care standard and will deliver better outcomes as clinical practice will not only be based on what is learnt but also on the current evidence. Recent researches have shown that reliable knowledge that is gained through EBP will change a patient's current health status into the desired outcome as EBP characterise the gap between what nurses knowledge and nurses clinical practice in the care of patients (Stevens: 2013).

The EBP gives nurses a way of utilising critically appraised and scientifically proven evidence to deliver quality care standard to critically ill patients. Moreover, nurses need enough knowledge of literature searching in order for them to be able to retrieve current, relevant and accurate evidence (Majid, Foo, Luyt *et al*., 2011).

To achieve excellence in practice, critical care nurses must embrace EBP as the norm. Studies about EBP has shown a clear indication of compatibility among Evidence-Based Practice and the nursing model of care as both emphasize care that entails patient values to formulate sound interventions(Dontje, 2007; Turenne, Heon, Aita *et al.*, 2016).

The research syntheses have provided the basis for developing strong evidence-based guidelines for clinical practice. These guidelines identify the best treatment plan for patient care, to promote quality outcomes (Grove, Burns & Gray, 2013).

2.2.1 Stages in Development of Evidence-Based Practice

Stages of encouraging the use of EBP can be seen from a perspective of those who want to share knowledge and those who practice it on a daily basis. AHRQ (Agency for Healthcare Research and Quality) model of knowledge transfer shows us three stages of transferring knowledge:

- Knowledge creation and distillation,
- Diffusion and dissemination,
- Organisational adoption and implementation.

These stages are shown from the researcher's point of view starting with identifying findings from the portfolio of patient safety. Knowledge creation and distillation are performing a research study then gathering the findings into a product that can be put in action such as recommendations that can be used in practice (Titler, 2008; Turenne, Heron, Aita *et al.*, 2016).

Diffusion and dissemination involve working together with leaders and health care organisations to spread widely knowledge that can form the basis of action such as protocols. Dissemination partnerships link researchers together with professional organisations that include national patient safety foundation or multidisciplinary that can function as knowledge brokers and connectors to the practitioners and health care delivery organisations (Titler, 2008; Turenne, Heron, Aita *et al.*, 2016).

Dissemination partnership gives a stamp of approval for new knowledge presented and assist in detecting powerful groups and communities make a request application of evidence in practice (Titler, 2008; Turenne, Heron, Aita *et al.*, 2016).

2.2.2 Evidence-Based Practice Implementation

Basically to adopt a nature of constant use of evidence-based practice in the daily running of a clinical area requires a complex combination of clinicians environment. The research topic relevant to the practice pilot study will be needed to help to see if the researched can be applied practically. This will give the organisation an opportunity to identify the potential challenges adapting to change is not easy it will require much effort from both the individual to the organisation. When an improvements occur after the implementation of this pilot study these could be communicated to other units in the organisation. This will make it easier for the key personnel to adapt since they can see how it brought change in the pilot unit and the more unit adopted this change it will no longer be considered an innovation but a standard of (Titler, 2008; Turenne, Heron & Aita *et al.*, 2016).

2.3 ETT SUCTIONING

The ETT suctioning is one of the necessary invasive procedures which is carried out to clear airway secretions and maintain its patency for ventilation. During intubation the ETT is placed in a way that patients cannot eliminate secretions, this is because the ETT (ETT) compromises glottis closure, thereby limiting the pressures and velocity of airflow that can be generated for a productive cough (Ansari, Alavi, Adib-Hajbagheri *et al.* 2012). However, if it is not carried out according to the current research recommendations, it will lead to inconsistent practices among nurses, affecting the health of the patient by causing ventilator-associated pneumonia, bleeding, infection, atelectasis, and hypoxemia, cardiovascular instability, elevated intracranial bleeding, and may also cause lesions in the tracheal mucosa (Argent, 2014).

The ETT suctioning method preferably should not be painful, uncomfortable, effective and safe with minimal adverse effects (Argent, 2014).

Most critically ill patients who are admitted in intensive care unit need mechanically ventilated as they have inadequate spontaneous ventilation and this mechanical ventilation is performed as a measure to control ventilation in critically ill patients as prophylaxis for the impending collapse of other physiologic functions. The tube is usually inserted through the mouth (oral intubation), and its distal tip rest above the carina. It is of importance that nurses have knowledge and skill of ETT suctioning procedure as well as the knowledge of the complications that may arise during the procedure and this can be achieved if suctioning is performed consistently in a manner that meets the standard guidelines (Ozden & Gorgulu, 2011; Sole, Penyoyer, Su *et al.*, 2009).

Endotracheal intubation is used in the management of critically ill patients, to provide sufficient gaseous exchange for those with respiratory insufficiency. Endotracheal intubation is non-surgical skill, which is performed to keep mechanically ventilated patient airway clear of secretions. Also it safeguards the lung from aspirates, and provide ventilated patients with leak free ventilation (Schmollgruber, Bruce, Rachidi *et al.,* 2014).

However, this endotracheal intubation device can lead to detrimental effects such as inflammation, infections, and traumatic lesions to the airways if not correctly managed (Yousefnia-Darzi, Hasavari, Khaleghdoost *et al.,* 2016).

Critically ill patients often have an increase in the production of mucous and a weakened ability to clear secretions to prevent detrimental effects occurring nurses have to perform ETT suctioning (ETS). This action is directed at removing secretions from the airway and, promoting the maintenance of the airways permeability, as well as optimising ventilation and oxygenation (Rolls, Smith, Jones *et al.,* 2010; Yousefnia-Darzi, Hasavari, Khaleghdoost *et al.,* 2016).

The ETT suctioning is an essential activity in reducing the risk of consolidation and atelectasis that may lead to inadequate ventilation (Day, Farnell & Wilson-Barnett, 2001; Pedersen, Rosendahl-Nielsen & Hjermind *et al.,* 2009; Yousefnia-Darzi, Hasavari, Khaleghdoost *et al.,* 2016). ETT suctioning, according to the American Association of Respiratory Care (AARC), is defined as "a component of bronchial hygiene while being mechanically ventilated and it involves the mechanical aspiration of pulmonary secretions from a patient with an artificial airway in place" (AARC, 1993:500; AARC, 2010).

The ETT suctioning procedure is essential for the maintenance of pulmonary function, as the presence of an artificial airway interferes in the physiology of coughing and of the mucociliary system, which can disturb the clearance of secretions from the airway and this may lead to the development of atelectasis, infections, respiratory compromise, obstruction of the ETT , hemodynamic changes and death (Wood, 1998; Sinha & Bhimji, 2017).

The ETT suctioning is one of the essential procedures which are carried routinely on critically ill intubated patients some suctioning practices which have little to no evidence to support their use, are still being performed. It must be recognised that a lack of research evidence does not necessarily mean that practice is of no benefit. The effectiveness of ETT suctioning depends on many issues which include underlying lung pathology, whether the patient is sedated or not, the skill that is being used to carry the suctioning technique (Argent, 2009; Heidari & Shahbazi, 2017).

The procedure includes patient preparation, the suctioning event, and follow-up care. There are two methods of ETT suctioning based on the selection of catheter: open and closed. The open suctioning technique is whereby a patient gets disconnected from the ventilator, and closed suctioning technique involves attachment of a sterile closed suction catheter to the ventilator circuit, allowing the patient to be suctioned without being disconnecting the patient from the ventilator (Argent, 2009; Heidari & Shahbazi, 2017).

Maintaining the critically ill patient airway patent is the primary goal of nursing care of patients intubated and mechanically ventilated. But however, if ETT suctioning is not carried out according to the current research recommendations, it will lead to inconsistent practices among nurses, affecting health of the patient by causing ventilator-associated pneumonia,

bleeding, infection and atelectasis, hypoxemia, cardiovascular instability, elevated intracranial bleeding, and may also cause lesions in the tracheal mucosa. (Zeb, Ul-Haq, Ali *et al.,* 2017).

An ideal suctioning technique would be painless and safe from the development of adverse events and effective whereby all secretions are successfully removed from the ETT leaving it up to the patient for proper gaseous exchange to take place (Argent, 2009) The success of an ETT suctioning procedure depends mostly on issues such as the underlying lung pathology, patient sedation, critical care nurse knowledge of correct suctioning technique (Argent, 2009).

In the Australian context, the Intensive Care Coordination and Monitoring Unit (ICCMU) came up with the latest guidelines with the aim of setting an outline of the best available evidence related to procedures which will facilitate effective removal of airway secretions, while preventing complications of artificial airway suctioning (Rolls, Smith, Jones *et al.,* 2010). Similarly, guidelines were developed by the New South Wales (NSW) suction network group comprising of senior clinicians and academics as part of the ICCMU Intensive Care Collaborative project (ICCMU, 2010). This guideline contains recommendations relating to the following aspects: frequency of suctioning (routine versus. non-routine), prior and post-assessment of patients, size of the suction catheter, preoxygenation, saline installation, closed vs open suctioning. This guideline is provided as a tool to inform the development of local practice policies in NSW Intensive Care Units. It should be used in conjunction with other processes usually used to develop practice guidelines (Rolls, Smith, Jones *et al.*, 2010).

Despite the importance of practice guidelines, studies have also revealed that the knowledge and skills of nurses are outdated and does not meet the desired standards which could be as a result of the level of training or guidelines which are not regularly updated in line with the latest international evidence (Kelleher & Andrews, 2008; Pederson, Rosendahl-Nielsen, Hjermind *et al.* 2009; Ozden & Gorgulu, 2011). Of which, if it was implemented this could contribute to the improvement of nursing care rendered to patients. In summary, ETT suctioning and its associated complications have a significant influence on patient outcomes. The EBP guidelines have been created to prevent unnecessary risks and complications including haemorrhage, infection, atelectasis, hypoxaemia, cardiovascular instability, elevated intracranial pressure and lesions of the tracheal mucosa. Therefore, intensive care nurses' adherence to these guidelines is essential for increasing positive patient outcomes (Elsaman, 2017).

In the study conducted by Carter (1996) it was reflected that nurses' responses to the questionnaire at times different to what they do in the clinical area. However, in the study conducted by Day, Farnell, Haynes *et al*. (2002), where a convenience sampling technique was used, it was also shown that nurses did not have enough knowledge of performing ETT suctioning in their clinical areas (Frota, Loureiro & Ferreira, 2013). Moreover, some unsafe practices we displayed from many nurses some nurses were not aware of the recommended practices which were put in place to help them while performing ETT suctioning procedure (Day, Farnell, Haynes *et al*., 2002). These findings are supported in the literature (Celik & Elbas 2000) and have considerable implications for the safety of critically ill patients (Kelleher & Andrews 2008). However, there is limited literature on how well nurses perform ETT suctioning. Most of which were focused on standards (Leddy & Wilkinson, 2015).

Most of the studies were retrospective, descriptive studies conducted in America and most of them have one current limitation, where it was reflected that most participants tend to respond to the line of social views not necessarily what they do in practice (Polit,& Beck, 2012). It is only a few observational studies that were based on nurse's practices in the clinical area in comparison to the recommendation set (Day, Farnell, Haynes *et al.* 2002; McKillop 2004). This leaves a need for more observational studies to be conducted, what literature recommend can merge with what nurse's practices in the clinical area and always being at the patient bedsides give intensive care nurses an excellent platform to give patient care that's in line with the latest evidence-based guidelines (Haghighat & Yazdannik, 2015).

In the study conducted in Pakistan, the authors found that most of the nurses were not aware of the current suctioning recommendations. Mostly in clinical areas practice nursing based on their experiences and what they have been taught of which in some years there have been many changes with knowledge being updated based on the latest research studies conducted (Zeb, Ul-Haq, Ali *et al.*, 2017).

A review of the research showed the main concepts and their recommendations that blended with the clinical practices of ETT suctioning by intensive care nurses. The primary concepts are presented in the following literature summaries and include knowledge for the ETT suctioning, the strategies for the prevention of adverse effects and implementation of guidelines by health care providers. An overview of the conceptual framework and literature review was described.

2.4 EVIDENCE-BASED GUIDELINES ON ETT SUCTIONING

The following Grading system of recommendations makes the following evidence-based recommendations on ETT suctioning.

Table 2.1 Evidence based guidelines on ETT suctioning

Guidelines	Recommendation	Grade
"Frequency	ETT suction should be performed only when necessary	1C
Suctioning catheter	Should occlude less than half of the lumen of the ETT	2C
Suctioning pressure	Should be lowest as much as possible, usually 80 to 120 mmHg	2B
Depth of suctioning	Minimum invasion to the length of the ETT only-should be the use of shallow suctioning	2B
Time of suctioning event	Should not last longer than 15 seconds	2C
Continuous vs intermittent	Should be continuous rather than intermittent suctioning during the individual suction procedures	2C
Normal saline instillation	No routine instillation of normal saline before ETT suction	2B
Oxygenation	There should be pre-oxygenation by the delivery of 100% oxygen for at least 30 seconds before and after the suctioning procedures to prevent a decrease in oxygen saturation	2C
Hyperinflation	Hyper-oxygenation before suctioning should be combined with hyperinflation (20 – 30 cmH20) and used cautiously not routinely in some patient populations	2B
Infection control	Aseptic technique should be used for infection control	C*
Closed vs open suctioning	Both open and closed suction systems are recommended."	2B

Key: * consensus agreement as strong evidence is not yet clear

Sources: AARC (2010), Chaseling, Baylis, Rose *et al.,* (2014) Pedersen, Rosendahl-Nielsen, Hjermind *et al.,* (2009) and Mwakanyanga, Masika & Tarimo (2018:3)

2.4.1 Frequency of Suctioning

Routine suctioning is not recommended as it can be detrimental to patients, ETT suctioning is associated with risks such as atelectasis, bradycardia, decreased lung compliance, hypoxia, transient increases in arterial and intracranial pressure and cerebral blood flow velocity, bacteraemia, and pneumothorax (Leddy & Wilkinson, 2015).

There is no consensus of the frequency of performing ETT suctioning; it depended on the clinical picture displayed by the patient (Sinha & Bhimji, 2017). There are clinical signs which are determined to help in determining the need for endotracheal suction such as patient agitation, a sudden drop in patient oxygen saturation, respiration sounds, a change in respiratory pattern on the flow volume loop (ICCMU, 2017; Sole & Bennett, 2015)

Due to the risk factors associated with ETT suctioning, it is recommended that is should only be performed when clinically indicated, and this will be indicated through a proper assessment which will include auscultation and visual inspection (AARC, 2010).

2.4.2 Suction Catheter Insertion and Size

The insertion of ETT suctioning tube in the ETT increase airway resistance and continuous insertion may lead to reduced pressures in the airway and formation of atelectasis (Nakstad, Opdahl, Heyerdahl *et al.*, 2017).

The suction catheter is one of the critical measures to consider while performing endotracheal suction as an incorrect size can lead to the detrimental outcome or inability to

clear the secretions effectively (Argent, 2014). ETT suctioning procedure requires a closed catheter system, and it is also indicated that if the suction catheter in use obstructs a large part of the ETT lumen, this may lead to change in ventilation drastically (Nakstad, Opdahl, Heyerdahl *et al*., 2017).

In the study Arbon & Siew Ping (2011), they stated the recommendation of a suction catheter used during endotracheal suction should occlude half the internal diameter of the ETT . This will prevent considerable intrapulmonary pressure building up in the ETT due to lack of sufficient return airflow down the ETT to compensate the air removed in the lung during the suctioning procedure (Arbon & Siew Ping 2011). This is supported by the recommendations AARC (2010) where its recommended that the ETT suction catheter diameter should not exceed one half of the inner diameter of the ETT , providing an internal to external diameter ratio of 0.5 in adults(AARC,2010).

However, there is a common misunderstanding that usually causes some complication in choosing catheter size known as Charriere's French scale which is often used when labelling suction catheters (Arbon & Siew Ping, 2011; Day, Farnell, Haynes *et al.,* 2002). The scale entails converting French scale to mm whereby a number is divided by 3. However, most manufacturers further complicate the process by using inaccurate mnemonics and calculations where an ETT size is multiplied by two and subtract two which gives 14fr for a size eight ETT internal diameter (Arbon & Siew Ping, 2011).

2.4.3 Suction Pressure

While performing ETT suctioning the suction catheter is placed inside the ETT partially obstructing the ETT lumen of which may lead to air being trapped distal to the ETT followed by the generation of negative airway pressure (Nakstad, Opdahl, Heyerdahl *et al.*, 2016). This process of using negative airway pressure may lead to atelectasis and potential hazards such as lung prolapse and haemodynamic instability (Nakstad, Opdahl, Heyerdahl *et al.*, 2016).

The AARC (2010) has recommended that the negative pressure used during ETT suctioning should not exceed -150mmHg, the negative pressure limit is from -80mmHg to – 120mmHg (AARC, 2010; Mwakanyanga, Masika & Tarimo, 2018).

In one United Kingdom study (Palazzo & Soni, 2013) the authors identified the three factors that can affect the pressure generated in the lower respiratory tract during suctioning. The ratio between the diameters of the suction catheter and ETT this is because it if the catheter tracheal tube diameter is greater than the recommended 0.5 then the negative pressure generated will be transferred to the intrathoracic space. Second the presence of secretion in the ETT which reduces the internal diameter of the ETT leading to greater negative pressure on suctioning. The last factor being a closed suction system where it might be expected that attenuate pressure changes generated by suction preventing ETT being opened to atmosphere, allowing delivery of compensatory gas flows but not all ventilators provide that compensatory flow (Palazzo & Soni, 2013).

