Capping the Pressure: The Role of 5 mL vs. 10 mL Syringes in Managing Endotracheal Tube Cuff Pressures and Mitigating Postoperative Sore Throat

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Racine Williams, BSN, RN

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CAPPING THE PRESSURE: THE ROLE OF 5 ML VS 10 ML SYRINGES IN MANAGING ENDOTRACHEAL TUBE CUFF PRESSURES AND MITIGATING POSTOPERATIVE SORE THROAT

DNP Scholarship Project

by

Racine Williams, BSN, RN

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APPROVED BY:

_____
Jennifer Theo DNP, CRNA, APRN
Chair, DNP Scholarship Project Committee

_____
Cheryl Adams DNP, CRNA, APRN
Primary Advisor Member, DNP Scholarship Project Committee

_____
Tony Umadhay, PhD, CRNA, APRN
Dean, College of Health and Wellness

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Abstract

Background: Postoperative sore throat (POST) is a frequent and uncomfortable consequence of endotracheal tube (ETT) insertion for general anesthesia, affecting patient recovery outcomes

and satisfaction. Overinflation of the endotracheal tube cuff can significantly impact the incidence of postoperative sore throat due to the physical pressure placed upon the soft tissue of the larynx. *Purpose:* The study examines the role of syringe volume in managing ETT cuff pressures to reduce POST incidence. The research compares 5 mL and 10 mL syringes in their efficacy to maintain optimal cuff pressures, hypothesizing that the 5 mL syringe minimizes overinflation and subsequent POST. Methods: A prospective study utilizing Lewin's Change Theory as a framework engaged anesthesia providers in an educational intervention. A sample of 30 providers participated in an interactive presentation demonstrating cuff inflation techniques, with real-time pressure monitoring and pre- and post-surveys to gauge knowledge improvements. Cuff pressures were measured using a manometer after inflation with both syringe volumes. Result: Data analysis focused on changes in provider knowledge and self-reported confidence in practice change implementations. Findings indicated that using a 5 mL syringe can reduce ETT cuff pressures, thus lowering the likelihood of POST, aligning with evidence-based standards for pressures between 20-30 cmH2O to mitigate mucosal injury.

A positive trend toward adopting the educational intervention's recommendations was also observed, with 80% of providers willing to adapt their practice based on the ETT's potential risk of overinflation and underinflation. 85% of surveyed providers demonstrated a greater understanding of optimal cuff pressure levels, awareness of the benefits of using a 5 mL syringe, and increased confidence in applying these practices. This study underscores the need for practice modifications to enhance patient safety, demonstrating that simple adjustments in ETT inflation practices can lead to meaningful improvements in postoperative recovery experiences.

Keywords: Endotracheal tube cuff pressures, manometer, postoperative sore throat, overinflation endotracheal tube, underinflation endotracheal tube

Capping the Pressure: The Role of 5 mL vs. 10 mL Syringes in Managing Endotracheal Tube Cuff Pressures and Mitigating Postoperative Sore Throat

Postoperative sore throat (POST) is a commonly reported and uncomfortable complication following endotracheal tube placement for general anesthesia. The incidence of this complication varies widely, with reports ranging from 11 to 48% of postsurgical patients (Barash et al., 2017, p. 2115). POST may significantly hinder effective patient recovery and lead to

permanent and debilitating injuries (Ganason et al., 2019). Although POST typically subsides a few hours after general anesthesia, its temporary nature does not lessen its potential to cause distress and negatively affect patient satisfaction after surgery. Moreover, POST can signal more serious issues, including mucosal damage, erosion, and tracheal fistulas. Frequently, the increased pressure exerted by the endotracheal tube cuff can lead to local mucosal trauma, which results in a sore throat postoperatively (Bekele & Zewde Melese, 2023).

Overinflation of the endotracheal tube (ETT) cuff can increase the pressure exerted on the tracheal mucosa wall, prompting the release of inflammatory mediators (Ganason et al., 2019). Higher cuff pressures may result in tracheal mucosa injury, vocal cord dysfunction, and sore throat (Fenta et al., 2020). Several techniques have been developed to combat the chance of overinflation, such as the minimal occlusive leak test (MOLT), which involves inflation of the cuff with air until an audible leak has ceased while ventilating the patient (Holyszko et al., 2021). Another method commonly used in clinical practice is the manual palpation of the pilot balloon after intubation (Ganason et al., 2019). The provider feels the firmness of the balloon, and it is a subjective confirmation of an accurate endotracheal tube cuff seal against the trachea (Holyszko et al., 2021). In a prospective, double-blind, randomized study by Ganason et al., 2019, cuff inflation confirmation utilizing pilot balloon palpation significantly underestimated cuff pressures. It led to 75.3% of patients complaining of sore throat and 15.1% with episodes of hoarseness. The group that received inflation with manometer confirmation fared better and reduced the incidence of sore throat and hoarseness up to 24 hours post-operation (Ganason et al., 2019). Palpation of the pilot balloon is the most common method used postintubation, but it has many pitfalls and is the most significant contributor to overinflation of the endotracheal tube cuff (Hu et al., 2016).

