DNP Scholarly Project Final Approvals

The DNP student Curt Laukhuf **and the Scholarly Project** ETT CUFF MANOMETERS: REDUCING BARRIERS AND INCREASING USE IN THE OPERATING ROOM **meet all the requirements for the degree of Doctor of Nursing Practice at University of Saint Francis-Fort Wayne, IN.**

Date of Final Approval: 6/18/21

DNP Student

Signature: Curt Laukhuf

DNP Faculty Advisor

Signature:

Graduate Nursing Program Director

Signature: Dr Wendy Clark

NAP Program Director

Signature:

Copies to: Student File, Graduate office and attached to the Final Project Manuscript.

ETT Cuff Manometers:

Reducing Barriers and Increasing Use in the Operating Room

Curt E. Laukhuf, SRNA

University of Saint Francis

June 18, 2021

I have read and understand the plagiarism policy as outlined in the course syllabus, the Nursing Student Handbook appropriate to my program of study and the USF Student Handbook relating to the USF Academic Integrity and Plagiarism Policy. By affixing this statement to the title page of my work, I certify that I have not violated any aspect of the USF Academic Integrity/Plagiarism Policy in the process of completing this assignment. If it is found that I have violated any of the aforementioned policy in this assignment, I understand the possible consequences of the act(s), which could include dismissal from USF.

DNP Scholarly Project Final Approval Form

UNIVERSITY of SAINT FRANCIS

DNP Scholarly Project Proposal Initial Approval

To: Curt Laukhuf, DNP, NAP Student

From: Dr. Susan Lown, Course Coordinator NURS 715

Re: DNP Project Proposal Review Council Endorsement

Date: 11-12-2020

DNP Scholarly Project Title: ETT Cuff Manometers: Reducing Barriers and Increasing Use in the Operating Room

DNP Scholarly Project Review Council:

DNP Project Advisor Signature:

Dr. Carla Mueller, Professor Division of Nursing

DNP Project Proposal Review Council Member Signature:

Dr. Gregory Louck, Assistant Professor Division of Nursing and Assistant Director Nurse Anesthesia Program

DNP Project Proposal Review Council Member Signature: Susan Lown, DNP, RN, CNE

Dr. Susan Lown, Associate Professor Division of Nursing Course Coordinator, NURS 715

Date of initial approval by DNP Scholarly Project Review Council: 11-12-2020

1 - Student File
2 - Attached to Proposal

2701 Spring Street
Fort Wayne, Indiana 46808

Phone: 260-399-7999
Fax: 260-399-8156
sf.edu

Abstract

Problem Statement- Anesthesia providers routinely place endotracheal tubes in patients having surgery. Previous studies show that using an ETT cuff manometer to verify cuff pressures are between 20-30 cm H_2O improves patient safety from multiple risks associated with under- or over-inflation. Anesthesia providers at Parkview Whitley Hospital (PWH) used subjective estimation techniques and did not use ETT cuff manometers to verify surgical patients ETT cuff pressures.

Purpose- The project attempted to reduce anesthesia providers perceived barriers to manometer use and increase the frequency of manometer use with operating room intubations at PWH.

Methods- This was a quality improvement project with a one-group pre/post intervention survey that also tracked post-intervention manometer use for a four-week period. The interventions attempted to reduce anesthesia providers perceived barriers related to knowledge, skills, and access to ETT cuff manometers. Interventions included a slideshow presentation, hands-on skills practice, and adding manometers to operating room anesthesia carts.

Inclusion Criteria- The project participants were required to be full-time anesthesia providers at PWH.

Results- Pre- to post-intervention surveys showed improvements in providers' scores related to knowledge, skills, and access to ETT cuff manometers. Anesthesia Providers at PWH used manometers with 91.3% of operating room intubation during the four-week post-intervention period.

Implications- Reducing anesthesia providers' perceived barriers related to knowledge, skills, and access to ETT cuff manometers translated to a high manometer use rate with operating room

intubations. The use of manometers allows providers to verify ETT cuff pressures are kept between 20-30 cm H_2O to maximize patient safety.

Table of Contents

Chapter 1: Introduction

Problem

Problem Statement

Anesthesia providers routinely place cuffed endotracheal tubes (ETT) in patients prior to surgery (Grant, 2013). This requires an ETT cuff to be placed in the patient's trachea then inflated with air to create a seal. Over or under inflation of an ETT cuff can lead to severe patient complications such as: tracheal inflammation, ischemia, ulceration, nerve damage, stenosis, fistulas, rupture, and aspiration (Bulamba et al., 2017; Harvie et al., 2016; Hockey et al., 2016; Liu et al., 2010; Seegobin & Hasselt, 1984). Subjective methods of estimating cuff pressure are inaccurate and often result in values outside the recommended range (Gilliland et al., 2015; Hockey et al., 2016). Evidence shows the use of ETT cuff manometers result in decreased patient complications. Despite the importance of appropriate ETT cuff pressures, providers routinely use subjective testing methods instead of objective measures (Gilliland et al., 2015; Hockey et al., 2016). Anesthesia providers at Parkview Whitley Hospital (PWH) in Columbia City, Indiana, did not have access to manometers and used subjective estimations for all ETT cuff pressure measurements. The inability to confirm safe cuff pressures increase patients' risk for post-operative complications.

Background

Each year there are over 20,000,000 intubations in the United States (Grant, 2013). Correct inflation of an ETT cuff allows for positive pressure ventilation, prevents the escape of anesthetic gases into the operating room, and reduces the risk of aspiration (Gilliland et al., 2015). Low cuff pressures (below 20 cm H_2O) will not form a seal allowing anesthetics gases into the operating room and increase the aspiration risk for the patient (Bulamba et al., 2017;

Seegobin & Hasselt, 1984). Elevated ETT cuff pressures cause the most complications related to patient intubations (Hedberg et al., 2015). High cuff pressures (above 30 cm H_2O) can lead to tracheal inflammation, ischemia, ulceration, nerve damage, stenosis, fistulas, and rupture (Hockey et al., 2016; Liu et al., 2010; Seegobin & Hasselt, 1984). The most common complaint following general anesthesia is a sore throat and occurs in up to 55% of cases (Liu et al., 2010). When ETT cuff pressures are greater than 50 cm H_20 it can completely obstruct tracheal blood flow causing damage and sore throat in under 15 minutes (Liu et al, 2010; Seegobin & Hasselt, 1984).

PICO Question

Will anesthesia providers at Parkview Whitley Hospital, given supplemental education, hands-on practice, and increased access to ETT cuff manometers, increase the use of manometers to measure endotracheal tube cuff pressures with operating room intubations?

Practice Gap and Needs Assessment

Anesthesia providers should utilize an ETT cuff manometer with every intubation in the operating room to ensure ETT cuff pressures are within 20-30 cm H_2O (Bulamba et al., 2017; Gilliland et al., 2015; Grant, 2013; Harvie et al., 2016; Hockey et al., 2016; Liu et al., 2010; Unsal et al., 2018). Cuff pressures between 20-30 cm H_2O permit tracheal mucosal blood flow while still providing an adequate seal (Seegobin, & Hasselt, 1984). Verifying that ETT cuff pressures are between 20-30 cm H20 maximizes patient safety because it maintains the functions and protections provided by the ETT cuff (Bulamba et al., 2017; Gilliland et al., 2015; Harvie et al., 2016; Hockey et al., 2016; Liu et al., 2010). The only way to verify that ETT cuff pressure is between 20-30 cm H_2O is with the use of a manometer.

A gap in practice was identified at PWH. Anesthesia providers at PWH only used subjective ETT cuff pressure measurement techniques for intubations in the operating room. The use of subjective techniques at PWH increases patient risks for complications and prevents consistency from provider to provider. Subjective techniques are unreliable and frequently produce unsafe cuff pressures regardless of the providers' experience level (Bulamba et al., 2017; Gilliland et al., Grant, 2013; Harvie et al., 2016; Hockey et al., 2016; Stewart et al., 2003; Liu et al., 2010; Sultan et al., 2011).

DNP Project Overview

Scope of Project

The project implemented interventions to reduce anesthesia providers' perceived barriers to manometer use and increase provider use of ETT cuff manometers in the operating room. Interventions were led by the project manager and included a slideshow presentation, hands-on skills workshop, and placing manometers in the anesthesia carts. Data was collected on post-intervention frequency of manometer use and perceived barriers before and after interventions. Interventions were developed based on previous studies that identified several common barriers to anesthesia providers using ETT cuff manometers. These barriers included inadequate provider knowledge, limited hands-on experience, and inadequate access to manometers (Abubaker et al., 2019; Ashman et al., 2017; De Castro & Gopalan, 2016; Lee et al., 2019; Stevens et al., 2018). Reducing providers' perceived barriers and increasing manometer use is shown to increase patient safety while maintaining all functions of a cuffed ETT (Bulamba et al., 2017; Gilliland et al., 2015; Harvie et al., 2016; Hockey et al., 2016; Liu et al., 2010).

Stakeholders

Stakeholders of this Quality Improvement (QI) project included Curt Laukhuf (Project Manager, University of Saint Francis DNP student), Dr. Carla Mueller (Project Advisor, University of Saint Francis faculty), Dr. Greg Louck (University of Saint Francis faculty), PWH anesthesia providers, and the operating room manager of PWH.

Budget and Resources

Cost

The projected budget accounted for direct and in-kind costs. Direct costs included the printed material for the pre/post intervention surveys, copies of slideshow presentation for each provider, and copies of the data tracking tool ($25). In-kind costs included the time commitment of the operating room manager and Chief of Anesthesia during project design ($500), time of anesthesia providers during project interventions ($300), and cost of manometers ($300). PWH provided a conference room for the slideshow presentation and hands-on skills workshop at no additional cost. A copy of the proposed budget is attached as Appendix A.

Description of Resources

PWH supplied multiple resources for the project including staff's use of time and use of a conference room. The project manager was responsible for the printing of all paper forms and obtaining access to IBM SPSS to run statistical tests on project data.

Process and Outcomes

General Timeline

Initial literature review and planning for the project began in January 2020. Development of the project continued until final project approval was achieved through University of Saint Francis in November 2020. The project was implemented at PWH in early December 2020. The first day of implementation at PWH included administering the pre-intervention survey, performing interventions, and completing the post-intervention surveys. Tracking the number of post-intervention intubations and manometer use started immediately after interventions were put in place and were tracked for a period of four weeks ending in January 2021. Analysis of data, discussions of project impact, and conclusions occurred from January to May 2021. The final project presentation and dissemination occurred in June 2021.

Setting and Target Population

The project took place at PWH in Columbia City, Indiana. The project focused on full-time anesthesia providers, which included the Chief of Anesthesia and three Certified Registered Nurse Anesthetists.

Expected Outcomes

The project had two expected outcomes. The first expected outcome was a reduction in anesthesia providers perceived barriers to using ETT cuff manometers in the operating room. The second expected outcome was an increase in the use of ETT cuff manometers with operating room intubations.

Risk Analysis

Risk Analysis

No immediate or long-term risks to the participants of this project were identified. All participants were voluntary and required to sign an informed consent at the beginning of project implementation. A copy of the informed consent form is attached as Appendix B. Participants of the project did not receive any special benefits or compensation and were free to withdraw their participation at any time during the project. None of the participants were recorded (audio or video) for this project and deception was not used at any time.

Chapter 2: Synthesis of Supporting Evidence and Project Framework

Framework

The Knowledge-to-Action Model (KTA) was used with this project. KTA was developed at the University of Ottawa by Dr. Ian Graham and his associates (Graham et al., 2006; White et al., 2016). KTA has grown in popularity and has been used in academic and healthcare settings (Field et al., 2014). The two main concepts driving KTA are the creation and application of knowledge (Graham et al., 2006; White et al., 2016). The creation of knowledge starts broad and is refined as it moves through phases until it can be utilized in an action cycle to create change (Graham et al., 2006; White et al., 2016). The broad stages of knowledge creation include inquiry, synthesis, and primary research (White et al., 2016). Once the knowledge is refined, tools are utilized to present and apply new knowledge (Graham et al., 2006; White et al., 2016). There are seven phases contained in KTA that are identified below:

1. Problem identification
2. Knowledge changed to local context
3. Assess barriers
4. Select interventions to promote knowledge use
5. Monitor the use of knowledge
6. Evaluate outcomes
7. Sustain the use of knowledge (Graham et al., 2006).

During each of the seven phases feedback was gathered so adjustments could be made to promote successful implementation (Graham et al., 2006; White et al., 2016). The use of KTA in healthcare helps with continual learning and reduces the gap between what is known by providers and the patients they serve (Willis et al., 2017).

The QI project at PWH was guided by KTA. First, published research was gathered showing the benefits of using ETT cuff manometers and a practice gap was identified. Anesthesia providers and the operating room manager were contacted to gain support for the project and identified as key supporters. A meeting was held to create a shared vision for the project between key supporters and the project manager. The operating room manger was a point of contact for the project manager. The head of the anesthesia department agreed to the aims of the project and served as a communication medium between the anesthesia providers and the project manager. Barriers to using ETT cuff manometers were assessed before and after interventions which included a slideshow presentation, hands-on skills workshop, and adding manometers to anesthesia carts. After interventions were implemented the number of operating room intubations and the frequency of manometer use were tracked for four weeks. The data collected during implementation was evaluated and analyzed to see if project aims and outcomes were reached. To encourage sustained knowledge each participant was provided with individual copies of educational material, recommended best practices, and continued access to ETT cuff manometers in the operating room anesthesia carts after project completion.