2.4.3 Suction Duration

In the study by Wang, Tsai, Chen et al. (2017) on the duration of the suctioning event. These authors indicated that majority of researchers recommend that suctioning should take between 10 and 15s to perform, as longer durations are associated with an increased risk of mucosal damage and hypoxaemia.

For ETT suctioning to be successful would be when endotracheal secretions are removed adequately and effectively. Suction duration should be kept to the minimum time needed for secretion clearance. Young (1984) suggests the duration of up to 30 seconds may be used, yet she writes that the duration of catheter insertion has been implicated in the degree of induced hypoxemia (Wood 1998). According to the AARC (2010), the duration of the suctioning event should be limited to less than 15 seconds.

2.4.4 Hyper oxygenation

Hyper oxygenation is the practice of increasing the oxygen concentration usually to 100%) for a suctioning period whereas Hyperinflation refers to the practice of adding an extra volume of air in the lungs, either means of a ventilator or by utilising manual resuscitation bag before commencing suctioning technique (Pedersen, Rosendahl-Nielsen, Hjermind *et al.*, 2009).

Hyper oxygenation is applied because suctioning is known to drop the oxygen saturation of the patient to the point of hypoxaemia (2013). This application has been universally adopted, but like any other procedure, it also has its detrimental effects such as causing barotraumas,

causes an accumulation of carbon dioxide in that patient with chronic obstructive pulmonary disease (Oh & Seo, 2003; Wang, Tsai, Chen *et al.*, 2017).

As a result of the literature reviewed and the AARC guidelines, it has been recommended that hyper-oxygenation be applied to a patient before and after suctioning. This allows patients respiratory system time and an opportunity to return the oxygen values to their normal baseline ranges decreasing chances of hypoxaemia occurring and an increase in both heart rate and mean arterial pressure as compensation for oxygen depletion following ETT suctioning procedure (AARC, 2010).

2.4.5 Hyperinflation

Hyperinflation is the practice of adding an extra volume of air in the lungs either by using a bag valve mask or by using mechanical ventilation before performing ETT suctioning. It is also known as "bagging" whereby a patient will be disconnected from the ventilator then connected to the ambubag whereby the get ventilated manually by applying larger than normal volumes of oxygen at a low inspiratory flow followed by an inspiratory pause (Negro, Opdahl, Heyerdahl *et al.,* 2016).

Lung hyperinflation can also be performed by giving patient 100% oxygen via mechanical ventilation on a patient who requires hypoxic drive and those who are in a CPAP mode of ventilation, where ventilated patients are breathing on their own with no set rate (Oh, & Seo, 2003; Wang, Tsai, Chen *et al.*, 2017)

Hyperinflation is known to improve lung compliance and decreased airway resistance for up to 30 minutes after performing endotracheal suction. However, in patients with Ventilator Associated Pneumonia (VAP), hyperinflation increased lung compliance and may decrease airway resistance in patients (Wang, Tsai, Chen *et al.*, 2017).

2.4.6 Saline Instillation

Installation of normal saline before suctioning in patients with artificial airway it is a traditional nursing intervention in clinical settings while performing ETT suctioning, this instillation involves giving a bolus of 0.25 ml – 10 ml via ETT suctioning (Schmollgruber, Bruce, Rachidi *et al.*, 2014). The instillation of normal saline was used with the aim of loosening thick secretions and enhancing cough reflexes of which it mobilises the secretions and increases secretion clearance (Leddy & Wilkinson, 2015).

AARC (2010) suggested that routine use of normal saline instillation before endotracheal suction should not be used. However, however, the same guidelines do not indicate the condition in which Saline installation should be performed it just state, only when necessary (Leddy & Wilkinson, 2015).

In the South African study by Morrow (2014), it was stated that it is known that mucus and water are immiscible and maintain their separate phases even after the vigorous shake, thus questioning the use of normal saline to dilute secretion (Morrow,2014). Furthermore, in another similar South African study in South Africa, it is indicated the use of saline beneficial, but lack evidence in the volume of saline to be utilised in order to get best results (Schmollgruber, Bruce, Rachidi *et al.*, 2014).

In the study by Zahran (2011) the use of saline was not recommended. Instead, they look at the use of humidification and hydration as instilling saline could lead to the patient developing lots of adverse effects (Zahran, 2011).

From all the reviewed studies it is clear that there appears not to be enough evidence to support the use of saline during suctioning and how it will benefit. No adequate evidence-based practice reflects the benefits of ETT suctioning with versus without saline instillation (Ayhan, Tastan, Lyigum *et al.*, 2015).

Studies by Ozden and Gorgulu (2012) and Ayhan, Tastan, Lyigum *et al.*, (2014) and Wang, Tsai, Chen *et al.* (2017) have highlighted that even though it was not mentioned in the literature, it is believed that instillation of isotonic sodium chloride solution may have been introduced prior the time ventilator circuits were routinely humidified

2.5 KNOWLEDGE AND BARRIERS ON ETT SUCTIONING

Knowledge is a human faculty resulting from interpreted information, understanding that germinates from a combination of data, information, experience, and individual interpretation. Variously defined as things that are held to be true in a given context and that drive us to action if there were no impediments (Boudreau, 2013). According to Colgate (2008), it is the sum of what is known and resides in the intelligence and competence of people.

ETT suctioning is one of the procedures that were regularly performed invasively on most ICU intubated patients. The method of performing ETT suctioning has a significant effect

on its complications and effectiveness as it is associated with very harmful adverse effects, to prevent adverse effects from occurring suctioning should be performed accordingly, according to right standards and codes set. ETT suctioning, if not performed with appropriate technique, can lead to adverse effects such as respiratory and cardiac defects, trachea endothelial trauma, bleeding, increase in brain pressure, hypoxemia and cardiac arrhythmia (Ansari, Alvai, Adib-Hajbagheri *et al.,* 2012).

Many earlier studies have looked at the intensive care nurse's knowledge and skills of suctioning technique (Celik & Elbas, 2000; Day, Farnell, Haynes *et al.* 2001; O'Neal, Grap, Thompson *et al.,* 2001; Wood, 1998; Ozden and Gorgulu (2011). It was found in a more recent study that nurses training and experience of suctioning was insufficient, and as a result, these nurses tend to rely on their personal experience and specific ward routines as sources of knowledge for suctioning patients in the unit. Hence, it also suggests ETT suctioning is not based on recent scientific evidence. In another study, by Davies (2008) findings showed that the intensive care nurses had varying degrees of clinical experience, which play a part in the accurate assessment of the patients' potential need for suctioning (Ozden & Gorgulu, 2011).

In the study conducted by Ansari, Alvai, Adib-Hajbagheri *et al.* (2012) in Iran, revealed that if a well-educated intensive care nurse performs ETT suctioning, after adequately assessing the need for patient suctioning has better efficiency and fewer side effects. However, Day, Farnell, Haynes *et al.* (2002) reported that manuals and protocol of suctioning are not in existence in most units it was shown that nurse's methods of using experiment were questionable as most nurses were lacking the knowledge of suctioning properly (Ansari Alvai, Adib-Hajbagheri *et al.,* 2012).

In performing ETT suctioning it is very crucial that a nurse has an understanding of the procedure based on the latest recommended guidelines. In the study conducted by Favretto, Silveira, Ferreira *et al*. (2012) it was also shown that despite having research studies for secure and effective ETT suctioning, many of these evidenced-based recommendations are not practiced in clinical areas by nurses, this has been found to be due to a lack of knowledge of ETT suctioning skill by nurses. Moreover, that is what motivated them to do a study on endotracheal suction with the belief that if all scientific evidence was all grouped this was going to make it easier for nurses to gain knowledge of the latest evidence available on how to properly perform ETT suctioning (Favretto Silveira, Ferreira *et al*., 2012). Through empowerment nurses,' abilities to make effective decisions in the clinical setting will be enhanced (Gomes, 2010).

2.6 SUMMARY

The chapter provided a literature review on ETT suctioning. The aspects included in the discussion were evidence-based literature, ETT suctioning, current ETT suctioning practices and recommendations, frequency, knowledge, saline instillation. Suction duration, suction catheter insertion/ size, hyperinflation, hyper-oxygenation and suction pressure were explained in detail.

The next chapter will discuss the methodology used in the study.

CHAPTER THREE

RESEARCH METHODS

3.1 INTRODUCTION

This chapter presents the research methods and includes research design, the study population, sample and sampling, the inclusion criteria, data collection, a description of the instrument used in data collection including the reliability and validity of the instrument and ethical procedures followed.

3.2 RESEARCH DESIGN

Research design refers to the blueprint for conducting a study. It provides a structure with which the study is implemented and encompasses the method and procedures employed to conduct research (Grove, Burns & Gray, 2013).A quantitative, non-experimental descriptive and cross-sectional design was utilised in this study. The most appropriate means to collect the data was a self-administered survey.

3.2.1 Quantitative Design

Quantitative research refers to an empirical investigation of a phenomenon that lends itself to precise measurement and quantification, often involving rigorous and controlled designs (Polit & Beck, 2012). The quantitative design was ideal for this study as it explained nurses' knowledge of evidence-based guidelines related to ETT suctioning, with data collection done numerically.

3.2.2 Non-experimental Design

Non-experimental refers to a design where the researcher collects data without introducing an intervention. Also known as an observational study, whereby the study is carried out in its natural location and no manipulation of variables is involved (Polit & Beck, 2012). A non-experimental design was appropriate for this study as it took place in intensive care units in the selected hospital and there was no manipulation regarding involvement or treatment or any intervention given to respondents.

3.2.3 Descriptive Design

A descriptive design observes, describes and documents aspects of a situation as it naturally occurs. Polit and Beck (2012) stated that it sometimes serves as a starting point for generating a hypothesis or developing a theory. According to Burns and Grove (2009), it may be used to gain more information about a particular or specific area of study and may be used to develop a theory without manipulation of the study variables. In this study, descriptive design was ideal as it was used to gain information about nurses' knowledge of evidence-based guidelines regarding endotracheal suctioning. A self-administered questionnaire was used to collect data to avoid bias.

3.2.4 Cross-sectional Design

As the study was conducted over a short period, it was also considered cross-sectional. A cross-sectional design aims to describe the population and to find the prevalence of the

outcome of interest (Polit & Beck, 2012). Cross-sectional studies provide information regarding a particular situation at a given time.

3.3 RESEARCH SETTING

The setting for this study was one university-affiliated public hospital in Johannesburg, Gauteng Province. The hospital has a 1,200 bed capacity with five adult intensive care units. These intensive care units provide services for critically ill patients in the hospital and also act as referral units for patients from surrounding hospitals and other neighbouring provinces.

The researcher chose their units because they represent highly specialised public sector intensive care units, which accept patients from both medical and surgical disciplines. Two of the units accept patients from the cardiothoracic and neurosurgical disciplines, and one unit receives only major trauma-related injuries. In 2015, the number of admissions to these units was 1460 (Schmollgruber, 2015). The acuity level of patients in these units was high (total mean SAPS II score 34.83 overall and 42.75 in trauma patients) (Schmollgruber, 2015). The average age of ICU patients was 48.2 years, mean length of stay in ICU was 7.3 days, and the predicted and actual mortality rate was 20% (Schmollgruber, 2015).

The average number of beds per unit varies between seven to twelve beds. The assigned nurse-to-patient ratio is one nurse to one patient. Nurses practicing in these units have access to specialist healthcare professionals and technical support on a 24-hour basis. All units have a dedicated nurse unit manager and a shift leader. As these units are academic sites for the education and training of intensive care nurses they also have a dedicated clinical facilitator.

3.4 RESEARCH METHODS

Research methods refer to the systemic process used to collect information and data and analysing it. The process includes population, sample and sampling methods, data collection instrument, pilot study, and data collection method and data analysis.

3.4.1 Target Population

The target population comprised of trained and experienced intensive care nurses of the intensive care units in one in university-affiliated public sector hospital in Johannesburg, Gauteng province. A preliminary record review undertaken in before commencement of the study in May 2014 indicated that there are approximately 150 (N = 150) intensive care nurses (trained and non-trained) working in these units, as displayed in **Figure 3.1**

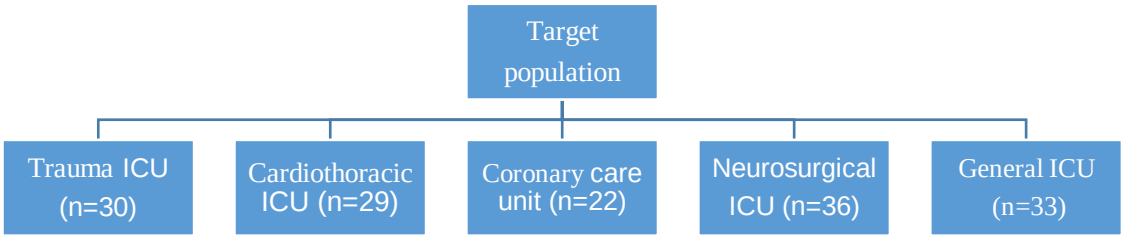

Figure 3.1 Total number of nurses working in the ICUs of the selected institution

3.4.2 Sample and Sampling

Following consultation with a biomedical statistician, an adjusted sample size of 80 (n=80) was achieved, with a confidence level of 95% (1.96), the margin of error of 5% and prevalence of 80%. This sample size was a representative sample as the results can be generalised to the population.

The sample size was calculated using a statistical formula:

$$n^* = \frac{z^2 \times p(1-p)}{d^2}$$

Where n*=estimated sample size, z=confidence interval at 95% (1.96), p=estimated prevalence of patient's bed occupancy in selected ICUs 80% (0.8), d=margin of error at 5% (0.5).

A non-probability and convenience sampling method was utilised to choose the nurse participants provided that they meet the inclusion criteria of the study.

Inclusion criteria for prospective respondents were:

- Registered by the South African Nursing Council (SANC) with an additional qualification in intensive care nursing;
- Registered professional nurse with more than six months of clinical experience in the selected unit; and
- Provided written informed consent was obtained.

Exclusion criterion included staff nurses and auxiliary nurses as their sub-professional category of nurses are not expected to have the skills and in-depth knowledge of evidence-based practice regarding endotracheal suctioning.

3.4.3 Data Collection Instrument

A self-administered structured questionnaire developed by Jordan (2011) identified in literature was used to achieve the study objectives. Five local domain experts, e.g. medical specialists (n=2) and intensive care registered and nurse education experts (n=3) have done verification of the questionnaire for it to be applicable in the local study context.

The self-administered structured questionnaire contains two sections (**Appendix A)**. The first section collects demographic data; section two employs constant, dichotomous, discrete and continuous variables. The second section consisted of 27 questions to assess nurses' knowledge towards ETT suctioning, which included frequency of suctioning, prior to and post assessment of patients, size of suction catheter, pre-oxygenation, hyperventilation, saline installation and closed versus open suctioning. Different questioning techniques were used: 1) Closed-ended questions: respondents could select from a fixed number of responses. 2) Scales – i.e. Likert scale: the respondent's agreement or disagreement was given a numerical value using continuous scales. Constant, dichotomous and discrete questions were worded positively and negatively to reduce the chances of responses by rote. Whereas, continuous variables are scored on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) with a middle value 3 (neither agree nor disagree). In this study, knowledge will be considered to be adequate with a score of at least 70% (Perrie, Schmollgruber, Bruce, *et al.* 2014).

After consultation with the statistician and supervisor, one open-ended questions was added at the end of the questionnaire to allow intensive care nurse respondents to comment on any issue relating to the study aims.

3.4.4 Pre-Testing

A small pre-testing procedure was conducted before the main study commenced. The purpose of a pre-test is to help to identify if the respondents understand the questionnaire, to see if any questions may be misinterpreted and to clarify if the methods, sample and

instruments are adequate and appropriate (Grove, Burns & Gray, 2013; Tabane, Ma, Chu *et al.*, 2010).

In this study, the pre-test was conducted with five (n = 5) respondents. These were nurses working in a 'private' intensive care unit at the selected study site. Participating nurses found the instrument easy to understand and it took about 15 minutes to complete the questionnaire. No changes were made to the questionnaire after the pre-testing procedure.

3.4.5 Data Collection Process

Permission was requested from management from the hospital in which the research study took place; a letter of permission to conduction the study attained from the institution was used. Following granting of permission, unit managers were asked for permission to perform the research study at the chosen units was informed about the research purpose and objectives. Confidentiality of data and anonymity were assured, and participation was voluntary. Nurses were informed that they could refuse to participate, decline to answer a question or discontinue their participation in the study at any time. Information letters were given to participants, and they were requested to sign a consent form (refer to **Appendices B & C**). The data collection questionnaire was given to the nurses who consented to participate in the study (refer to **Appendix A**).

The researcher collected data by administering questionnaires to day shift and night shift during weekdays and weekends. The unit managers in the respective intensive care units also assisted in distributing questionnaires to nurses who were willing to participate in the study. The identities of the participants was protected, as their names were not revealed on the

questionnaires. Completed questionnaires were placed into sealed envelopes by the respondents and collected by the researcher from each unit.

