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Evaluation of an Intervention to Maintain Therapeutic Pressure of the Endotracheal Tube Cuff During Intraoperative Surgery

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EVALUATION OF AN INTERVENTION TO MAINTAIN THERAPEUTIC PRESSURE OF THE ENDOTRACHEAL TUBE CUFF DURING INTRAOPERATIVE SURGERY

by

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ABSTRACT

The current practice of intraoperatively assessing the cuff pressure of the endotracheal tube (ETT) is arbitrary and potentially leads to negative impacts on patients. This best practice project aimed to review and synthesize the existing evidence-based literature on measuring ETT cuff pressure and to establish a policy guideline for anesthesia providers to measure ETT cuff pressure in the intraoperative environment. Based on the star model of the knowledge transformation framework model provided by the Academic Center for Evidence-Based Practice (ACE), the creation of evidence-based policy on ETT cuff measurement is expected to potentially prevent poor patient outcomes, patient expenses, and hospital expenses (Chism, 2019). Also, the use of the IHI Triple aims at improving patients' safety, enhancing effectiveness, contributing to the implementation of the patient-centered approach, as well as the provision of timely and efficient care to improve patients' experiences (Whittington et al., 2015). A comprehensive literature review was undertaken to evaluate and synthesize the latest evidence-based research that can be used to improve the measurement policy of the endotracheal tube cuff pressure. The established evidence-based policy was emailed to the expert panel for review and assessment per the protected server at The University of Southern Mississippi (USM). The best practice policy recommendation regarding postoperative complications caused by over-inflated ETT was conducted at a USM clinical affiliate hospital in Mississippi. A DNP committee, will be used to assess the utility and practicality of the policy(stakeholders). In addition to quantitative measurements of a clinical affiliate's ETT pressure, qualitative feedback from a DNP

committee, was used to assess the evidence-based policy. Policy revisions were made based on data collected from the ACE tool.

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DEDICATION

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LIST OF ABBREVIATIONS

AANA	The American Association of Nurse Anesthetists
CRNAs	Certified Registered Nurse Anesthetists
ETI	Endotracheal Intubation
ETT	Endotracheal Tube
IRB	Institutional Review Board
MLT	Minimal Leak Technique
MOV	Minimal Occlusive Volume
PVA	Predetermined Volume of Air
PPV	Positive Pressure Ventilation
USM	The University of Southern Mississippi

CHAPTER I - INTRODUCTION

Many patients undergo surgery requiring intubation with the use of an endotracheal tube (ETT) for airway management. Intubation is considered an invasive procedure. The use of the endotracheal tube is the general practice for patients who undergo surgical procedures (Tsaousi et al., 2018) Complications occur when the client is undergoing surgery within the operative setting, due to over-inflation of the ETT by the anesthesia provider causing over-inflation of the cuff pressure (Hedberg et al., 2015). This outcome is due to the use of the minimal leak technique (MLT) without adequately measuring the ETT cuff pressure. Tracheal perfusion pressure, estimated to be 22 mm Hg to 30 mm Hg, must not be exceeded by the ETT cuff pressure (Khan et al., 2016). Several complications can potentially cause problems for patients if pressure is not adequately managed. There are two types of tracheal tube cuff pressure techniques. The two types of techniques are fixed volume and minimal leak test. The most common technique for cuff pressure measurement is MLT (Sanaie et al., 2019). This technique is easy, simple, and inexpensive. Still, the correlation between the cuff to the tracheal wall pressure and the volume of air is not linear and occasionally leads to cuff distention and overpressure (Sanaie et al., 2019). Tracheal injury with pathological changes begins when the ETT cuff pressure exceeds the capillary blood pressure supplying the trachea and is followed by ischemia with inflammation (Khan et al., 2016).

Certified registered nurse anesthetists (CRNAs) play a vital role in the occurrences and outcomes of patient complications during airway management through gained knowledge, technical skills, and crisis management capabilities (Divatia & Bhowmick, 2005). During pre-operation, intra-operation, and post-operation periods, it is

essential to assess the airway of the patient before, during, and after anesthesia has been provided (Zambouri, 2007). Most importantly, checking on the ETT intra-operatively is very important. There are numerous ways to add air into the pilot balloon to create a seal to manage the airway. Adding air to the pilot balloon includes minimal leak technique (MLT), minimal occlusive volume (MOV), the cuff inflation with a predetermined volume of air (PVA), and the palpation of the pilot balloon as a guide for the quantity of air needed for the cuff inflation (Khan et al., 2016). Poor pressure measurement can be hazardous to the patient and can lead to patient complications. Some significant complications that can occur after intubating a patient are sore throat, laryngeal edema, trachea or bronchus hoarseness, laryngeal nerve injury, vocal cord, aspiration, and tracheal stenosis (Divatia & Bhowmick, 2005).

The work of the anesthesia providers in the operating room is essential for the provision of holistic health care to all patients by assisting the surgeon in performing surgical procedures. The CRNA's ultimate goal is to make sure the patient is safe from harm during pre-operation, intra-operation, and post-operation periods by adequately managing the airway. The purpose of this project was to address ETT cuff over inflation by implementing a technique to decrease complications. The optimal method for establishing and maintaining safe cuff pressures (20–30 cmH2O) is the cuff pressure manometer. The cuff pressure manometer is not widely available, especially in the resource-limited settings where its use is limited by the cost of acquisition and maintenance (Bulamba et al., 2017). The implementation of evidence-based policy and recommended clinical practice guidelines to improve patient outcomes will assist in decreasing problems that can result in life-threatening consequences.

Problem Description

Background of the Problem

Intubation with the ETT is a critical skill and invasive procedure provided to most patients under anesthesia. The primary function of the ETT cuff is twofold: to limit air leakage during positive pressure ventilation (PPV) and to prevent aspiration of gastric content by creating a seal between the patient's trachea and the cuff (Gilliland et al., 2015). The risk of complications arises when anesthesia providers overinflate the ETT cuff pressure that exceeds pressure limited on the ETT pilot balloon. The ETT cuff pressure must be in a range that ensures the delivery of the prescribed mechanical ventilation tidal volume, reducing the risk for secretion aspiration that accumulates above the cuff without compromising the tracheal perfusion (Khan et al., 2016).

In the intraoperative setting, the current practice of many nurse anesthetists varies significantly in terms of the measurement of the ETT cuff pressure. In an organization, several methods can be applied since the choice is based on the discretion of the anesthesia provider. The most common method to inflate an ETT is to inject a set volume of air into an endotracheal cuff through a syringe (Sanaie et al., 2019). Estimation techniques are the most common techniques used in practice to evaluate the endotracheal cuff pressure (Sultan et al., 2011).

A disparity has been observed in training between anesthesia providers as it relates to the ETT cuff pressure measurement. A manometer is the most accurate way to measure the ETT cuff pressure after placing it into the trachea. The gold standard approach is a calibrated manometer that is suggested to adults to measure the cuff

pressure (Sanaie et al., 2019). As a result, evidence-based policy based on the use of a manometer will decrease the variability in the ETT cuff pressure measurement.

Problem Statement

The inconsistency of the endotracheal tube (ETT) cuff pressure measurement during surgical procedures can cause postoperative complications when anesthesia providers fail to use a manometer to measure ETT cuff pressures, leading to cuff over inflation (Bulamba et al., 2017). Potential complications of over-inflated ETT cuffs include laryngeal injury, vocal cord paralysis, and patient reintubation (Divatia & Bhowmick, 2005). Furthermore, the hospital is not reimbursed for the reintubation of patients less than 72 hours after surgery. In addition, patients may experience more extended hospital stays, which increases the risk of hospital-acquired infections.

Significance of the Problem

In order to potentially avoid patient harm, patient billing costs, and hospital supply costs, it is necessary to resolve the inconsistency of the endotracheal tube (ETT) cuff pressure measurement in surgery. Anesthesia providers will be able to use the knowledge presented to make more informed decisions regarding the ETT cuff pressure measurement. The evidence-based recommendation has the potential to decrease patient injury, patient expenses, and hospital expenses (Chism, 2019).