Literature Review

A comprehensive literature review was completed. Search engines and databases were used to find pertinent research studies and journal articles. A combination of 30 filtered and raw databases were used. Many of the databases and search engines did not return useful results due to the specific nature of the topic. The search engines that provided useful results included: CINAHL Plus, EBSCO, EMCARE, ProQuest, PubMed, Cochrane Reviews, and Google Scholar. Inclusion criteria required articles to be peer reviewed, but a publication date was not used to help with the comprehensive nature of the search. Keywords included: endotracheal tube, endotracheal tube cuff, endotracheal tube cuff manometer, objective cuff measuring, and Knowledge to Action Framework. Current guidelines were sought by searching five separate databases to include the National Guideline Clearinghouse and the American Association of Anesthesiologists website. Additionally, the American Association of Nurse Anesthetists website was searched for pertinent studies. To help aid in finding productive material the university librarians were consulted for additional search techniques. The librarians along with using the interlibrary loan request program resulted in multiple additional articles. Several high-quality articles were identified, and their reference lists were used to find additional articles. The aim was to perform a comprehensive search related to ETT cuff pressures, measuring techniques, and barriers to use.

Supporting Evidence

ETT Cuff Pressure

Modern ETTs utilize a high volume and low-pressure inflatable cuff to seal air and surgical gases from escaping around the tube and hold the tube in the trachea (Hockey et al., 2016). The cuff also allows the anesthesia provider to apply positive pressure ventilation and provides protection from aspiration of stomach contents into the lungs (Gilliland et al., 2015; Hockey et al., 2016). The landmark study by Seegobin and Hasselt (1984) used endoscopic photographs to monitor tracheal mucosal blood flow under differing amounts of cuff pressure. This study found tracheal cuff pressures ranging from 20-30 cm H_2O does not hinder mucosal blood flow yet still provides aspiration protection (Seegobin, & Hasselt, 1984). Thirty-six years later, the recommended pressure for ETT cuffs continues to be 20-30 cm H_20 (Bulamba et al., 2017; Grant, 2013; Harvie et al., 2016; Hedberg et al., 2015; Hockey et al., 2016; Lizy et al., 2014; Youngsuk et al., 2019).

Cuff pressures less than 20 cm H_20 are considered underinflated (American Thoracic Society, n.d; Seegobin & Hasselt, 1984). Underinflated cuffs can let anesthetic gases escape into the operating room and place the patient at risk for aspiration. Aspiration during surgery can result in ventilator associated pneumonia (VAP), increased morbidity, mortality, longer hospital stays, and increased medical costs (American Thoracic Society, n.d; Bulamba et al., 2017). Current guidelines for the prevention of VAP state that cuff pressures should be maintained above 20 cm H_20 (American Thoracic Society, n.d). ETT cuff pressures need to be monitored because they will change over time (Alzahrani et al., 2015).

Cuff pressures greater than 30 cm H_20 are considered elevated and can surpass tracheal mucosal perfusion pressure reducing blood flow to the tissues (Seegobin & Hasselt, 1984). When cuff pressures are higher than 50 cm H_20 it can completely obstruct blood flow and cause injury in 15 minutes (Hockey et al., 2016; Seegobin & Hasselt, 1984). Elevated cuff pressures have been shown to cause tracheal mucosal ischemia, ulcerations, inflammation, stenosis, fistulas, sore throat, and ruptures (Hockey et al., 2016; Liu et al., 2010, Seegobin & Hasselt, 1984). The most common complications from elevated cuff pressures are sore throat, post-operative cough, hoarseness, and bloody sputum (Liu et al., 2010). Post-operative sore throats occur in over 50% of patients after general anesthesia due to elevated cuff pressures (El-Boghdadly et al., 2016; Liu et al., 2010).

Cuff Pressures are Dynamic

Cuff pressures change over time and are impacted by several factors associated with surgery. Changes in patient position, use of nitrous gas, and laparoscopic surgery are all known to change ETT cuff pressures. Surgical patients start in the supine position for intubation. Once intubated, patients are moved based upon the type of operation that is to be performed. Changes in patient position can increase or decrease ETT cuff pressure (Lizy et al., 2014; Olsen et al., 2016; Pehlivan et al., 2016). Significant cuff pressure changes occur during all surgical positioning (Lizy et al., 2014). The Trendelenburg position is associated with a large increase in cuff pressure, especially in the obese population (Pehlivan et al., 2016). Patient position changes can cause unsafe ETT cuff pressures and monitoring is required to ensure values stay between the recommended 20-30 cm H_20 (Lizy et al., 2014; Olsen et al., 2016; Pehlivan et al., 2016).

Anesthesia providers often use nitrous gas as an inhalation adjunct during surgical procedures. Nitrous oxide can rapidly diffuse through an ETT cuff causing a progressive rise in ETT cuff pressures (Hockey et al., 2016; Mogal et al., 2018). Anesthesia providers need to closely monitor cuff pressures when nitrous oxide is being used to maintain ETT cuff pressures between 20-30 cm H_20 range (Hockey et al., 2016; Mogal et al., 2018).

Laparoscopic surgery is a common surgical approach that can result in elevated ETT cuff pressures (Geng, Hu, & Huang, 2015; Lakhe & Sharma, 2018; Rosero et al., 2018; Youngsuk et al., 2019). Laparoscopic surgeries require insufflation of the abdomen with carbon dioxide to create a space for the surgeon to work (Geng et al., 2015). Insufflation increases pressure in the abdomen and makes it harder to ventilate the patient. Increased airway pressure is needed to inflate the lungs against higher abdominal pressures and causes an increase in ETT cuff pressure (Rosero et al., 2018; Lakhe & Sharma, 2018). Anesthesia providers need to closely monitor cuff pressures during laparoscopic surgery as they can increase above the safe range (Geng et al., 2015; Kwon et al., 2019; Lakhe, & Sharma, 2018; Youngsuk et al., 2019).

Methods of ETT Cuff Pressure Measurement

Subjective measurement techniques for ETT cuff pressures are commonly used by anesthesia providers (Bulamba et al., 2017; Gilliland et al., 2015; Grant, 2013; Harvie et al., 2016; Hockey et al., 2016). Common subjective techniques include pilot balloon palpation, fixed volume, and the minimal leak test (Hockey et al., 2016). All subjective techniques are an estimation and do not verify that cuff pressure is in the recommended range (Hockey et al., 2016). Anesthesia providers cannot safely use subjective techniques to inflate or measure safe cuff pressure regardless of their experience levels (Bulamba et al., 2017; Gilliland et al., 2015; Hockey et al., 2016; Stewart et al., 2003). The use of subjective methods of cuff measurement frequently result in elevated cuff pressures above the safe range of 20-30 cm H_20 (Bulamba et al., 2017; Gilliland et al., Grant, 2013; Hockey et al., 2016; Stewart et al., 2003). Providers cannot reliably identify dangerously high pressures with subjective estimation techniques and place the patient at higher risk for complications (Bulamba et al., 2017; Gilliland et al., Grant, 2013; Harvie et al., 2016; Hockey et al., 2016; Stewart et al., 2003; Liu et al., 2010; Sultan et al., 2011).

An ETT cuff manometer is an objective measurement tool that displays the pressure inside the cuff. Having a measurable value eliminates the need for subjective estimation techniques and verifies that pressures are in the recommended range. Cuff manometers are non-invasive, technically simple, and provide instant results (Leung et al., 2016). The use of a manometer is recommended and decreases airway complications related to intubation compared to subjective techniques (Bulamba et al., 2017; Gilliland et al., 2015; Grant, 2013; Harvie et al., 2016; Hockey et al., 2016; Liu et al., 2010; Unsal et al., 2018). Historically, national anesthetic associations around the world have not addressed intraoperative cuff monitoring despite the evidence to support manometer use (Sultan et al., 2011). In recent years, some countries have started to institute guidelines that require immediate access and use of manometers by anesthesia providers with ETT intubations (Canadian Anesthesiologists' Society, 2020; Checketts et al., 2016). Currently, the United States and the American Society of Anesthesiologists are lacking any guidelines or minimum standards relating to intraoperative ETT cuff pressure measurement and monitoring (Hockey et al., 2016). The current standards do not maintain consistent safe cuff pressures and increase patient risks (Grant, 2013). Despite the lack of current guidelines, the evidence clearly supports the use of manometers (Bulamba et al., 2017; Gilliland et al., 2015; Grant, 2013; Harvie et al., 2016; Hockey et al., 2016; Liu et al., 2010; Unsal et al., 2018).

Barriers to Manometer Use

Outside of the few countries with specific guidelines for intraoperative ETT cuff pressure measuring, anesthesia providers have no consistency or standardization regarding cuff pressures (De Castro & Gopalan, 2016). Common barriers to manometer use included limited provider knowledge, skills, and access to manometers (Abubaker et al., 2019; Ashman et al., 2017; De Castro & Gopalan, 2016; Lee et al., 2019; Stevens et al., 2018). Most anesthesia providers have never utilized or received education on the use of manometers (Abubaker et al., 2019; De Castro and Gopalan, 2016). A survey of anesthesia providers found that less than 40% of respondents knew the recommended safe ETT cuff pressure range (Lee et al., 2019). Anesthesia providers need additional education related to manometers and cuff inflation monitoring (Dassanayake, 2018; De Castro et al., 2016; Stevens et al., 2018; Sultan et al., 2011).

Another common barrier is a lack of access to manometers in the operating room. An ETT cuff manometer is not a tool routinely stocked in anesthesia carts at most hospitals. Providers are not able to verify cuff pressures if they do not have the required tool. Manometers are inexpensive, but many providers reported not having access to them in the operating room (Ashman et al., 2017; De Castro and Gopalan, 2016; Lee et al., 2019). The use of manometers has become common with intubated patients in intensive care units but has had a slower integration in the operating room (Abubaker et al., 2019).

Literature Limitations

The literature supported the intraoperative use of manometers and cuff monitoring. Additional studies are needed to examine how frequently the cuff pressure should be checked as most recommendations are vague. Only one study gave a measurable time recommendation of checking the cuff pressure at least once every hour in the intraoperative period (Dassanayake, 2018).

Practice Recommendations

After completing a comprehensive review of the literature, the following practice recommendations were made:

1. Cuff pressure should be maintained between 20-30 cm H_2O **(**Bulamba et al., 2017; Grant, 2013; Hockey et al., 2016; Lizy et al., 2014; Seegobin & Hasselt, 1984**;** Youngsuk et al., 2019)
2. Manometers should be used and readily available on anesthesia carts (Ashman et al., 2017; Hockey et al., 2016; Gilliland et al, 2015; Stevens et al., 2018**)**
3. Anesthesia providers should be given supplemental education and hands on practice with ETT cuff manometers (Ashman et al., 2017; Dassanayake, 2018; De Castro et al., 2016; Stevens et al., 2018; Sultan et al., 2011)

Summary of Supportive Evidence

The safe range for ETT cuff pressure is between 20-30 cm H_2O. Pressures in this range will provide an adequate seal while maintaining tracheal mucosa blood flow (Bulamba et al., 2017; Harvie et al., 2016; Hedberg et al., 2015; Hockey et al., 2016; Lizy et al., 2014; Seegobin, and Hasselt, 1984; Youngsuk et al., 2019). Many anesthesia providers use inaccurate and unmeasurable subjective cuff pressure inflation methods such as pilot balloon palpation, minimal leak test, or a fixed volume technique (Bulamba et al., 2017; Gilliland et al., 2015; Grant, 2013; Hockey et al., 2016; Liu et al., 2010; Lizy et al., 2014). The use of subjective methods is inconsistent and leads to inappropriate ETT cuff pressures (Gilliland et al., 2015; Hockey et al., 2016). Cuff pressure is dynamic and can change over the course of surgery. Factors that influence cuff pressure include position changes, use of nitrous oxide gas, and laparoscopic surgery (Grant, 2013; Hockey et al., 2016; Lizy et al., 2014; Youngsuk et al., 2019). The use of ETT cuff manometers can confirm cuff pressures and decrease patient postoperative complications (Bulamba et al., 2017; Harvie et al., 2016; Hockey et al., 2016).

Chapter 3: Project Design

Methodology

Plan, Do, Study, Act (PDSA) cycles for quality improvement were used as the methodological model for this DNP project. PDSA cycles are commonly used with QI projects and helps minimize variation and improves a project's desired outcome (Rouen, 2020). The PDSA method was chosen because it was a simple, yet effective, way to test the changes being implemented. The first phase of PDSA was coming up with the plan. The plan consisted of a statement of what was being tested, the measurement outcome desired, and the steps needed to accomplish it (AHRQ, n.d). The second phase was the "Do" phase. That occurred when the project manager implemented the designed interventions which included a slideshow presentation, hands-on skills workshop, and adding manometers to anesthesia carts. The third phase was called "Study" and allowed the author to study the results from implementation, learn, and assess if goals were accomplished. The final phase is the "Act" phase which assessed the overall success and determined if changes were required before the next PDSA cycle (AHRQ, n.d). The project manager used PDSA cycles for each step of project implementation to gauge how successfully each step was implemented and if different approaches were needed.

Project Design

The project was a QI project that was data-based and focused on improving a clinical process or outcome. Three interventions were performed by the project manager including a slideshow presentation, hands-on skills workshop, and placement of manometers in the anesthesia carts. The project utilized a one-group pre/post-intervention survey along with tracking post-intervention manometer use with a data collection tool (manometer use tracking form). The pre/post-intervention survey and data collection tool were paper forms created by the project manager after an unsuccessful search of nursing, medical, and educational research for appropriate tools. Face validity of the pre/post-intervention survey and manometer use tracking form was established by a nurse anesthesia content expert prior to implementation.

Ethical Considerations

The project received approval from the Institutional Review Board at the University of Saint Francis prior to implementation. The approval letter from the USF IRB is attached as Appendix C. To comply with University of Saint Francis requirements, CITI Training was completed by the project manager between January 31, 2020 and February 2, 2020. A copy of the completed CITI training certificates is attached as Appendix D. Approval by the Parkview IRB was not needed, which is stated in the facility letter of support attached as Appendix E. All participation was voluntary, and participants signed an informed consent (previously referenced as Appendix B) at the beginning of project implementation. To protect participant confidentiality no identifiable information was utilized in the project. Unique identification numbers were randomly assigned to link each participant's pre/post surveys and data collection tool forms. Participants of the project did not receive any special benefits or compensation and were free to withdraw their participation at any time during the project. None of the participants were recorded (audio or video) for this project and deception was not used at any time.