3.4.6 Data Analysis

Descriptive and inferential statistics were used to synthesise and describe intensive care nurses' knowledge of evidence-based guidelines on endotracheal suctioning for the adult intubated patient and draw conclusions about the population. In this study, knowledge will be considered to be adequate with a score of at least 70% (Perrie, Schmollgruber, Bruce, *et al*. 2014).

Descriptive statistics were used to calculate measures of central tendency for instance means and standard deviation and frequency distribution. Figures and tables were used to enhance the interpretation of the respondent and categorical data. The total knowledge score was calculated based on the number of correct responses and converted to percentages. A one-way analysis of variance (ANOVA) was used to determine differences in the total knowledge scores on the questionnaire schedules based on the participants' demographic data. A multivariable logistic regression model was fitted to determine whether there was an association between respondents age, years of experience and qualification and knowledge levels Testing was done on the 0.05 ($p<0.05$) level of significance. The statistical software STATISTICA^{TM} version 13.2 was used to analyse the data. Statistical assistance was obtained from a statistician from the research office of the Faculty of Health Sciences.

3.5 ETHICAL CONSIDERATIONS

Ethics are concerned with values and principles that highlight what is wrong and what is right or what is good or bad to a human being when performing research study. All researcher acts and actions should abide by the set norms, standards and values (Grove, Burns & Gray, 2013). Ethical considerations will be discussed under the following headings: informed consent, permission to conduct research, confidentiality and anonymity and data management.

3.5.1 Informed Consent

The process of informed and voluntary consent entails notifying prospective subjects of the research study of the content of the study and allowing the prospective subject to decide freely to participate in the study out of his or her free will without being forced to participate (Grove, Burns & Gray, 2013).

For this study, respondents were informed that participation in the study is voluntary and they can refuse to respond to any questions or terminate involvement in the study at any given time without experiencing penalty. Before inclusion into the study, a written informed consent was obtained from all the respondents (refer **Appendices B & C**).

3.5.2 Permission to Conduct Research

Prior to conducting a research study a researcher is required to submit their study protocol to the institutional review board, which is a committee that ensures that the researcher conducts the procedures of their research in an ethical manner (Grove, Burns & Gray, 2013).

In this study, protocols were submitted to the Department of Nursing Education for peer review to assess the feasibility of the study. The research protocol and procedures were submitted to the University Postgraduate Committee for permission to perform the research study (refer to **Appendix F**). Clearance to conduct research was obtained from the Research Committee on Human Subjects (Medical) of the University of the Witwatersrand (refer **Appendix D**). Permission to conduct the study was obtained from Hospital management on behalf of the Gauteng Department of Health (refer to **Appendix E**).

3.5.3 Confidentiality and Anonymity

Confidentiality is the obligation to maintain specific information in strict confidence and cannot share with others without subject permission (Grove, Burns & Gray, 2013; Marquis & Huston, 2009). Anonymity is an act of keeping respondents nameless in the study and this was achieved by keeping the master list of respondents names and matching codes in separate locations, under lock and key, after providing each respondent with a number for the code name, destroying the list of actual names, and using code names when discussing the data (Grove, Burns & Gray, 2013; Marquis & Huston, 2009).

Confidentiality and anonymity were achieved in this study as the respondent's names were not utilised during data collection and reporting. The researcher applied study generated codes and only the researcher and the supervisor had access to the raw data.

3.5.4 Data Management and Security

Management of all research material was ensured by safekeeping in a locked up private place by the research supervisor at the university. A backup copy is available and kept on the computer. Access to backup is only through a password, which is available to the researcher and supervisor. After six years, the stored data will be destroyed by shredding hard copy documents and permanently deleting all electronic data from the computer and backup hard drives.

3.6 VALIDITY AND RELIABILITY OF THE STUDY

Validity refers to an instrument that determines the extent to which it reflects or can measure the construct being examined (Grove, Burns & Gray, 2013: 393).

Reliability refers to the consistency of measure achieved, its purpose is the indication of the extent of random error in the measurement method (Botma, Greef, Mulaudzi *et al.*, 2010). According to Grove, Burns and Gray (2013) reliability is referred to as an instrument that denotes the consistency of the measures obtained of an attribute, item or situation in a study or clinical practice (Grove, Burns & Gray, 2013: 389)

A small pre-testing procedure was performed to ensure the feasibility of the study and detect possible flaws in the instrument used. Reliability was sustained by emphasising constant and correct data recording. Data collection was performed only by the researcher. The suitable sample size was discussed with a statistician to ensure representation of the population of the study taking into account the consideration of possible refusal to participate.

A validated questionnaire developed by Jordan (2011) was used in this study. Also, face and content validity were ensured before the commencement of the study by the use of five (n=5) local domain specialists, e.g. medical (n=2) and intensive care registered and nurse education experts (n=3) who reviewed the relevance of the instrument content for the local study setting. This was deemed necessary because treatment standards and practices can vary between intensive care units.

3.7 SUMMARY

In this chapter, the research methods of the study have been described. The research design was selected to meet the study's purpose and objectives appropriately. A detailed description was given of the questionnaire used for data collection. A small pre-testing procedure was conducted at the main study site using the questionnaire schedule. A small pre-testing procedure was conducted at the main study site using the questionnaire schedule. The questionnaire used met the study objectives.

The following chapter presents data analysis and research findings.

CHAPTER FOUR

RESULTS AND FINDINGS

4.1 INTRODUCTION

This chapter presents the results and findings of the study, with the intention of describing intensive care nurses' knowledge on current evidence-based guidelines for ETT suctioning. This was achieved within a non-experimental, quantitative, descriptive and cross-sectional design. The population included intensive care nurses working in adult intensive care units at the selected study site. A sample size of 80 (n = 80) was obtained by means of convenience sampling. Data was collected by means of a structured questionnaire (Appendix A). The data files were entered manually in an excel spreadsheet. The data management process included: checking for errors in recording, missing values and duplicates. Data was analysed by means of descriptive and inferential statistics. Statistical tests included ANOVA, t-tests and Multivariable logistical regressions. Testing was done on the 5% ($p<0.05$) levels of significance.

4.2 APPROACH TO DATA ANALYSIS

All demographic variables were categorical and were described as frequencies and percentages. From the 27 questions on knowledge of current evidence-based guidelines for ETT suctioning in intensive care units, a total score was calculated based on the number of correct answers and converted into a percentage.

The total scores for knowledge on current evidence-based guidelines on endotracheal suctioning in intensive care units were assessed for normality and described as a mean and standard deviation (SD).

To compare the total score on knowledge on current evidence-based guidelines on ETT suctioning in intensive care units based on demographic data, an analysis of variance (ANOVA) test was used in instances where the demographic variable had three or more categories (e.g. age and years of experience). In instances where the demographic variable had two categories (e.g. gender and qualification), a t-test was computed.

Lastly to assess the association between qualification, years of experience and knowledge of nurses (trained and non-trained) on evidence-based guidelines of endotracheal suctioning, a multivariable linear regression model was fitted adjusting for the gender and age of the ICU nurses. In the linear regression model, baseline categories were selected based on having the highest proportion of ICU nurses.

Testing was done at the 5% ($p<0.05$) level of significance. The statistical software STATISTICA^{TM} version 13.2 was used to analyse the data. The data analysis was verified by a biomedical statistician from the research office of the Faculty of Health Sciences.

4.3 RESULTS

4.3.1 Demographic data

This section related to respondent demographic data, which comprises four (4) items. Items included were: gender, age, qualifications and years of ICU experience Results of this process are summarised in table 4.1.

Table 4.1 Frequencies obtained for demographic data

Categorical variables	Frequency	Percentage
Gender (n = 79)		
Male	13	16.3%
Female	67	**83.8%**
Age (n = 78)		
25 to 29 years	7	8.8%
30 to 39 years	26	**32.5%**
40 to 49 years	15	18.8%
50 to 59 years	32	**40.0%**
Years of ICU experience (n = 79)		
>1 year	7	8.8%
>1 to 5 years	24	30.0%
6 to 10 years	25	**31.3%**
>10 to 15 years	18	22.5%
>15 years	6	7.5%
Additional qualification		
Not intensive care trained	23	28.8%
Intensive care trained	57	**71.3%**

In this study, females accounted for 83.8% (n = 67) and 16.3% (n = 13) were males. The largest group of the respondents (40.0%; n = 32) were aged between 50 to 59 years, followed

by 32.5% (n = 26) in the age categories 30 to 39 years. The majority (71.3%; n = 57) of the respondents were intensive care trained nurses. The largest group of respondents (31.3%; n = 25) had from 6 to 10 years of ICU experience, followed by 30.0%% (n = 24) and 22.5% (n = 11) in the >1 to 5 years and 6 to 10 years of experience, respectively.

4.3.2 Endotracheal tube (ETT) suctioning questionnaire

This section related to the nurses' responses on the questionnaire, which included 27 items (refer **Appendix A**). Each of the items are discussed separately.

4.3.2.1 Frequency of ETT suctioning

Question 1 focused on the frequency of ETT suctioning. The respondents were presented with a statement, which stated: *"How often do you perform ETT suctioning in the mechanically ventilated patient",* where they had to select their responses from a list of five possible responses. **Figure 4.1** displays the results obtained.

- 78.8% (n = 63) of the respondents indicated that they would only suction the patient when necessary, which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 1.3% (n = 1) perform suctioning at 1 to 2 hour intervals.
- 15.0% (n = 12) every 4 hours
- 2.5% (n = 2) every 6 hours
- 2.5% (n = 2) every 12 hours

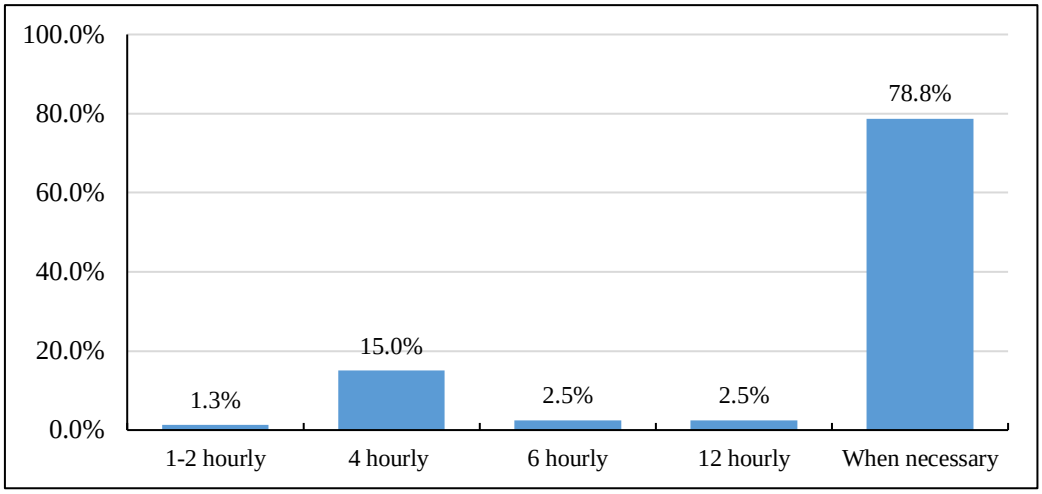

Figure 4.1 Frequency for ETT suctioning

4.3.2.2 Indications for ETT suctioning

Question 2 focused on indications for ETT suctioning. The respondents were presented with a statement, which stated: *"When do you perform ETT suctioning in the mechanically ventilated patient*", where they had to select their responses from a list of five possible responses. **Figure 4.2** displays the results obtained.

- 88.8% (n = 71) of the respondents indicated agreement with all the above responses, which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 7.5% (n = 6) visible or audible secretions
- 1.3% (n = 1) if desaturation occurs
- 2.5% (n = 2) increase in airway pressure

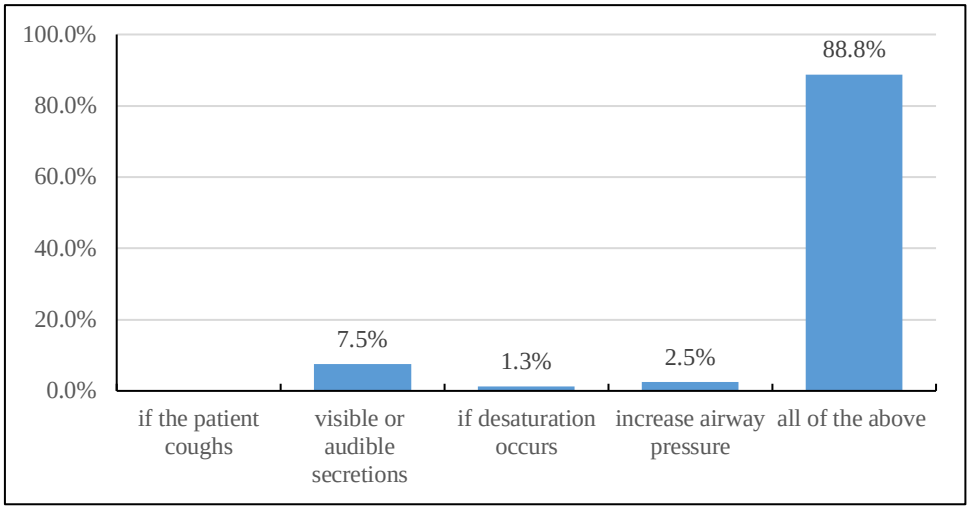

Figure 4.2 Indications for ETT suctioning

4.3.2.3 Suction catheter size

Question 3 focused on suction catheter size. The respondents were presented with a statement, which stated: *The external diameter of the suction catheter should be half the amount of the internal diameter of the ET tube*", where they had to select responses from a list of five possible responses. **Figure 4.3** displays the results obtained.

- 25.3% (n = 20) of the respondents agreed strongly that the external diameter of the suction catheter should be half the amount of the internal diameter of the ETT tube, which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 58.2% (n = 46) agreed
- 7.6% (n = 6) neither agreed nor disagreed
- 6.3% (n = 5) disagreed
- 2.5% (n = 2) strongly disagreed

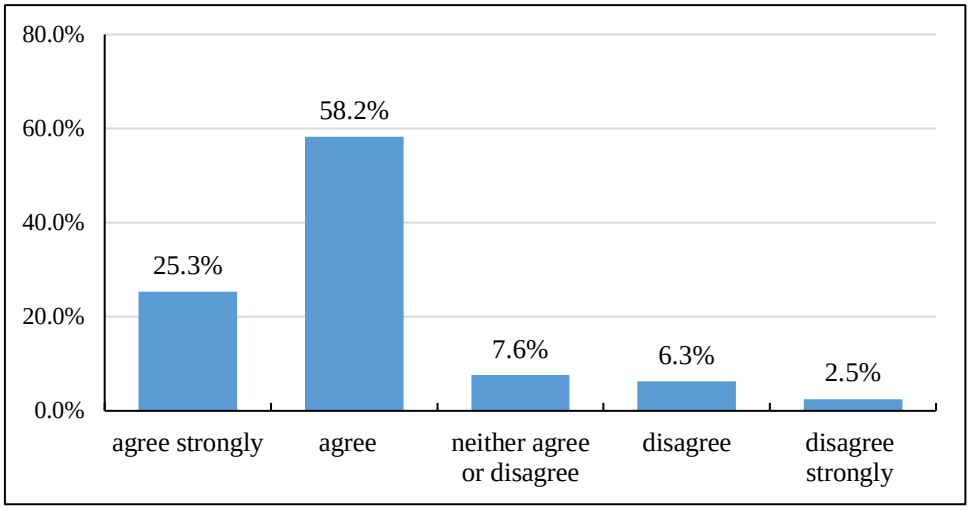

Figure 4.3 Suction catheter size

4.3.2.4 Respiratory assessment before suctioning

Question 4 focused on respiratory assessment before suctioning. The respondents were presented with a statement, which stated: "*Do you perform a respiratory assessment prior to ETT suctioning",* where they had to select their responses from a list of two possible responses. **Figure 4.4** displays results obtained.

- 100.0% (n = 80) of the respondents indicated that they performed a respiratory assessment before ETT suctioning, which is the correct response.

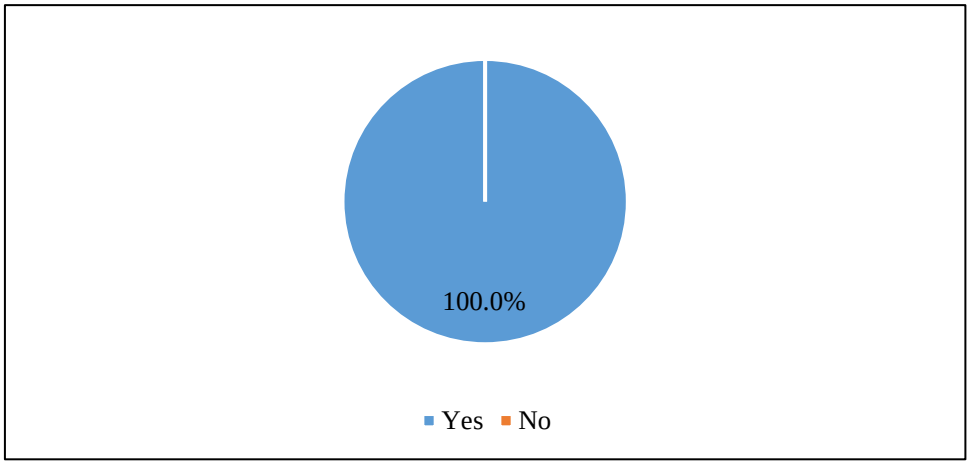

Figure 4.4 Respiratory assessment before ETT suctioning

4.3.2.5 Respiratory assessment findings

Question 5 focused on respiratory assessment findings. The respondents were presented with a statement, which stated: "*If you answered yes to question 4, which of the following assessment findings will indicate that your patient needs suctioning",* where they had to select their responses from a list of four possible responses. **Figure 4.5** displays results obtained.