Available Knowledge

CINAHL, EBSCOhost, MEDLINE, and Google Scholar databases were used to collect evidence-based peer-reviewed articles. The key terms used in the search were: endotracheal tube cuff, endotracheal cuff pressure, handheld manometer, techniques, and complications. Articles published within the previous five years, along with seminal

articles were considered for use. The articles collected were sorted and recorded in the Literature Matrix (Appendix E). The matrix was organized by the year distributed and level of proof. The evidence-based practice incorporated the information and built up a proof-based strategy proposal for the ETT cuff pressure estimation using an adequate amount of air.

Best Practice Guideline

A best practice guideline can be a standard of care or guideline in an organization to help ensure patients' safety. Best practice guidelines in the hospital are vital as they help provide quality health care to patients. It is crucial to understand how it affects the standard of practice. Health policy influences multiple care delivery issues, including health disparities, cultural sensitivity, ethics, the internalization of healthcare concerns, access to care, quality of care, healthcare financing, issues of equity, and social justice in the delivery of health care (Chism, 2019). A best practice guideline will enhance communication, provide structure to an organization, and give the patient the highest quality of care that is demonstrated by clinical outcome.

Endotracheal Tube (ETT)

The ETT is a plastic flexible tube or airway management device placed in the mouth into the trachea, placed 4 cm above the crania, to help the patient breathe while having surgery. A critical function of the ETT cuff is to seal the airway, thus preventing leaks and aspiration of pharyngeal contents into the trachea during ventilation. This device will help the patient breathe while on the ventilator (Khan et al., 2016). The ETT will allow the passage of air in and out of the patient's lungs. The endotracheal tube has a pilot balloon, and it sits in the trachea. Endotracheal tube cuff pressure must be kept

within an optimal range that ensures ventilation and prevents aspiration while maintaining tracheal perfusion (Sole et al., 2011). In addition, ETT pilot balloons and balloon cuff is inflated with air while the patient receives general anesthesia. Scientific literature reports the catastrophic consequences of ETT cuff over inflation and insufficient inflation.

Manometry and Cuff Pressures

The single complication of intubation under general anesthesia caused by anesthesia providers is high cuff pressure. The high cuff pressure can cause complications postoperatively to the tracheal mucosal lining from the high volume of air in the ETT. An ETT cuff inflator manometer can deflate and inflate high volume on the ETT pilot balloon, which can alleviate cuff pressure on the tracheal mucosal line. The ETT cuff inflator manometer will be a more accessible alternative versus other methods to provide adequate air in the ETT. Using the manometer will help provide pressure in the bulb that will gauge the appropriate pressure range on the cuff. The ETT cuff pressure must be in a range that ensures delivery of the prescribed mechanical ventilation tidal volume to reduce the risk for aspiration of secretions that accumulate above the cuff without compromising the tracheal perfusion (Khan et al., 2016).

Cuff pressure is an essential factor when placing ETT into the trachea. During clinical use, the cuff pressure is observed by the anesthesia provider by palpation of the ETT pilot balloon. However, to provide an adequate seal, the anesthesia provider adjusts the pressure according to the need to create a seal. The anesthesia provider must not over inflate the ETT cuff. The implied goal of endotracheal tube cuff pressure monitoring is to maintain the cuff pressures between 20-30 cm H2O to minimize air leaks and loss of tidal

volume due to underfilling the cuff and to prevent injury to the tracheal mucosa due to overfilling the cuff (Letvin et al., 2018).

Complications of Over Inflated Endotracheal Tube

Endotracheal intubation (ETI) is a rapid, simple, safe, and non-surgical technique that achieves all goals of airway management, namely, maintains airway patency, protects the lungs from aspiration, permits leak-free ventilation during mechanical ventilation, and remains the gold standard procedure for the airway management (Borhazowal et al., 2017). Adding air to the ETT is mandatory to provide a seal to eliminate leaks to avoid patient complications. However, there is a risk that occurs when adding air to the ETT that can cause a problem if overinflated using MLT. If overinflated, the ETT needs to be assessed due to the frequent incidence of a significant intraoperative complication caused by the anesthesia provider, especially if complaints require investigation. The high cuff pressure is usually associated with postoperative complications. During cuff intubation, excessive pressure on the tracheal mucosa, more than mean capillary perfusion pressure of the mucosa, leads to tracheal damage. The overinflation of the ETT cuff might lead to severe complications, ranging from tracheal mucosa pressure necrosis to tracheal ruptured, tracheoesophageal fistula formation. In addition, some pathologic changes can occur, for example, ischemia, inflammation, and ulceration. Moreover, a postoperative sore throat is more common in the cases in which the endotracheal cuff pressure is elevated (Borhazowal et al., 2017).

Maintaining the ETT cuff pressure is challenging. The larger volume of pressure in the endotracheal tube cuff will affect the tracheal mucosa lining. The ETT cuff pressure must be in a range that ensures delivery of the prescribed mechanical ventilation

tidal volume, reduces the risk for aspiration of secretions that accumulate above the cuff and does not compromise tracheal perfusion (Sole et al., 2011).

Patient Injury Evidence

Patient injury to the trachea can occur after the ETT placement by increasing pressure in the pilot balloon that results in the blood flow decrease to the surrounding tissues. The contributing factor of increased pressure will cause complications to the tracheal during intraoperative. The ETT placement has a significant contributor to morbidly and morality of patients when an anesthesia provider administers anesthesia. According to the article, complications of the endotracheal tube can occur following initial placement. Laryngeal injury is the most common complication associated with ETT placement. Hoarseness/dysphonia is a general clinical manifestation assessed immediately following extubation (Alwassia et al., 2016). Other injuries are prone to occur from the ETT intubation; examples include bilateral vocal cord paralysis, severe edema, severe laryngotracheal stenosis, which are severe complications that require close emergency attention. As an example, in the case series of 136 patients, 12% of the patients exhibited extubating failure within 48 hours, half of whom had stridor (Alwassia et al., 2016). These types of complications need more interventions, which may require ETT reinsertion.

Evidence has shown that more than inflammation and edema is detected after intubation (Alwassia et al., 2016). Between men and women, laryngeal injuries are more frequent in women than men (Tadie, et al., 2010). According to an article by Kikura et al. in 2007 age and comorbidity are risk factors leading to vocal cord paralysis associated with tracheal intubation once a patient has ETT in place. Older patients greater than 50

years may be at higher risk of developing vocal cord paralysis than younger patients (Alwassia et al., 2016).

Increase Hospital Expense

CRNA is an anesthesia provider who administers high-quality anesthesia to patients safely, according to the American Association of Nurse Anesthetists (AANA,2019). CRNAs perform more than 49 million anesthetic procedures. A report provided by the Institute of Medicine on the AANA website states that anesthesia care by CRNAs is 50 times safer than in the past. Foremost, CRNAs provide cost-efficient anesthesia care to patients. The primary goal of the CRNA is to provide high-quality anesthesia care to reduce expenses towards patients and insurance companies.

A research study was conducted to show the cost analysis of intubation related injuries to the patients after the ETT placement. The research proposed to examine whether ETT expands the typical length of stay and readmission rate, therefore growing medical service costs by 20%.The purpose of this study was, first, to identify postintubation tracheal injury and its associated impact on the length of stay, and the cost of the index hospital admission and, second, to examine costs related to subsequent readmissions required to treat the injury (Bhatti et al., 2010).

In the future, it is conceivable that medical facilities will not be repaid for the extra expenses related to the post-intubation tracheal damage. When performing the ETT placement during the intraoperative period, the CRNA must examine the ETT balloon cuff pressure to eliminate postoperative complications. Hence, it is essential to keep cuff pressure between 20-30 cm H_20. If not, postoperative complications will be the factors

associated with poor management, leading to extended hospital stays and readmission that will increase the cost to the facility.