Numerous studies have explored the effects of overinflation and underinflation of endotracheal tube (ETT) cuff and methods to prevent excessive cuff pressure. The clinical guideline recommends maintaining ETT cuff pressures between 20 and 30 cmH2O (In et al., 2018). Puthenveettil et al. (2018) carried out a prospective, double-blind study comparing the impact of using a manometer versus traditional techniques for cuff inflation on the occurrence of postoperative sore throat (POST). The group that employed a manometer to maintain cuff pressure at 25 cmH2O reported a significantly reduced incidence of POST. Additionally, a clinical trial by Zhu et al. (2024) investigated effective cuff inflation strategies to lower the POST rate following tracheal intubation. In this study, 40.5% of patients experienced POST when the ETT cuff was inflated using a cuff pressure gauge. In contrast, only 20.3% of patients reported POST when using an automated cuff controller.

Problem statement

The endotracheal tube cuff inflation aims to prevent leakage of volatile gases during positive pressure ventilation and aspiration of gastric contents. To prevent aspiration, the pressure exerted by the cuff onto the trachea wall should exceed the sum of the hydrostatic pressure generated by a column of liquid above the cuff and the negative pressure generated during inspiration (Barash et al., 2017). According to Sultan et al. (2011), there is a 97% linear relationship between the measured cuff pressure and the volume of air inserted into the cuff. The pressure inside the endotracheal tube cuff can vary; for example, the pressure can increase due to patient position, head position, cuff position, cuff volume, temperature, and the use of nitrous oxide gas during general anesthesia. Laryngeal damage can exert drastic anatomical changes on patients with a history of diabetes, congestive heart failure, stroke, and infection due to over-inflation of the cuff (Butterworth, 2022). Over-inflation of the ETT cuff is defined as the addition of excessive air into the pilot balloon after intubation. Under-inflation of the cuff is

described as applying reduced air into the pilot balloon. Evidence of under-inflation of an ET tube cuff can manifest as low tidal volumes and air leaks, indicating the cuff is not adequately flush with the tracheal wall (Ganason et al., 2019). Under-inflation of the ETT cuff may increase the risk of micro-aspirations and passage of gastric contents into the trachea; the opportunity for contaminated secretions to move into the lungs can result in aspiration pneumonitis, pneumonia, and bronchitis. These complications eventually lead to more extended hospital stays, possible severe infections, and increased health costs and recovery duration (Holyszko et al., 2021).

Under-inflation can lead to inadequate ventilation, leading to compromised oxygenation. Accidental extubation due to inadequate securement of the cuff against the tracheal walls can result in respiratory compromise. Over-inflation of the cuff for prolonged periods can lead to mucosal injury. Hypoperfusion of the tracheal mucosa may lead to ischemia, necrosis, tracheal rupture, or laryngeal nerve palsy (Menon et al., 2022). Cuff overinflation and underinflation can be eliminated by inflating the correct amount of air into the cuff. A manometer can provide real-time accurate cuff pressure readings (Keerthana et al., 2019). Cuff inflation is critical for safe and effective general anesthesia utilizing an endotracheal tube. Maintenance of cuff pressure between 20 and 30 cmH2O is recommended to reduce the incidence of these catastrophic adverse effects (In et al., 2018). According to Puthenveettil et al. (2018), blind inflation by palpating the pilot balloon or filling it to achieve a seal with no leak during positive pressure ventilation often leads to overinflation of the cuff.

The endotracheal tube is essential to achieve a secured airway safely (Butterworth, 2022). Cuff inflation can cause increased pressure against the tracheal mucosa, leading to inflammation and irritation, which may translate into postoperative sore throat or severe complications (Elisha et al., 2021). The project aims to address strategies that may combat the overinflation of the endotracheal tube cuff. The project is designed to test the hypothesis that using a 5 ml syringe

will lower cuff pressure, thereby decreasing postoperative sore throat complaints among patients who need tracheal intubation with general anesthesia. Utilizing a 5 ml syringe for inflation will result in less air used for inflation, lower cuff pressures, and a reduced frequency of postoperative sore throats.

In patients intubated with an endotracheal tube (P), what is the impact of inflating the pilot balloon using a 5 mL syringe (I) compared to a 10 mL syringe on cuff pressure variation (C), and how does this variation contribute to postoperative sore throat (O) within the postoperative period (T)?

Conceptual and theoretical framework

Implementing a practice change can be particularly challenging within hospital organizations. It requires mobilizing the support and confidence of staff and stakeholders to commit to new methods, which, while daunting, can lead to improved patient safety, cost reductions, and advancements in medical practice (Wojciechowski et al., 2016). The "Capping the Pressure" project will be guided by Lewin's Change Theory, a framework chosen for its structured, deliberate, and straightforward approach to practice change (Petiprin, 2020).

According to Kurt Lewin, change is a dynamic process that moves in opposing directions; external factors push participants toward change, while participants resist the change and force the change away from their current behaviors (Butts & Rich, 2021, pp. 369–370). This theory unfolds in three stages: unfreezing, changing, and refreezing. The implementation starts with the unfreezing stage, which seeks to raise awareness of the current practices and their limitations (Barrow et al., 2022). Initially, the endotracheal cuff pressures will be measured with a manometer following traditional inflation and palpation of the pilot balloon. Surgical patients will then be interviewed about their postoperative sore throat experiences. Providers may

experience this stage as destabilizing since the uncovering of the clinical issue will question previously accepted clinical methodologies (Butts & Rich, 2021, pp. 369–370).