Project Schedule

Project implementation began in December 2020 and concluded in January 2021. The final project presentation to USF faculty and peers occurred in June 2021. A copy of the project timeline is attached as Appendix F.

Implementation Methods

The project incorporated three interventions to reduce anesthesia providers' perceived barriers to using manometers. The interventions included a slideshow presentation, hands-on skills workshop, and placement of manometers in the anesthesia carts.

Slideshow Presentation

The slideshow presentation was delivered by the project manager at PWH in early December 2020. The slideshow was created by the project manager and approved by both the DNP project advisor and a nurse anesthesia subject matter expert prior to implementation. The location of the presentation was a conference room at PWH. All anesthesia providers were encouraged to attend and were notified well in advance of the implementation date by the Chief of Anesthesia. The presentation was concise and took approximately 15 minutes. It covered the project aims, background, need, and evidence-based recommendations relating to the use of ETT cuff manometers. All providers in attendance were given a paper copy of the presentation to keep as a reference. The providers were also given an opportunity for questions and comments following the presentation. A copy of the slideshow presentation is attached as Appendix G.

Hands-On Skills Workshop

The hands-on skills workshop was led by the project manager and occurred immediately after the slideshow presentation. The supplies needed for the workshop included a cuffed endotracheal tube and ETT cuff manometer. Each provider had the opportunity for hands-on practice with the manometer and to ask questions after the project manager gave a demonstration. Providers were able to correctly connect, inflate, read pressures, and deflate ETT cuffs with the manometers during the workshop. The workshop was succinct to respect the providers' time and lasted approximately 10 minutes.

Addition of Manometers to Anesthesia Carts

Manometers were added to the anesthesia carts in the operating rooms immediately after the hands-on skills workshop. This intervention also took place in early December 2020 at PWH. The same manometers utilized in the hands-on workshop were used in the anesthesia carts to ensure familiarity. Providers were shown the manometer storage location on the anesthesia carts, which was the same in each operating room to ensure continuity. The project manager was responsible for adding the manometers to the anesthesia carts.

Measures/Tools/Instruments

The project utilized a pre/post-intervention survey and a data collection tool (manometer use tracking form). These tools were in paper form and were created by the project manager after an unsuccessful search of nursing, medical, and educational research for appropriate tools. Face validity of the pre/post-intervention survey along with the manometer use tracking form was established by an anesthesia content expert prior to implementation.

Pre/Post-Intervention Survey

The pre-intervention survey is attached as Appendix H and consisted of three demographic questions, four multiple choice questions, six Likert scale statements, and three open-ended questions. The questions were pre-identified to correlate with specific outcomes, and the multiple-choice questions were based on key learning objectives from the slideshow presentation. The survey identified the providers' knowledge and perceived barriers to using ETT cuff manometers. After interventions were completed, including a slideshow presentation, hands-on skills workshop, and the addition of manometers to the anesthesia carts, the participants completed the post-intervention survey. The post-intervention survey was the same as the pre-intervention survey with the exclusion of the demographic questions and is attached as Appendix I. Comparing the pre/post-intervention surveys provided a way to measure if perceived barriers (knowledge, skills, access) were reduced. To ensure confidentiality of data, no patient information was used, and each form had a unique provider identifier to link pre/post-intervention surveys for comparison.

Data Collection Tool (Manometer Use Tracking Form)

Use of the data collection tool began after interventions were in place and is attached as Appendix J. The data collection tool tracked the number of post-intervention operating room intubations and post-intervention ETT cuff manometer usage. Each participating anesthesia provider filled out a new tracking form after every intubation they performed in the operating room. The form was designed for easy use by allowing providers to circle their unique identifier, if an intubation was performed, and if a manometer was used. The forms were kept in the anesthesia provider office along with a sealed drop box where the completed forms were deposited after completion. The collection box contained a large visible label with instructions to remind providers to complete the forms along with the project manager's contact information to help with concerns or issues. This data allowed a post-intervention percentage of manometer use to be calculated.

Evaluation Plan

The project had two aims each with accompanying measures and outcome indicators:

1. Reduce anesthesia providers' perceived barriers pertaining to the use of endotracheal tube cuff manometers.

    1a. Pre to post-intervention surveys will show a reduction in anesthesia providers' perceived knowledge barriers of manometers as evidenced by a 10% increase in mean scores of related questions. This was measured by comparing pre/post-intervention survey items 1, 2, 3, 9, and 10.

    1b. Pre to post-intervention surveys will show a reduction in anesthesia providers' perceived experience/skills barriers to manometer use as evidenced by a 10% increase in mean scores of related questions. This was measured by comparing pre/post-intervention survey items 5 and 6.

    1c. Pre to post-intervention surveys will show a reduction of anesthesia providers' perceived access barriers to manometers as evidenced by a 10% increase in mean scores of related questions. This was measured by comparing pre/post-intervention survey items 7 and 8.

2. Increase anesthesia providers' use of endotracheal tube cuff manometers with intubations in the operating room.

    2a. Anesthesia providers will use an ETT cuff manometer in 50% of operating room intubations for a four-week period following the slideshow presentation, hands-on skills lab, and addition of manometers to anesthesia carts. This was measured with data from the manometer use tracking tool.

2b. Pre to post-intervention surveys will show an increase in providers' intentions to use manometers as evidenced by a 10% increase in mean scores of related questions. This was measured by comparing pre/post-intervention survey item 4.

Methods for Collection of Data

Data collection consisted of primary data gathered via a one group pre/post-intervention survey and a data collection tool to track post-intervention manometer use. Providers were randomly assigned a unique identifier found at the top of their pre/post-intervention surveys. Providers used the same unique identifier at the top of each submitted data collection tool. The pre-intervention survey was given to providers by the project manager in paper form in early December 2020 in a conference room at PWH. The intent of the survey was to gather demographic information of the participants, identify perceived barriers to manometer use, and assess baseline knowledge. The post-intervention surveys were completed by anesthesia providers immediately after the slideshow presentation, hands-on skills workshop, and placement of manometers in the anesthesia carts. The post-intervention survey mirrored the pre-intervention survey with the exemption of the demographic questions. Comparing pre/post-intervention scores to correlated outcome measures allowed the project manager to see if the project aims were achieved.

After the post-intervention surveys were completed, anesthesia providers were shown the location of the manometer use tracking forms. These forms were used to track the number of post-intervention operating room intubations and ETT cuff manometer use. Providers were guided on how to fill out the data collection tool and provided an opportunity to ask questions to the project manager. The manometer use tracking forms and a sealed collection box were placed at an area of convenience frequented by the providers for charting after each surgical case. Participants agreed to use manometer tracking forms for a four-week time period. Tracking the number of intubations and manometer use allowed the percentage of manometer use to be calculated. Calculating post-intervention manometer use allowed the project manager to see if the second project aim was accomplished.

Data Analysis Plan

The project manager was responsible for all data collection and verification of data completeness. The paper surveys and manometer tracking forms did not have any personal identifiable characteristics outside of a unique identifier to link the pre/post-surveys and forms to the same participant. During project implementation, the completed manometer tracking forms were kept in a sealed storage box in the provider charting office until collected by the project manager at the ends of weeks two and four. At the conclusion of the data collection period, all physical data was stored at the project manager’s residence in a secured office filing cabinet. All data was aggregate data. The data was cleaned and inputted into SPSS for data analysis and statistics by the project manager. Electronic data was stored on the University of Saint Francis password protected OneDrive. There were no patient or provider identifiers on electronic data, so it was not required to be encrypted.

Dissemination Plan

After project completion, the findings were emailed to the Chief of Anesthesia at PWH. All other participants were sent a copy of the final manuscript upon request. Once the final project was disseminated, all physical data was destroyed by use of a paper shredder and all electronic data was deleted. The completion of the project included doing a professional slideshow presentation covering the project aims, methods, outcomes, results, analysis, and conclusions to USF faculty and students. The final presentation occurred in June 2021. Participant confidentiality was maintained during all phases of the project.

Chapter 4: Results and Outcomes Analysis

Data Collection Techniques

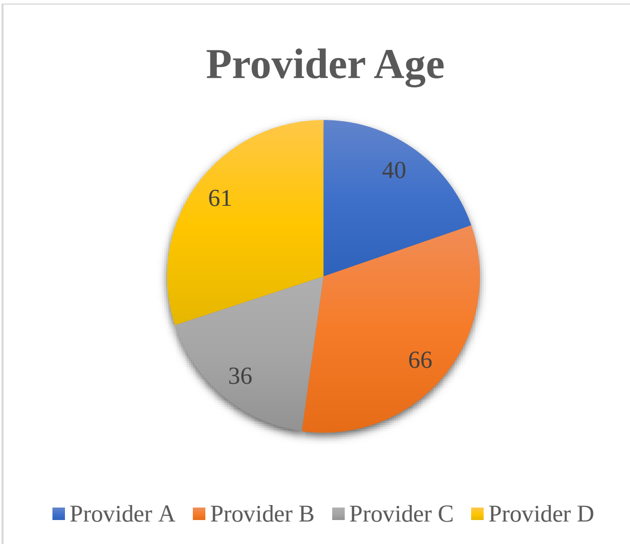
Data collection was completed by the project manager and consisted of primary data gathered via a one-group pre/post-intervention survey and a data collection tool to track post-intervention manometer use. The pre/post-intervention surveys were collected immediately prior to and following interventions on December 4, 2020 at PWH. All four PWH anesthesia providers completed the pre/post-intervention surveys. Manometer use tracking forms were collected at two- and four-weeks post-interventions on December 18, 2020 and January 1, 2021. A total of 23 manometer use forms were completed over the four-week tracking period. The data collected was then put into SPSS version 26 for analysis.

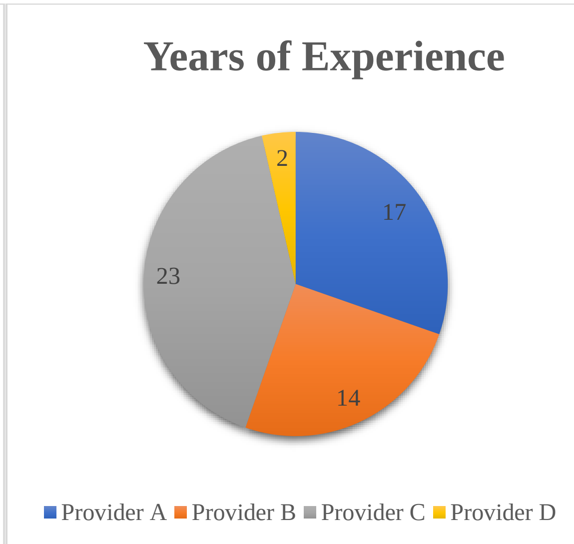
Measures/Indicators

Once the data was placed into SPSS, it was separated into demographic information and individual survey questions. The data from each survey question was then grouped by its correlating project aim and outcome measure.

Demographic Questions

Three demographic questions were utilized on the pre-intervention survey. The data showed an average provider age of 52 years old with a range from 36 to 66 years old. The providers had an average of 14 years of anesthesia experience with a range from 2 to 23 years. All four providers worked at more than one hospital.





Aim 1

The first project aim was to reduce anesthesia providers' perceived barriers pertaining to the use of endotracheal tube cuff manometers. There were three measured outcomes associated with this aim and all three were met.

Measure 1a

Pre- to post-intervention surveys will show a reduction in anesthesia providers' perceived knowledge barriers of manometers as evidenced by a 10% increase in mean scores of related questions.

Measure 1a was met with a 120% increase in correlated multiple-choice questions and a 37.9% increase in Likert scale questions from the pre/post-intervention surveys. Measure 1a compared pre/post-intervention survey items 1, 2, 3, 9, and 10. The data showed the pre-intervention scores for multiple choice questions were 5/12 (0.416) which increased to a post-intervention score of 11/12 (0.916). The average pre-intervention Likert scale score was 3.625 and the post-intervention average rose to 5.

Measure 1b

Pre- to post-intervention surveys will show a reduction in anesthesia providers' perceived experience/skill barriers to manometer use as evidenced by a 10% increase in mean scores of related questions.

The measure 1b was met with a 33.3% increase in mean scores. This was measured by comparing pre/post-intervention survey items 5 and 6. The Likert scale pre-intervention average scores for these questions was 3.75 and the post-intervention average rose to 5.

Measure 1c

Pre- to post-intervention surveys will show a reduction of anesthesia providers' perceived access barriers to manometers as evidenced by a 10% increase in mean scores of related questions.

Measure 1c was met for this project with a 225% increase in mean scores. This was measured by comparing pre/post-intervention survey items 7 and 8. The data for these questions showed a pre-intervention Likert scale average of 1.5. The post-intervention average increased to 4.875.

Aim 2

The project's second aim was to increase anesthesia providers' use of endotracheal tube cuff manometers with intubations in the operating room. This aim had two associated measures both of which were met.

Measure 2a

Anesthesia providers will use an ETT cuff manometer in 50% of operating room intubations for a four-week period following the slideshow presentation, hands-on skills lab, and addition of manometers to anesthesia carts.

This was measured with data from the manometer use tracking tool. A manometer was used in 21 out of 23 possible operating room intubations over the four-week data collection period. This equaled a 91.3% use rate. The two occurrences when manometers were not used during data collection, the providers indicated they forgot to use them.

Measure 2b

Pre- to post-intervention surveys will show an increase in providers' intentions to use manometers as evidenced by a 10% increase in mean scores of related questions.

Measure 2b was met. This was measured by comparing pre/post-intervention survey item 4. The pre-intervention score average was 0% (0/4). The post-intervention score increased to 100% (4/4).

Data Analysis Inferences

The data collected from the pre/post-intervention surveys and manometer use tracking forms was analyzed for inferences.