Needs Assessment

Inflated ETTs and complications have been discovered to be related to high cuff pressure on the tracheal wall. There have been reviews on ETT cuff that show the current practical techniques have caused overinflated cuffs. Moreover, the analysis of the relevant literature sources has indicated safe pressure measurement limits and evidence-based recommendations to monitor techniques to provide adequate cuff pressure to the ETT. Intubation is estimated to be performed 13-20 million times annually in the United States alone (Sultan et al., 2011). The ETT cuff pressure management is an essential step in airway management after endotracheal intubation, especially in the case of critically ill patients who undergo mechanical ventilation (Sanaie et al., 2019). There are two methods of technique generally performed, MLT and fixed volume of air in the pilot balloon. The MLT is the most general application in practice to add air with a syringe into the ETT and check the pilot balloon through palpation. However, the gold standard to measure the cuff pressure is to use a handheld manometer to correlate adequate pressure of 20-30 cmH2O in ETT. Therefore, anesthesia providers need to be aware of this standard to realize the problems created by the MLT.

Rationale

The complications of the airway are unanticipated and can harm patients during the intraoperative period in the general procedure performed by the anesthesia provider. There is one skill above all that an anesthetist is expected to exhibit, and that is to maintain the airway impeccably (Cook & Macdougall-Davis, 2012). Intubation with the

ETT while measuring the ETT balloon cuff is the most common procedure performed by an anesthesia provider. The gold standard technique is to measure the cuff pressure by a calibrated manometer (Sanaie et al., 2019).

Patient safety is the target factor while providing professional care to the patient. The current project focuses on the investigation of policy and procedure improvement to increase patients' safety. This project helps to validate standards for the patients and decrease complications after intubation. In addition, the use of the best practice guidelines in implementing adequate pressure into the pilot balloon will improve patient outcomes.

Theory or Framework

The creation of an evidence-based best practice guideline that surrounds the ETT cuff measurement is expected to potentially prevent poor patient outcomes, patient expenses, and hospital expenses based on the Academic Center for Evidence-Based Practice (ACE) star model of the knowledge transformation framework model. The ACE star model of knowledge transformation combines research evidence with clinical expertise and includes the individualization of care through the incorporation of a patient's preference and setting circumstances (Melnyk & Fineout-Overholt, 2015). “The ACE model illustrates five significant stages of knowledge transformation: 1) discovery research, 2) evidence summary, 3) translation to guidelines, 4) practice integration, and 5) process, outcome evaluation” (Melnyk & Fineout-Overholt, 2015, p. 306). The ACE star model was implemented to investigate results in a series of states to make an impact on the health results with the emphasis on evidence-based practice. The first series should build a body of research results about poor patient outcomes caused by the overinflated

ETT cuff pressure. The second series presupposes the conduction of the randomized control trials to measure the ETT cuff pressure by two types of techniques (fixed volume and minimal leak test techniques) to assess consistency and demonstrate the ETT cuff pressure inequalities. In the third series, the DNP committee evaluated the best practice recommendation. The fourth series incorporate best practice recommendations to stakeholders to address factors that affect patients by the overinflated ETT cuff pressure to adopt innovation. The fifth series includes the stakeholder's evaluation of the best practice guideline impact on patient health outcomes, patient satisfaction, efficiency, effectiveness, financial expenses, and health status.

Triple Aim of the IHI

Healthcare delivery expenses in the hospital environment have increased tremendously due to fluctuating factors. The triple Aim of the IHI incorporates by improving the individual experience of care, improving the health of populations, and reducing per capita costs of care for populations. The use of the Triple Aim of the IHI goal is aim to toward patient improvement by being safe, effective, patient-centered, timely, efficient, and equitable to improve patient experience of care. Numerous patients experience medical procedures requiring intubation with the utilization of an ETT for the alternate route to management airway, which is an invasive procedure that can cause complications when ETT being over-inflated decreases patient satisfaction. Over inflation of ETT can cause patient outcomes, patient expenses, and hospital expenses that can negatively affect the economic impact, cost, and potential reimbursement issues. If anesthesia providers use the concept design of Triple Aim, enable cost-benefit plus enhance patient safety (Whittington et al., 2015).

DNP Essentials

This project led to the development of an evidence-based policy that supports the use of a manometer to measure the ETT cuff pressures intraoperatively. The goal of this project was to strengthen the evidence-based policy guidelines based on a review of the current best practices for the evaluation of the ETT cuff pressure. The results of this project indicate that in the practice setting, the expert panel suggests acceptance of the recommendations. This work is consistent with several DNP essentials presented in Appendix B, which outlines the basics involved in achieving a DNP degree or recommendations (American Association of Colleges of Nursing [AACN], 2019).

Specific Aims

The purpose of this project is to potentially decrease poor patient outcomes and expenses to the patient and facility through policy intervention. The project aims to develop evidence-based on the ETT cuff pressure measurement policy. A DNP committee, consisting of stakeholders, will be used to assess the policy's usefulness and practicality. In addition to the quantitative measurements of the ETT cuff pressures from a USM clinical affiliate, qualitative feedback from a DNP committee will be utilized to evaluate the evidence-based policy. Postoperative complications, such as sore throat and tracheal capillary perfusion decrease, can lead to a significant complication (Divatia & Bhowmick, 2005).

Conclusion

The inconsistency of the ETT cuff pressure measurement during surgical procedures can cause postoperative complications when anesthesia providers fail to use a manometer to measure the ETT cuff pressures, leading to the cuff over-inflation.

Complications of the overinflated ETT cuffs include laryngeal injury, vocal cord paralysis, and patient reintubation. Furthermore, the hospital is not reimbursed for patients who are reintubated less than 72 hours after surgery. In addition, patients may experience longer hospital stays, which increases the risk of hospital-acquired infections. In conclusion, the main goal is to provide a proper guideline to reduce postoperative complications, as well as to improve patient satisfaction and outcomes. As healthcare providers, anesthesia providers should care about the provision of excellent care towards the patient's needs, influencing the surgical experience of patients. The need for assessment is to address the overinflated ETT during the intraoperative period. Measuring of the ETT cuff pressure through the use of the hand instrumental cuff inflator versus conventional method MLT makes a difference when it comes to inflating the balloon on the ETT. Ischemia of the oropharyngeal and tracheal mucosa may result due to over-inflation of the cuff (Khan et al, 2016). Other studies indicate that an ideal cuff pressure with ETT must be monitored, and adequate air must be provided to ensure a proper seal. The ETT cuff pressure has to be in a range that ensures the delivery of the prescribed mechanical ventilation tidal volume, reduces the risk for aspiration of secretions that accumulate above the cuff, and does not compromise tracheal perfusion (Sole et al., 2011).

Summary

A disparity has been observed in training between anesthesia providers as it relates to the ETT cuff pressure measurement. ETT cuff management is routine practice for anesthesia providers. A best practice guideline can be a standard of care in an organization to help ensure patients' safety. Poor pressure measurement can be hazardous

to the patient and can lead to patient complications due to inconsistent of the ETT cuff pressure that is not being monitor by a handheld manometer to check the cuff pressure of ETT.

CHAPTER II – METHODOLOGY

The inconsistency of endotracheal tube (ETT) cuff pressure measurement during surgical procedures can cause postoperative complications when anesthesia providers fail to use a manometer to measure ETT cuff pressures, leading to over-inflation of the cuff. Potential complications of over-inflated ETT cuffs include laryngeal injury, vocal cord paralysis, and patient reintubation (Divatia & Bhowmick, 2005). The purpose of this project was to potentially decrease poor patient outcomes and expenses to the patient and facility through with best practice guidelines. The project aimed to develop an evidence-based ETT cuff pressure measurement for a best practice guideline.