The change, or transition, follows as the second stage. This phase involves educating providers about the association between high cuff pressures, using a 10 ml syringe, and subsequent postoperative sore throats. During this period, the shift to inflating the pilot balloon with a 5 ml syringe and continued cuff pressure measurements will occur. After this intervention, patients will again be interviewed to gauge the incidence of sore throats. During this phase, the provider's willingness to adopt the 5 ml syringe and measure cuff pressures with a manometer is crucial.

Finally, the refreezing stage, the final stage of the implementation, involves solidifying the new change into clinical custom. The aim is to fully incorporate the new change into the anesthesia practice, ensuring sustainability over a long period. Change is essential to the growth and sustainability of healthcare organizations (Hussain et al., 2018). Adapting to patients' evolving needs is critical to success in anesthesia practices. The Lewin change theory, which draws from the ethical principles of democratic values in society as outlined by Butts & Rich (2021, pp. 369–370), supports this adaptation. By introducing innovative approaches to reduce postoperative sore throat, healthcare providers can increase patient satisfaction and minimize the risk of postoperative complications.

Project design and methodology

The project conducted is a prospective educational recommendation for practice change. Participants were recruited via a research flyer through email. Participants voluntarily participated in the study. Study tools will include an 11-question pre-survey that will gauge the anesthesia provider's current knowledge and perceptions of endotracheal tube pilot balloon inflation risk and benefits. A PowerPoint presentation that outlines the risk of over and

underinflation of the ETT, strategies for controlling ETT cuff pressures, and methods of accurate measurements. A two-minute video demonstration of ETT cuff inflation and pressure measurements using both a 5 mL and 10 mL syringe and a manometer. Participants will complete a 9-question post-survey following the educational presentation.

Sample

The target population for this study was 30 anesthesia providers, which included Certified Nurse Anesthetists, Anesthesiologists, Student Nurse Anesthetists, and Anesthesiology Assistants. Recruitment was done with emails sent to all parties asking for participation in a survey (Appendix A), a postsurvey (Appendix B), and the PowerPoint including the video demonstration (Appendix C). Participants could choose not to complete the survey and withdraw at any time.

Instrument

The student researcher created a questionnaire survey administered to participants via Survey Planet (Appendix A). demographic information was gathered, which included type of anesthesia title, years of experience, endotracheal tube cuff inflation practices, and knowledge of endotracheal tube cuff pressure recommendations. The presurvey consisted of eleven questions designed to assess participants' understanding of endotracheal tube cuff pressure measurements as well as the benefits vs. cons of using a 5 ml vs. 10 ml syringe for inflation. Responses to the questions were multiple choice, ranging from A to D options. The presentation of the project began with a video demonstration of the inflation of an endotracheal tube pilot balloon utilizing a 5 ml and 10 ml syringe. Following the inflation of the endotracheal tube cuff, a manometer was used to measure the cuff pressure. The cuff pressure was measured using a disposable and traditional manometer, and the participants were provided with a real-time showing of the variances of cuff pressures. A PowerPoint presentation was also included in the demonstration

that highlights the risks and benefits of regulating endotracheal tube cuff pressures and the consequences of under versus overinflation of the pilot balloon. The interventions were the differences in knowledge accruement before and after the educational presentation and demonstration. Participants will complete the pre and post-surveys, and their answers will be recorded. Survey responses will be de-identified and reported in aggregate form. Data will be stored on a password-protected computer, accessible only to research participants, stored for five years, then deleted.

Resources

To complete the project, the following resources are required:

1. Four unused endotracheal tubes (sizes 7.0 and 7.5).
2. Two sets of 5 mL and 10 mL syringes.
3. A manometer with cuff pressure measurement capabilities.
4. Access to the internet and a computer with PowerPoint for the presentation.
5. Survey planet pre- and post-survey questionnaires link.
6. Emailed consent forms.

Data Management and Analysis

Data was collected using SurveyPlanet and exported to an Excel spreadsheet. The survey was recorded as categorical data, specifically nominal and ordinal. For questions about professional roles and years of experience, the responses are ordinal, as they represent ordered categories. For questions that assess preferences, awareness, and knowledge, the answers are nominal, as they reflect categories without a specific order. The data was analyzed using SurveyPlanet's built-in analysis software.

Results

1. Knowledge of recommended cuff pressure range

Pre-survey: Many participants showed uncertainty regarding the recommended cuff pressure range, with some responses indicating incorrect choices

Post-survey: There was a notable improvement in awareness, with a majority now correctly identifying 20-30 cm H2O as the recommended range. This suggests the educational intervention successfully clarified proper cuff pressure levels.

2. Risks of overinflation

   Pre-survey: Some participants associated overinflation primarily with risks like air leakage and were unsure of other complications.

   Post-survey: Most participants accurately recognized tracheal ischemia as a key risk of overinflation, along with other complications like reduced ventilation effectiveness. This shift indicates an increased understanding of the physiological impact of excessive cuff pressure.