Pre-Intervention

The pre-intervention data showed a provider knowledge deficit pertaining to the key learning objectives of the project. The data revealed that 50% of the providers did not know the safe recommended ETT cuff pressure range, and 0% knew how fast injury could occur from high cuff pressures. The highest pre-intervention survey scores were regarding providers perceived experience and skills with a manometer. The higher scores in this area could represent some providers' previous exposure to ETT cuff manometers. The data pertaining to anesthesia providers perceived access to manometers had the lowest scores of all measures for aim 1. This was an expected finding because providers did not have any access to manometers prior to project implementation. No providers identified using a manometer as their planned method to check ETT cuff pressure prior to interventions. No information was gained from the open-ended questions.

Post-Intervention

After interventions were in place, there was an increase in all measured outcome indicators above the project goals. The post-survey revealed a 120% increase of knowledge-based multiple-choice questions based on key learning objectives. All providers were able to identify the safe ETT cuff pressure range and the time frame in which injury can occur. After interventions, all providers indicated that using manometers would benefit their patients, and 100% of providers planned on using manometers in their practice. The largest increase was seen in perceived access to manometers with a 225% increase in scores. The improvement seen in knowledge, skills, and access to manometers indicates the project interventions were successful. The high frequency of post-intervention manometer usage (91.3%) indicated that improving provider knowledge, skills, and access can have a positive impact on manometer use. No information was gained from the post-intervention open-ended questions.

Gaps

The project had participation from all four of the possible anesthesia providers at PWH. The small number of anesthesia providers resulted in a small sample size, which inhibited the generalization of the project results.

Unanticipated Consequences

No negative consequences were discovered during the project, but it did reveal that all four anesthesia providers work at multiple facilities. Although it was not tracked as part of the project, the providers working at multiple facilities could broaden the project's impact beyond PWH.

Expenditures

The project manager spent $25 on materials to create and print the pre/post-intervention surveys and manometer use tracking forms. For data analysis a six-month lease of IBM's SPSS Version 26 was purchased by the project manager for $75. Both costs were considered in-kind costs for the project.

Chapter 5: Leadership and Management

Organizational Culture

An organizational assessment using the Institutional and Organizational Assessment (IOA) model was conducted for PWH. Conducting an organizational assessment was important to gauge PWH's culture and readiness for an evidence-based quality improvement project. An organization's culture can promote or hinder the implementation of an evidence-based project (White et al., 2016).

IOA Model

The IOA model was developed by Universalia (a Canadian management consulting firm) and the International Development Research Centre (Universalia, 2020). The IOA model is a flexible and forward-thinking framework used to guide organizational assessments (Universalia, 2020). The IOA model assesses an organization's strengths and weaknesses by its performance (Lusthaus et al., 2002). The IOA model identified good performance as a balance of efficiency, effectiveness, relevance, and financial viability (Lusthaus et al., 2002). The IOA model involved examining an organization's capacities, external environment, and motivations in relation to its overall performance (Universalia, 2020).

Organizational Motivation

The IOA model understands the motivation of an organization as what gives it personality, quality, and motivation (Lusthaus et al., 2002). To assess PWH's motivation a review of its history, mission, culture, and incentives were completed.

Parkview Health can trace its roots as a not-for-profit healthcare provider back to 1878 in downtown Fort Wayne, Indiana. Over time, Parkview Health has expanded to consist of ten hospitals that serve northeastern Indiana and northwest Ohio (Parkview Health, 2020a). The entire Parkview Health system covers a population of over 895,000 people and has more than 13,000 employees (Parkview Health, 2020a). Parkview Health has developed into its region's largest employer (Parkview Health, 2020a).

PWH is one of the ten hospitals that fall under Parkview Health. PWH was established in 1951 in Columbia City, Indiana (Parkview Health, 2016). The hospital moved to a brand-new building in 2011 and is the only hospital in Whitley County (Parkview Health, 2016). The new facility has 30 inpatient beds, five birthing suites, outpatient services, emergency medical services, surgical services, and a medical plaza for various physician offices (Parkview Health, 2016). The hospital has stable leadership with the current president in place since 2010 (Parkview Health, 2020a). In 2017, the hospital earned Magnet designation for nursing excellence (Parkview Health, 2020e). Over the years Parkview Health and PWH have earned various other accolades in areas such as best place to work, use of technology, research innovation, patient safety, and top 100 performing hospitals (Parkview Health, 2020e).

PWH has the same mission statement as Parkview Health, which states “as a community owned, not-for-profit organization, Parkview Health is dedicated to improving your health and inspiring your well-being” (Parkview Health, 2017, p.1). The vision statement of Parkview Health includes:

- Tailoring a personalized health journey to achieve your unique goals
- Demonstrating world-class teamwork as we partner with you along that journey
- Providing the excellence, innovation, and value you seek in terms of convenience, compassion, service, and quality. (Parkview Health, 2017, p.1)

PWH promotes a culture of diversity, inclusiveness, and innovation. Parkview has an Office of Diversity and Inclusion that ensures these concepts are used in their hiring practices, policies, community leadership, and clinical care (Parkview, 2020b). Parkview values innovation and is evident by its promotion of research and evidence-based practice. Parkview has completed over 300 clinical studies and established a Department of Nursing Research and Professional Practice (Parkview Health, 2020d). Parkview has further shown its commitment to research with the development of their Mirro Center for Research and Innovation (Parkview Health, 2020d). The health system also employs a Chief Innovation Officer to promote innovation across Parkview (Parkview, 2020f).

Employees at PWH are subject to the same incentive and rewards systems as the rest of Parkview Health employees. Parkview incentivizes staff performance by offering a biannual bonus based on patient satisfaction scores and meeting system-wide financial goals (Parkview Health, 2020g). Parkview also encourages staff to participate in continuing education by offering reimbursement for college classes and professional certifications (Parkview Health, 2020g). Parkview conducts semiannual employee reviews to assess work performance and compliance with standards of behavior (Parkview Health, 2020g).

The motivational factors that were found throughout Parkview were also found in PWH's surgical services. A high priority was placed on promoting quality, evidence-based care, patient safety, and patient satisfaction. The mission and vision of PWH were exemplified by the surgical and anesthesia staff in the operating room environment.

External Environment

The external environment of an organization is important to assess because it could have an impact on organizational performance (Lusthaus et al., 2002). There are many outside issues that can impact the performance of a hospital such as laws, political influence, social conditions, economic factors, stakeholders, and technology (Universalia, 2020).

PWH has various external political and legal considerations. As a healthcare organization they must stay in compliance with various county, state, and federal regulations. Parkview has a Board of Directors that is comprised of prominent medical, professional, and community leaders to help guide the organization. Parkview also employs a senior leadership team and chief legal compliance officer to ensure the organization is meeting external legal obligations (Parkview Health, 2020f).

PWH is the sole hospital for Whitley County Indiana. Whitley county is a conservative, rural community with nearly 34,000 residents (U.S Census Bureau, n.d). The median household income is over $60,000 and almost 93% have at least a high school education (U.S Census Bureau, n.d). Roughly 7% of the county population lives in poverty while 8% do not have health insurance (U.S Census Bureau, n.d). The major stakeholders of PWH include Parkview Health, the Board of Directors, residents of Whitley County, and hospital staff. The hospital improves access to critical medical services for the residents of Whitley County. It also provides hundreds of jobs, insurance, and benefits to its employees which benefits the local economy.

PWH and Parkview Health have been recognized for their implementation and use of technology. All aspects of technology are overseen by the Chief Information Officer who is part of the senior leadership team (Parkview Health 2020f). The hospital utilizes the EPIC electronic charting system and uses data analysis for system improvements. All employees wear electronic badges that provide employee locations, measure call light response times, and provide access to secured doors. For six straight years Parkview has been recognized with the Most Wired award by the College of Healthcare Information Management Executives due to its use of advanced technology to improve health care (Parkview Health, 2020e).

Organization Capacity

PWH has a new and modern infrastructure due to its facility being built in 2011 (Parkview Health, 2016). It was designed with modern single occupancy rooms and has up to date utilities. The staff benefits from the latest technology and an electronic charting system with computers in each patient room. The hospital has an onsite Human Resource Officer and Nurse Educator to maintain staff orientation and development.

PWH has its own President, Chief Nursing Officer, and unit level management. PWH is also advised by the senior leadership team and Board of Directors at Parkview Health (Parkview Health 2020f). PWH's partnership with Parkview Health allows additional guidance and resources from senior experts regarding the future and direction of the hospital. This partnership also increases the medical capabilities and referral sources PWH can provide its patients. The leadership of Parkview focuses on patient-centered quality care (Parkview Health, 2020f). Parkview's leadership team aims to increase the quality and safety of patient care (Parkview, 2020f). Parkview has developed affiliations with Cleveland Clinic, Cincinnati Children's Hospital, and the MD Anderson Cancer Network (Parkview Health, 2020h).

Surgical services at PWH have three operating rooms and perform a variety of orthopedic, obstetric, podiatric, and general surgery cases. The key stakeholders to surgical services include the operating room manager, Chief of Anesthesia, surgeons, and surgical patients. The operating room manager at PWH oversees policies, staffing, and budget issues for the surgical services department. Anesthesia services are provided by a contracted group consisting of one physician anesthesiologist and three Certified Registered Nurse Anesthetists.

Organizational Performance

The IOA model equates organizational performance to an organization's ability to fulfill its mission (Universalia, 2020). An organization's performance is assessed based on its effectiveness, efficiency, relevance, and financial viability (Universalia, 2020). PWH was assessed to be an effective organization. It had earned 3 out of 5 overall stars with the Medicare Hospital Compare rating system along with 4 out of 5 stars for patient satisfaction (Medicare, n.d). The hospital has been recognized as one of the best places to work and a top performing hospital (Parkview Health, 2020e).

Parkview has been proactive about increasing its efficiency. It has utilized outside resources to help reduce its first-year nursing turnover by 36% (Work Institute, n.d). Some concerns related to cost of services were sparked by a RAND Corporation study in 2017. The study found PWH to be one of the most expensive hospitals in the country for private insurance by charging private insurance over 400% more for services than Medicare costs (The Rand Corporation, 2020). Parkview has called the study misleading and disagrees with its findings (Parkview Health, 2020c).

PWH strives to remain a relevant organization. Each year PWH assesses its local community needs and dedicates 10% of its net income to fund community initiatives (Parkview Health, 2020i). The funds have gone to improve facilities, create outreach programs, reduce care costs, and provide education (Parkview Health, 2020i). The emphasis on community outreach has kept PWH relevant to the needs of Whitley County.

PWH is a subsidiary of Parkview Health Systems and is a non-profit organization classified as a 501(c) 3 for tax purposes (State of Indiana, 2018). Parkview Health and PWH are both financially viable. In the year 2018, PWH had the most revenue of all the Parkview community hospitals at $76,188,000 (State of Indiana, 2018). PWH had revenues in excess over their total expenses of $6,679,000 (State of Indiana, 2018). The Moody’s credit rating system echoed a solid outlook for Parkview’s financial viability. Parkview has been assigned an Aa3 credit rating since 2016 (Moody’s, 2020). This is the second-best possible rating and means the company has a low credit risk (Moody’s, 2020). The biggest financial concern for Parkview is its lost contract with Anthem insurance. Anthem terminated its contract with Parkview, although both parties are still attempting to negotiate a deal (Parkview Health, 2020c). This could put many patients out-of-network with Parkview Health and lead to declining patient numbers and revenue in the future.

Assessment Conclusion

The IOA model helped assess PWH's motivation, environment, capacity, and performance. PWH was deemed to have good performance due to its efficiency, effectiveness, relevance, and financial viability. PWH, through its solid leadership, had a culture that promoted innovation and inclusion. The high importance PWH placed on quality patient care, patient safety, and research indicated they would value an evidence-based quality improvement project.

Change Strategy

Kurt Lewin's Force Field Analysis was used as the change theory for the project. Lewin's theory views change as the competition between driving and restraining forces that promote or inhibit change (White et al., 2016). The three phases that encompass Lewin's theory are known as the unfreezing, change, and refreezing phases (White et al., 2016).

The first phase, known as the unfreezing phase, required the project manager to increase the driving forces and reduce the restraining forces to the project. Lewin's theory views the ability to sway the balance between driving and restraining forces as the key to instituting change (White et al., 2016). The driving forces included ensuring the project was evidenced-based and improved patient safety, both of which aligned with the organization's previously stated goals. The evidence pertaining to patient safety was discussed when garnering early support from the operating room manager and Chief of Anesthesia to promote project acceptance. The restraining forces included the cost of buying manometers and an unknown level of support from anesthesia providers. To decrease the restraining forces the project manager was able to contact several medical companies and get manometers supplied for the project. The project manager encouraged provider support by keeping the project simple, convenient, and creating a shared vision.

The second phase (change phase) is when the balance of driving forces and restraining forces shift and the organization makes a change (White et al., 2016). This took place during project implementation when providers changed their practice to include using ETT cuff manometers with intubations. Providers were given supplemental education, hands-on practice, and increased access to ETT cuff manometers during project implementation, which resulted in increased use of cuff manometers with operating room intubations.

The third phase, or refreezing phase, occurred after implementation to maintain the change within the organization (White et al., 2016). To promote sustained change the organization agreed to keep the manometers in each operating room anesthesia cart after project completion. Each provider was also given a copy of the evidence-based slideshow for future reference, and permission was given to share the slideshow with any future anesthesia providers at the hospital.

Leadership Style

Transformational leadership was utilized by the project manager and the leadership at PWH. This leadership style was useful to institute change by creating a shared vision for the future and improving motivation for all team members (Grossman & Valiga, 2017). Transformational leaders get others to act, assume leadership, and create change (Grossman & Valiga, 2017). A transformational leader must have vision and use charisma, encouragement, and motivation to get others to accept the vision and make it a reality (Grossman & Valiga, 2017). Transformational leadership inspires followers' hearts and minds to challenge the status quo and enact change (Rodriguez et al., 2017).