- 34.2% (n = 27) of the respondents indicated the presence of rhonchi indicated that ETT suctioning was needed, which is the correct response.
- 57.0% (n = 45) stated the presence of crackles indicated that ETT suctioning was needed, which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 8.9% (n = 7) stated the presence of wheezes indicated that ETT suctioning is needed

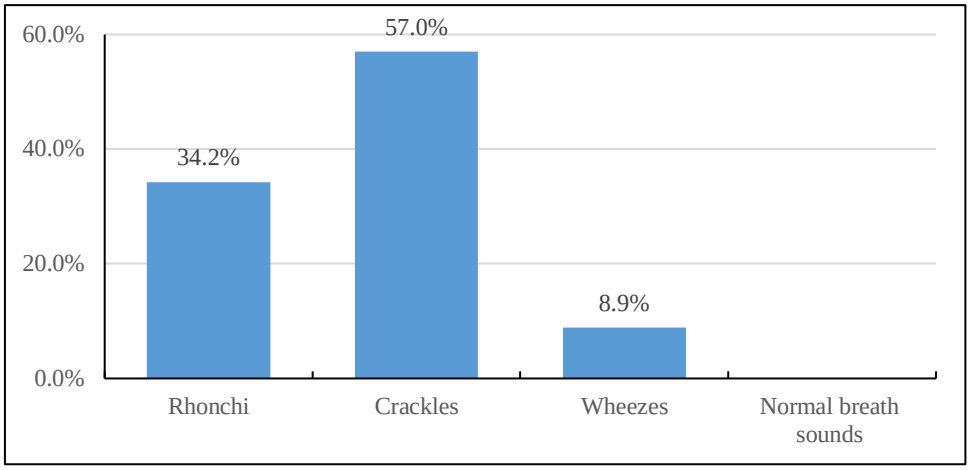

Figure 4.5 Respiratory assessment findings

4.3.2.6 Position of the patient

Question 6 focused on the position of the patient. The respondents were presented with a statement, which stated: *"How would you position the patient prior to performing ETT suctioning",* where they had to select their responses from a list of three possible responses. **Figure 4.6** displays results obtained.

- 86.1% (n = 68) of the respondents indicated the patient would be placed in a semi-fowlers position prior to ETT suctioning, which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 7.6% (n = 6) high fowlers
- 6.3% (n = 5) supine

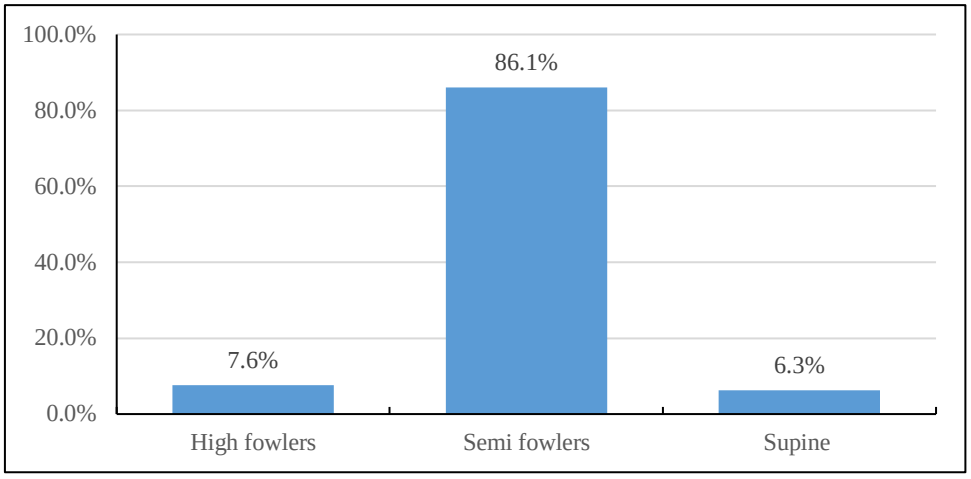

Figure 4.6 Positioning patient prior ETT suctioning

4.3.2.7 Suction pressure

Question 7 focused on suction pressure. The respondents were presented with a statement, which stated: *"What suction pressure do you use when performing ETT suctioning",* where they had to select their responses from a list of five possible responses. **Figure 4.7** displays results obtained.

- 67.9% (n = 53) of the respondents indicated the suction pressure of 80 to 120 mmHg would be used when performing ETT suctioning, which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 20.5% (n = 16) 150 to 180 mmHg
- 2.6% (n = 2) 200 mmHg
- 1.3% (n = 1) 250 mmHg
- 7.7% (n = 6) 300 mmHg

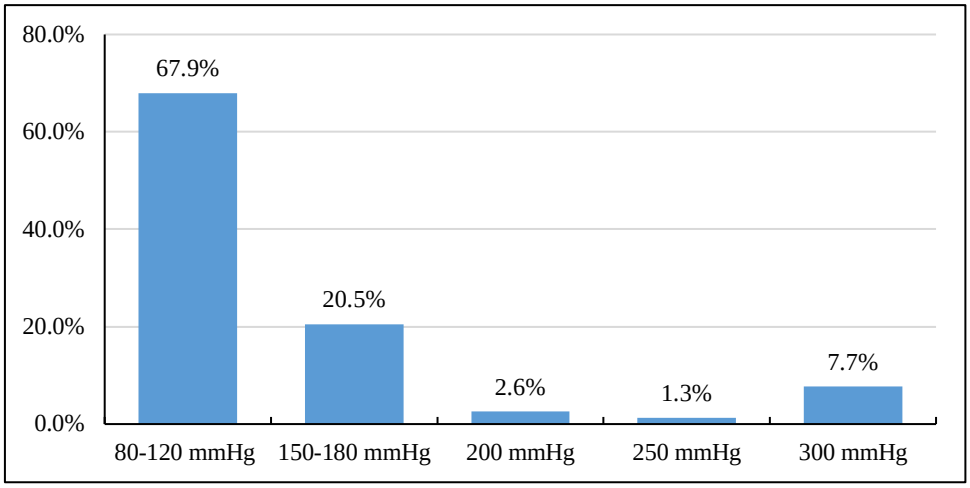

Figure 4.7 Suction pressure

4.3.2.8 Hyper oxygenation

Question 8 focused on hyper oxygenation. The respondents were presented with a statement, which stated: "*Do you hyper oxygenate your patient prior to ETT suctioning*", where they had to select their responses from a list of two possible responses. **Figure 4.8** displays results obtained.

- 100.0% (n = 80) of the respondents indicated that they hyper oxygenated the patient prior to ETT suctioning, which is the correct response.

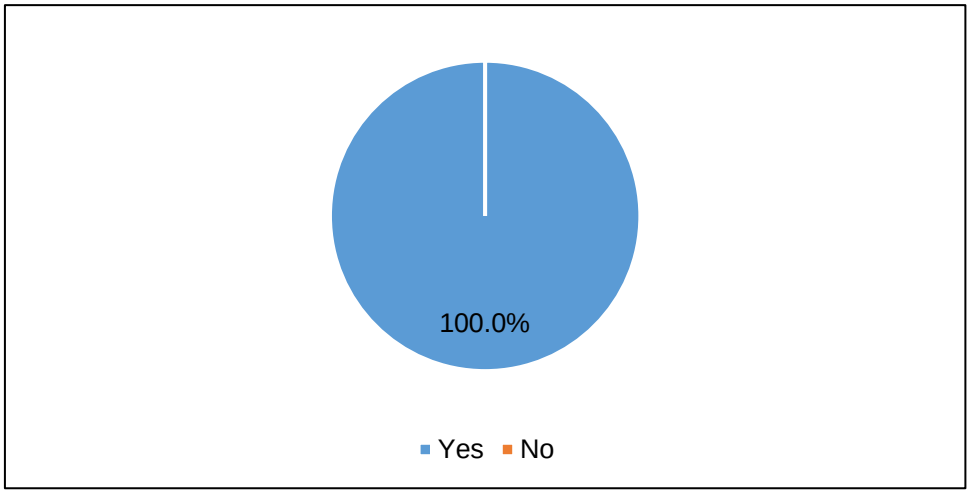

Figure 4.8 Hyper oxygenation prior to ETT suctioning

4.3.2.9 Percentage of oxygen for hyper oxygenation

Question 9 focused on percentage of oxygen used for hyper oxygenation. The respondents were presented with a statement, which stated: *"If you answered yes to question 8, indicate what percentage of oxygen you use",* where they had to select their responses from a list of four possible responses. **Figure 4.9** displays results obtained.

- 100.0% (n = 80) of the respondents indicated the percentage of oxygen used for hyper oxygenation was 100% for at least 30 seconds, which is the correct response.

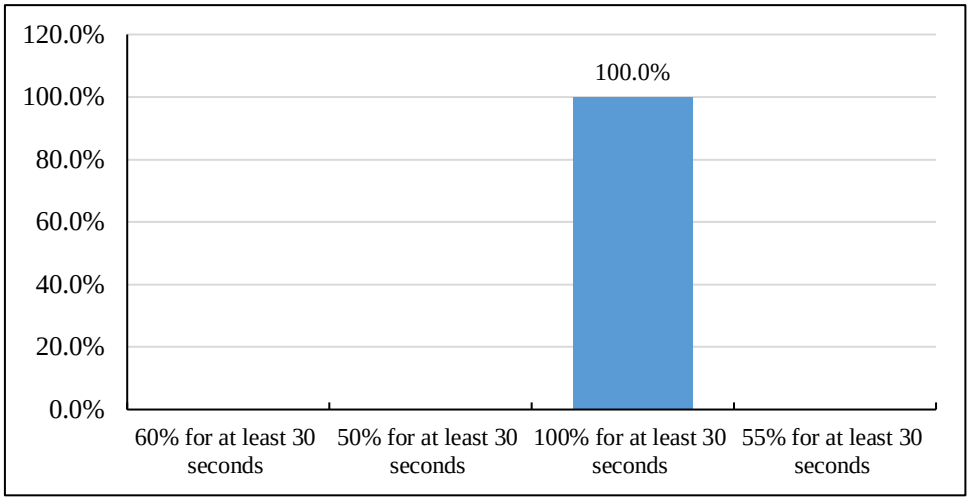

Figure 4.9 Percentage of oxygen for hyper-oxygenation

4.3.2.10 Indications for hyper oxygenation

Question 10 focused on indications for hyper oxygenation. The respondents were presented with a statement, which stated: "*Hyper oxygenation is performed to minimize hypoxia and related complications induced by ETT suctioning",* where they had to select their responses from a list of five possible responses. **Figure 4.10** displays results obtained.

- 52.5% (n = 42) of the respondents agreed strongly that hyper oxygenation minimise hypoxia and related complications, which is the correct response.
- 47.5% (n = 38) of the respondents agreed that hyper oxygenation minimise hypoxia and related complications, which is the correct response.

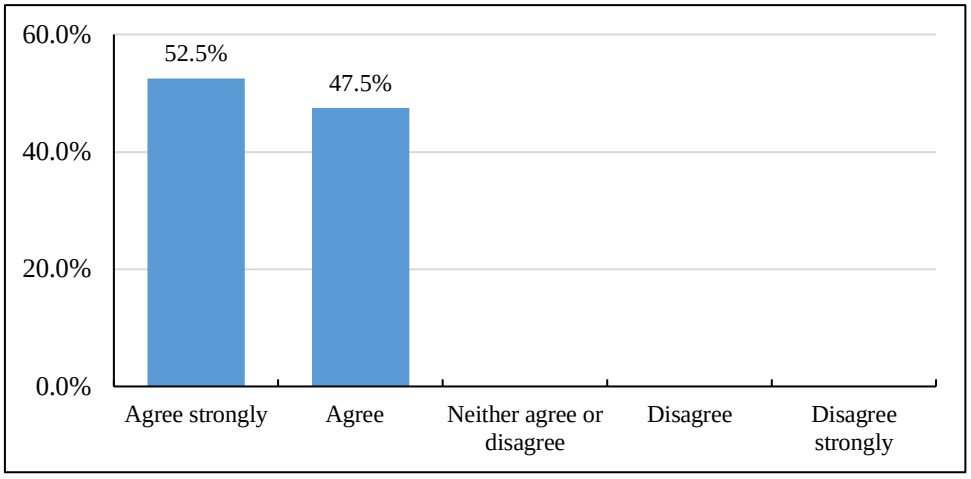

Figure 4.10 Indications for hyper-oxygenation

4.3.2.11 Hyper-inflation

Question 11 focused on hyper-inflation. The respondents were presented with a statement, which stated: "*Do you practice hyper-inflation prior to ETT suctioning*", where they had to select their responses from a list of two possible responses. **Figure 4.11** displays results obtained.

- 61.3% (n = 49) of the respondents indicated that they practiced hyper-inflation prior to ETT suctioning, which was the correct response.

The remaining respondents indicated the following incorrect responses:

- 38.8% (n = 31) of the respondents did not practice hyper-inflation prior to ETT suctioning.

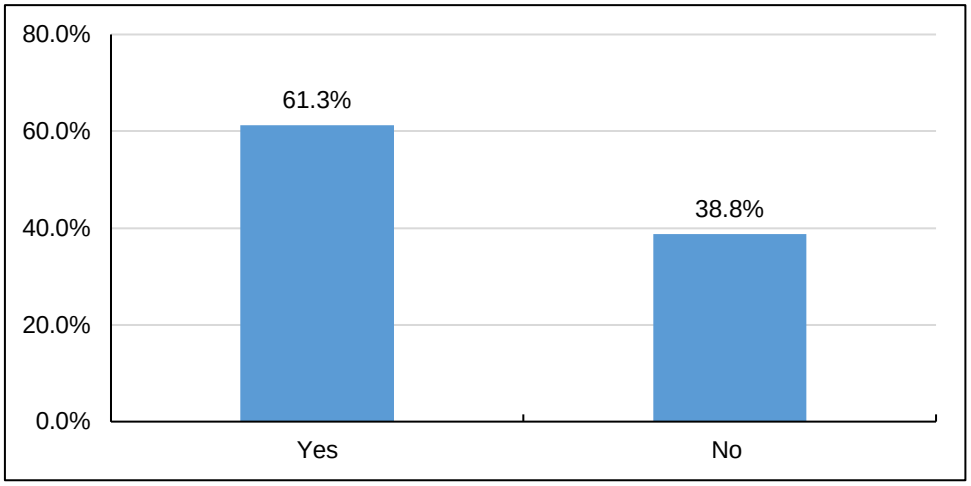

Figure 4.11 Use of hyperinflation prior to ETT suctioning

4.3.2.12 Methods for hyperinflation

Question 12 focused on methods for hyper-inflation. The respondents were presented with a statement, which stated: "*If you answered yes to question 11, indicate what method you use for hyperinflation",* where they had to select their responses from a list of two possible responses. **Figure 4.12** displays results obtained.

- 15.0% (n = 15) of the respondents indicated they performed hyper-inflation manually with the ventilator, which is the correct answer.

The remaining respondents indicated the following incorrect responses:

- 80.0% (n = 64) performed hyper-inflation manually with an ambubag.

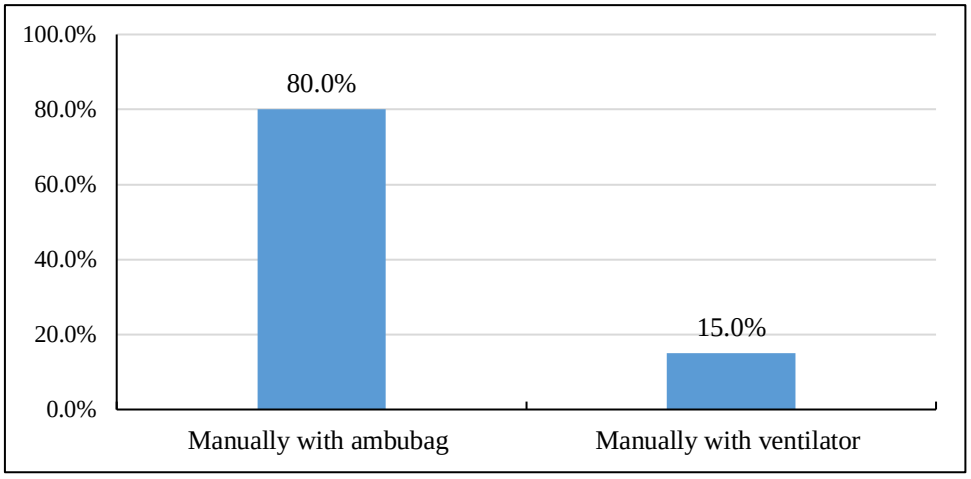

Figure 4.12 Methods used for hyperinflation

4.3.2.13 Indications for saline instillation

Question 13 focused on indications for saline instillation. The respondents were presented with a statement, which stated: *"Saline instillation loosens the secretions prior to ETT suctioning",* where they had to select their responses from a list of two possible responses. **Figure 4.13** displays results obtained.

- 7.5% (n = 6) strongly disagreed that normal saline instillation thins secretions prior to ETT suctioning.

The remaining respondents indicated the following incorrect responses:

- 27.5% (n = 22) strongly agreed
- 58.8% (n = 47) agreed
- 3.8% (n = 3) neither agreed or disagreed
- 2.5% (n = 2) disagreed

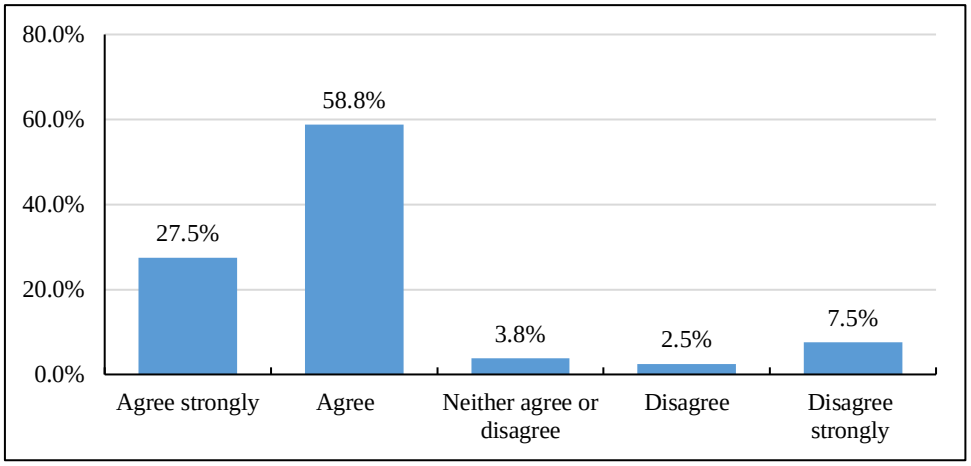

Figure 4.13 Indication for normal saline instillation prior to ETT suctioning

4.3.2.14 Normal saline instillation

Question 14 focused on normal saline instillation. The respondents were presented with a statement, which stated*: "Do you instil normal saline when performing ETT suctioning",* where they had to select their responses from a list of two possible responses. **Figure 4.14** displays results obtained.

- 10.0% (n = 8) of the respondents indicated that they did not instil normal saline when performing ETT suctioning, which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 90.0% (n = 72) of respondents indicated that they instilled normal saline when performing ETT suctioning.

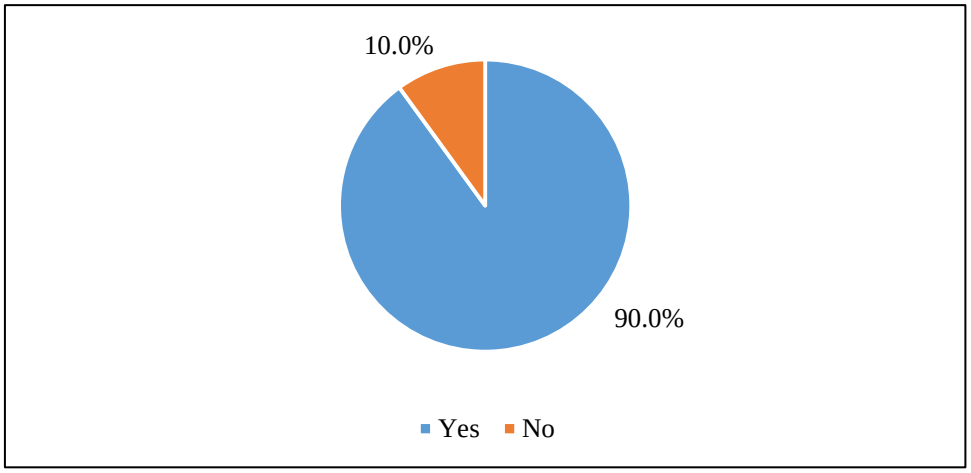

Figure 4.14 Installation of normal saline when performing ETT suctioning

4.3.2.15 Amount of saline

Question 15 focused on the amount of normal saline. The respondents were presented with a statement, which stated: *"How much normal saline do you instil",* where they had the option of an open-ended response. Five (n = 5; 6.3%) respondents omitted responses to this item. **Figure 4.15** displays results obtained.

Five respondents omitted responses to this item. The remaining respondents (n = 75) indicated the following incorrect responses:

- 17.5% (n = 14) 2mls
- 32.5% (n = 26) 3mls
- 35.0% (n = 28) 5mls
- 6.3% (n = 5) 5 to 10mls
- 2.5% (n = 2) >10mls

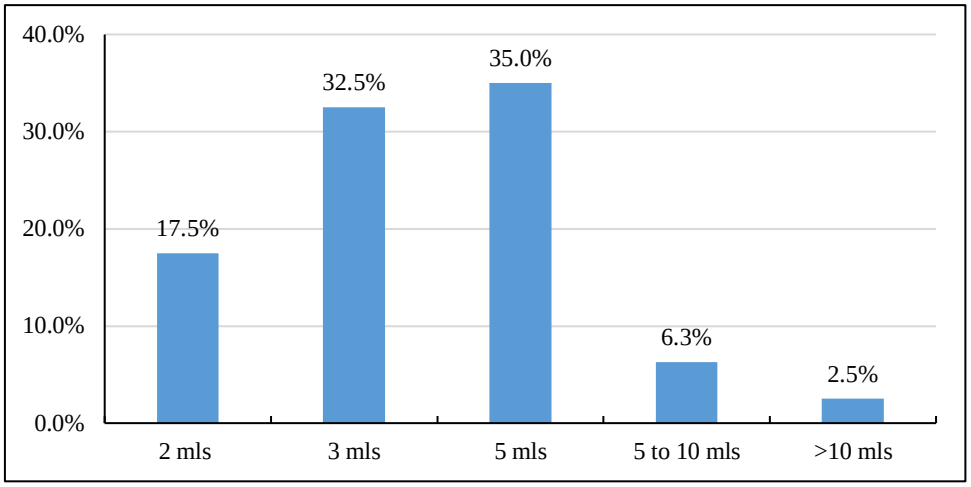

Figure 4.15 Amount of normal saline instilled when performing ETT suctioning

4.3.2.16 Timing of saline instillation

Question 16 focused on the timing of saline instillation. The respondents were presented with a statement, which stated: *"When do you instil the normal saline",* where they had to select their responses from a list of three possible responses. **Figure 4.16** displays results obtained.

All the respondents (n = 80) indicated the following incorrect responses:

- 20.0% (n = 16) instilled normal saline prior to ETT suctioning
- 77.5% (n = 62) during ETT suctioning
- 2.5% (n = 2) post ETT suctioning

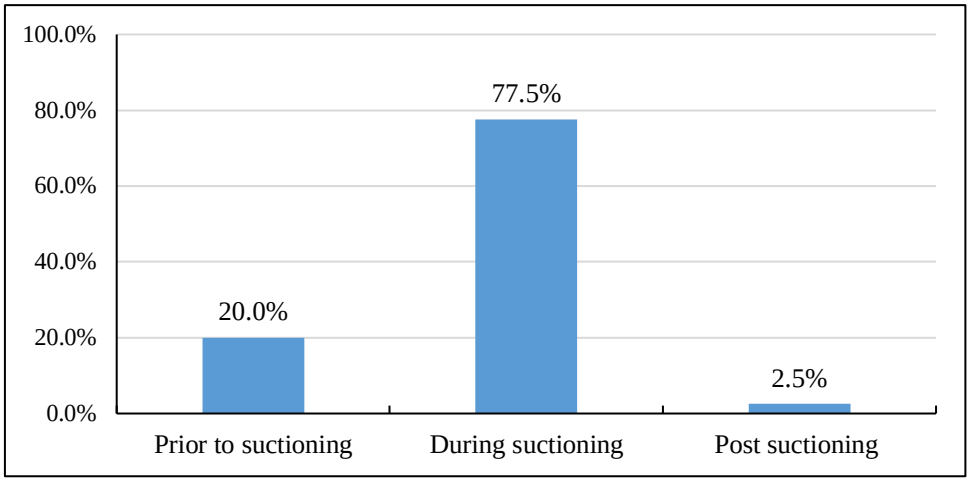

Figure 4.16 Timing of saline instillation

4.3.2.17 Adverse effects of saline instillation

Question 17 focused on the adverse effects of saline. The respondents were presented with a statement, which stated: "*Normal saline instillation have adverse effects e.g. bronchoconstriction, decreased saturation and excessive fluid volume in the mechanically ventilated patient"*, where they had to select their responses from a list of two possible responses. **Figure 4.17** displays results obtained.

- 71.3% (n = 57) of the respondents agreed that instillation of normal saline has adverse effects in the mechanically ventilated patient, which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 28.8% (n = 23) respondents disagreed that normal saline instillation has adverse effects in the mechanically ventilated patient.

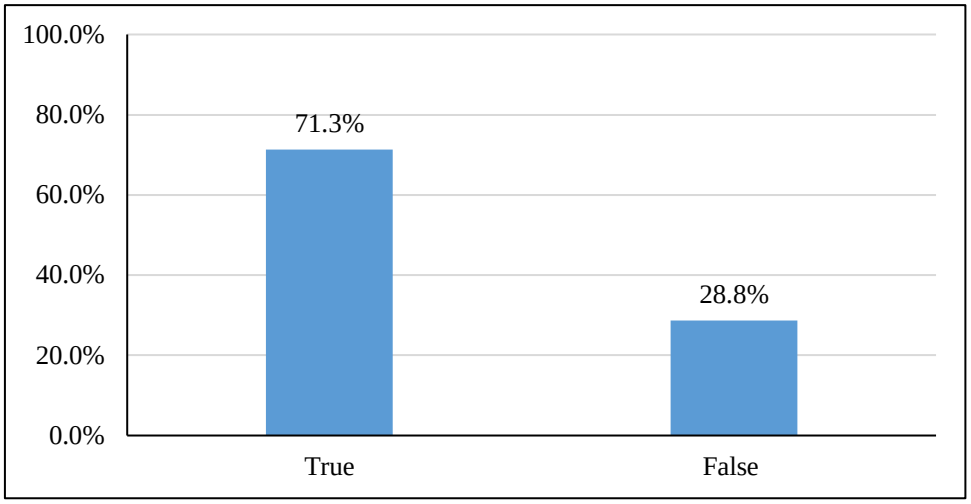

Figure 4.17 Adverse effects of normal saline instillation

4.3.2.18 Hand hygiene

Question 18 focused on hand hygiene. The respondents were presented with a statement, which stated: *"When do you wash/spray your hands in performing ETT suctioning",* where they had to select their responses from a list of four possible responses. **Figure 4.18** displays results obtained.

- 92.5% (n = 74) of the respondents indicated that they wash/spray hands before and after ETT suctioning, which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 7.5% (n = 6) prior to ETT suctioning

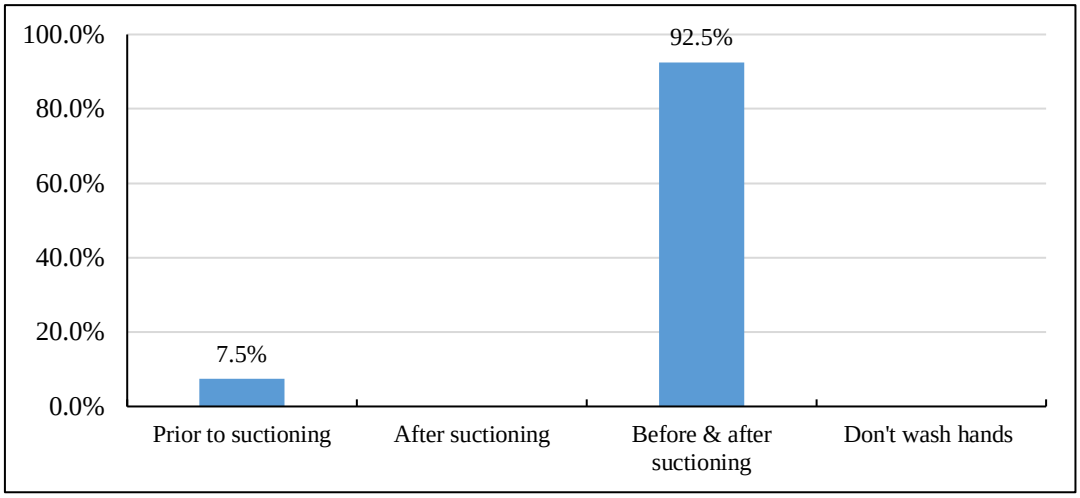

Figure 4.18 Hand hygiene in performing ETT suctioning

4.3.2.19 Duration of suction

Question 19 focused on duration of suction. The respondents were presented with a statement, which stated: *"Indicate the duration of the suction procedure when performing ETT suctioning in the mechanically ventilated patient",* where they had to select their responses from a list of four possible responses. **Figure 4.19** displays results obtained.

- 65.0% (n = 52) of the respondents indicated the duration of the suction procedure should not exceed 10 seconds, which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 15.0% (n = 12) indicated 18 seconds
- 16.3% (n = 13) 20 seconds
- 3.8% (n = 3) 25 seconds

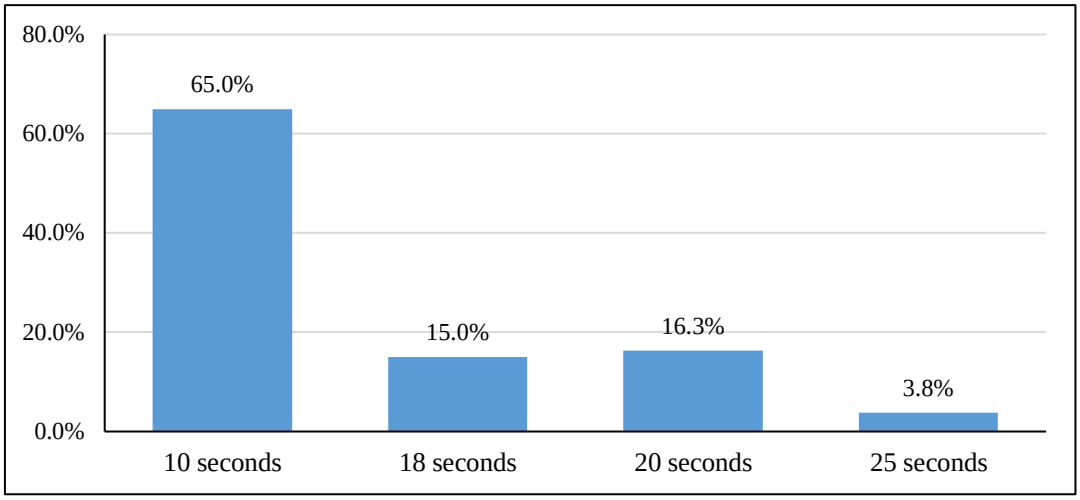

Figure 4.19 Duration of suction procedure

4.3.2.20 Depth of suction catheter

Question 20 focused on depth of suction catheter. The respondents were presented with a statement, which stated: *"How far do you insert the suction catheter when performing ETT suctioning",* where they had to select their responses from a list of four possible responses. **Figure 4.20** displays results obtained.

- 27.5% (n = 22) of the respondents indicated the depth of suction catheter insertion to the level of the carina, which is the correct response.

The remaining respondents

- 25.0% (n = 30) until resistance is felt
- 41.3% (n = 33) until the patient coughs
- 6.3% (n = 3) past length of endotracheal tube

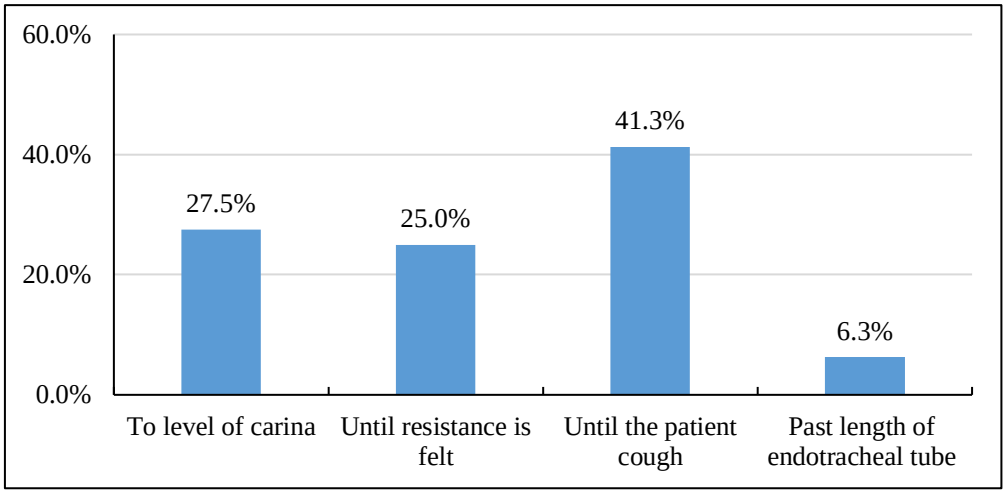

Figure 4.20 Depth of insertion of a suction catheter

4.3.2.21 Adverse effects of ETT suctioning

Question 21 focused on the adverse effects of ETT suctioning. The respondents were presented with a statement, which stated: "*Which of the following complications can occur as a result of ETT suctioning",* where they had to select their responses from a list of six possible responses. **Figure 4.21** displays results obtained.