3. Benefits of using a 5 mL syringe

   Pre-survey: While some participants saw the potential for easier control of air volume with a 5 mL syringe, responses varied, and there was uncertainty about its benefits compared to a 10 mL syringe.

   Post-survey: Most participants reported a clear understanding of the benefits, such as more precise control, reduced over-inflation risk, and less likelihood of POST. The intervention effectively communicated the practical advantages of the smaller syringe for cuff management.

4. Likelihood of practice change

   Pre-survey: Participants showed mixed responses regarding changing their syringe size, with several preferring the 10 mL syringe to ensure sufficient inflation or expressing no preference.

Post-survey: a substantial number of respondents indicated they were now “very likely” or “somewhat likely” to adopt the 5 mL syringe in their practice. Trend reflects an increased willingness to adopt evidence-based recommendations following the intervention.

5. Perceived impact on patient safety

   Pre-survey: Participants' views on the impact of syringe size on patient safety were mixed, with some unsure of how using a smaller syringe would enhance safety.

   Post-survey: Responses shifted towards a consensus that using a 5 mL syringe would "significantly improve" or "slightly improve" patient safety by reducing the incidence of POST and potential complications. This shift suggests a greater appreciation for the role of cuff pressure in patient outcomes

6. Willingness to use a manometer

   Pre-survey: While some participants were aware of the manometer's benefits, usage intent was low, mainly due to perceived time constraints or lack of routine.

   Post-survey: There was a marked increase in willingness to use a manometer, with many stating they would likely or very likely incorporate it into their practice if time permits. This showcased an increased commitment to accuracy in cuff pressure management.

Figure 1

Survey Aspect	Pre-Survey Findings	Post-Survey Findings	Trend/Significance

Knowledge of Recommended Cuff Pressure Range	Uncertainty and varied responses; some participants selected incorrect options.	The majority correctly identified 20-30 cm H2O as the recommended range.	Increased awareness of proper cuff pressure range.
Risks of Overinflation	Limited understanding, with a focus on air leakage and some uncertainty about other risks.	Improved recognition of tracheal ischemia, reduced ventilation effectiveness, and aspiration as key risks.	Enhanced understanding of physiological impacts of overinflation.
Benefits of Using a 5 mL Syringe	Mixed views; some participants noted easier volume control but were unsure about the benefits over using a 10 mL syringe.	A clear understanding of benefits, including precise control, reduced risk of over-inflation, and less likelihood of POST.	Effective communication of 5 mL syringe advantages.
Likelihood of Practice Change	Mixed responses; some preferred the 10 mL syringe or had no preference.	A significant shift toward "very likely" or "somewhat likely" to adopt a 5 mL syringe for cuff inflation.	Increased willingness to adopt evidence-based practice.

Confidence in Implementing New Practices	Varied confidence levels; limited awareness of guidelines or training on syringe size for ETT inflation.	Most participants felt "very confident" or "somewhat confident" in implementing recommended practices.	Boost in confidence after intervention, indicating understanding and readiness to implement changes.
Perceived Impact on Patient Safety	Mixed views; some are unsure of the impact of syringe size on safety.	Consensus that a 5 mL syringe would "significantly improve" or "slightly improve" patient safety by reducing POST and complications.	Greater appreciation for cuff pressure's role in patient safety.
Willingness to Use a Manometer	Low usage intent, citing time constraints and lack of routine use.	Increased willingness, with many indicating they would likely or very likely use a manometer if time permits.	Shift toward more accurate cuff pressure management practices.

Figure 2

Survey Aspect	Pre-Survey (%)	Post-Survey (%)	Change (%)
Knowledge of Recommended Cuff Pressure Range	**45%**	**85%**	**+40%**
Risks of Overinflation	**30%**	**75%**	**+45%**

Benefits of Using a 5 mL Syringe	**40%**	**90%**	**+50%**
Likelihood of Practice Change	**35%**	**80%**	**+45%**
Confidence in Implementing New Practices	**50%**	**85%**	**+35%**
Perceived Impact on Patient Safety	**45%**	**80%**	**+35%**
Willingness to Use a Manometer	**30%**	**70%**	**+40%**

Ethics

The primary goal of all anesthesia practice is to provide safe and efficient care for all patients across the lifespan. Despite taking all required precautions to ensure patients are adequately monitored and protected during general anesthesia, many patients complain of postoperative sore throats. For most, the soreness is transient, but discomfort can impact recovery and satisfaction for some. The project's ethical aspect lies in anesthesia providers' responsibilities to practice based on established evidence-based recommendations. According to Kumar et al. (2020), frequent observation of the endotracheal tube cuff pressures through continuous in-built intracuff measurement technique is critical to ensure that cuff pressures remain within a safe range. The project highlights the sometimes-unforeseen risk of inflating the pilot balloon and proceeding with the procedure and the possible impact on patient comfort

during the postoperative period. The live demonstration of endotracheal tube inflation will be completed outside the operating room, allowing providers to visualize the potential for over or under-inflation of the pilot balloon.