The use of transformational leadership helped get initial project acceptance at PWH and increased anesthesia provider's acceptance to change. The project manager used enthusiasm in early discussions with the operating room manager and Chief of Anesthesia to motivate them for project acceptance. The project was emphasized to be evidence-based, convenient, and beneficial to patient safety. After the project gained early approval, the project manager maintained frequent communications with key hospital personnel and project team members to create a shared vision for the project. Creating a shared vision for the project increased hospital staff buy-in, while maintaining the project met the rigorous DNP standards. Utilizing a transformational leadership approach allowed the project to be accepted and a practice change to occur.

Interprofessional Collaboration

Collaboration is an important part of any team. The use of interprofessional collaboration allows the use of shared knowledge and results in improved care and costs to patients (Conrad, 2020). The elements of interprofessional collaboration include utilizing good communication, values, and ethics (IPEC, 2016).

An important element to interprofessional collaborative practice is the use of interprofessional communication (IPEC, 2016). This improves healthcare outcomes by improving a provider's communication with patients, their families, other professionals, and the community (IPEC, 2016). Good communication between these invested parties can establish shared goals and encourage participation in patient care and outcomes (Conrad, 2020). The use of interprofessional communication can be hindered by several barriers. Providers may use complex terminology that is not understood by family members or public. Another obstacle is not using respectful language when dealing with patients or other professionals. When people feel insulted, they often shut down and stop active listening.

A second important aspect of interprofessional collaborative practice is utilizing values and ethics (IPEC, 2016). This requires healthcare professionals to maintain appropriate values and ethics to patients, their families, and all members of the healthcare team (IPEC, 2016). Displaying values and ethics will help build trusting relationships with patients and other healthcare providers (IPEC, 2016). Potential barriers include not showing respect for other's dignity, privacy, or culture. Poor values and ethics can lead to a breakdown of trust between patients and other professionals.

Interprofessional collaboration was utilized throughout the project. The project manager maintained respectful communication, via in-person meetings and emails, with all members of the project team and key staff at PWH. Maintaining communication and displaying values and ethics encouraged participation by all team members. The collaboration by all team members resulted in a broad gathering of ideas and knowledge which improved project design and implementation.

Conflict Management

Conflict can be expected when trying to enact change and can become a barrier if not handled appropriately. Change requires replacing familiarity with uncertainty, which can lead to various forms of conflict. To implement positive changes, a leader must be comfortable with conflict and not look to avoid it (Grossman & Valiga, 2017).

In the early phases of project design, the cost of ETT cuff manometers was identified as a potential source of conflict. This conflict was anticipated and addressed in initial communications with PWH. Although PWH agreed to purchase the manometers, the project manager contacted several manometer companies to gather product information and costs. This led to two companies donating manometers for the project at the same time PWH backed out of purchasing manometers due to a Covid-19 spending freeze. Anticipating potential conflict and being proactive allowed the project to be implemented without any delays.

Another area of anticipated conflict was getting the anesthesia providers to participate in the project. Due to the small number of anesthesia providers at PWH, it was important to maximize participation. Getting project support from the Chief of Anesthesia and minimizing participant inconvenience were all effective in promoting participation. Project implementation was held at a location and time agreeable to all participants and was kept succinct in appreciation of their time. This led to all four members of the anesthesia team participating in the project.

Chapter 6: Discussion

Impact of Project

This quality improvement project was implemented at PWH with aims to reduce anesthesia providers' perceived barriers (knowledge, skills, and access) to using ETT cuff manometers and increase the use of ETT cuff manometers with operating room intubations. Providing an educational slideshow, hands-on skills workshop, and placing manometers in the anesthesia carts were effective interventions to reduce anesthesia providers' perceived barriers. The project met all measurable goals showing reductions in post-intervention perceived barriers (knowledge, skills, and access) to ETT cuff manometers. The reduction in perceived barriers resulted in providers using manometers in 91.3% of post-intervention operating room intubations.

The project had an impact on the practice habits of all anesthesia providers at PWH. The post-intervention surveys indicated that all providers plan to use ETT cuff manometers with operating room intubations in their practice, which coincided with the high rate of manometer use during post-intervention data collection (91.3%). The change in practice at PWH allows providers to confirm safe ETT cuff pressures, which reduces patient risk and complications.

Decisions and Recommendations

The project showed the need for supplemental education, hand-on skills practice, and increased access to ETT cuff manometers for anesthesia providers. PWH should continue to keep manometers stocked in all anesthesia carts and plan for their eventual upkeep and replacement in future budgets. Providers should also have information related to cuff manometers included in their continuing education to stay up to date with best practice.

Limitations of the Project

PWH is a small, rural hospital with a four-member anesthesia team. All four of the anesthesia providers participated in the project, but the project still had a small sample size consisting of four pre/post-intervention surveys and 23 post-intervention intubations. The small sample size inhibited the generalization of the project results.

Application to Other Settings

This project design is applicable to other settings. Using evidence-based research to improve knowledge, skills, and access to resources is an effective strategy to institute a practice change in a variety of settings. The project followed the KTA framework which has a history of being successful in settings in and out of healthcare (Field et al., 2014).

A specific setting this project would benefit is intensive care units where respiratory therapists monitor intubated patients. These patients are often intubated for long periods of time and can experience fluctuation in ETT cuff pressures. This project could be implemented to reduce respiratory therapists' barriers to using ETT cuff monometers in hopes to increase the frequency of manometer use in monitoring cuff pressures.

Strategies for Maintaining and Sustaining

The project manager completed several actions to promote the continued use of ETT cuff manometers with operating room intubations at PWH. Each provider was given a copy of the slideshow presentation with references. Providing individual copies of the slideshow presentation allows providers to review key learning objectives and evidence supporting manometer use at any time. The project manager also gave the anesthesia providers permission to share the slideshow presentation with any new providers at PWH. This will ensure new hires have access to the information supporting manometer use. Another action to promote sustained use of manometers was keeping manometers in each operating room anesthesia cart after project completion. This will ensure providers have continued access to manometers. Keeping interventions in place should continue to minimize providers' perceived barriers and promote manometer usage with intubations.

Lessons Learned

Implementing an evidence-based quality improvement project taught the project manager the importance of teamwork. Having a solid project team allowed for the sharing of ideas and tasks between various experts and exemplified DNP Essential VI. The collaboration between the project team members enhanced the quality of the project and provided a support system for the project manager. Each member of the project team contributed to the project through their unique skills, talents, and positions. The use of teamwork prevented the project manager from feeling isolated and overwhelmed in leading the project.

A multitude of other lessons were learned throughout the project that correlated with other DNP Essentials. Initial project development required the formation of a PICO question and conducting a literature review (DNP Essential I). Selecting an organization to implement the project included performing an organizational assessment, identifying key stakeholders (DNP Essential II), and finding a gap in practice (DNP Essential VII). Other lessons included obtaining IRB approval, project implementation, and data collection/analysis (DNP Essential III). The project manager also developed an educational slideshow presentation (DNP Essential IV) and disseminated the information to other healthcare providers (DNP Essential VIII).

Chapter 7: Conclusion

Potential Project Impact on Health Outcomes Beyond Implementation Site

This quality improvement project could be used as a template for other hospitals in the Parkview Health system. Instituting this practice change throughout all of Parkview Health's operating rooms could decrease risks for thousands of surgical patients every year. Parkview Health covers an area of nearly 900,000 individuals in northeastern Indiana (Parkview Health, 2020a).

This project could also be expanded to include using manometers with the placement of laryngeal mask airways (LMA) in surgical patients. This is another type of airway frequently used by anesthetists in surgical patients. LMAs are also inflated to create a seal but have different recommended safe cuff pressure ranges compared to ETT cuffs. The expansion of this project to include LMAs would increase the number of surgical patients positively impacted with using manometers.

Health Policy Implications of Project

Currently, there are no rules that mandate the use of ETT cuff manometers with intubations in the United States. As healthcare becomes increasingly driven by evidence-based practice and improving patient outcomes, it is more likely the use of manometers will become the standard. Even though it is not currently mandated, the practice of using ETT cuff manometers is shown to increase the safety of intubated surgical patients.

Proposed Future Direction for Practice

The use of ETT cuff manometers should be continued at PWH and expanded to the rest of the Parkview Health system. The practice of using subjective measurement techniques to measure ETT cuff pressure is not reliable and places patients at increased risk (Gilliland et al., 2015; Hockey et al., 2016). Cuff pressures outside the recommended range increase the risk for multiple complications and high pressures can start to cause damage in 15 minutes (Liu et al, 2010; Seegobin & Hasselt, 1984). Using manometers is a simple and effective way to verify that ETT cuff pressures are within the recommended safe range of 20-30 cm H_2O. Interventions to reduce barriers to manometer use should be implemented and maintained to promote manometer use and decrease patient risks (Bulamba et al., 2017; Gilliland et al., 2015; Grant, 2013; Harvie et al., 2016; Hockey et al., 2016; Liu et al., 2010; Unsal et al., 2018).

References

Abubaker, J., Zia, U., Ahmed, S., Rehman, M., Abubaker, Z., Ansari, M., & Karim, M. (2019). Evaluating the knowledge of endotracheal cuff pressure monitoring among critical care providers by palpation of pilot balloon and by endotracheal tube cuff manometer. *Cureus, 11*(7), 5061. doi:10.7759/cureus.5061

Aeppli, N., Lindauer, B., Steurer, M., Weiss, M., & Dullenkopf, A. (2019). Endotracheal tube cuff pressure changes during manual cuff pressure control maneuvers: An in-vitro assessment. *Acta Anaesthesiologica Scandinavica, 63*(1), 55-60. doi:10.1111/aas.13249

AHRQ. (n.d). *Health literacy universal precautions toolkit, 2nd edition*. https://www.ahrq.gov /health-literacy/quality-resources/tools/literacy toolkit/healthlittoolkit2-tool2b.html

Alzahrani, A., Al Abbasi, S., Abahoussin, O., Al Shehri, T., Al-Dorzi, H., Tamim, H., . . . Arabi, Y. (2015). Prevalence and predictors of out-of-range cuff pressure of endotracheal and tracheostomy tubes: A prospective cohort study in mechanically ventilated patients. *Bio Met Central Anesthesiology, 15*(1), 1-7. doi:10.1186/s12871-015-0132-7

American Thoracic Society. (n.d). Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. Retrieved from https://www.thoracic.org/statements/resources/mtpi/guide1-29.pdf

Ashman, R. E., Appel, S. J., Barba, A. J. (2017). Effectiveness of interventions to increase provider monitoring of endotracheal tube and laryngeal mask airway cuff pressures. *American Association of Nurse Anesthetists Journal, 85*(2), 98-103.

Athiraman, U., Gupta, R., & Singh, G. (2015). Endotracheal cuff pressure changes with change in position in neurosurgical patients. *International Journal of Critical Illness and Injury Science, 5*(4), 237-41. doi:10.4103/2229-5151.170841

Ayça, T., Dumanlı, O., Döğer, C., But, A., Kutlu, I., & Şemsi, M. A. (2018). Comparison of endotracheal tube cuff pressure values before and after training seminar. *Journal of Clinical Monitoring and Computing, 32*(3), 527-531.

Balakrishnan, S., & Jacob, K. K. (2016). Cuff pressure manometer: A luxury or necessity? *Indian Journal of Clinical Anaesthesia, 3*(4), 588-592. doi:10.18231/2394-4994.2016.0019

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), 1-7. https://doi.org/10.1155/2017/2032748

Canadian Anesthesiologists' Society. (2020). Guidelines to the practice of anesthesia. *Canadian Journal of Anesthesia, 66*(1), 75-108. doi:10.1007/s12630-018-1248-2

Checketts, M. R., Alladi, R., Ferguson, K., Gemmell, L., Handy, J. M., Klein, A. A., . . . Love, N. J. (2016). Recommendations for standards of monitoring during anaesthesia and recovery 2015: Association of anaesthetists of Great Britain and Ireland. *Anaesthesia, 71*(1). 85-93. doi:10.1111/anae.13316

Conrad, D. (2020). Interprofessional and intraprofessional collaboration in the DNP project. In K. Moran, R. Burson, & D. Conrad (Eds.), *The doctor of nursing practice project: A framework for success* (3rd ed., pp. 187-206). Burlington, MA: Jones & Bartlett Learning.

Dassanayake, V. (2018). Intraoperative airway cuff pressure monitoring: Are we doing it right? *Sri Lankan Journal of Anaesthesiology, 26*(2), 137-143.

De Castro, A., & 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*. *2016*(1), 151-155.

El-Boghdadly, K., Bailey, C. R., Wiles, M. D. (2016). Postoperative sore throat: A systematic review. *Anaesthesia, 2016*(71), 706-717. doi:10.1111/anae.13438

Field, B., Booth, A., Ilott, I., & Gerrish, K. (2014). Using the knowledge to action framework in practice: A citation analysis and systematic review. *Implementation Science, 9*(1), 172. https://doi-org.ezproxy.sf.edu/10.1186/s13012-014-0172-2

Geng, G., Hu, J., & Huang, S. (2015). The effect of endotracheal tube cuff pressure change during gynecological laparoscopic surgery on postoperative sore throat: A control study. *Journal of Clinical Monitoring and Computing, 29*(1), 141-144.

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 & Analgesia, 21*(3), 35-84.

Graham, D., Logan, J., Harrison, M. B., Straus, S. E., Tetroe, J., Caswell, W., & Robinson, N. (2006). Lost in knowledge translation: Time for a map? *Journal of Continuing Education in the Health Professions. 26*(1): 13-24. doi:10.1002/chp.47

Grant, T. (2013). Do current methods for endotracheal tube cuff inflation create pressures above the recommended range? A review of the evidence. *The Journal of Perioperative Practice, 23*(12), 292-295. https://doi.org/10.1177/175045891302301205

Grossman, S., & Valiga, T. M. (2017). *The new leadership challenge: Creating the future of nursing* (5th ed.). F. A. Davis Company.