Context

At present, observations and informal interviews reveal that manometers are not readily available or supplied to the CRNAs at USM clinical affiliates. Also, they are not widely available, especially in resource-limited settings, where their use is limited by the cost of acquisition and maintenance (Bulamba et al., 2017). The profit election of facilities represents for-profit and nonprofit corporations. From an organizational perspective, the accurate measurement of the ETT cuff pressures and the use of manometers are not recognized as an essential issue. Motivation to change is largely absent even though the anesthesia department support quality improvement, as evidenced by recent and ongoing projects

Study Steps

To develop an evidence-based best practice guideline for the ETT cuff pressure measurement for use in the curriculum in the USM Nurse Anesthesia Program and USM

clinical affiliate facilities for use in the curriculum in the USM Nurse Anesthesia Program and USM clinical affiliate facilities, the following steps were instituted:

1. A survey tool and email invitation template were created.
2. The survey tool and email invitation template were submitted for approval from the DNP committee.
3. USM Institutional Review Board (IRB) application was submitted and approved.
4. After approval from USM IRB, email invitations with an anonymous survey were sent to 30 CRNAs practicing nurse anesthesia at USM clinical affiliate facilities.
5. Data was collected, recorded, and arrayed into a table for analysis. Results were stored on a password-protected laptop. Physical data was held in a locked drawer.
6. Based on collected data and evidence-based literature, a best practice guideline for the use of a manometer for measurement of ETT cuff pressures was created.
7. The best practice guideline for the use of a manometer for measurement of ETT cuff pressures was submitted to the DNP committee for approval.
8. Following approval from the DNP Committee, an executive summary, including the best practice guideline was submitted to the administration of the USM Nurse Anesthesia Program for consideration. The executive summary was presented to the anesthesia administration at USM clinical facilities.

9. Results were disseminated at the USM DNP Scholarship Day on September 25, 2020.
10. Physical data were destroyed by shredding. Electronic data was deleted from a password-protected computer and the trash folder emptied.

Study for Intervention

The intervention of the project was the creation of a best practice guideline for ETT cuff pressure measurement. The study for the intervention was the data collection from practicing CRNAs, and a peer-reviewed literature search performed to develop the best practice for ETT cuff pressure measurement. Data collection from practicing CRNAs was done by survey. The objectives of the survey were three-fold. The current practice of ETT cuff measurement, the current way of ETT cuff re-measurement during surgery, and barriers to ETT cuff pressure measurement will be quantitatively measured. The data collected from the survey aided in the creation of the best practice guideline, as it was used to help to identify educational needs and barriers to manometer use. Participants included stakeholder representatives. Survey participants consisted of stakeholder representatives, including practicing CRNAs. Practicing CRNAs were chosen because of their first-hand involvement in measuring ETT cuff pressures. After data collection and analysis, the best practice guideline for ETT cuff measurement by a manometer was created using evidence-based peer-reviewed literature, along with data collected from the CRNA participants.

Intervention

The best practice guideline is intended to reduce excessive variation in practice that is not an evidence base for the best way when measuring ETT. The main advantages

of the best practice guideline are to increase the level of treatment provided by CRNAs. CRNAs measuring ETT cuff pressures currently use MLT and the pilot balloon palpation to analyze cuff pressure during cases preoperatively. The best practice guideline has the potential to promote intervention to demonstrate effective cuff pressure measurement aim to reduce the morbidity and mortality while providing care to enhance the quality of life (Bulamba et al., 2017). After creation, the best practice guideline for ETT cuff measurement using a manometer was submitted to the DNP committee for qualitative feedback and approval.

Survey

The survey is only a tool to collect supporting data to create a best practice guideline. The ACE Star Knowledge Transformation Framework is one guiding structure for understanding the transformation of knowledge to help to evaluate the quality of the creation of policy (or best practice guideline) to providing evidence (Kring,2008). ACE Star models have been considered useful in highlighting the process of finding and evaluating valuable evidence for ETT measurements. The model is a 5-point star (Figure 1), with each point a stage in the EBP method shall be as follows (Stevens, 2012). The ACE Star Framework as a structure assists in the systematic application of best research into practice. The Discovery of new knowledge is found through traditional research. Searching for further information in conventional quantitative and qualitative methodologies involves this step (Stevens, 2004). The result from the survey provided an assessment of the current practice of ETT cuff pressure measurement by CRNAs and barriers to manometer use. Evaluation of the existing ETT cuff pressure measurement procedure, cuff pressure measurement intervals, and barriers to manometer usage for cuff

pressure measurement will provide knowledge that can be used to determine the CRNA's physical and educational needs. The answer choices represented the most common methods of ETT cuff pressure measurement, the most common reasons for cuff pressure measurement during anesthesia, and the most common reasons for not using manometers for measurement. The cuff pressure manometer is the ideal technique for establishing and maintaining healthy cuff pressures (20–30 cmH2O), but this is not widely available, especially in resource-limited settings where its usage is limited by acquisition and maintenance costs (Bulamba et al., 2017).

Figure 1. *Star Guide.*

Note. Stevens, 2012

The survey tool was developed based on the required feedback for a best practice guideline. The tool consisted of three questions (Appendix A). All question was designed to help developed data to conduct study. The first question is: What technique do you most commonly use to estimate ETT cuff pressure intraoperatively? Assessment of current practice will enable to evaluate the context to develop an evidence-based policy recommendation for the measurement of the ETT cuff pressures. The second question is: What are the reasons that you reassess ETT cuff pressure intra-operatively? The assessment will help define practical treatment approaches and set procedural criteria to use a handheld manometer to decrease compilations after the ETT placement. The third question is: If not using cuff manometer for ETT cuff pressure measurement, what are the reasons that you do not routinely use cuff manometers to measure ETT cuff pressure? A quantitative survey was used to analyze the measure numbers of responses. The study aimed to assess the proportion of ETT cuff pressure measurement via a survey to determine cuff press inflation methods' accuracy, the need for accurate measurement of the ETT cuff's pressure is critical in the operating room, and the use of a survey tool to identify barriers.

Interventions

The goal of the project was to construct an evidence-based best practice guideline ETT cuff pressure measurement. The evidence-based best practice guideline was submitted to the DNP committee for qualitative feedback on the best practice guideline from the committee. Within the request, the committee was asked to review the adherence to evidence-based practice, work at the level of doctoral study, and clearness of guidelines. The feedback was used to alter the best practice guidelines.

Analysis

The purpose of this project was to potentially decrease poor patient outcomes and expenses to the patient and facility through best practice guideline intervention. The project aimed to develop an evidence based on the ETT cuff pressure measurement best practice guideline. A DNP committee, consisting of stakeholders, was used to assess the best practice guideline usefulness and practicality. In addition to quantitative measurements of ETT cuff pressures from a USM clinical affiliate, qualitative feedback from a DNP committee and stakeholders were utilized to evaluate the evidence-based best practice policy. The data analysis methods were consistent with the project aims and measures.

The measure of the intervention and best practice guideline was the evaluation by the DNP committee. Both quantitative and qualitative methods were used to gather information. Results may not be statistically significant due to the small sample size. The evaluation responses were organized into a table to ensure a good understating of the received results. At the same time, quantitative responses were reported as numbers, and common themes were determined from qualitative feedback.

Ethical Considerations

Potential healthcare-related ethical considerations include the possibility of providing two levels of care. The anesthesia provider may use another technique other than the manometer for a variety of reasons. Because the evidence-based guideline states the preferred use of a manometer, the patients could get two levels of care. Therefore, the use of a cuff manometer can be useful in patients with general anesthesia to reduce the

incidence of tracheal and laryngeal trauma caused by the continuity of the tracheal mucosal blood flow (Saracoglu et al., 2014).

The project was presented to The University of Southern Mississippi Institutional Review Board (IRB) to ensure that all ethical concerns were taken into consideration. The application was reviewed and approved (Protocol Number IRB-20-189) by the USM Office of Research Integrity. There were no conflicts of interests disclosed.

Summary

The best practice guideline project used evidence bases practice to develop guideline to measure pressure in ETT. The panel of experts from the USM Nurse Anesthesia Program helps in aid to the developed survey to send out to USM clinical affiliate facilities to collect data. ACE Star models have been considered useful in highlighting the process of finding and evaluating valuable evidence for ETT measurements. Ethical Considerations were addressed by the IRB at USM to avoid potential ethical predicaments.

CHAPTER III - RESULTS

Introduction

The inconsistency of the endotracheal tube (ETT) cuff pressure measurement during surgical procedures can cause postoperative complications when anesthesia providers fail to use a manometer to measure ETT cuff pressures, leading to cuff over inflation (Bulamba et al., 2017). Potential complications of over-inflated ETT cuffs include laryngeal injury, vocal cord paralysis, and patient reintubation (Divatia & Bhowmick, 2005). Furthermore, there is no hospital reimbursed for patients who are reintubated less than 72 hours after surgery. In addition, patients may experience longer hospital stays, which increases the risk of hospital-acquired infections.

The purpose of this project is to potentially decrease poor patient outcomes and expenses to the patient and facility through policy intervention. The project aims to develop evidence-based on the ETT cuff pressure measurement policy. A DNP committee, consisting of stakeholders, will be used to assess the policy's usefulness and practicality. In addition to the quantitative measurements of the ETT cuff pressures from a USM clinical affiliate, qualitative feedback from a DNP committee will be utilized to evaluate the evidence-based policy.

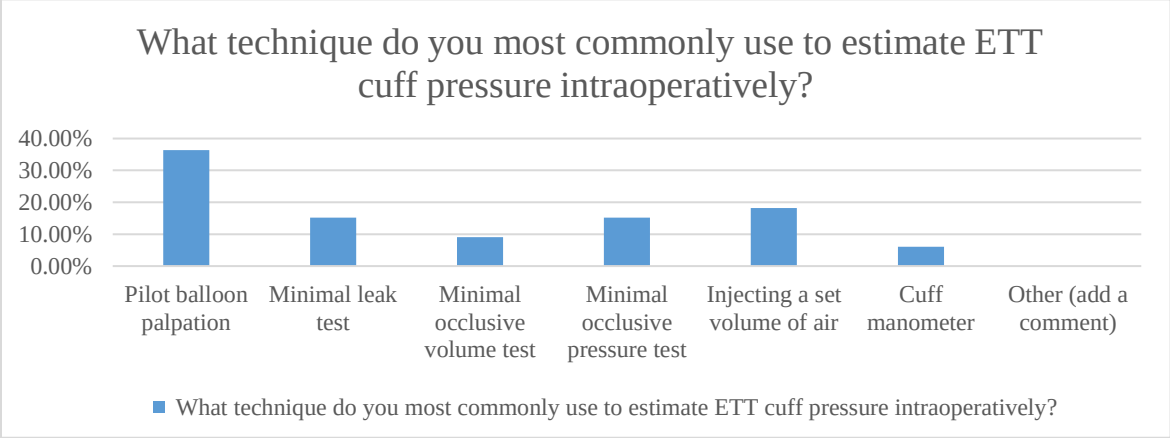
Steps of the Intervention

Thirty survey participants were administered the survey following the previously outlined steps in the methodology, with 16 responses. The 16 participants completed 100% of all three survey questions. Participants reported using the pilot balloon palpation at 36.36%, 18.18% inject a set volume of air, 15.15% used minimal leak test, 15.15% used minimal occlusive volume test, and 6.06% used cuff manometer for ETT cuff

measurement. For reasons participants revaluate cuff pressure during surgery, 20.34% reassess during lengthy procedures, 18.64% reassess when there is a change in patient position, 15.25% when ventilation parameters change, and 15.25% for other reasons. As an added comment, one participant added the comment air leak around ETT cuff. When asked about the barrier to cuff manometer use, 36.1% of participants reported that the cuff manometer, 13.89% reported not knowing how to use the cuff manometer, and 22.22% trusted their measurement method (Table 1).

Table 1

Survey Report Results



The best practice guideline was presented via email to the DNP Project Chair and Committee for evaluation. Committee members were asked to provide qualitative feedback on adherence to evidence-based practice, the appropriateness of doctoral-level work, and the clearness of the guideline. The guideline was approved by the DNP Project Chair and Committee with no comments or suggestions for alteration to the best practice guideline for the measurement of ETT cuff pressures by a manometer.

Details of Process Measures and Outcome

Resolving the inconsistency of the ETT cuff pressure measurement in surgery is essential in avoiding patient harm, patient billing cost, and hospital supply expenses. Anesthesia providers will be able to use the best practice guideline to make more informed decisions regarding the ETT cuff pressure measurement. The evidence-based recommendation has the potential to decrease patient injury, patient expenses, and hospital expenses (Chism, 2019). Collecting current practice data from anesthesia providers in the project context aided in identifying CRNA needs and barriers to ETT cuff measurement best practice.

Summary

The ETT cuff pressure can cause problem to airway when CRNA provider fail to use manometer to measure ETT cuff pressures. Potential complications of over-inflated ETT cuffs include laryngeal injury, vocal cord paralysis, and patient reintubation (Divatia & Bhowmick, 2005). The best practice guideline is aimed to help ensure patient safety while in intraoperative. A survey study was used to help obtain data to achieve results in the study.

CHAPTER IV – DISCUSSION

Summary

The data collected from the survey indicates that a more significant number of CRNAs used pilot balloon estimation techniques to measure ETT cuff pressures. Pilot balloon palpation, the injection of a set volume of air, and minimal leak tests were the most commonly used ways CRNAs measure ETT cuff pressures. The collected data has shown the common reason for a reassessment of ETT cuff pressure intraoperatively to maintain therapeutic cuff press, provide adequate tidal volumes, and decrease aspiration risk. . The most common issue in the intraoperative setting included CRNA do not have a handheld monometer available to check the cuff's pressure and a lack of information about using the cuff's handheld manometer. The endotracheal tube cuff's primary function is to close the airways while preventing pharyngeal contents' aspiration into the trachea and ensuring no leakage through the cuff during positive pressure ventilation. The cuff pressure should be 20–30 cm H2O in ETT (Sengupta et al., 2004). The tube cuff is insufficiently inflated when not using manometers (Sengupta et al., 2004). Among surveyed anesthesia providers, data collection results conclude that a disparity exists between evidence-based practice and actual clinical practice. Knowledge deficit and limited access to cuff manometers were reported as primary barriers.

This project's strengths were the use of both practical feedback from practicing CRNAs as a basis and peer-reviewed literature in the development of the best practice guideline. Qualitative and quantitative methods were both used to develop the best practice guideline. The current practice of ETT cuff measurement is an everyday routine of ETT cuff re-measurement during surgery. Barriers to ETT cuff pressure measurement

were quantitatively measured by practicing clinicians. The best practice guideline was qualitatively measured by anesthesia research faculty. The literature review found that anesthesia providers' current procedures are often not performed in compliance with the best-recommended recommendations and possibly contribute to adverse effects on patients (Castro & Gopalan, 2016). The literature findings closely mirrored the results from the data collection from practicing CRNAs, highlighting the need for a best practice guideline for ETT cuff pressure measurement.

Interpretation

Data from the literature review coincided with the data from the survey collected. The pilot balloon palpation technique was most frequently used in this research to reassess these cuff pressures of ETT. The data collected showed that the pilot balloon palpation technique was commonly used in cuff pressure measurement. At the same time, literature states that estimation techniques are not the most accurate way of determining cuff pressure. Barriers to using the manometer for ETT cuff pressure measurement included the unavailability of manometers and practitioner knowledge deficit. Multiple factors influence the healthcare practitioner, including intention, motivation, beliefs, social influences, and economic and organizational factors (Castro & Gopalan, 2016). Factors influencing cuff pressure, such as the ETT size, form of the cuff, initial cuff pressure, instruments for measuring cuff pressure, and patient characteristics, should be considered when measured (Kumar et al., 2020).

The discrepancy was observers related to measuring the ETT cuff pressure. The data collected that was observed that the best way to measure the ETT cuff pressure after placing it in the tracheal with a cuff pressure manometer. The evidence-based

recommendation can decrease patient injury, patient expenses, and hospital expenses (Chism, 2019).

Limitations

Since the survey was a questionnaire-based review, the responses may have been skewed. The answers to current practice may not reflect actual clinical practice. Observational research may be more useful in the precise assessment of current clinical practice.

Because of the limited number of CRNAs surveyed, results may not be a true reflection of the current practice of the ETT cuff measurement of all practicing CRNAs. The disadvantages of the initiative include the small number of CRNAs surveyed. Anonymously sent a survey to CRNAs at practicing locations in different operating settings to overcome limitations. While the number of participants in the survey represents only a small portion of practicing CRNAs, the sent survey to CRNAs practicing at sites with varying profit elections and anesthesia practice models.

Conclusion

This best practice guideline aims to potentially reduce poor patient outcomes and costs to the patient and hospital. The project aims to establish evidence-based on the best practice guidelines measuring pressure in ETT cuff. The intraoperative anesthetic approach for measuring ETT cuff pressures is subjective and is dependent on the provider's expectations. The University of Southern Mississippi, Nurse Anesthesia Program, can use the best practice guidelines in NUR 837, NUR 855, and clinical orientation, where cuff measurement is taught. The guideline is potentially useful as it addresses knowledge and experience in hands-on use of manometers in training.

Anesthesia administration can potentially use the collected data and guidelines to ensure evidence-based practice in their department, and address barriers to a manometer that will decrease patient injury and expense, increase satisfaction.

Complications from improperly inflated ETTs are linked to high cuff pressure at the tracheal wall. In addition to the nurse anesthesia profession, data collected, and the resulting evidence-based guideline can educate other healthcare professions that use endotracheal intubation, such as physicians, paramedics, and respiratory therapy. Also, it can be used as continuing education in the healthcare field for licensed professionals using ETT. Recommendations for further study include observational research on the use of manometers.

APPENDIX A - Evaluation Tool

Voluntary Participation and Responses Will be Anonymous.

1. What technique do you most commonly use to estimate ETT cuff pressure intraoperatively? SELECT ALL THAT APPLY.
   - Pilot balloon palpation
   - Minimal leak test
   - Minimal occlusive volume test
   - Minimal occlusive pressure test
   - Injecting a set volume of air
   - Cuff manometer
   - Other (add a comment)

2. What are the reasons that you reassess ETT cuff pressure intraoperatively? SELECT ALL THAT APPLY.
   - Change in ventilation parameters
   - Use of N20
   - Long procedures
   - Change in patient position
   - Routinely reassess
   - Aspiration risk
   - Pediatric patients
   - Other reasons (add a comment)

3. If not using a cuff manometer for ETT cuff pressure measurement, what are the reasons that you do not routinely use cuff manometers to measure ETT cuff pressure? SELECT ALL THAT APPLY.
   - Using cuff manometer
   - Cuff manometer not readily available
   - Consider the duration of surgeries too short
   - Do not know how to use a cuff manometer
   - Do not know the recommended pressures for ETT cuff pressure
   - Too time-consuming
   - Trust own method
   - Do not feel postoperative complications are significant enough
   - Do not consider it best practice
   - Did not know about cuff manometer use for ETT cuff pressure measurement

APPENDIX B –IRB Approval Letter

Office *of*
Research Integrity

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

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NOTICE OF INSTITUTIONAL REVIEW BOARD ACTION

The project below has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services regulations (45 CFR Part 46), and University Policy to ensure:

- The risks to subjects are minimized and reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered involving risks to subjects must be reported immediately. Problems should be reported to ORI via the Incident template on Cayuse IRB.
- The period of approval is twelve months. An application for renewal must be submitted for projects exceeding twelve months.
- FACE-TO-FACE DATA COLLECTION WILL NOT COMMENCE UNTIL USM'S IRB MODIFIES THE DIRECTIVE TO HALT NON-ESSENTIAL (NO DIRECT BENEFIT TO PARTICIPANTS) RESEARCH.

PROTOCOL NUMBER: IRB-20-189
PROJECT TITLE: Measurement of Endotracheal Tube Cuff Pressure: A Policy Proposal
SCHOOL/PROGRAM: School of LANP, Leadership & Advanced Nursing
RESEARCHER(S): Jamare Reed, Mary Jane Collins

IRB COMMITTEE ACTION: Approved
CATEGORY: Expedited
7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

PERIOD OF APPROVAL: May 6, 2020

Donald Sacco Jr.

Donald Sacco, Ph.D.
Institutional Review Board Chairperson

APPENDIX C – DNP Essential

Doctor of Nursing Essentials	**How the Essential is Achieved**
I. Scientific Underpinning for Practice	This best practice recommendation is based on the most current research results about poor patient outcomes caused by the overinflated ETT cuff pressure. The primary outcome of this project was to create the best practice recommendation.
II. Organizational and Systems Leadership for Quality Improvement and Systems Thinking	Evaluate the measurement approach of the ETT cuff pressure by two types of techniques, which are fixed volume and minimal leak test techniques to assess consistency and demonstrate inequalities of the ETT cuff pressure based on the clinical setting findings.
III. Clinical Scholarship and Analytical Methods for Evidence-Based Practice	Applying relevant findings to refine practice guidelines to enhance practice and practice setting by systematic methods were used to accumulate data on the different techniques for measuring the ETT cuff pressure.
V. Health Care Policy for Advocacy in Health Care	The best practice recommendation helps to estimate the ETT cuff pressure in the intraoperative setting to influence stakeholders critically analyze health policy.
VII. Clinical Prevention and Population Health for Improving the Nation's Health	This primary reason for the best practice recommendations is to evaluate care by improving possible postoperative complexities created by the modern methods utilized to estimate the ETT cuff pressure technique.
VIII. Advanced Nursing Practice	The systematic assessment of best practice recommendations to help design to implement and evaluate the current practice of measuring the ETT cuff pressure while reducing the risk of complications to use contemporary evidence-based literature to develop the best practice recommendation to ensure optimal patient care.

APPENDIX D -Literature Matrix

Author/Year/Title	Type of Evidence	Summary or conclusion from source
Bulamba et al, 2017,). Achieving the Recommended Endotracheal Tube Cuff Pressure: A Randomized Control Study Comparing Loss of Resistance Syringe to Pilot Balloon Palpation. *Anesthesiology Research and Practice*, *2017*, 1–7.https://doi.org/10.1155/2017/2032748	Randomized clinical trial	The loss of resistance syringe method was superior to pilot balloon palpation at administering pressures in the recommended range. This method provides a viable option to cuff inflation.
Khan et al, 2016 Measurement of endotracheal tube cuff pressure: Instrumental versus conventional method. *Saudi Journal of Anaesthesia*, *10*(4), 428. https://doi.org/10.4103/1658-354x.179113	Prospective observational study.	The conventional method for ETT cuff inflation and pressure measuring is unreliable. As a routine instrumental cuff pressure, monitoring is suggested.
Sole et al, 2011. *Evaluation of an Intervention to Maintain Endotracheal Tube Cuff Pressure Within Therapeutic Range*. American Journal of Critical Care. https://aacnjournals.org/ajcconline/article/20/2/109/6016/Evaluation-of-an-Intervention-to-Maintain.	Repeated-measure crossover design	The intervention was effective in maintaining cuff pressure within an optimal range, and cuff pressure decreased over time without intervention. The effect of the intervention on outcomes such as ventilator-associated pneumonia and tracheal damage requires further study.
Sultan et al, (2011). Endotracheal Tube Cuff Pressure Monitoring: A Review of the Evidence. *Journal of Perioperative Practice*, *21*(11), 379–386. https://doi.org/10.1177/175045891102101103	Research Support	There has been a recent renewal of interest in the morbidity associated with endotracheal tube cuff overinflation, particularly regarding the rationale and requirement for endotracheal tube cuff monitoring intra-operatively
Tsaousi et al, (2018). Benchmarking the Applicability of Four Methods of Endotracheal Tube Cuff Inflation for Optimal Sealing: A Randomized Trial. *Journal of PeriAnesthesia Nursing*, *33*(2), 129–137. https://doi.org/10.1016/j.jopan.2016.09.002	A double-blind, randomized trial	The air-return back into the syringe method emerges as an attractive and simple-to-perform alternative regarding effective ETT sealing and low incidence of intubation-related morbidity when a cuff manometer is not readily available

Best Practice Guideline for Endotracheal Tube Cuff Pressure

Handheld Monometer

By: Jamare` Reed SRNA, The University of Southern Mississippi

Best Practice Guideline

Executive Summary

This policy is intended to ensure that the cuff pressure of the endotracheal tubes is inflated within the recommended range of 20-30 cm H20. The aim of the project to decrease poor patient outcomes, expenses to the patient, and facility through policy intervention with the use of a cuff handheld manometer. The project's objective is to develop evidence-based on the ETT Cuff Pressure Measurement Policy due to barriers to manometer usage for cuff pressure measurement not appropriately done.