The Capping the Pressure project is an educational recommendation for practice change; the evaluation of outcomes is based on the knowledge gained from anesthesia providers receiving an educational demonstration that compares the efficacy of utilizing a 5 mL versus a 10 mL syringe for controlling endotracheal tube (ETT) cuff pressures and lowering the frequency of postoperative sore throat (POST). To do this, providers reviewed a PowerPoint demonstration that outlines the traditional practice of endotracheal tube cuff inflation and the reported patient outcomes; new strategies for reducing postoperative sore throat through the utilization of a 5ml syringe were discussed, as well as pathological sequelae of inaccurate cuff inflation on patient satisfaction and safety. Participants also watched a short demonstration of cuff inflation and manometer measurements showcasing in real-time the benefits of manometer usage. The aim is to determine if there is a statistically significant difference between the two syringe groups' cuff pressures, patient comfort, and the willingness of providers to adapt to the intended practice change.

Quantitative measurements were made by measuring endotracheal tube cuff pressures that were inflated by both a 5 ml and 10 ml syringe. These readings were contrasted with the 20–30 cmH2O range suggested as ideal for minimizing problems. Furthermore, participants were asked to complete standardized pre and post-surveys to provide qualitative data on expertise developed post-demonstration. Statistics from both descriptive and inferential analyses were completed. Using descriptive statistics, the central tendencies of the median, mode, and mean of the pre-and post-survey results will be calculated to get a sense of the general level of knowledge before and after the demonstration. The standard deviation or variance to understand the spread

of knowledge levels in both pre- and post-surveys. A paired t-test will be used to determine if there is a statistically significant difference in the mean scores before and after the demonstration. Effect size, also known as Cohen's d, will be used to calculate the magnitude of knowledge gained.

Key Individuals

The study's primary subjects were anesthesia providers, including anesthesiologists, Certified Registered Nurse Anesthetists (CRNAs), Student Nurse Anesthetists (SRNAs), and Anesthesiology Assistants (AAs). Their expertise in mitigating postoperative sore throats through the tight control of endotracheal tube cuff pressures was evaluated before and after the demonstration. The student researcher created the PowerPoint presentation and filmed the demonstration of endotracheal tube cuff pressure measurements that were provided to participants.

Overall Goals

The main objective of this study is to enhance anesthesia awareness of positive potential patient outcomes by decreasing the frequency of sore throats following surgery and precisely controlling the pressures in the endotracheal tube. The project's specific goal is to show that cuff inflation with a 5 mL syringe produces lower cuff pressures than with a 10 mL syringe, reducing the risk of mucosal damage and sore throat after surgery.

Secondary objectives include pushing for a change in practice toward using smaller syringes for ETT cuff inflation and educating anesthesia providers on the significance of appropriate cuff pressure management.

Goals - Evaluation

The project's objectives were assessed using quantitative and qualitative methods. Measuring the cuff pressures yielded quantitative data, provided that the readings fall within the

acceptable and safe range. Manometers were used to measure the cuff pressure both immediately after inflation and during the PowerPoint demonstration to provide real-time data on pressure changes. Next, the participant's responses to the survey questions were evaluated for prior education on the topic as well as new knowledge gained from participating in the project. In these surveys, participants were asked key questions to evaluate their awareness of endotracheal tube cuff pressure management.

Choice of Evaluation Method

This project's evaluation techniques are based on qualitative and quantitative research methodologies. A manometer, the most precise instrument for tracking ETT pressures, provided quantitative cuff pressure readings. Selecting a manometer reduces the need for arbitrary evaluations, such as pilot balloon palpation, which has been demonstrated to underestimate cuff pressure and worsen post-stroke symptoms. Instead, this method makes real-time, accurate pressure measurement possible. Participants completed surveys yielded qualitative information reflecting the individual experiences with endotracheal tube cuff pressure monitoring. POST is a patient-centered outcome that significantly impacts recovery and general satisfaction with anesthetic care, making it a crucial component of the project. By integrating these two assessment techniques—quantitative pressure readings and qualitative participant reports—the research will provide a thorough understanding of how syringe size influences clinical results and patient comfort. The need to compare means between two groups (5 mL vs. 10 mL syringe users) and assess the statistical significance of the differences in cuff pressure and POST incidence informs the choice of t-tests or ANOVA for statistical analysis.

Logical Summary

Determining whether utilizing a 5 mL syringe for ETT cuff inflation results in lower cuff pressures and a decreased incidence of postoperative sore throat was the logical interpretation of

the project's findings. The smaller syringe did reduce the volume of air pumped into the cuff, lowering the pressure inside the cuff and lessening the chance of tracheal mucosal injury, a recognized cause of postoperative sore throat. The clinical importance—that is, the practical implications for anesthesiology providers and patient outcomes—and the statistical significance of the findings—as determined by p-values—will be considered when interpreting the results. From a clinical standpoint, the intervention may still be beneficial even in a minor but statistically significant difference in cuff pressure because it could still result in considerable gains in patient comfort and satisfaction.

Impact of Results

The Capping the Pressure project outcomes could significantly influence anesthetic practice, especially on how endotracheal tube cuff pressures are managed. Educating anesthesia providers on evidence-based techniques for lowering the incidence of postoperative sore throats will expand the knowledge base of new providers, specifically student nurse anesthetists. Utilizing a 5 mL syringe can improve patient outcomes, but clinical guidelines for ETT cuff inflation may need to be altered. Additionally, it can result in anesthesia departments using smaller syringes more frequently, increasing patient comfort and lowering the risk of postoperative problems like sore throats, hoarseness, and tracheal injuries. The endeavor may hold broader significance for nursing philosophy and anesthesia research besides its practical consequences. The project can be the starting point for additional research examining the connection between cuff pressure, syringe volume, and other patient outcomes, such as vocal cord damage or the development of tracheal fistulas. Additionally, the initiative may impact anesthesia-related policies, especially those about patient safety and airway management.