Harm, F., Zuercher, M., Bassi, M., & Ummenhofer, W. (2013). Prospective observational study on tracheal tube cuff pressures in emergency patients: Is neglecting the problem a problem? *Scandinavian Journal of Trauma, Resuscitation & Emergency Medicine, 21*(83) 1-6.

Harvie, D. A., Darvall, J. N., Dodd, M., De La Cruz, A., Tacey, M., D'Costa, R. L., & Ward, D. (2016). The minimal leak test technique for endotracheal cuff maintenance. *Anaesthesia Intensive Care, 44*(5), 599-604.

Hedberg, P., Eklund, C., & Hogqvist, S. (2015). Identification of a very high cuff pressure by manual palpation of the external cuff balloon on an endotracheal tube. *American Association of Nurse Anesthetist Journal, 83*(3), 179-182.

Hockey, C. A., Van Zundert, A. J., & Paratz, J. D. (2016). Does objective measurement of tracheal tube cuff pressures minimize adverse effects and maintain accurate cuff pressures? A systemic review and meta-analysis. *Anaesthesia and Intensive Care, 44*(5), 560-570.

Interprofessional Education Collaborative. (2016). Core competencies for interprofessional collaborative practice: 2016 update. Retrieved from https://www.ipecollaborative.org/ipec-core-competencies

Kako, H., Alkhatib, O., Krishna, S. G., Khan, S., Naguib, A., & Tobias, J. D. (2015). Changes in intracuff pressure of a cuffed endotracheal tube during surgery for congenital heart disease using cardiopulmonary bypass. *Pediatric Anesthesia*, *25*(7), 705–710.

Keerthana, N., Ranade, S., & Wagh, H. (2019). Assessing correlation of endotracheal tube cuff pressure between estimation techniques and direct cuff pressure measurement by anaeroid manometer: A prospective observational study. *Indian Journal of Applied Research, 9*(11), 15-16.

Khan, M., Khokar, R., Qureshi, S., Al Zahrani, T., Aqil, M., & Shiraz, M. (2016). Measurement of endotracheal tube cuff pressure: Instrumental versus conventional method. *Saudi Journal of Anaesthesia, 10*(4), 428-431. doi:10.4103/1658-354X.179113

Kwon, Y., Jang, J., Hwang, S., Lee, J., Hong, S., Kang, B., & Lee, H. (2019). The change of endotracheal tube cuff pressure during laparoscopic surgery. *Open Medicine, 14*, 431-436. doi:10.1515/med-2019-0046

Lakhe, G., & Sharma, S. (2018). Evaluation of endotracheal tube cuff pressure in laparoscopic cholecystectomy and postoperative sore throat. *Journal of Nepal Health Research Council, 15*(3), 282-285.

Lee, J., Reynolds, H., Pelecanos, A., & Van Zundert, A. (2019). Bi-national survey of intraoperative cuff pressure monitoring of endotracheal tubes and supraglottic airway devices in operating theatres. *Anaesthesia and Intensive Care, 47*(4), 378-384.

Leung, S., Chung, A., Chan, W., & Tsui, S. (2016). Case series of inflation pressures of the endotracheal tube cuffs among intubated patients at an accident and emergency department in hong kong. *Hong Kong Journal of Emergency Medicine, 23*(1), 42-50.

Liu, J., Zhang, X., Gong, W., Li, S., Wang, F., Fu, S., . . . Hang, Y. (2010). Correlations between controlled endotracheal tube cuff pressure and postprocedural complications: A multicenter study. *Society for Ambulatory Anesthesiology, 111*(5), 1133-1137.

Lizy, C., Swinnen, W., Labeau, S., Poelaert, J., Vogelaers, D., Vandewoude, K., . . . Blot, S. (2014). Cuff pressure of endotracheal tubes after changes in body positions in critically ill patients treated with mechanical ventilation. *American Journal of Critical Care, 23*(1), e1-e9.

Lusthaus, C., Adrien, M., Anderson, G., Carden, F., Montalvan, G. P. (2002) *Organizational Assessment: A framework for improving performance.* International Development Research Center and Inter-American Development Bank.

Medicare. (n.d) *Hospital compare.* https://www.medicare.gov/hospitalcompare/profile.html#profTab=0&ID=150101&Distn=1.5&dist=50&loc=COLUMBIA%20CITY%2C%20IN&lat=41.1572686&lng=-85.4883127

Milat, A., & Li, B. (2017). Narrative review of frameworks for translating research evidence into policy and practice. *Public Health Research & Practice, 27*(1), 1-13.

Minonishi, T., Kinoshita, H., Hirayama, M., Kawahito, S., Azma, T., Hatakeyama, N., & Fujiwara, Y. (2013). The supine-to-prone position change induces modification of endotracheal tube cuff pressure accompanied by tube displacement. *Journal of Clinical Anesthesia, 25*(1), 28-31.

Mogal, S. S., Baliarsing, L., Dias, R., & Gujjar, P. (2018). Comparison of endotracheal tube cuff pressure changes using air versus nitrous oxide in anesthetic gases during laparoscopic abdominal surgeries. *Brazilian Journal of Anesthesiology, 68*(4), 369-374.

Moody's. (2020). *Parkview health system, inc.* https://www.moodys.com/credit-ratings/Parkview-Health-System-Inc-credit-rating-802907771

Olsen, G. H., Krishna, S. G., Jatana, K. R., Elmaraghy, C. A., Ruda, J. M., Tobias, J. D., & Ungern, S. B. (2016). Changes in intracuff pressure of cuffed endotracheal tubes while positioning for adenotonsillectomy in children. *Pediatric Anesthesia*, *26*(5), 500–503.

Parkview Health. (2016). *The history of parkview health: A legacy of caring for our community.* http://www.parkviewhealthmagnet2016.com/files/organizational- overview/oo1/ %20PHHistory.pdf

Parkview Health. (2017). *Parkview whitley hospital implementation strategies 2017.* https://www.parkview.com/media/file/Whitley%20County%20Plan.pdf

Parkview Health. (2020a). *About us.* https://www.parkview.com/about-us/about-us

Parkview Health. (2020b). *Diversity & inclusion*. https://www.parkview.com/about-us/diversity-inclusion

Parkview Health. (2020c). *Important information for patients with anthem health insurance.* https://www.parkview.com/about-us/anthem#accordionMenu4

Parkview Health. (2020d) *Parkview research center.* https://www.parkview.com/locations/mirro-center-for-research-and-innovation/parkview-research-center

Parkview Health. (2020e). *Quality.* https://www.parkview.com/about-us/awards

Parkview Health. (2020f). *Parkview health senior leadership.* https://www.parkview.com/about-us/parkview-leadership

Parkview Health. (2020g). *Compensation & benefits.* https://www.parkview.com/careers /working-at-parkview/compensation-and-benefits

Parkview Health. (2020h). *Parkview affiliations.* https://www.parkview.com/about-us/news/news-story?news=73

Parkview Health. (2020i). *Community health improvement.* https://www.parkview.com/locations/parkview-whitley-hospital/community-health-improvement-whitley

Pehlivan, S., Deniz, M. N., Sergin, D., & Ulukaya, S. (2016). The effect of body position on endotracheal tube cuff pressure in morbidly obese patients. *Bariatric Surgical Practice and Patient Care, 11*(4), 165-168.

Rodriguez, R. A., Green, M. T., Sun, Y., & Baggerly-Hinojosa, B. (2017). Authentic leadership And transformational leadership: An incremental approach. *Journal of Leadership Studies, 11*(1), 21-36. doi:10.1002/jls

Rosero, E. B., Ozayar, E., Eslava-Schmalbach, J., Minhajuddin, A., & Joshi, G. P. (2018). Effects of increasing airway pressures on the pressure of the endotracheal tube cuff during pelvic laparoscopic surgery. *Anesthesia & Analgesia, 127*(1), 120–125.

Rouen, P. (2020). Aligning design, method, and evaluation with the clinical question. In K. Moran, R. Burson, & D. Conrad (Eds.), *The doctor of nursing practice project: A framework for success* (3rd ed., pp. 155-185). Jones & Bartlett Learning.

Seegobin, R. D., & Hasselt, G. L. (1984). Endotracheal cuff pressure and tracheal mucosal blood flow: Endoscopic study of effects of four large volume cuffs. *British Medical Journal, 288*(1), 965-968. https://doi.org/10.1136/bmj.288.6422.965

Sengupta, P., Sessler, D., 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. *Bio Met Central Anesthesiology, 4*(8), 1-6.

Seyed, S., Mohseni, M., & Memarian, A. (2015). Endotracheal tube cuff pressure assessment: Education may improve but not guarantee the safety of palpation technique. *Anesthesiology and Pain Medicine, 5*(3), 161-163.

State of Indiana. (2018). *Parkview health systems, inc.and subsidiaries: Consolidated financial report.* https://www.in.gov/isdh/files/2018%20Parkview%20Health%20System%20with%20Supplemental%20AFS.pdf

Stevens, G., Warfel, J., Aden, J., & Blackwell, S. (2018). Intraoperative endotracheal cuff pressure study: How education and availability of manometers help guide safer pressures. *Military Medicine, 183*(10), 419.

Stewart, S. L., Secrest, J. A., Norwood, B. R., & Zachary, R. (2003). A comparison of endotracheal tube cuff pressures using estimation techniques and direct intracuff measurement. *American Association of Nurse Anesthetists Journal*, *71*(6), 443–447.

Sultan, P., Carvalho, B., Rose, B. O., & Cregg, R. (2011). Endotracheal tube cuff pressure monitoring: A review of the evidence. *The Journal of Perioperative Practice, 21*(11), 379-86.

The Rand Corporation. (2020). *Hospital price comparisons in indiana.* https://www.rand.org/health-care/projects/price-transparency/hospital-pricing/indiana-hospital-prices.html

Totonchi, Z., Jalili, F., Hashemian, S., & Jabardarjani, H. (2015). Tracheal stenosis and cuff pressure: Comparison of minimal occlusive volume and palpation techniques. *Tanaffos, 14*(4), 252-6.

United States Census Bureau. (n.d) *Quick facts: Whitley county, in.* https://www.census.gov/quickfacts/fact/table/whitleycountyindiana/PST045219

Universalia. (2020). *Institutional and organizational performance assessment*. Universalia. https://www.universalia.com/en/services/institutional-and-organizational-performance-assessment

Unsal, O., Seyhun, N., Turk, B., Ekici, M., Dobrucali, H., &Turgut, S. (2018). The evaluation of upper airway complications secondary to intubation: Cuff pressure manometer versus conventional palpation method. *The Medical Bulletin of Sisli Etfal Hospital, 52*(4), 289-295. doi:10.5350/semb.20171214085933

White, K. M., Dudley-Brown, S., & Terhaar, M. F. (2016). *Translation of evidence into nursing and health care* (2nd ed.). Springer Publishing Company.

Willis, C., Riley, B., Lewis, M., Stockton, L., & Yessis, J. (2017). Guidance for organizational strategy on knowledge to action from conceptual frameworks and practice. *Evidence & Policy: A Journal of Research, Debate & Practice*, *13*(2), 317–341.

Work Institute. (n.d) *Parkview health.* https://workinstitute.com/success-stories/parkview-health/

Youngsuk, K., Jang, J. S., Hwang, S. M., Lee, J. J., Hong, S. J., Hong, S. J., . . . Lee, H. S. (2019). The change of endotracheal tube cuff pressure during laparoscopic surgery. *Open Medicine, 14*(1), 431-436. https://doi.org/10.1515/med-2019-0046

Appendix A

Project Budget

Project Budget				
Legend	Direct Costs			
	Indirect Costs			
	In-Kind Costs			
Project Expenses				
Salaries and Wages	**Description**	**Year 1**	**Year 2**	**Total**
DNP Project Manager	(self) not paid	0	0	0
MDA and 3 CRNAs attending interventions	time costs for 15 minute workshop	300		300
OR manager and Chief of Anesthesia	time emailing/meeting/planning projec	500		500
				0
				0
Total Salary Costs		800	0	800
Startup Costs	**Description**	**Year 1**	**Year 2**	**Total**
		0	0	0
		0	0	0
			0	
				0
Total Start Up Costs		0	0	0
Supplies and Materials	**Description**	**Year 1**	**Year 2**	**Total**
Handouts/Printing	Printing presentation slides and forms	25	0	25
Equipment: manometers, practice ETT	Equipment being supplied by hospital	300	0	300
Room/utilities for presentation/workshop	hospital providing room	0	0	0
Total Supplies and Materials		325	0	325
Capital Costs (costs >2,000)	**Description**	**Year 1**	**Year 2**	**Total**
			0	
				0
				0
Total Capital Costs		0	0	0
Total Expenses		1125	0	1,125
Donated Salary Costs		-800		-800
Donated Material Costs		-300		-300
Net Costs		**25**		**25**

Appendix B

Informed Consent

INFORMED CONSENT FORM

ETT Cuff Manometers:

Reducing Barriers and Increasing Use in the Operating Room

Introduction

My name is Curt Laukhuf and I am a graduate student at the University of Saint Francis (USF) in Fort Wayne, Indiana. I am in the nurse anesthesia program and am conducting a scholarly project for my Doctor of Nursing Practice (DNP). My DNP advisor is Dr. Carla Mueller and we would appreciate your participation in this quality improvement project.

The purpose of this project is to implement interventions to reduce anesthesia providers perceived barriers to ETT cuff manometers and increase manometer use in the operating room.

Project Interventions

Participants will receive a slideshow presentation on the use and benefits of ETT cuff manometers for intubated patients in the operating room. Next, participants will have a guided hands-on skills workshop to ensure proper use and familiarity with ETT cuff manometers. The slideshow presentation and hands-on skills workshop will take place at Parkview Whitley Hospital and will last for an estimated 25 minutes. Immediately following these interventions ETT cuff manometers will be added to the anesthesia carts in the operating rooms. Over the next four weeks participants will fill out a manometer use tracking form after every operating room intubation.