Report of Findings

It is recommended to maintain endotracheal tube cuff pressure within a range of 20 to 30 cm H2O to prevent complications (Balakrishnan & Jacob,2016). Several studies have shown that there is frequent over-inflation of endotracheal tube cuffs by anesthesia providers and that estimation techniques such as palpation technique and minimal occlusive volume technique are incorrect. Cuffs inflated to inappropriately high pressures cause ischemia, reducing tracheal mucosal blood flow, while cuffs inflated at a lower pressure than necessary give rise to inadequate ventilation, aspiration of gastric contents, or extubation due to air leakage (Saracoglu et al., 2014). A disparity has been identified in practice among anesthesia providers related to ETT cuff pressure measurements because the cuff manometer is not readily available (Castro & Gopalan, 2016).

Policy or Best Practice Guidelines

1. The anesthesia provider will inflate the endotracheal tube after intubation to provide area in cuff to create an adequate seal.
2. Connect the pilot balloon manometer and test the cuff pressure is between 20-

30 cm H20.

3. If cuff pressure is not within the range of 20-30 cm H2O, the anesthesia provider will adjust cuff volume and recheck pressure.
4. Document cuff pressure in anesthesia record.

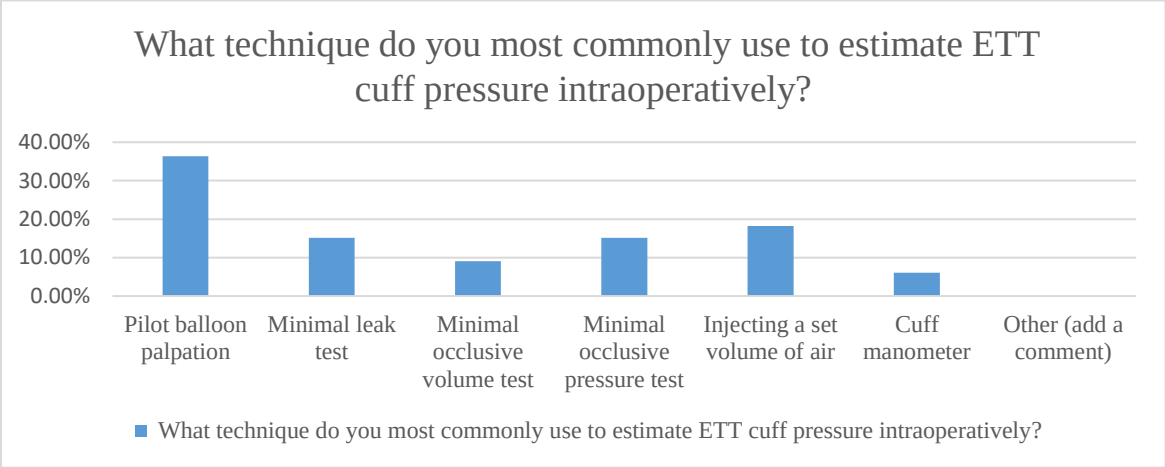
References

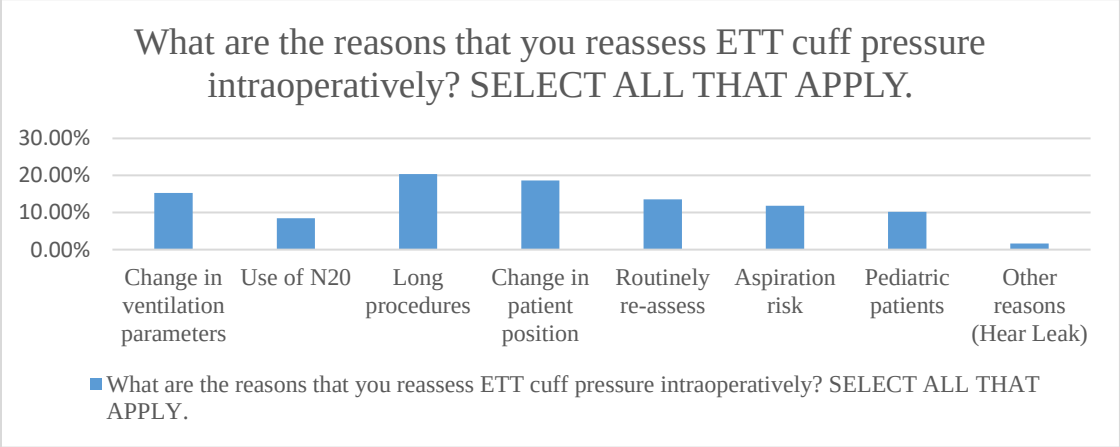
Balakrishnan, S., & Jacob, K. K. (2016, December 15). *Cuff pressure manometer - a luxury or necessity?* https://www.ipinnovative.com/journals/IJCA/article-full-text/3150.

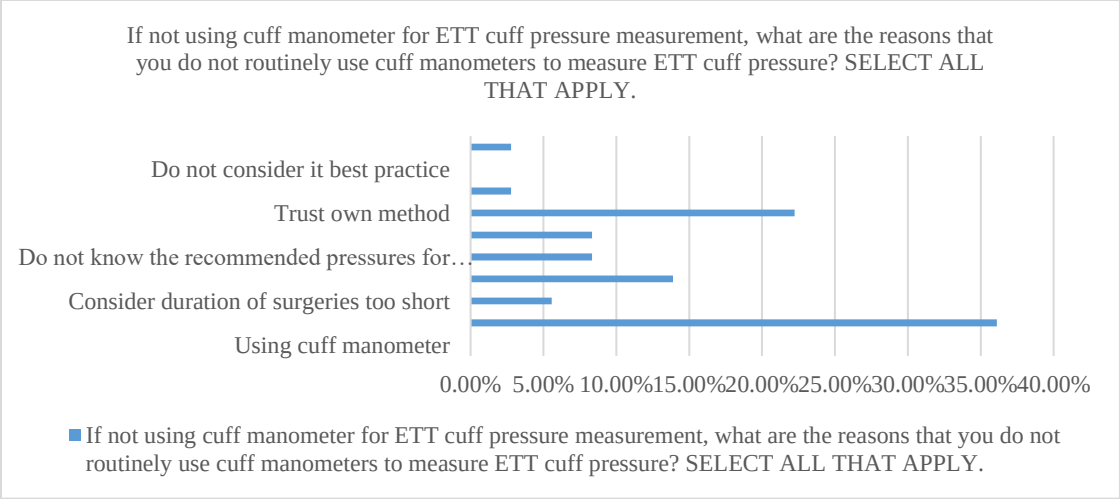
Castro, A. D., & Gopalan, P. (2016). Intraoperative management of ETT and LMA cuff pressures: a survey of anaesthetists' knowledge, attitude and current practice. *Southern African Journal of Anaesthesia and Analgesia*, *22*(5), 151–155. https://doi.org/10.1080/22201181.2016.1234664

Saracoglu, A., Dal, D., Pehlivan, G., & Gögüs, F. Y. (2014). The Professional Experience of Anaesthesiologists in Proper Inflation of Laryngeal Mask and Endotracheal Tube Cuff. *Turkish Journal of Anesthesia and Reanimation*, *42*(5), 234–238. doi: 10.5152/TJAR.2014.87487

APPENDIX F - Survey Report Results







REFERENCES

Alwassia, A., Kistler, C., & Alwassia, A. (2016). Using Ultrasound to Confirm Endotracheal Tube Position in the Intensive Care Unit. *Journal of Anesthesia & Intensive Care Medicine, 1*(2). https://doi.org/10.19080/jaicm.2016.01.555560

American Association of Nurse Anesthetists (AANA). (2019, August 8). *Prolific Providers*. Certified Registered Nurse Anesthetists Fact Sheet. https://www.aana.com/membership/become-a-crna/crna-fact-sheet.

Bhatti, N. I., Mohyuddin, A., Reaven, N., Funk, S. E., Laeeq, K., Pandian, V., & Feller - Kopman, D. (2010). Cost analysis of intubation-related tracheal injury using a national database. *Otolaryngology–Head and Neck Surgery*, *143*(1), 31–36. https://doi.org/10.1016/j.otohns.2009.11.004

Borhazowal, R., Harde, M., Bhadada, R., Dave, S., & Aswar, S. G. (2017). Comparison between Two Endotracheal Tube Cuff Inflation Methods; Just-Seal Vs. Stethoscope-Guided. *Journal Of Clinical And Diagnostic Research*. https://doi.org/10.7860/jcdr/2017/26301.10017

Bulamba, F., Kintu, A., Ayupo, N., Kojjo, C., Ssemogerere, L., Wabule, A., & Kwizera, A. (2017). Achieving the Recommended Endotracheal Tube Cuff Pressure: A Randomized Control Study Comparing Loss of Resistance Syringe to Pilot Balloon Palpation. *Anesthesiology Research and Practice*, *2017*, 1–7. https://doi.org/10.1155/2017/2032748

Castro, A. D., & Gopalan, P. (2016). Intraoperative management of ETT and LMA cuff pressures: a survey of anaesthetists' knowledge, attitude and current practice.

Southern African Journal of Anaesthesia and Analgesia, *22*(5), 151–155. https://doi.org/10.1080/22201181.2016.1234664

Chism, L. A. (2019). *The doctor of nursing practice: a guidebook for role development and professional issues*. Jones & Bartlett Learning.

Cook, T., & Macdougall-Davis, S. (2012). Complications and failure of airway management. *British Journal of Anaesthesia*, *109*, i68–i85. https://doi.org/10.1093/bja/aes393

Divatia, J. V., & Bhowmick, K. (2005). Complications of Endotracheal Intubation. *Principles of Airway Management*, *49*(4), 255–302. https://doi.org/10.1007/0-387-22650-8_9

Gilliland, L., Perrie, H., & Scribante, J. (2015). Endotracheal tube cuff pressures in adult patients undergoing general anaesthesia in two Johannesburg academic hospitals. *Southern African Journal of Anaesthesia and Analgesia*, *21*(3), 81–84. https://doi.org/10.1080/22201181.2015.1056504

Hedberg, P., Eklund, C., & Hogqvist, S. (2015, June 1). Identification of a very high cuff pressure by manual palpation of the external cuff balloon on an endotracheal tube. *AANA Journal*. https://www.ncbi.nlm.nih.gov/pubmed/26137758.

Kaki, A., & Almarakbi, W. (2014). Tracheal tube cuff inflation guided by pressure volume loop closure associated with lower postoperative cuff-related complications: Prospective, randomized clinical trial. *Saudi Journal of Anaesthesia*, *8*(3), 328. https://doi.org/10.4103/1658-354x.136422

Khan, M., Khokar, R., Qureshi, S., Zahrani, T. A., Aqil, M., & Shiraz, M. (2016). Measurement of endotracheal tube cuff pressure: Instrumental versus conventional

method. *Saudi Journal of Anaesthesia*, *10*(4), 428. https://doi.org/10.4103/1658-354x.179113

Kikura, M., Suzuki, K., Itagaki, T., Takada, T., & Sato, S. (2007). Age and comorbidity as risk factors for vocal cord paralysis associated with tracheal intubation. *British Journal of Anaesthesia*, *98*(4), 524–530. https://doi.org/10.1093/bja/aem005

Kring, D. L. (2008). Clinical nurse specialist practice domains and evidence-based practice competencies. *Clinical Nurse Specialist*, *22*(4), 179–183. https://doi.org/10.1097/01.nur.0000311706.38404.cf

Kumar, C. M., Seet, E., & Tom C. R. V. Van Zundert. (2020). Measuring endotracheal tube intracuff pressure: no room for complacency. *Journal of Clinical Monitoring and Computing*. https://doi.org/10.1007/s10877-020-00501-2

Letvin, A., Kremer, P., Silver, P. C., Samih, N., Reed-Watts, P., & Kollef, M. H. (2018). Frequent versus infrequent monitoring of endotracheal tube cuff pressures. *Respiratory Care*, *63*(5), 495–501. https://doi.org/10.4187/respcare.05926

Melnyk, B. M. (2015). *Evidence-based practice in nursing and healthcare: a guide to best practice*. Lippincott Williams & Wilkins.

Mississippi State Department of Health. (2018). *State health plan 2018*. https://msdh.ms.gov/msdhsite/_static/19,0,184,665.html.

Sanaie, S., Rahmani, F., Chokhachian, S., Mahmoodpoor, A., Panahi, J. R., Esfanjani, R. M., … Soleimanpour, H. (2019). Comparison of tracheal tube cuff pressure with two technique: fixed volume and minimal leak test techniques. *Journal of Cardiovascular and Thoracic Research*, *11*(1), 48–52. https://doi.org/10.15171/jcvtr.2019.08

Saracoglu, A., Dal, D., Pehlivan, G., & Gögüs, F. Y. (2014). The professional experience of anaesthesiologists in proper inflation of laryngeal mask and endotracheal tube cuff. *Turkish Journal of Anesthesia and Reanimation, 42*(5), 234–238. https://doi.org/10.5152/tjar.2014.87487

Sengupta, P., Sessler, D. I., Maglinger, P., Wells, S., Vogt, A., Durrani, J., & Wadhwa, A. (2004). Endotracheal tube cuff pressure in three hospitals, and the volume required to produce an appropriate cuff pressure. *BMC Anesthesiology, 4*(1). https://doi.org/10.1186/1471-2253-4-8

Sole, M. L., Su, X., Talbert, S., Penoyer, D. A., Kalita, S., Jimenez, E., … Bennett, M. (2011, March 1). Evaluation of an intervention to maintain endotracheal tube cuff pressure within therapeutic range. *American Journal of Critical Care.* https://aacnjournals.org/ajcconline/article/20/2/109/6016/Evaluation-of-an-Intervention-to-Maintain.

Steven, K. R. (2013). Ace star model of knowledge transformation. American nurses association. photograph, Kathleen R., Ed.D., RN, ANEF, FAAN; The Impact of Evidence-Based Practice in Nursing and the Next Big Ideas. https://ojin.nursingworld.org/MainMenuCategories/ANAMarketplace/ANAPeriodicals/OJIN/TableofContents/Vol-18-2013/No2-May-2013/Impact-of-Evidence-Based-Practice.html.

Stevens, K. R. (2002). ACE star model of the cycle of knowledge transformation. *Nursing Research*. http://sharonbsn.tripod.com/new_page_1.htm.

Sultan, P., Carvalho, B., Rose, B. O., & Cregg, R. (2011). Endotracheal Tube Cuff Pressure Monitoring: A Review of the Evidence. *Journal of Perioperative Practice*, *21*(11), 379–386. https://doi.org/10.1177/175045891102101103

Tadie, J.-M., Behm, E., Lecuyer, L., Benhmamed, R., Hans, S., Brasnu, D., … Guerot, E. (2010). Post-intubation laryngeal injuries and extubation failure: a fiberoptic endoscopic study. *Intensive Care Medicine*, *36*(6), 991–998. https://doi.org/10.1007/s00134-010-1847-z

Tsaousi, G. G., Pourzitaki, C., Chlorou, D., Papapostolou, K., & Vasilakos, D. G. (2018). Benchmarking the applicability of four methods of endotracheal tube cuff inflation for optimal sealing: A randomized trial. *Journal of PeriAnesthesia Nursing*, *33*(2), 129–137. https://doi.org/10.1016/j.jopan.2016.09.002

Whittington, J. W., Nolan, K., Lewis, N., & Torres, T. (2015). Pursuing the triple aim: the first 7 years. *Milbank Quarterly*, *93*(2), 263–300. https://doi.org/10.1111/1468-0009.12122

Zambouri, A. (2007, January). Preoperative evaluation and preparation for anesthesia and surgery. *Hippokratia*. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2464262/.