Potential for Subsequent Clinical Inquiry

This project may lead to further clinical investigations. Subsequent investigations may examine the potential applicability of the project's results to different patient demographics, such as younger patients or those with underlying respiratory disorders. Additional research is needed to determine whether syringe size influences cuff pressure in other airway management devices, including laryngeal mask airways, or to look at the long-term effects of various cuff inflation strategies on respiratory outcomes. Another possible study field is developing automated or semi-automatic ETT cuff inflation systems that account for syringe size. These technologies would significantly improve patient safety and comfort during general anesthesia by giving anesthesia practitioners real-time input on cuff pressure.

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Appendix A

Recruitment email

My name is Racine Williams, and I am a Student Nurse Anesthetist (SRNA) enrolled in the Post Baccalaureate Doctor of Nursing Practice (DNP) program at Barry University, Class of 2025.

I am investigating the impact of an educational in-service for anesthesia providers on the benefits and risk of utilization of a 5 ml vs a 10 ml syringe to inflate the pilot balloon of the endotracheal tube. Participation in this quality improvement project is strictly voluntary.

Should you agree to join the study, you will be asked to participate in an in-service that will educate and inform on the risks and benefits of different syringe sizes on endotracheal cuff pressures. The in-service will take approximately 10 minutes. No risks are associated with participating in this study. No identifying information will be collected, and all data will be kept confidential. Data will only be shared with my project chair and other committee members at Barry University.

Remember, this is entirely voluntary. You can choose to withdraw from the study at any time.

Also, there is no compensation for this study.

Pre-survey: https://s.surveyplanet.com/rhktzjvq

Demonstration:

Post- survey: https://s.surveyplanet.com/9ynmwynb

Primary investigator: Racine Williams BS, SRNA, CCRN

Affiliation: Barry University Nurse Anesthesiology Program

Email: Racine.williams@mymail.barry.edu

DNP Advisor: Cheryl Adams, DNP, CRNA

Affiliation: Barry University Nurse Anesthesiology Program

Email: cadams@barry.edu

DNP Chair: Jennifer Theo, DNP, CRNA

Email: jtheo@barry.edu

I appreciate your time and assistance with my educational research study.

By attending the in-service, you are consenting to participate in the research.

If you have questions about your rights as a participant or wish to obtain further information, ask questions, or discuss any concerns about this project with someone other than the researcher, please contact Barry University Institutional Review Board (IRB):

IRB Point of contact: Anoush McNamee

Telephone: 305-899-3020

Email: amcnamee@barry.edu

Appendix B

Capping the Pressure Presurvey

1. Are you a(n) *
    a. Anesthesiologist
    b. Certified Registered Nurse Anesthetist
    c. Anesthesiologist Assistant
    d. Student Registered Nurse Anesthetist
2. How many years have you practiced anesthesia?
    a. 0-3 years
    b. 4-7 years
    c. 8-11 years
    d. > 11 years
3. In your practice, how do you typically inflate the pilot balloon of the endotracheal tube?
    a. Inflate 8 mL of a 10 mL syringe
    b. Inflate 5 mL of a 10 mL syringe
    c. Inflate 5 mL of a 5 mL syringe
    d. Inflate 10 mL of a 10 mL syringe
4. What risks do you associate with using a 5ml syringe to inflate the pilot balloon of an endotracheal tube?
    a. Over-inflation of the balloon

b. Under-inflation of the balloon

c. Increased risk of air leakage

d. Not sure

5. What risks do you associate with using a 10ml syringe to inflate the pilot balloon of an endotracheal tube?

a. Over-inflation of the balloon

b. Under-inflation of the balloon

c. Increased risk of air leakage

d. Not sure

6. What benefits do you see in using a 5ml syringe to inflate the pilot balloon of an endotracheal tube?

a. Easier to control the volume of air

a. Reduces the risk of over-inflation

b. Both A and B

c. No significant benefits

7. What benefits do you see in using a 10ml syringe to inflate the pilot balloon of an endotracheal tube?

b. Easier to control the volume of air

d. Reduces the risk of over-inflation

e. Both A and B

f. No significant benefits

8. Have you received any specific training or guidelines on the appropriate syringe size to use for this purpose?

a. Yes, training recommends a 5ml syringe

b. Yes, training recommends a 10 ml syringe

c. Yes, training recommends either syringe

d. No, I have not received specific training

9. What is the recommended cuff pressure range for an endotracheal tube to prevent complications?

a. 5-10 cm H2O

b. 20-30 cm H2O

c. 40-50 cm H2O

d. Not sure

10. Endotracheal cuff pressures can increase the incidence of postoperative sore throat?

a. True

b. False

11. How can endotracheal cuff pressure impact patient experience during the postoperative period?

a. Cuff pressures do not impact patient experience

b. High cuff pressures can increase patient discomfort in the postoperative period

c. Low cuff pressures cannot influence patient experience in the postoperative period.

d. Not sure

Appendix C

Capping The Pressure Postsurvey

1. What is the recommended cuff pressure range for an endotracheal tube to prevent complications?

a. 5-10 cm H2O

b. 20-30 cm H2O

c. 40-50 cm H2O

d. Not sure

2. What are the potential risks of over-inflating the endotracheal tube cuff?

a. Tracheal ischemia

b. Increased risk of aspiration

c. Reduced ventilation effectiveness

d. Not sure

3. What benefits were highlighted in the presentation regarding the use of a 5 ml syringe for inflating the pilot balloon of an endotracheal tube?

a. More precise control of cuff pressure

b. Reduced risk of over-inflation

c. Reduced risk of postoperative sore throat

d. All of the above

4. After the presentation, how likely are you to change your practice to use a 5 ml syringe for inflating the endotracheal tube cuff?

a. Very likely

b. Somewhat likely

c. Not likely

d. Not sure

5. How likely are you to use a manometer to measure endotracheal tube cuff pressures after inflation?

a. Very likely

b. Somewhat likely

c. Not likely

d. Likely, if time permits

6. How do you think using a 5 ml syringe will impact patient safety during anesthesia?

a. Significantly improve safety

b. Slightly improve safety

c. No change in safety

d. Decrease safety

7. How confident are you in your ability to implement the recommended practices discussed in the presentation?

a. Very confident

b. Somewhat confident

c. Not very confident

d. Not confident at all

8. How will you apply the information learned from the presentation in your daily practice?

a. Use a 5 ml syringe to inflate the cuff

b. Monitor cuff pressures more closely

d. All of the above

9. What additional training or resources do you feel would be beneficial to support your practice in managing endotracheal tube cuff pressures?

a. Hands-on workshops

b. More detailed guidelines and protocols

c. Access to updated research and literature

d. All of the above

Appendix D

Capping The Pressure Demonstration

Capping the Pressure.pptx

Appendix E

Capping The Pressure IRB Approval

Barry University
Division of Academic Affairs

Institutional Review Board
11300 NE 2nd Avenue, Miami, FL 33161
P: 305.899.3020 or 1.800.756.6000, ext. 3020
F: 305.899.3026
www.barry.edu

Research with Human Subjects

LETTER OF APPROVAL AS EXEMPT RESEARCH

Date: June 13, 2024
Protocol Number: 2206390-1
Study Title: Capping the Pressure: The Role of 5 mL vs. 10 mL Syringes in Managing Endotracheal Tube Cuff Pressures and Mitigating Postoperative Sore Throat
Principal Investigator: Racine Williams
Faculty Sponsor: Jennifer Theo

Dear Researcher:

On behalf of the Barry University Institutional Review Board (IRB), I have granted final approval of this study as exempted from further review. As an exempted study, there is no expiration date and no annual report requirement. However, please note the following:

- As principal investigator of this protocol, it is your responsibility to ensure that this study is conducted as approved by the IRB.
- Any modifications to the study or related documents will require prior approval, which you may request by submitting a protocol Modification Form. You can download the most current version of the form from the IRBNet library (Forms and Templates).
- You must promptly report to the IRB any serious, unanticipated adverse events experienced by participants during this research.

If you have questions about these procedures, or need any additional assistance from the IRB, please contact the IRB point of contact, Ms. Anoush McNamee (305-899-3020 or amcnamee@barry.edu)

Sincerely,

Michele Upvall

Michele Upvall, PhD, RN, FNP-C, CNE, FAAN
Chair, Institutional Review Board (IRB)
Barry University

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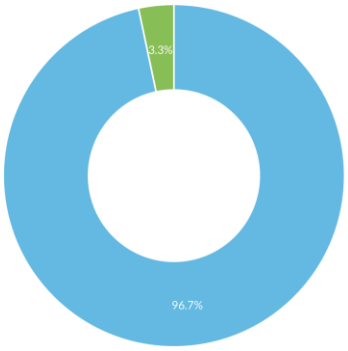
Note: The investigator will be solely responsible and strictly accountable for any deviation from or failure to follow the research protocol as approved. Barry University has no liability related to claims arising from said deviation or failure.

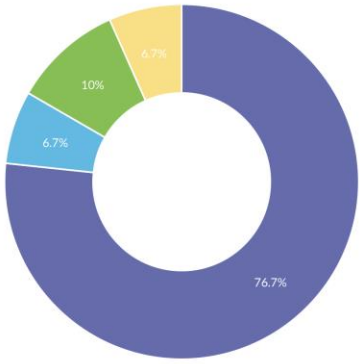
Appendix F

Q1 What is the recommended cuff pressure range for an endotracheal tube to prevent complications?
Multiple Choice



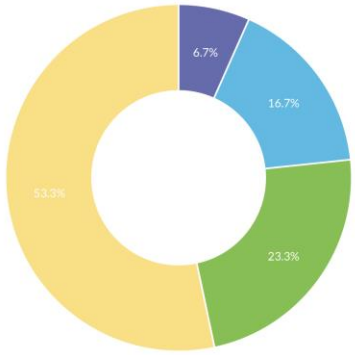
Choice	Total
A. 5-10 cm H2O	0
B. 20-30 cm H2O	29
C. 40-50 cm H2O	1
D. Not sure	0

Q2 What are the potential risks of over-inflating the endotracheal tube cuff?
Multiple Choice



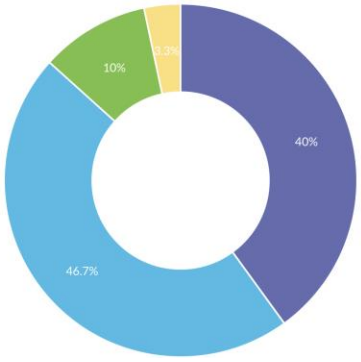
Choice	Total
A. Tracheal ischemia	23
B. Increased risk of aspiration	2
C. Reduced ventilation effectiveness	3
D. Not sure	2

Q3 What benefits were highlighted in the presentation regarding the use of a 5 ml syringe for inflating the pilot balloon of an endotracheal tube?
Multiple Choice



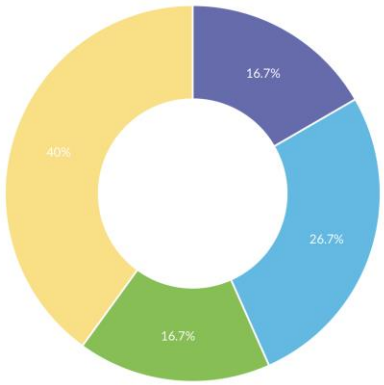
Choice	Total
A. More precise control of cuff pressure	2
B. Reduced risk of over-inflation	5
C. Reduced risk of postoperative sore throat	7
D. All of the above	16

Q4 After the presentation, how likely are you to change your practice to use a 5 ml syringe for inflating the endotracheal tube cuff?
Multiple Choice



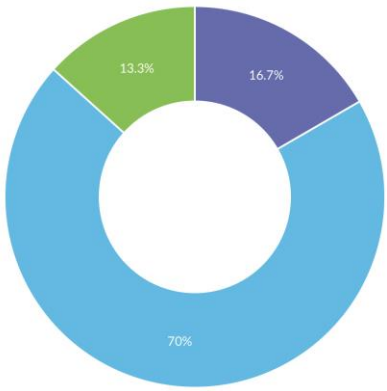
Choice	Total
A. Very likely	12
B. Somewhat likely	14
C. Not likely	3
D. Not sure	1

Q5 How likely are you to use a manometer to measure endotracheal tube cuff pressures after inflation?
Multiple Choice



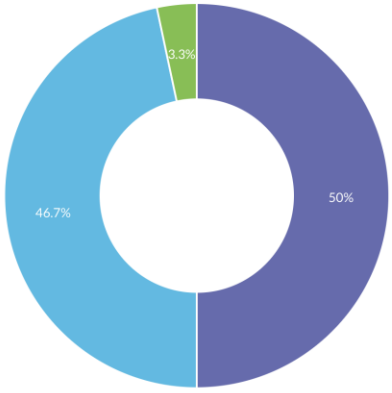
Choice	Total
A. Very likely	5
B. Somewhat likely	8
C. Not likely	5
D. likely, if time permits	12

Q6 How do you think using a 5 ml syringe will impact patient safety during anesthesia?
Multiple Choice



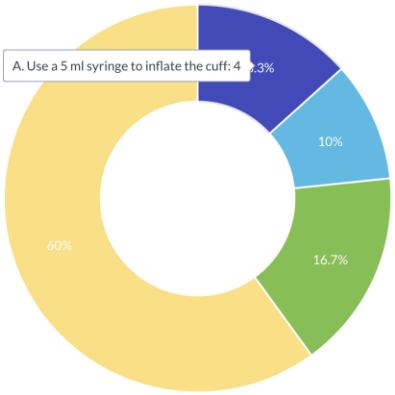
Choice	Total
A. Significantly improve safety	5
B. Slightly improve safety	21
C. No change in safety	4
D. Decrease safety	0

Q7 How confident are you in your ability to implement the recommended practices discussed in the presentation?
Multiple Choice



Choice	Total
A. Very confident	15
B. Somewhat confident	14
C. Not very confident	1
D. Not confident at all	0

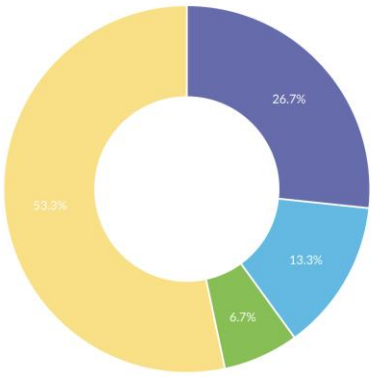
Q8 How will you apply the information learned from the presentation in your daily practice?
Multiple Choice



Choice	Total
A. Use a 5 ml syringe to inflate the cuff	4
B. Monitor cuff pressures more closely	3
C. Educate colleagues on best practices	5
D. All of the above	18

Q9 What additional training or resources do you feel would be beneficial to support your practice in managing endotracheal tube cuff pressures?

Multiple Choice



Choice	Total
A. Hands-on workshops	8
B. More detailed guidelines and protocols	4
C. Access to updated research and literature	2
D. All of the above	16