Risks and Benefits

There is no financial compensation for participation in this project. While this project has no direct benefit to participants, it can contribute to advancement of evidence-based practice at your facility and help us the understand the effectiveness of the interventions used.

There are no foreseeable risks with this project. Participants could be minimally inconvenienced by the 30-minute time commitment for the interventions. The in-service will take place at Parkview Whitley hospital to limit the inconvenience to participants.

Project Safeguards

In this quality improvement project, the identity of patients will not be recorded. The guidelines of the Health Insurance Probability and Accountability Act (HIPAA) will be followed in this quality improvement project. Anesthesia providers who participate in the project will not be linked to their data within this project by any identifying information, so project participants will not be directly identifiable. Paper forms will be stored at the project managers residence in a secured filling cabinet. Data will be recorded onto the DNP project managers computer into an Excel spreadsheet and imported into SPSS for analysis. Data will be stored on the University of Saint Francis OneDrive and will be password protected. As the data will have no identifiers, it will not need to be encrypted. All data reported to USF faculty and Parkview Whitley Hospital management will be aggregate (group) data.

Freedom to Withdraw

Participation with this project is completely voluntary. Participants may withdraw at any time without penalty. There is no risk of penalty or loss of benefits to which the subject is otherwise entitled. Any information gathered from participants who withdraw from the project will still be used due to the anonymous nature of the data. Subjects who do not attend the educational in-service and hands on workshop will be excluded from the remainder of the project.

Inquiries

I will be glad to provide you with the results once the project is complete. For any immediate questions please contact me at:

Curt Laukhuf
7570 S. 850 W.
South Whitley, IN 46787
Phone: (765) 635-4709
Email: laukhufce@cougars.sf.edu

For any complaints about your treatment as a participant in this project, please call or write:

IRB Chairperson
University of Saint Francis
2701 Spring Street
Fort Wayne, Indiana 46808
Phone: (260) 399-7700
Administration Email: IRB@sf.edu

I have received an explanation of this study and agree to participate. I understand that my participation in this project is strictly voluntary.

Name________________________________

Date_________________________________

This project has been approved by the University of Saint Francis' Institutional Review Board for the Protection of Human Subjects for a one-year period.

Appendix C

USF IRB Approval Form

University of Saint Francis
Institutional Review Board
Human Subjects Review Committee/ACUC/IBC
Institutional Review Board Approval Form

Protocol Number: 16010587440-HSRC

Review by (underline one): HSRC ACUC IBC

Date Reviewed: 10/12/2020
Principal Investigator: Curt Laukhuf
Faculty Advisor: Dr. Carla Mueller
Protocol Title: ETT cuff manometers:Reducing barriers and increasing use in the operating room
Study Site(s): Parkview Whitley County

Type of Proposal:
Original research
Replication or extension of previous research
Quality Improvement/Evidence-Based Practice Project

Items submitted for review:
☒CITI Certificate
☒Initial protocol
☒Abstract
☒Informed Consent Form (if applicable)
☒Approval letter from outside institution – Parkview Whitley County, Surgical Services
☒Other – explain: pre/post surveys, manometer tracking form

Type of Review:
☒Full Review
☐Expedited Review
☐Exempt Review

Approval:
☒Approval granted on 10/12/2020 ___________
☐Approval granted on ____________ for a period of one year.
☐Conditional approval* granted on ____________ for a period of one year.
☐Not approved*
☐IRB approval is not required:
☐Other

*Comments: ______________________________________

The committee performing this review is duly constituted and operates in accordance and compliance with local and federal regulations and guidelines.

Stephanie Oetting	*Stephanie Oetting*	10/12/2020
Printed Name (Chair or designee)	Signature	Date

IRB Committee Approval Form sjo 110/12/2020

Appendix D

CITI Program Certificates

CITI PROGRAM

Completion Date 31-Jan-2020
Expiration Date 30-Jan-2023
Record ID 35172632

This is to certify that:

Curt Laukhuf

Has completed the following CITI Program course:

GCP – Social and Behavioral Research Best Practices for Clinical Research (Curriculum Group)
GCP – Social and Behavioral Research Best Practices for Clinical Research (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

University of Saint Francis

CITI Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?wb1a70029-57cb-4a84-a165-19bb7f5da479-35172632

CITI PROGRAM

Completion Date 01-Feb-2020
Expiration Date N/A
Record ID 35172630

This is to certify that:

Curt Laukhuf

Has completed the following CITI Program course:

Information Privacy Security (IPS) (Curriculum Group)
Researchers (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

University of Saint Francis

CITI Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w0da05bfd-bfd0-4c17-928c-8a78f767871d-35172630

CITI PROGRAM

Completion Date 02-Feb-2020
Expiration Date 01-Feb-2023
Record ID 35172629

This is to certify that:

Curt Laukhuf

Has completed the following CITI Program course:

Social & Behavioral Research - Basic/Refresher (Curriculum Group)
Social & Behavioral Research (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

University of Saint Francis

CITI Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w6d9bcba3-2f75-432f-b713-524017a75a46-35172629

CITI PROGRAM

Completion Date 01-Feb-2020
Expiration Date 31-Jan-2023
Record ID 35172633

This is to certify that:

Curt Laukhuf

Has completed the following CITI Program course:

Public Health Research (Curriculum Group)
Public Health Research (Course Learner Group)
1 - Basic (Stage)

Under requirements set by:

University of Saint Francis

CITI Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w27a4a4a2-a53e-4e56-9e61-2a968828d6ce-35172633

CITI PROGRAM

Completion Date 01-Feb-2020
Expiration Date 31-Jan-2023
Record ID 35172631

This is to certify that:

Curt Laukhuf

Has completed the following CITI Program course:

Social and Behavioral Responsible Conduct of Research (Curriculum Group)
Social and Behavioral Responsible Conduct of Research (Course Learner Group)
1 - RCR (Stage)

Under requirements set by:

University of Saint Francis

CITI Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?wc057b086-26fc-43f7-85be-0a3de56eaafd-35172631

Appendix E

Facility Letter of Support

PARKVIEW
WHITLEY HOSPITAL

September 9, 2020

To the University of Saint Francis Institutional Review Board:

This letter is being written in support of Curt Laukhuf, Doctor of Nursing Practice-Nurse Anesthesia Student at the University of Saint Francis, and his scholarly project entitled "ETT Cuff Manometers: Reducing Barriers and Increasing Use in the Operating Room". Parkview Whitley Hospital understands the aims of the DNP Scholarly Project are to reduce anesthesia providers' perceived barriers to the use of ETT cuff manometers and increase manometer use with operating room intubations.

Parkview Whitley Hospital is supportive of the aims of this project and will allow Curt Laukhuf to administer surveys and questionnaires before and after implementing interventions. The interventions will include a slideshow presentation, hands-on skills workshop, and placing provided manometers in the operating room anesthesia carts. Jan Powers PhD, RN, CCNS, NE-BC, and director of Parkview's Nursing Research and Professional Practice department, was consulted and decided this project does not need to go through the Parkview IRB.

Sincerely,

Courtney Tobias, BSN, RN, CNOR

Courtney Tobias, BSN, RN, CNOR

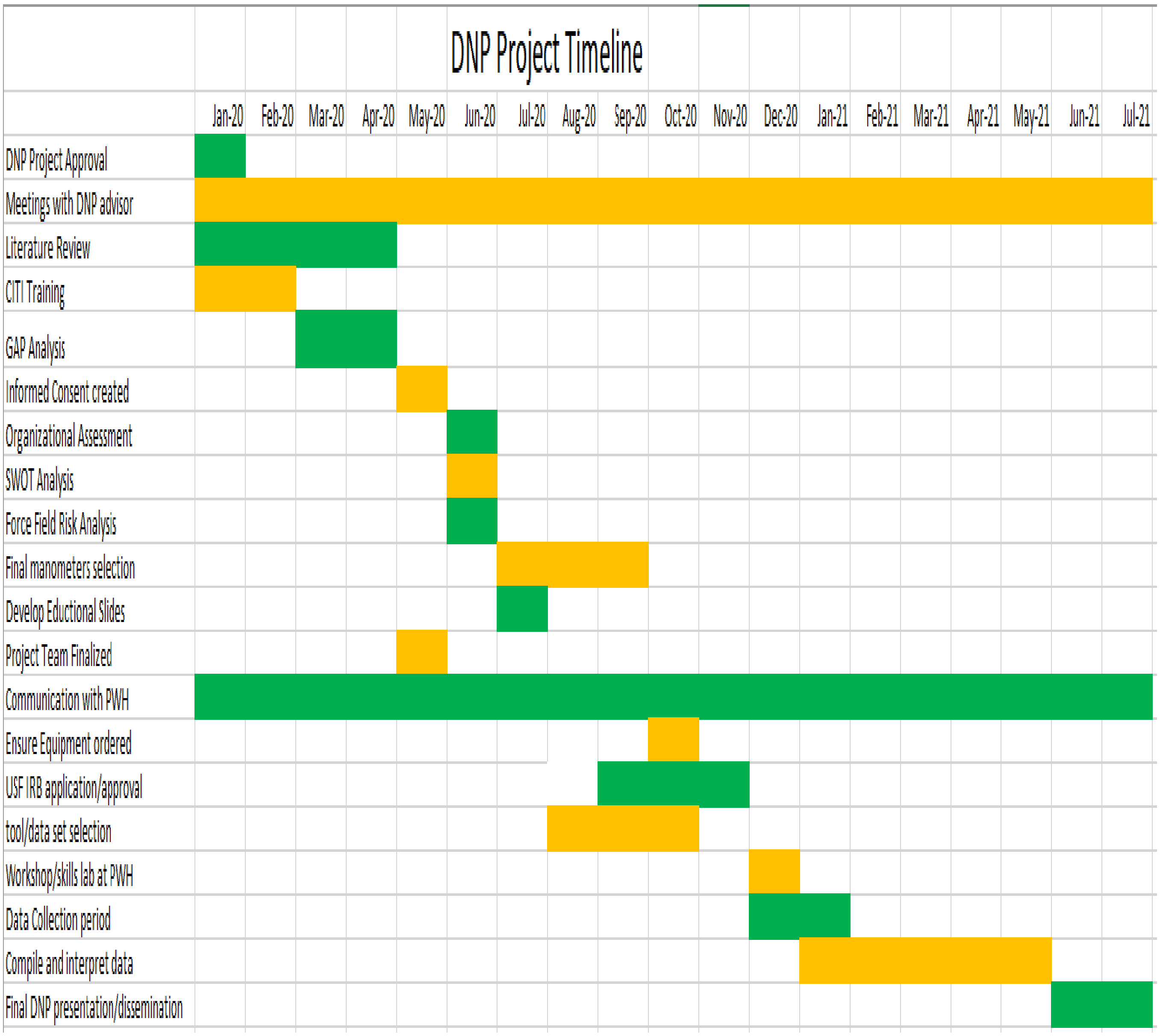
Surgical Services Manager, Parkview Whitley Hospital

Courtney.Tobias@parkview.com

260-248-9330

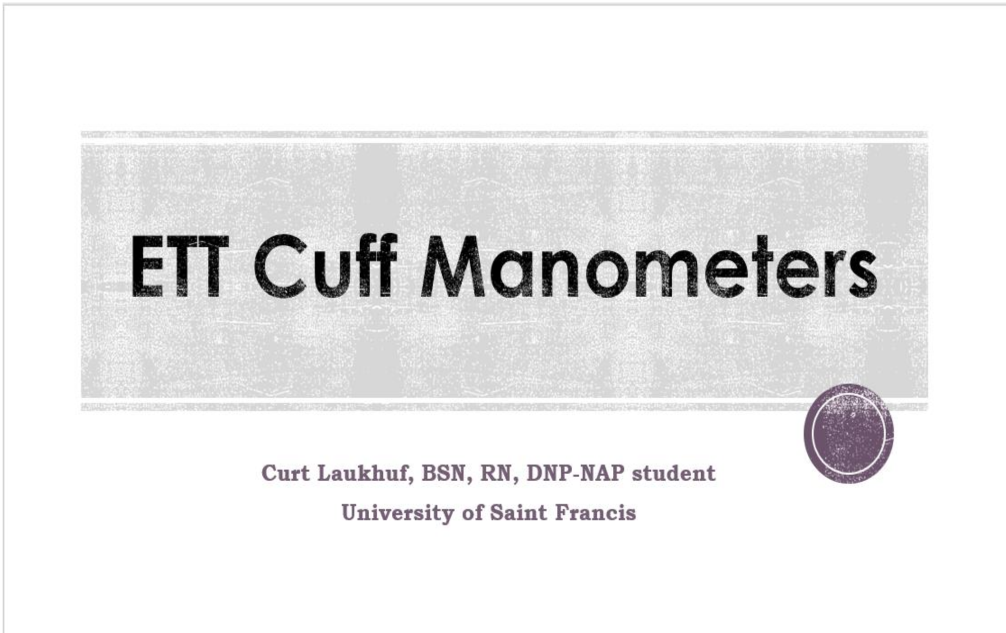
Appendix F

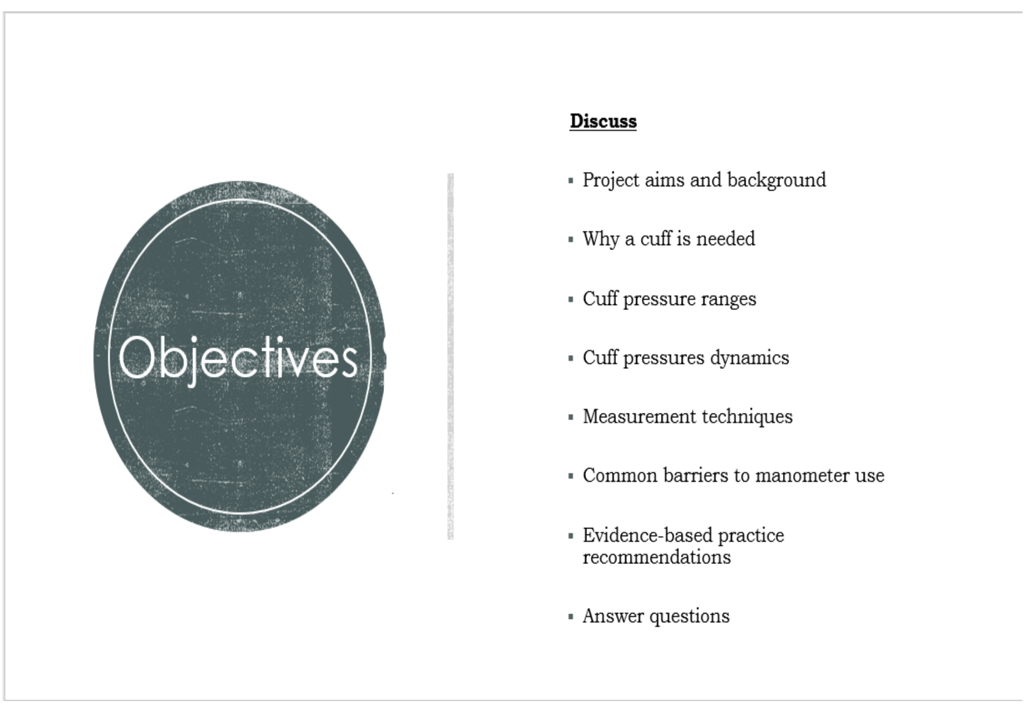
Project Timeline



Appendix G

Slideshow Presentation





Projects Aims

- Reduce perceived barriers to manometer use
- Increase the use of ETT cuff manometers

Why Does This Matter?