- 95.5% (n = 76) of the respondents indicated that all the listed complications could occur as a result of ETT suctioning, which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 4.0% (n = 4) indicated hypoxia

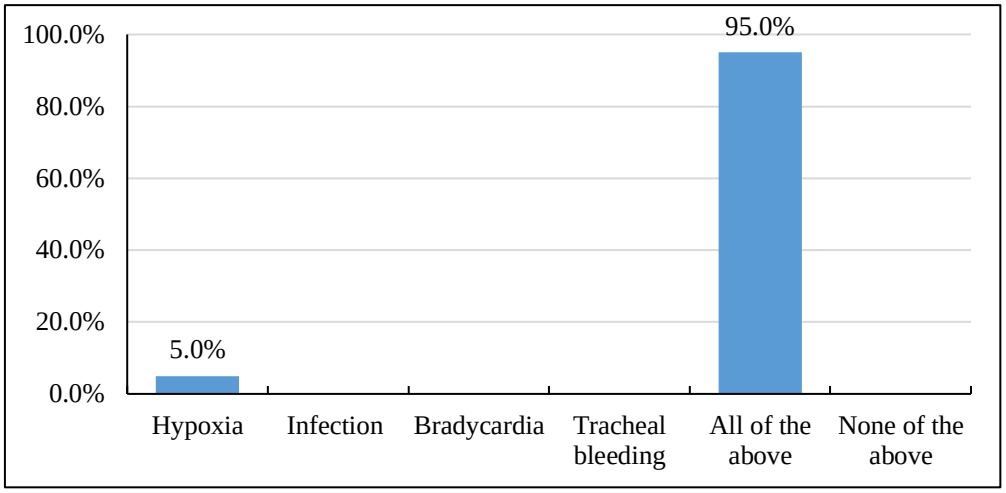

Figure 4.21 Adverse effects of ETT suctioning

4.3.2.22 Respiratory assessment after ETT suctioning

Question 22 focused on respiratory assessment after ETT suctioning. The respondents were presented with a statement, which stated: *"A comprehensive respiratory assessment must be done after performing ETT suctioning and should include chest auscultation",* where they had to select their responses from a list of two possible responses. **Figure 4.22** displays results obtained.

- 100.0% (n = 80) of the respondents indicated they performed a comprehensive respiratory assessment post ETT suctioning, which is the correct response.

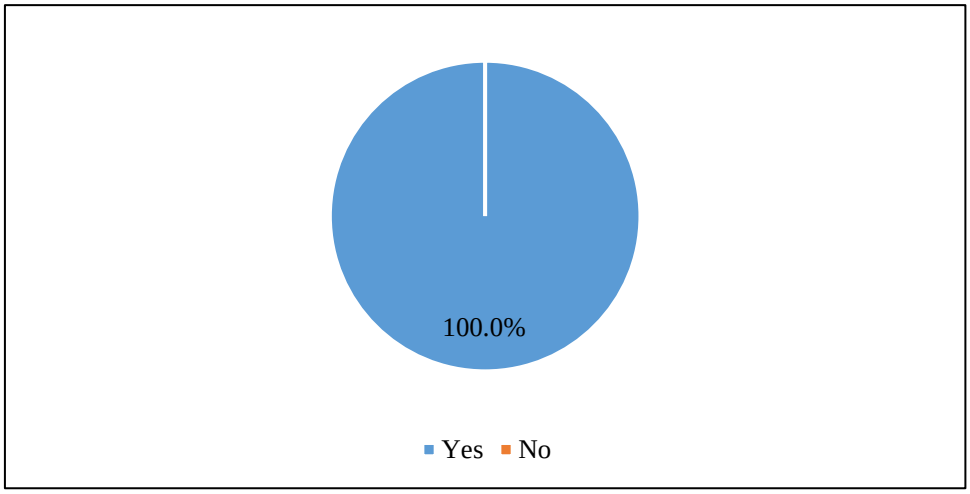

Figure 4.22 Respiratory assessment performed post-ETT suctioning

4.3.2.23 Effectiveness of ETT suctioning

Question 23 focused on the effectiveness of ETT suctioning. The respondents were presented with a statement, which stated: *"To evaluate the effectiveness of the tracheal suctioning, the following must be observed",* where they had to select their responses from a list of five possible responses. **Figure 4.23** displays results obtained.

- 20.3% (n = 16) of the respondents indicated the effectiveness of ETT suctioning is evaluated by all of the above-listed items, which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 68.4% (n = 55) an increase in oxygen saturation
- 1.3% (n = 1) decrease in rhonchi on auscultation
- 1.3% (n = 1) decrease in peak inspiratory pressure
- 8.8% (n = 7) decrease in secretions

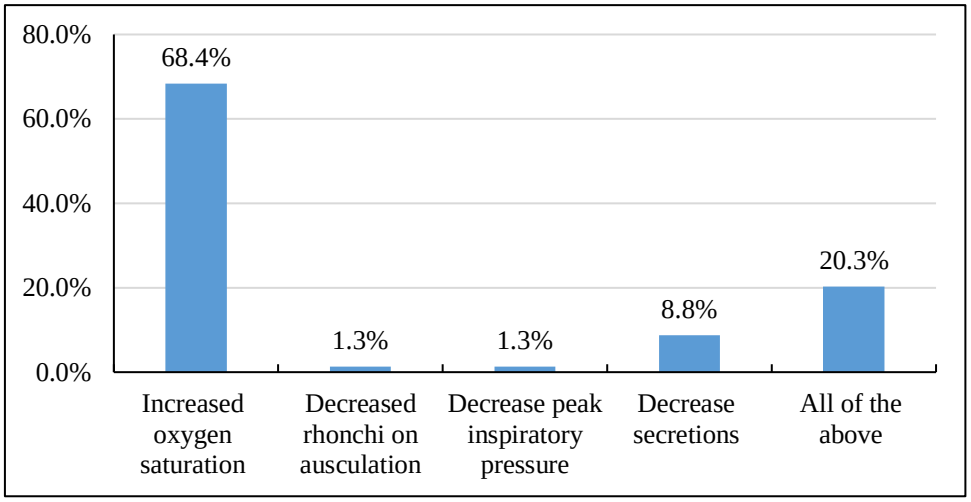

Figure 4.23 Evaluation of the effectiveness of ETT suctioning

4.2.3.24 Institutional guidelines

Question 24 focused on institutional guidelines. The respondents were presented with a statement, which stated: "*Does your unit have an institutional guideline in place on ETT suctioning practices for the mechanically ventilated patient*", where they had to select their responses from a list of two possible responses. **Figure 4.24** displays results obtained.

- 66.3% (n = 53) of the respondents indicated their unit had an institutional guideline in place for ETT suctioning, which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 33.8% (n = 27) stated their unit had not had institutional guidelines in place on ETT suctioning practices

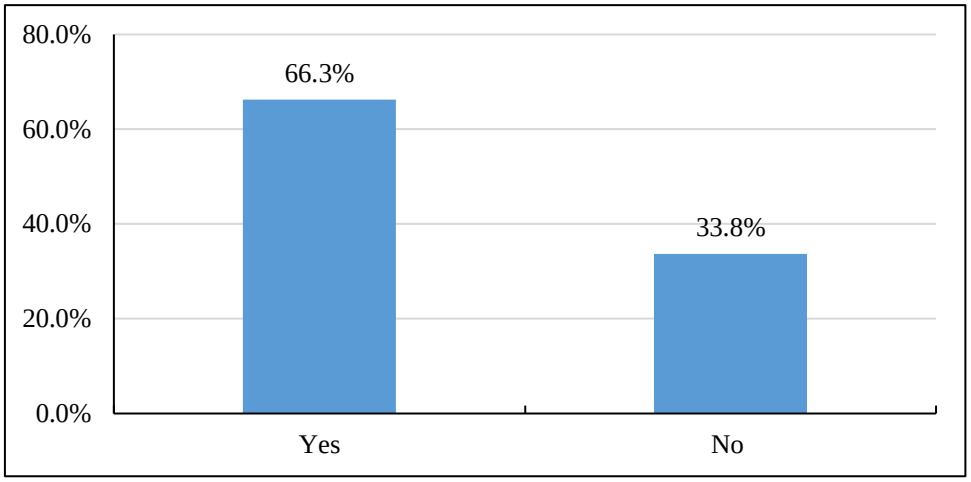

Figure 4.24 Institutional guidelines in place for ETT suctioning practices

4.2.3.25 Developers of institutional guidelines

Question 25 focused on the developers of institutional guidelines. The respondents were presented with a statement, which stated: *"If you answered yes to question 24, indicate who developed the guideline",* where they were given the option of an open-ended response. **Figure 4.25** displays results obtained.

The following responses were obtained from a sample of 50 (n = 50) respondents who responded to this open-ended item:

- 25.6% (n = 20) indicated institutional guidelines were developed by their unit manager.
- 16.7% (n = 13) clinical instructor
- 21.8% (n = 17) collaborative development

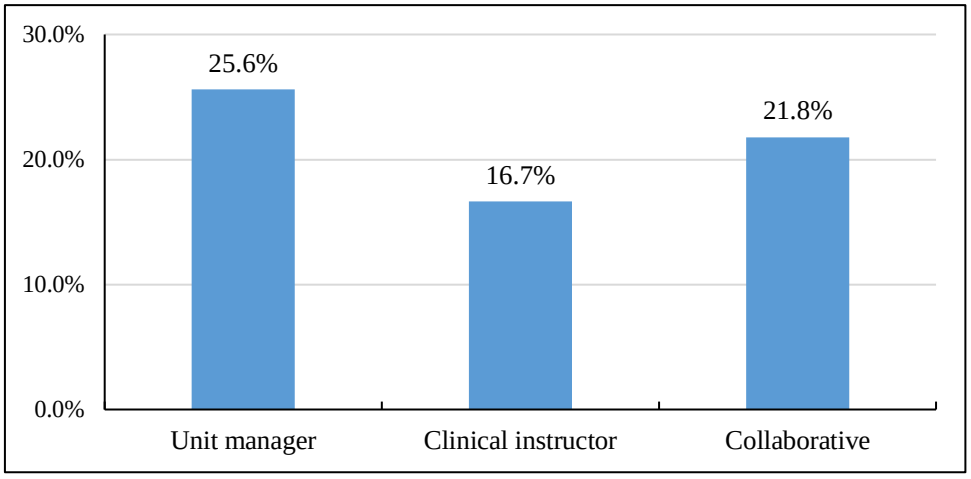

Figure 4.25 Developers of institutional guidelines for ETT suctioning practices

4.3.2.26 Sources used for decision-making choices

Question 26 focused on sources used for decision-making choices. The respondents were presented with a statement, which stated: *"If you answered no to question 24, indicate on what you base your current ETT suctioning practices",* where they had to select their responses from a list of three possible responses. **Figure 4.26** displays results obtained.

The following responses were obtained from a sample of 35 (n = 35) respondents who responded to this item:

- 13.8% (n = 11) indicated their own expertise determined their decision-making choices
- 17.5% (n = 14) informed by the most recent literature
- 12.5% (n = 10) as taught in the unit

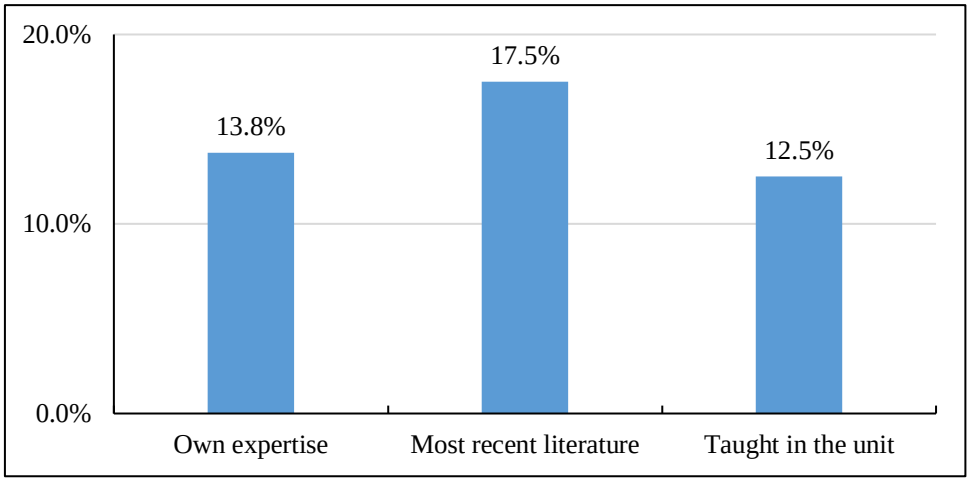

Figure 4.26 Sources used for decision-making choices

4.3.2.27 In-service education

Question 27 focused on in-service education. The respondents were presented with a statement, which stated: *"Would you like to receive in-service education regarding ET tube verification methods in order to ensure the safety of the mechanically ventilated patient*", where they had to select their responses from a list of two possible responses. **Figure 4.27** displays results obtained.

- 96.3% (n = 77) of the respondents indicated that they would like to receive in-service education regarding ETT verification methods
- 3.7% (n = 3) responded in the negative.

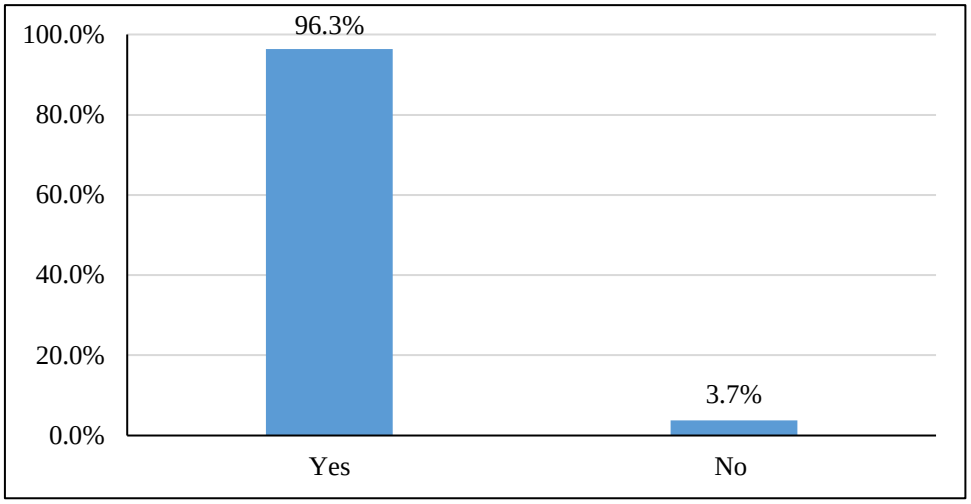

Figure 4.27 In-service education for ETT verification methods

4.3.3 Summary of Results obtained for ETT suctioning

Table 4.2 Summary of results obtained for ETT suctioning

Statements		Correct or best-recommended responses		Incorrect or not best-recommended responses	
		f	%	f	%
1	Frequency of ETT suctioning (n=80)	63	78.8%	17	21.3%
2	Indications for ETT suctioning (n=80)	71	88.8%	9	11.3%
3	Suction catheter size (n=79)	20	25.3%	59	74.6%
4	Performing a respiratory assessment before suctioning (n=80)	80	100.0%	-	-
5	Respiratory assessment findings (n=79)	72	91.1%	7	8.9%
6	Positioning of the patient when performing suctioning (n=79)	68	86.1%	11	13.9%
7	Suction pressure (n=80)	53	67.9%	25	32.1%
8	Hyper-oxygenation (n=80)	80	100.0%	-	-

Table 4.2 continued

Statements		Correct or best-recommended responses		Incorrect or not best-recommended responses	
		f	%	f	%
9	Percentage of oxygen to use for hyper-oxygenation (n=80)	80	100.0%	-	-
10	Indications for hyper-oxygenation	80	100.0%	-	-
11	Hyperinflation (n=80)	49	61.3%	31	38.8%
12	Methods for hyperinflation (n=80)	12	15.0%	64	80.0%
13	Indications for normal saline instillation (n=78)	6	7.5%	74	92.6%
14	Normal saline instillation (n=80)	8	10.0%	72	90.0%
15	Amount of saline instilled (n=80)	-	-	80	100.0%
16	When normal saline is used	-	-	80	100.0%
17	Adverse effects of normal saline instillation (n=80)	57	71.3%	23	28.8%
18	Hand hygiene (n=80)	74	92.5%	6	7.5%
19	Duration of suction procedure (n=80)	52	65.0%	28	35.1%
20	Depth of catheter insertion (n=80)	22	27.5%	66	72.6%
21	Complications of endotracheal suctioning (n=80)	76	95.0%	4	4.0%
22	Performing a respiratory assessment after suctioning (n=80)	80	100.0%	-	-
23	Findings indicating effectiveness of ETT suctioning (n=80)	16	20.3%	64	79.8%
24	Institutional guideline in place for ETT suctioning (n=78)	53	66.3%	27	33.8%
25	Developed by whom (n=50)	17	34.0%	33	66.0%
26	Decision-making choices (n=35)	14	17.5%	21	59.9%
27	In-service education (n=80)	77	96.3%	3	3.8%

Table 4.2 shows the proportions of correct answers by intensive care nurses on knowledge on current evidence-based guidelines on endotracheal suctioning in intensive care units. All the ICU nurses enrolled for the study were *aware* of the guidelines on; when to perform a respiratory assessment, hyper oxygenating patient prior to endotracheal tube suctioning at the correct percentage, when a comprehensive respiratory assessment must be done. The intensive care nurses scored *poorly* on guidelines on whether saline instillation loosens the secretions prior to endotracheal tube suctioning, whether normal saline is instilled when performing endotracheal tube suctioning and the amount of saline instilled, on how far to insert the suction catheter when performing endotracheal tube suctioning and on how to evaluate the effectiveness of the tracheal suctioning, the following must be observed.

4.3.4 Comparison of the Total Score on Knowledge on Demographic Data

The Shapiro Wilk test indicated that the total score percentage of the nurses' knowledge on ETT suctioning was normally distributed (p=0.092) on the mean total score of the nurses enrolled for the study (n = 80) was mean 66.7% and standard deviation was 6.6 with a minimum score of 42.8% and maximum score of 73.9%.

Table 4.3 Average total scores on ICU nurses on knowledge on current evidence-based guidelines on ETT suctioning in intensive care units

Characteristic	Mean (SD)	p-value
Gender		
Male	64.85 (8.62)	0.5082
Female	63.51 (6.22)	
Age		
<25 years	64.59 (6.84)	0.9811
25-30 years	63.51 (6.77)	
31-40 years	63.45 (6.96)	
41-50 years	63.85 (6.60)	
Years in ICU		
>1 year	61.48 (8.85)	0.1679
1-5 years	65.03 (6.84)	
6-10 years	65.75 (5.07)	
10-15 years	62.54 (7.52)	
>15 years	68.84 (3.27)	
Holds additional qualification		
Yes	64.13 (6.41)	0.3985
No	62.74 (7.17)	

The results of the t-test show that there was no significant ($p>0.05$) difference in knowledge on current evidence-based guidelines on endotracheal suctioning in intensive care units based on gender and qualification. The results of the ANOVA test show that there was no significant ($p>0.05$) difference in knowledge on current evidence-based guidelines on endotracheal suctioning in intensive care units based on age and years of experience.

4.3.5 Associations between Qualifications, Years of experience and Knowledge

Table 4.4 Multivariable linear regression results for the association between training (or qualification), years of experience and knowledge on current evidence-based guidelines on ETT suctioning in intensive care units

Characteristic	**Coefficient (95% CI)**	**p-value**
Gender		
Male	1.27 (-3.01-5.47)	0.566
Female	1 (base)	1
Age		
<25 years	0.30 (-5.52-6.12)	0.918
25-30 years	-0.32 (-3.93-3.29)	0.859
31-40 years	-0.47 (-0.488-3.94)	0.833
41-50 years	1 (base)	1
Years in ICU		
>1 year	-3.45 (-9.36-2.46)	0.249
1-5 years	1 (base)	1
6-10 years	-2.21 (-6.9-1.68)	0.261
10-15 years	-2.66 (-6.98-1.64)	0.222
>15 years	-3.62 (-2.66-9.90)	0.254
Additional qualification		
Yes	1 (base)	1
No	-1.20 (-4.61-2.21)	0.484

Table 4.4 shows that there was no significant association between qualification years of experience and knowledge of the nurses on current evidence-based guidelines on endotracheal suctioning in intensive care units when adjusting for demographic data.

4.4 OPEN ENDED RESPONSES

The questionnaire made provision for one open-ended question at the end of the questionnaire (refer **Appendix A**) for open comments. Unfortunately, the study participants chose not to elaborate by providing additional information on the space provided on the questionnaire (**Appendix A)** for open comments.

4.5 DISCUSSION OF MAIN FINDINGS

The purpose of this study was to describe intensive care nurses' knowledge for the current evidence-based guidelines on ETT suctioning in a university-affiliated public hospital in Johannesburg, in order to make recommendations for clinical practice and education and training of these nurses.

In this study, the demographic profile of the respondents is presented in this part of the questionnaire. Four items supported the results and discussion in this part of the questionnaire.

The distribution of the sample revealed the majority 83.8% (n = 67) of the nurse respondents were female, while only 16.3% (n = 13) were male. These findings are consistent with the results of more recent locally published studies (Perrie, Schmollgruber, Bruce *et al.*, 2014;

Schmollgruber, Bruce, Rachidi *et al.*, 2014), which have consistently demonstrated nursing as a predominantly female profession.

Regarding age distribution, the largest group (40.0%; n = 32) of the nurses were between the ages of 41 to 50 years and followed by 32.5% (n = 26) in the 25 to 30 years age categories. This suggests a close three-quarters (72.5%) of nurses in this study were less than 50 years of age. These findings are slighly lower than 100.0% reported in a survey (Maras, Guler, Eser *et al.* (2017) with a sample of Turkish nurses (n = 72).

In this study, the majority 71.2% (n = 57) of the nurse respondents were intensive care trained. These findings are slightly lower than 75.0% in the survey (Maras, Guler, Eser *et al.*, 2017) with Turkish nurses (n = 72), but higher than 69% indicated in a survey (Sole *et al.*, 2014) with American nurses (n = 92). In this current study, 28.8% (n = 23) of the nurse respondents were professional nurses who were non-trained in intensive care nursing. This finding is lower than 43.7% reported in a survey (Mwakantange, Masika & Tarimo, 2018) with Tanzanian nurses (n = 103).

Regarding years of experience, the largest group 31.3% (n = 25) of the respondents had between 6 to 10 years of experience, followed closely by 30.0% (n =24) in the 1 to 5 years of experience categories. This suggests a majority (61.3%; n = 49) of the nurses in this study had less than ten years of ICU experience. These findings are similar to 63.9% reported in a survey (Maras Guler, Eser *et al.,* 2017) with a sample of Turkish nurses. However, this finding is higher than 43.7% reported in a survey (Mwakantange, Masika & Tarimo, 2018) with a sample of Tanzanian nurses (n = 103).

The *first objective* of this study was to determine and describe intensive care nurses' knowledge for the current evidence-based guidelines of ETT suctioning in intensive care units. Twenty-seven items supported the results and discussion in this part of the questionnaire.

The finding of this study revealed that the majority 78.8% (n = 63) of the nurse respondents performed ETT suctioning according to the evidence-based practice frequencies. According to Chaseling, Bayliss, Rose *et al.* (2014), Pedersen, Rosendahl-Nielsen, Hjermind *et al.* (2008) and Day, Farnell, Haynes *et al.* (2002) routine suctioning is not recommended as it can be harmful to patients. The ETT suctioning procedure is associated with risks such as atelectasis, bradycardia, decreased lung compliance, hypoxia, transient increases in arterial and intracranial pressure and cerebral blood flow, bacteraemia and pneumothorax (Leddy & Wilkinson, 2015; Pedersen, Rosendahl-Nielsen, Hjermind *et al.*, 2009).

Several authors have indicated that ETT suctioning is indicated when the patient is unable to clear visible or audible secretions independently (Chaseling, Bayliss, Rose *et al.*, 2014; Pedersen, Rosendahl-Nielsen, Hjermind *et al.*, 2008). Also, the patient should be suctioned when the airway pressure increases on the ventilator, when desaturation occurs on pulse oximetry or when the patient coughs (Sole, Bennett & Ashworth, 2014). The current study findings revealed that the majority 88.8% (n = 71) of the nurse respondents were in agreement with the indications mentioned above.

Selection of the appropriately sized catheter for a given inner endotracheal tube lumen is an important consideration to avoid complications. According to Chaseling, Bayliss, Rose *et al.*, (2014) and Pederson, Rosendahl-Nielsen, Hjermind *et al.* (2008) recommendations choosing the incorrect catheter size might be harmful to patients and compromise their

safety. These study findings revealed that the majority 74.6% (n = 59) of the respondents selected the incorrect response, and might compromise the safety of the intubated and mechanically ventilated patient. Arbon and Siew Ping (2011) stated that the suction catheter used during ETT suctioning should occlude half the internal diameter of the ET tube. It will prevent a large intra-pulmonary pressure building up in the ET tube due to lack of sufficient return airflow down the ET tube to compensate the air removed in the lung during the suctioning procedure (Arbon & Siew Ping, 2011). However, according to the AARC (2010) evidence-based recommendations, the internal diameter should be less than half the amount of the internal diameter of the ET tube. In this current study, it should be noted that only 25.3% (n = 20) of the nurse respondents were more inclined to select the correct response. These findings are lower than 47.2% reported in a survey (Maras, Guler, Eser *et al.,* 2017) with a sample of Turkish nurses (n = 72).

The evidence-based practice recommendations suggest that when performing a respiratory assessment, the nurse should auscultate the chest to verify the need for ETT suctioning (AARC, 2010). Auscultation findings such as crackles and rhonchi are indicative of the need to implement suctioning in the intubated and mechanically ventilated patient (Chaseling, Bayliss, Rose *et al.,* 2014; Pedersen, Rosendahl-Nielsen, Hjermind *et al.,* 2009; Sole, Bennett & Ashworth, 2009). The current study findings showed that approximately 8.9% (n = 7) of the nurse respondents did not practice this.

Pedersen, Rosendahl-Nielsen, Hjermind *et al.* (2009) suggest that the patient should ideally be positioned in a semi-fowlers position as it promotes gaseous exchange when performing ETT suctioning. In this current study, only a small (13.9%; n = 11) percentage of nurse respondents indicated that they would place the patient in a supine or high fowlers position

when performing ETT suctioning. It needs to be addressed to ensure consistency in practices amongst nurses in intensive care units.

The lowest possible suction pressure is 80 to 120 mmHg, and it is recommended to reduce the risk of atelectasis, hypoxia and damage to the mucosa (AARC, 2010). These study findings showed that 32.1% (n = 25) of the nurse respondents were more inclined to choose the incorrect response. The current pressures suggested by these nurses practicing in intensive care units have been proven to be unsafe and are not based on the evidence-based practice recommendations (Pedersen, Rosendahl-Nielsen, Hjermind *et al.*, 2009). Kelleher and Andrews (2008) reported similar findings where 33.3% (n = 45) of their sample of British nurses (n = 45) failed to use the recommended suction pressure of 80 to 120 mmHg.

Chaseling, Bayliss, Rose *et al.* (2014) and AARC (2010) recommendations suggest the application of hyper-oxygenation by delivery 100.0% oxygen for at least 30 seconds before and after ETT suctioning. Hyper-oxygenation is recommended to prevent or minimise desaturation and effects of hypoxia (Pedersen, Rosendahl-Nielsen, Hjermind *et al.*, 2009). The study findings showed that all (100.0%; n = 80) the nurse respondents indicated agreement with the current evidence-based recommendations.

The evidence-based practice recommendations suggest that the application of hyperinflation should be used after an individual patient's assessment has been done because it can be harmful to some patients (AARC, 2010; Pedersen, Rosendahl-Nielsen, Hjermind *et al.*, 2009). According to Oh and Seo (2003), Ayhan, Tastan, Iyigun *et al.* (2015) and Wang, Tsai, Chen *et al.* (2017) this procedure is presumed to enhance the patient's oxygen capacity by recruiting pulmonary volume and loosening secretions. The application of hyperinflation

should be performed manually using the mechanical ventilator (Day, Farnell, Haynes *et al.*, 2002; Pedersen, Rosendahl-Nielsen, Hjermind *et al.*, 2009). The study findings showed that the majority 61.3% (n = 49) of the nurse respondents indicated that they do practice hyperinflation before ETT suctioning. However, the majority (80.0%; n = 64) of these nurses did not use the best-recommended practice method, namely using a ventilator, and might thus jeopardise the safety of the mechanically ventilated patient.

Several authors have reported that normal saline instillation in airway management does not thin or loosen secretions and may have significant effects on the patient (Ayhan, Tastan, Iyigun *et al.*, 2015; Wang, Tsai, Chen *et al.*, 2017). The study findings showed that the majority 92.6% (n = 74) of nurse respondents could not state the correct indications for using normal saline. These findings are congruent with other studies conducted overseas. In one Turkish study, Ayhan, Tastan, Iyigun *et al.* (2015) indicated that 87.7% (n = 57) of the nurses (out of a sample of 65) instilled normal saline bolus prior to and during ETT suctioning, while another study conducted in America (Sole, Penoyer, Su *et al.*, 2009) reported that most institutions include the instillation of normal saline as a treatment for thick secretions in their institutional policies. However, the current practice related to saline instillation as performed by nurses is not considered to be the best-recommended practice (AARC, 2010; Chaseling, Bayliss, Rose *et al.*, 2014; Pederson, Rosendahl-Nielsen, Hjermind *et al.*, 2009). The study findings showed that the majority 90.0% (n = 72) of the nurse respondents instilled from 2ml to more than 10ml of normal saline before and during ETT suctioning. These findings are slightly lower than 96.4% in a survey (Day, Farnell, Haynes et al., 2002) with British nurses (n = 28), where nurses suggested they would instil up to 5 ml of normal saline during suctioning. However, no respondents were observed to use normal saline in practice (Day,

Farnell, Haynes *et al.*, 2002). Another study (Kelleher & Andrews, 2008) also observed similar findings with their sample of British nurses (n = 45).

ETT suctioning is an invasive procedure commonly associated with risks and complications. The strict maintenance of hand hygiene is an important aspect when performing ETT suctioning. The study findings showed that the majority 92.5% (n = 74) of the nurse respondents were more inclined to select the best practice recommended response, such as before and after they performed ETT suctioning.

The evidence-based practice recommendations suggest the duration of suctioning should not exceed ten seconds (AARC, 2010). The study findings showed that the majority 85.0% (n = 52) of the nurse respondents selected the best practice recommended response. These findings are higher than 48.6% (n = 17) in a survey (Mwakanyanga, Masika & Tarimo, 2018) with a sample of Tanzanian nurses (n = 103).

Regarding the depth of insertion of the suction catheter, the best practice recommendations are that the suction catheter should be advanced until it reaches the carina, which would be felt by resistance or by a cough. Advancing the catheter further beyond the recommended depth will cause the application of greater negative pressure on the lungs. According to Day, Farnell, Haynes *et al.* (2002), this may lead to bradycardia. However, a small percentage of the nurse respondents (27.5%; n = 22) indicated correctly that the catheter should be advanced until it reaches the carina. Also, the study findings showed that 73.0% (n = 58) of the nurse respondents in intensive care units do not insert the catheter to the recommended depth.

Many authors have reported that there are many complications associated with performing ETT suctioning. Intensive care nurses need to possess in-depth knowledge of these complications in order to maintain patient safety when performing ETT suctioning. The study findings showed that the majority 95.0% (n = 76) of the nurse respondents indicated the complications related to ETT suctioning correctly. Also, all (100.0%; n = 80) of the nurse respondents indicated that they would perform a respiratory assessment including auscultation of the chest on completion of the ETT suctioning procedure.

The best-recommended practices can be maintained by the presence of an institutional guideline for ETT suctioning. The findings in this study showed that the majority 66.3% (n = 53) of the nurse respondents were more inclined to choose the affirmative response. Based on the researcher's experience in the ICUs, unit protocols existed for performing ETT suctioning. However, these were not evidence-based practice guidelines. Further studies are required for verification of these decisions.

Intensive care nurses are expected to work as part of a multi-disciplinary team in order to ensure appropriate care for their patients. A small percentage of the nurse respondents (34.0%; n = 17) indicated that either unit managers, clinical preceptors or collaborative processes between team members developed their institutional guidelines. However, the findings of the study showed that only a small 17.5% (n = 17) percentage of nurse respondents based their decision-making responses on current evidence. These findings suggest the majority of the nurse respondents working in intensive care units base their decisions regarding ETT suctioning on their expertise and traditional practices. It may not be considered as an appropriate practice because it could compromise the quality of care and safety of the mechanically ventilated patient.

The *second objective* of the study was to establish whether there is a relationship between qualification, years of experience and knowledge of nurses (trained and non-trained) on evidence-based guidelines of ETT suctioning.

The **mean total score** of **nurses' knowledge was 66.7%** (SD = 6.62) with a minimum score of 42.8% and maximum score of 73.9%. The cut-of pint for knowledge to be considered adequate was a score of 70% (Perrie, Schmollgruber, Bruce *et al.*, 2014). Findings in this study suggest nurses' knowledge of evidence based guidelines on ETT suctioning was **less than adequate.**

All the intensive care nurses enrolled for the study were *aware* of the guidelines on; when to perform a respiratory assessment, hyper oxygenating patient prior to endotracheal tube suctioning at the correct percentage, when a comprehensive respiratory assessment must be done.

The intensive care nurses scored *poorly* on guidelines on whether saline instillation loosens the secretions prior to endotracheal tube suctioning, whether normal saline is instilled when performing endotracheal tube suctioning and the amount of saline instilled, on how far to insert the suction catheter when performing endotracheal tube suctioning and on how to evaluate the effectiveness of the tracheal suctioning, the following must be observed.

The results of the ANOVA test shows that there is **no statistical ($p>0.05$) difference in knowledge** on current evidence based guidelines on ETT suctioning **based on age and years of experience** of these nurses.

Further, the results of the Multivariable linear regression shows that there is **no significant (p>0.05) association** between **qualification, years of experience and knowledge** of the nurses on current evidence-based guidelines on ETT suctioning in intensive care units.

4.6 SUMMARY

This chapter discussed descriptive and comparative statistical tests that were used to describe and analyse the data collected. The data and interpretations of findings supported by literature discussion were presented. The following chapter will discuss the limitations of the study, the summary of the research findings, conclusions and recommendations.

CHAPTER FIVE

SUMMARY OF THE STUDY, MAIN FINDINGS, RECOMMENDATIONS AND CONCLUSION

5.1 INTRODUCTION

The final chapter of this research report presents a summary of the study, the main findings and conclusions from the main findings. This will be followed by a discussion of the limitations of the study and recommendations for clinical practice, nursing education and further research in this area.

5.2 SUMMARY OF THE STUDY

5.2.1 Purpose of the Study

The purpose of this study was to describe intensive care nurses' knowledge for the current evidence-based guidelines on endotracheal suctioning in a university-affiliated public hospital in Johannesburg. The intention was to make recommendations for clinical practice and education and training of intensive care nurses.

5.2.2 Objectives of the Study

The objectives of the study were to:

- Determine and describe intensive care nurses' knowledge for the current evidence-based guidelines on endotracheal suctioning in intensive care units

- Establish whether there is a relationship between qualification, years of experience and knowledge of nurses (trained and non-trained) on evidence-based guidelines on endotracheal suctioning

5.2.3 Methodology

The Committee for Research on Human Subjects (Medical) of the University of the Witwatersrand granted ethical clearance before the commencement of the study. Permission to conduct the study was further granted by the Faculty of Health Sciences Postgraduate Committee and the Chief Executive Officer of the Charlotte Maxeke Johannesburg Academic Hospital (CMJAH).

A panel of local domain experts did face and content validity of the self-administered questionnaire before the commencement of the study to ensure the applicability of the instrument to the South African context.

To test the feasibility of the questionnaire pre-testing was conducted with five participants who completed the self-administered questionnaire before the commencement of the main study. The questionnaire used in the study was developed by Jordan (2011), and permission was obtained from the developer to use the instrument. The questionnaire comprised of three sections. The first section collected demographic data, section two collected data for evaluation of nurses' knowledge related to the evidence-based guidelines of endotracheal suctioning. One open-ended question was added at the end of the questionnaire that allowed nurse respondents to comment on any issues relating to the study aim.

To meet the study objectives, a quantitative, non-experimental, descriptive and cross-sectional survey design was used. Descriptive and inferential statistics were used to analyse the data which was done in consultation with a biomedical statistician from the research office of the Faculty of Health Sciences.

5.3 SUMMARY OF MAIN FINDINGS

The *first objective* was to determine and describe intensive care nurses' knowledge for the current evidence-based guidelines on ETT suctioning in intensive care units.

Overall the study yielded a mean total score of the nurses enrolled for this study was mean 66.73% (SD 6.6), where the highest score was 73.91% and lowest 42.82%. All nurses were aware of the guidelines on when to perform a respiratory assessment, hyper oxygenating patient prior to ETT suctioning at the correct percentage when a comprehensive respiratory assessment must be done. In this study, the nurses scored poorly on guidelines on whether saline instillation loosens the secretions prior to ETT suctioning, whether normal saline is instilled when performing ETT suctioning and the amount of saline instilled, on how far to insert the suction catheter when performing ETT suctioning and how to evaluate the effectiveness of ETT suctioning.

The *second objective* was to establish whether there is a relationship between qualification, years of experience and knowledge of nurses (trained and non-trained on evidence-based guidelines on ETT suctioning.

Findings in this study yielded no statistically significant difference in knowledge on current evidence-based guidelines on ETT suctioning based on years of experience and

qualifications. Also, no significant association was found on current evidence-based guidelines on ETT suctioning in intensive care units when adjusting for demographic data.

5.4 LIMITATIONS OF THE STUDY

The researcher acknowledges the following limitations in this study:

- The study was conducted in one public hospital in one province, and therefore these findings cannot be generalised to other populations.
- The sampling method used in the study is based on convenience sampling and a relatively small sample.
- The perceptions and practices of nurses may not be representative of actual patient care because the study only surveyed nurses' knowledge of ETT suctioning.

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

5.5 CONCLUSION

This study presents findings of intensive care nurses' knowledge of evidence-based guidelines on ETT suctioning in adult intensive care units. The results showed that many nurses are educated in the speciality but lack the knowledge of current evidence-based practice when it comes to ETT suctioning. Most nurses emphasized "*using normal saline*" as an important consideration of ETT suctioning. According to the current best practice statements normal saline should not be used prior to ETT suctioning as it impairs

oxygenation up to 5 minutes after ETT suctioning procedure had been completed (Wang, Tsai, Chen et al., 2017). In this study nurses, attempts of improving oxygenation in combination with hyperinflation by using the method of "*manual inflation with an ambubag*" is potentially dangerous for the safety of patients with a diagnosis of acute lung injury (ALI) and acute respiratory distress syndrome (ARDS). These findings are not in agreement with the updated best practice guidelines by the American Association of Respiratory Care (AARC), National Guideline Clearinghouse and the Australian Intensive Care Coordination and Monitoring Unit (ICCMU). In this study the major barrier for nurses to ETT suctioning is a poor nursing knowledge on current evidence-based guidelines particularly "*on whether saline installation loosens the secretions prior to suctioning*", *whether normal saline is instilled*" and "*the amount of saline instilled*" or whether alternative measures, for example, nebulization, could be used as an alternative rather than resorting to ritualistic nursing practices. The findings of this study are in agreement with other similar studies by Maras, Guler, Eser *et al.,* (2017) and Ayhan, Tastan, Iyigun *et al.* (2015). In light of these findings, ETT suctioning remains a challenge for nurses working in these South African intensive care units hence it can be concluded that some nursing practices may be outdated and potentially threaten the safety of patients and quality of care in adult intensive care units.

5.6 RECOMMENDATIONS ARISING FROM THE STUDY

Based on the findings of this study the following recommendations for clinical practice, nursing education and further research are made.

5.6.1 Recommendations for Clinical Nursing Practice

Recommendations for clinical nursing practice are as follows:

The study raised concern about some aspects of ETT suctioning that highlight the need for changes in clinical practice. Intensive care units need to develop locally based clinical guidelines that are aligned with current best practice. These locally developed guidelines can be used to audit practices and drive a change process among all nurses involved in direct patient care. Although this study did not yield statistical significance on knowledge and years of experience, more experienced nurses need to act as evidence-based champions and become 'visible' role models to ensure current evidence-based practice is implemented consistently by all nurses in patient care and across all shifts.

5.6.2 Recommendations for Nursing Education

Recommendations for nursing education are as follows:

The implications of findings for intensive care nursing education is based on findings that reveal intensive care nurses have poor knowledge of evidence-based clinical guidelines. Educators also need to keep abreast of current developments in the clinical setting. This can be achieved by attending unit based ward rounds and actively participating in clinical teaching programmes. There should be a focused practice-based programme promoting the implementation of current best practice. This can be done in a collaborative partnership between clinicians and educators in the academic setting.

5.6.3 Recommendations for Further Research

The following recommendations are made for further research

This study should be repeated using the same method and questionnaire in a different setting in another hospital or province or even the private hospital setting. This may generate a larger sample and help to generalise or refute the findings of this study.

There is also a need for a study that combines both nurses' knowledge and practices related to ETT suctioning. This could be achieved by using a knowledge-based survey and non-participant observations of the nurses' actual practices. Method triangulation could be used to explore, and possibly explain potential strengths and weaknesses in nursing practices. Knowing this information will help to close the perceived gap between theory and practice and could then lead to development of meaningful interventions to change nursing practices and thereby enhance the safety of patients and quality of care.

In conclusion, this research report has described intensive care nurses' knowledge of current evidence-based guidelines for endotracheal suctioning in the adult intensive care units of one university-affiliated public hospital. The findings from this study provide evidence that supports a theory-practice gap in the South African setting where best practice clinical guidelines on ETT suctioning are not being implemented.

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APPENDIX A

INTENSIVE CARE NURSES' KNOWLEDGE OF EVIDENCE-BASED GUIDELINES REGARDING ENDOTRACHEAL SUCTIONING IN AN ACADEMIC HOSPITAL IN JOHANNESBURG

DATA COLLECTION INSTRUMENT

SECTION A – DEMOGRAPHIC DATA

Please read each item below and place an X at the correct answer or fill in the correct response where required.

1. Indicate your gender.

Male	
Female	

2. Indicate how old you are.

< 25 years	
25-30 years	
31-40 years	
41-50 years	
51-60 years	
61-65 years	

3. Indicate the years you have been working in an intensive care unit.

< 1 year	
1-5 years	
6-10 years	
11-15 years	
>15 years	

4. As a professional nurse do you hold an additional qualification in intensive care nursing with SANC?

Yes	
No	

SECTION B: ENDOTRACHEAL TUBE SUCTIONING

Please read each item below and place an X at the correct answer or fill in the correct response where required.

1. How often do you perform endotracheal tube suctioning in the mechanically ventilated patient.

1-2 hourly	
4 hourly	
6 hourly	
12 hourly	
Only when necessary	

2. When do you perform endotracheal tube suctioning in the mechanically ventilated patient?

If the patient cough	
Visible or audible secretions	
If desaturation occurs	
Increased airway pressure	
All of the above	

3. The external diameter of the suction catheter should be half the size of the internal diameter of the ET tube.

Agree strongly	
Agree	
Neither agree or disagree	
Disagree	
Disagree strongly	

4. Do you perform a respiratory assessment prior endotracheal tube suctioning?

Yes	
No	

5. If you answered yes, which of the following assessment findings will indicate that your patient needs suctioning?

Rhonchi	
Crackles	
Wheezes	
Normal breath sounds	

6. How would you position the patient prior performing endotracheal tube suctioning?

High Fowlers	
Semi-Fowlers	
Supine	

7. What suction pressure you do use when performing endotracheal tube suctioning?

80-120 mmHg	
150-180 mmHg	
200 mmHg	
250 mmHg	
300 mmHg	

8. Do you hyper-oxygenate your patient prior endotracheal tube suctioning?

Yes	
No	

9. If you answered yes to question 8, indicate what percentage of oxygen you use.

60 % for at least 30 seconds prior suctioning	
50% for at least 30 seconds prior suctioning	
100% for at least 30 seconds prior suctioning	
55% of at least 30 seconds prior suctioning	

10. Hyper-oxygenation is performed to minimize hypoxia and related complications induced by endotracheal tube suctioning.

Agree strongly	
Agree	
Neither agree or disagree	
Disagree	
Disagree strongly	

11. Do you practice hyperinflation prior to endotracheal tube suctioning?

Yes	
No	

12. If you answered yes to question 11, indicate what method you use for hyperinflation.

Manually with a Ambubag	
Manually by means of the ventilator	

13. Saline instillation loosens the secretions prior to endotracheal tube suctioning.

Agree strongly	
Agree	
Neither agree or disagree	
Disagree	
Disagree strongly	

14. Do you instil normal saline when performing endotracheal tube suctioning?

Yes	
No	

15. How much normal saline do you instil?

_____

16. When do you instil the normal saline?

Prior to suctioning	
During suctioning	
Post suctioning	

17. Normal saline instillation have adverse effects e.g. bronchoconstriction, decreased saturation and excessive fluid volume in the mechanically ventilated patient.

True	
False	

18. When do you wash/spray your hands in performing endotracheal tube suctioning?

Prior to suctioning	
After suctioning	
Before and after suctioning	
Don’t wash hands	

19. Indicate the duration of the suction procedure when performing endotracheal tube suctioning in the mechanically ventilated patient.

10 seconds	
18 seconds	
20 seconds	
25 seconds	

20. How far do you insert the suction catheter when performing endotracheal tube suctioning?

To the level of the carina	
Until resistance is felt	
Until the patient cough	
Past the length of the endotracheal tube	

21. Which of the following complications can occur as result of endotracheal tube suctioning?

Hypoxia	
Infection	
Bradycardia	
Tracheal bleeding	
All of the above	
None of the above	

22. A comprehensive respiratory assessment must be done after performing endotracheal tube suctioning and should include chest auscultation.

True	
False	

23. To evaluate the effectiveness of the tracheal suctioning, the following must be observed:

Increased oxygen saturation	
Decreased rhonchi on auscultation	
Decrease peak inspiratory pressure	
Decrease secretions	

24. Does your unit have an institutional guideline in place on endotracheal tube suctioning practices for the mechanically ventilated patient?

Yes	
No	

25. If you answered yes to question 24, indicate who developed the guideline?

_____

_____

26. If the answer is no to question 24, indicate on what do you base your current endotracheal suctioning practices

Own expertise	
The most recent literature	
What you have been taught in the unit	

27. Would you like to receive in-service education regarding ET tube verification methods in order to ensure the safety of the mechanically ventilated patient in the critical care unit?

Yes	
No	

Should you wish to make additional comments about aspects related to the study, please use the space provided below:

THANK YOU FOR YOUR TIME AND CO-OPERATION IN ANSWERING THIS QUESTIONNAIRE

APPENDIX B

INTENSIVE CARE NURSES' KNOWLEDGE OF EVIDENCE BASED GUIDELINES REGARDING ENDOTRACHEAL SUCTIONING IN AN ACADEMIC HOSPITAL IN JOHANNESBURG

PARTICIPANT INFORMATION SHEET

Dear Colleagues,

My name is Christine Ncube, I am currently registered as a student at the University of the Witwatersrand, in the Department of Nursing Education for the degree of Masters of Science in Nursing (Intensive Care Nursing). I am conducting a research project and would like your consent to participate in my study. The purpose of this study is to evaluate and describe intensive care nurses' knowledge of evidence based guidelines regarding endotracheal suctioning of intubated adult patients. The study will include registered nurses with a degree or diploma in intensive care nursing, with different levels of experience, working in selected intensive care units in public hospitals.

Should you consent to participate in the study, I will ask you to sign a consent form. I will then ask you to fill out a questionnaire, consisting of 27 questions known in the literature to result in better patient outcomes regarding endotracheal suctioning. Questions are both closed ended questions and Likert scales (agree/disagree), which include frequency of suctioning, prior and post assessment of patients, size of suction catheter, pre-oxygenation, saline installation and close versus open suctioning. This should not take you more than 20 minutes to complete. I will obtain permission from your unit manager for you to complete the questionnaire in 'on duty' time, and I will personally bring you the questionnaire.

Completed questionnaires will be placed in sealed unmarked envelopes. Your participation is voluntary and you may choose not to participate or to withdraw from the study at any time. Anonymity and confidentiality is guaranteed. No names or identifying information will be asked of you. Only my supervisor and I will have access to the completed questionnaires. Results will be reported in general terms and no identifying information will be reported. Results of the study will be made available to you if you so wish.

While you may not benefit directly from participation in this study, it is hoped that it will help to clarify educational needs of nurses with regard to endotracheal suctioning of the intubated adult patient. The appropriate people and research committees of the University of the Witwatersrand and your health care institution will be asked to approve this study. Should you require further information regarding this research study, you may contact Mrs Anisa Keshava, Secretary of the University of the Witwatersrand, Human Research Ethics Committee (HREC) at (011) 7172229.

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 number 072 3870977. Thank you for taking the time to read this information letter.

Yours Sincerely
Christine Ncube
MSc Nursing Student

APPENDIX C

INTENSIVE CARE NURSES' KNOWLEDGE OF EVIDENCE BASED GUIDELINES REGARDING ENDOTRACHEAL SUCTIONING IN AN ACADEMIC HOSPITAL IN JOHANNESBURG

PARTICIPANT CONSENT FORM

I _____ (Name), fully understand the contents of the information letter. I have been offered the opportunity to ask questions and these have been answered to by satisfaction. I understand that I may withdraw from this research process at any stage without penalty. I have been assured that my anonymity and confidentiality will be maintained.

_____ _____

Date Signature

_____

Witness

APPENDIX D

Ethical Clearance Certificate

R14/49 Ms CM Ncube

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M140643

NAME: (Principal Investigator)	Ms CM Ncube
DEPARTMENT:	Nursing Education Charlotte Maxeke Johannesburg Academic Hospital, Chris Hani Baragwanath Academic Hospital
PROJECT TITLE:	ICU Nurses' Knowledge of Evidence Based Guidelines regading Endotracheal Suctioning of the Adult Intubated Patient in Two Academic Hospitals in Gauteng
DATE CONSIDERED:	27/06/2014
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Shelley Schmollgruber
APPROVED BY:	Professor P Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	29/07/2015

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 Secretary in Room 10004, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized 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 the application to the Committee. **I agree to submit a yearly progress report.**

Principal Investigator Signature

Date 10·08·15

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX E

Hospital Permission

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
27 August 2015

Mrs. Christine Ncube
Department of Nursing Education
Faculty of Health Sciences
University of Witwatersrand

Dear. Mrs. Christine Ncube

RE: "Intensive care nurse's knowledge of evidence based guidelines regarding endotracheal suctioning of intubated adult patient in two academic hospitals in Gauteng"

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

1. Charlotte Maxeke Johannesburg Academic hospital will not in anyway incur or inherit costs as a result of the said study.
2. Your study shall not disrupt services at the study sites.
3. Strict confidentiality shall be observed at all times.
4. Informed consent shall be solicited from patients participating in your study.
5.

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: 01/09/2015

Approved / not approved
Ms. G. Bogoshi
Chief Executive Officer
3/9/2015

APPENDIX F

Postgraduate Approval

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: 0704014P
PAG

Miss CM Ncube
942 Block D
0192
South Africa

Dear Miss Ncube

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 regarding entotracheal suctioning in Academic Hospitals in Gauteng* 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