Why it Matters

- Over 20,000,000 intubations in U.S every year
- Over or under inflation of ETT cuff pressure increases patient complications
- Subjective techniques are commonly used but unreliable, incapable of confirming ETT cuff pressure, and increase patient complications

(Bulamba et al., 2017; Gilliland et al., 2015; Grant, 2013; Harvey et al., 2016; Hedberg et al., 2015; Hockey et al., 2016; Liu et al., 2010; Seegobin & Hasselt, 1984)

Why Do We Inflate the Cuff?

Cuff Inflation

- **ETT cuff allows for:**
  - Positive Pressure Ventilation (PPV)
  - Prevents escape of anesthetic gas into OR
  - Decreases patient aspiration risk
  - Helps hold ETT in trachea

(Gilliland et al., 2015)

What is a Safe Cuff Pressure?

ETT Cuff Pressures

- **Recommended pressure 20-30 cm H20**
  - Will provide aspiration protection and not hinder tracheal mucosa blood flow
  - Holds tube in trachea and allows positive pressure ventilation
- **Low cuff pressure < 20 cm H20**
  - Anesthetic gas can escape into operating room
  - Risk for aspiration and ventilator associated pneumonia
- **Elevated cuff pressure > 30 cm H20**
  - Causes the most complications related to intubation
  - Causes tracheal mucosa ischemia, ulcerations, inflammation, stenosis, fistulas, sore throat, hoarseness, and ruptures
  - Pressures > 50 cm H2O can cause injury in 15 minutes

(American Thoracic Society, n.d; Bulamba et al., 2017; Grant, 2013; Gilliland et al., 2015; Harvie et al., 2016; Hedberg et al., 2015; Hockey et al., 2016; Liu et al., 2010, Seegobin & Hasselt, 1984)

Cuff Pressures are Dynamic

- **Patient position**
  - Can increase or decrease ETT cuff pressure
- **Nitrous oxide**
  - Rapidly diffused through ETT cuff and can increase cuff pressure
- **Laparoscopic surgery**
  - Increases airway pressure and ETT cuff pressure

(Geng et al., 2015; Lakhe & Sharma, 2018; Rosero et al., 2018; Youngsuk et al., 2019)

Measurement Techniques

- **Subjective techniques**
  - Pilot balloon palpation
  - Fixed volume technique
  - Minimal leak test/MOP
- **Objective technique**
  - Manometer

Subjective Cuff Pressure Techniques

- Pilot balloon palpation, fixed volume, and minimal leak test
- Estimations with no confirmation
- Commonly used by anesthesia providers
- Unreliable regardless of provider experience level
- Often results in high cuff pressures
- Patients at higher risk for complications

(Bulamba et al., 2017; Gilliland et al., 2015; Grant, 2013; Harvie et al., 2016; Hockey et al., 2016; Liu et al., 2010; Stewart et al., 2003).

Objective Cuff Measuring

- **Endotracheal tube cuff manometer**
  - Non-invasive, simple, and instant results
  - Can verify cuff pressures
  - Decreased airway complications vs subjective techniques
  - Recommended for use with intubation

(Leung et al., 2016; Bulamba et al., 2017; Gilliland et al., 2015; Grant, 2013; Harvie et al., 2016; Hockey et al., 2016; Liu et al., 2010; Unsal et al., 2018)

Figure 1 Manual pressure gage (VBM Medizintechnik GmbH, Sulz am Neckar, Germany).

Common Barriers to Use

- **Knowledge**
  - Many anesthesia providers have not been educated on benefits of manometers
- **Lack of experience**
  - Many anesthesia providers have never used a manometer in routine practice
- **Manometer availability**
  - Many providers do not have access to manometers in the operating room

(Abubaker et al., 2019; Ashman, Appel, Barba, 2017; De Castro & Gopalan, 2016; Lee et al., 2019; Stevens et al., 2018)

Evidence-Based Recommendations

- Manometer should be utilized to confirm cuff pressures are in range (Ashman et al., 2017; Hockey et al., 2016; Gilliland et al, 2015; Stevens et al., 2018)
- ETT Cuff Pressures should be maintained between 20-30 cm H2O
- Providers should have immediate access to manometers

(Bulamba et al., 2017; Grant, 2013; Hockey et al., 2016; Lizy et al., 2014; Seegobin & Hasselt, 1984; Youngsuk et al., 2019)

Questions and Comments

- Thank you for the opportunity to be here today!

References

Abubaker, J., Zia, U., Ahmed, S., Rehman, M., Abubaker, Z., Ansari, M., & Karim, M. (2019). Evaluating the knowledge of endotracheal cuff pressure monitoring among critical car providers by palpation of pilot balloon and by endotracheal tube cuff manometer. *Cureus,11*(7), 5061. doi:10.7759/cureus.5061

American Thoracic Society. (n.d). Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. Retrieved from https://www.thoracic.org/statements/resources/mtpi/guide1-29.pdf

Ashman, R. E., Appel, S. J., Barba, A. J. (2017). Effectiveness of interventions to increase provider monitoring of endotracheal tube and laryngeal mask airway cuff pressures. *AANA Journal, 85*(2), 98-103.

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), 1-7. https://doi.org/10.1155/2017/2032748

Canadian Anesthesiologists' Society. (2020). Guidelines to the practice of anesthesia. *Canadian Journal of Anesthesia*, *66*(1), 75-108. doi:10.1007/s12630-018-1248-2

Checketts, M. R., Alladi, R., Ferguson, K., Gemmell, L., Handy, J. M., Klein, A. A., . . . Love, N. J. (2016). Recommendations for standards of monitoring during anaesthesia and recovery 2015: Association of anaesthetists of Great Britain and Ireland. *Anaesthesia, 71*(1). 85-93. doi:10.1111/anae.13316

References Continued

Dassanayake, V. (2018). Intraoperative airway cuff pressure monitoring: Are we doing it right? *Sri Lankan Journal of Anaesthesiology*, *26*(2), 137-143.

De Castro, A., & 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*. *2016*(1), 151-155.

El-Boghdadly, K., Bailey, C. R., Wiles, M. D. (2016). Postoperative sore throat: A systemic review. *Anaesthesia, 2016*(71), 706-717. doi:10.1111/anae.13438

Geng, G., Hu, J., & Huang, S. (2015). The effect of endotracheal tube cuff pressure change during gynecological laparoscopic surgery on postoperative sore throat: A control study. *Journal of Clinical Monitoring and Computing*, *29*(1), 141-144. doi:http://dx.doi.org. ezproxy.sf.edu/10.1007/s10877-014-9578-2

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 & Analgesia*, *21*(3), 35-84.

Grant, T. (2013). Do current methods for endotracheal tube cuff inflation create pressures above the recommended range? A review of the evidence. *The Journal of Perioperative Practice*, *23*(12), 292-295. https://doi.org/10.1177/175045891302301205

Harvie, D. A., Darvall, J. N., Dodd, M., De La Cruz, A., Tacey, M., D'Costa, R. L., & Ward, D. (2016). The minimal leak test technique for endotracheal cuff maintenance. *Anaesthesia Intensive Care*, *44*(5), 599-604.

References Continued

Grant, T. (2013). Do current methods for endotracheal tube cuff inflation create pressures above the recommended range? A review of the evidence. *The Journal of Perioperative Practice, 23*(12), 292-295. https://doi.org/10.1177/175045891302301205

Harvie, D. A., Darvall, J. N., Dodd, M., De La Cruz, A., Tacey, M., D'Costa, R. L., & Ward, D. (2016). The minimal leak test technique for endotracheal cuff maintenance. *Anaesthesia Intensive Care, 44*(5), 599-604.

Hedberg, P., Eklund, C., & Hogqvist, S. (2015). Identification of a very high cuff pressure by manual palpation of the external cuff balloon on an endotracheal tube. *American Association of Nurse Anesthetist Journal, 83*(3), 179-182.

Hockey, C. A., Van Zundert, A. J., & Paratz, J. D. (2016). Does objective measurement of tracheal tube cuff pressures minimize adverse effects and maintain accurate cuff pressures? A systemic review and meta-analysis. *Anaesthesia and Intensive Care, 44*(5), 560-570.

Lakhe, G., & Sharma, S. (2018). Evaluation of endotracheal tube cuff pressure in laparoscopic cholecystectomy and postoperative sore throat. *Journal of Nepal Health Research Council, 15*(3), 282-285.

Lee, J., Reynolds, H., Pelecanos, A., & Van Zundert, A. (2019). Bi-national survey of intraoperative cuff pressure monitoring of endotracheal tubes and supraglottic airway devices in operating theatres. *Anaesthesia and Intensive Care, 47*(4), 378-384.

Appendix H

Pre-Intervention Survey

Pre-Intervention Survey

Age: ______

Years of experience as an anesthesia provider: ________

Do you work at multiple facilities? Yes _____ No________

Please circle an answer for the following questions

1. What is the recommended safe ETT cuff pressure range? (answers in cm H_2O)

   a. 10-20 b. 20-30 c. 30-40 d. 40-50 e. 50-60

2. How fast can injury occur from high cuff pressures?

   a. 5 minutes b. 15 minutes c. 30 minutes d. 1hour e. 4 hours

3. How can you verify safe ETT cuff pressures?

   a. Pilot balloon palpation b. Minimal leak test c. Fixed volume technique

   d. Manometer e. All the above

4. If intubating a patient today in the operating room at Parkview Whitley Hospital what method of ETT cuff measurement would you use?

   b. Pilot balloon palpation b. Minimal leak test c. Fixed volume technique

   d. Manometer e. none of the above

Please circle how much you agree with the following statements on a scale of 1-5:

1= Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree

5. I am familiar with how to operate all functions of an ETT cuff manometer	**1 2 3 4 5**
6. I feel comfortable using an ETT cuff manometer with intubation	**1 2 3 4 5**

1= Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree

7. I know where to locate an ETT cuff manometer if I need one	**1 2 3 4 5**
8. I have easy access to an ETT cuff manometer in the operating room	**1 2 3 4 5**
9. Using an ETT cuff manometer with intubation benefits the patient	**1 2 3 4 5**
10. Evidence supports the use of an ETT cuff manometer with intubation	**1 2 3 4 5**

Please write in your responses to the following questions

11. What concerns do you have about using an ETT cuff manometer in your practice?

12. Are there any barriers to using ETT cuff manometer in your current practice at Parkview Whitley Hospital?

13. What other considerations would impact your likelihood to use an ETT cuff manometer?

Appendix I

Post-Intervention Survey

Post-Intervention Survey

Please circle an answer for the following questions

1. What is the recommended safe ETT cuff pressure range? (answers in cm H_2O)
   a. 10-20 b. 20-30 c. 30-40 d. 40-50 e. 50-60

2. How fast can injury occur from high cuff pressures?

   a. 5 minutes b. 15 minutes c. 30 minutes d. 1hour e. 4 hours

3. How can you verify safe ETT cuff pressures?

   a. Pilot balloon palpation b. Minimal leak test c. Fixed volume technique

   d. Manometer e. All the above

4. If intubating a patient today in the operating room at Parkview Whitley Hospital what method of ETT cuff measurement would you use?

   a. Pilot balloon palpation b. Minimal leak test c. Fixed volume technique
   d. Manometer e. none of the above

Please circle how much you agree with the following statements on a scale of 1-5:

1= Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree

5. I am familiar with how to operate all functions of an ETT cuff manometer	**1 2 3 4 5**
6. I feel comfortable using an ETT cuff manometer with intubation	**1 2 3 4 5**
7. I know where to locate an ETT cuff manometer if I need one	**1 2 3 4 5**
8. I have easy access to an ETT cuff manometer in the operating room	**1 2 3 4 5**

1= Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree

9. Using an ETT cuff manometer with intubation benefits the patient	**1** **2** **3** **4** **5**
10. Evidence supports the use of an ETT cuff manometer with intubation	**1** **2** **3** **4** **5**

Please write in your responses to the following questions

11. What concerns do you have about using an ETT cuff manometer in your practice?

12. Are there any barriers to using ETT cuff manometer in your current practice at Parkview Whitley Hospital?

13. What other considerations would impact your likelihood to use an ETT cuff manometer?

Appendix J

Manometer Use Tracking Tool

Manometer Use Tracking Tool

Please circle your responses

Provider I.D: A B C D

Patient Intubated in OR: Yes No

Cuff Manometer Used: Yes No

If manometer was not used please describe why below: