Nurse Anesthetists' Perceptions of the Airway Assessment of Patients with Obesity and the Impact of an Educational Intervention:

A Quality Improvement Project

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Abstract

As the prevalence of obesity increases, there are more patients with obesity presenting for surgery requiring anesthesia. The increased adiposity in obese patients alters anatomy and physiology and places them at higher risk for a difficult perioperative airway. There are a variety of techniques to properly assess these risks; however, no single source could be found that succinctly incorporated predictive scales for properly identifying and managing potential difficult airways in obese patients. This quality improvement project aimed to better understand CRNA perceptions of airway assessment techniques for patients with obesity. Perceptions of nurse anesthetists regarding methods for assessing the airways of patients with obesity before and after receipt of an educational resource and presentation were assessed using Qualtrics pre- and post-surveys. Results from the project showed increased access to education on airway assessment for obese patients, better awareness of evidence-based practices supported by AANA and ASA, more efficient access to clinical guidelines, and increased confidence among CRNAs in their knowledge of airway assessment. CRNAs also indicated a higher likelihood of using various airway assessment methods. Improving airway prediction accuracy can reduce prolonged PACU stays, hospital days, and postoperative intubations, lowering healthcare costs. The primary limitations of this quality improvement project were its small sample size and brief implementation period. Knowledge gained from this pilot project could be used in future quality improvement and policy efforts aimed at improving anesthesia care of obese patients.

Keywords: nurse anesthetist, obesity, bariatric, airway assessment, difficult airway

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Section I. Introduction

Background

When anesthesia providers conduct a preoperative evaluation, assessment of the patient's airway is an essential component. For the patient to be anesthetized for the procedure, drugs are administered that cause apnea and loss of protective reflexes. Obtaining and maintaining patients' airways is how anesthesia providers ventilate patients, protect airways, and prevent gastric contents from entering the lungs. Being unable to secure a patient's airway can result in serious harm to the patient, including aspiration pneumonitis, anoxic brain injury, and even death. Proper evaluation of the airway and correct identification of concerning findings aid in the decision to prepare for a potential difficult airway scenario. Once potential of a difficult airway is identified, anesthesia providers can minimize the risk by ensuring emergency equipment is available before induction, appropriate airway management techniques are used, and the patient is properly positioned for optimal visualization of the glottis. Patient factors that contribute to a difficult airway should be carefully considered when conducting a patient-centered airway assessment.

According to the Centers for Disease Control and Prevention (CDC, 2021), the prevalence of obesity continues to rise in North Carolina by more than 7% over 10 years (2011-2021) and is unlikely to slow in the near future. As the prevalence of obesity continues to rise in North Carolina, increasing numbers of obese patients will be presenting for surgery requiring anesthesia. According to the American Association of Nurse Anesthesiology (AANA), patients with obesity are at a 30% increased risk of difficult mask ventilation and difficult tracheal intubation (AANA, 2023).

The AANA is the national authority on standards of practice for nurse anesthesia. The state level organization is the North Carolina Association of Nurse Anesthetists (NCANA). Nurse anesthetists must adhere to the AANA's standards and guidelines published in the AANA Professional Practice Manual. These include positions on various aspects of practice, including airway assessments. Standard 2: Pre-anesthesia Patient Assessment and Evaluation outlines the expectations for a preoperative assessment (AANA, 2019). According to this standard, nurse anesthetists are expected to perform an anesthesia-focused physical assessment. Airway assessment is briefly mentioned in a table, though very few specifics are listed. Physical examination of the airway anatomy and teeth, including dentures, partials, and veneers, use of the Mallampati classification, and reviewing any past airway issues is the standard related to airway assessment. No special considerations on how obesity influences this assessment are mentioned. This standard asserts that the airway anatomy should be assessed but does not specify how to best do so, apart from mentioning the Mallampati classification.

In addition to the *Standards of Nurse Anesthesia Practice,* the AANA has published an infographic titled *Patient Selection Criteria: Special Considerations for Elevated BMI*, along with the disclaimer that the information contained is not written as requirements or standards to follow (AANA, 2023). This document has much more specific recommendations on assessment techniques to use in this patient population, including the STOP-Bang questionnaire. The author explains that the content is largely based on expert opinion, citing the reason for a lack of formal standards is due to a lack of supporting evidence.

Unidentified comorbidities, such as obstructive sleep apnea (OSA), can hinder obtaining an accurate assessment of the patient with obesity, which can compromise their airway during induction and maintenance of general anesthesia. OSA was the most common undiagnosed

comorbidity that was found in numerous articles to predict difficult intubation and other perioperative complications (Pouwels et al., 2019; Seyni-Boureima et al., 2022; Smith et al., 2022). OSA is very common among patients with obesity; the incidence of severe OSA is nearly 20%, with a BMI greater than 35 kg/m^2 (Pouwels et al., 2019). Because OSA is an independent risk factor for postoperative complications, and it is very common in patients with obesity, identification of diagnosed and undiagnosed OSA should be included in the preoperative assessment of patients with obesity. Current guidelines set by the American Society of Anesthesiologists (ASA, 2014) recommend that if characteristics appreciated during the preoperative assessment suggest that the patient has OSA, management and/or treatment of OSA must be considered by the anesthesia provider and the surgeon. How patients with obesity are screened for OSA is still a topic of discussion.

According to the AANA, certified registered nurse anesthetists deliver over 50 million anesthetics annually to patients in the US. This statistic supports utilizing Certified Registered Nurse Anesthetists as the target population when developing quality improvement interventions that explore the problems of unanticipated difficult airway management. Throughout this paper, this author will consistently refer to Certified Registered Nurse Anesthetists simply as nurse anesthetists.

Organizational Needs Statement

Within the partnering medical center, nurse anesthetists are among the professionals responsible for administering anesthesia, including airway assessment and management, during surgery and medical procedures. Due to the prevalence of obesity in the surrounding counties, ensuring adequacy of airway assessments in this patient population is a relevant issue for the partnering medical center. Nurse anesthetists at the partnering medical center look to the AANA,

their professional association, for standards of care to follow. The standards allow for some degree of professional judgment in that providers are free to decide which assessment techniques to use. Understanding the factors that contribute to their decision making could inform interventions designed for improving practice. Providing a patient-centered airway assessment that identifies potential difficult airways aligns with the mission statement of the partnering medical center, which is to improve the health and well-being of the people in the community it serves.

Problem Statement

Obesity (BMI $\geq$ 30 kg/m^2) has increased to over 40%, and morbid obesity (BMI $\geq$ 40 kg/m^2) to more than 9% of the population in the United States (National Institute of Diabetes and Digestive and Kidney Diseases, 2021). Subsequently, there are more patients with obesity presenting for surgery and anesthesia. The increased adiposity in obese patients alters anatomy and physiology and places them at higher risk for difficult perioperative airway management (Mehta et al., 2022; Mora et al.,2021). There are a variety of techniques to properly assess these risks; however, no single source could be found that succinctly incorporated predictive scales for properly identifying and managing potential difficult airways in obese patients.

Purpose Statement

The purpose of this Doctor of Nursing Practice (DNP) quality improvement (QI) project was to assess nurse anesthetists' perception of adequacy of a newly developed quick reference guide (QRG) as a useful tool for their practice as it pertains to assessment of the airway of patients with obesity. Knowledge gained from this pilot project could be used in future quality improvement and policy efforts aimed at improving anesthesia care of obese patients.

Section II. Evidence

Description of Search Strategies

A literature search for current evidence addressing airway assessment in patients with obesity was conducted to guide the development of a quick reference guide to implement at the partnering facility. A PICOT question was written to guide the search strategy: "How do CRNAs accurately predict difficult airways in obese patient populations?" A search of current literature was performed using the databases PubMed and Cumulative Index to Nursing and Allied Health Literature (CINAHL) as well as the search engine Google Scholar.

The key concepts used to develop search strategies included nurse anesthetist, airway, and obesity. The primary keywords used to guide the searches of all three sources included, but were not limited to, obesity, obese patients, bariatric, difficult airway, airway assessment, airway management, laryngoscopy, CRNA, nurse anesthetist, and anesthesia providers. Boolean operators were used to combine keywords and concepts. See Appendix A for a list of keywords, MeSH terms, and subject terms utilized in searches.

The search strategy used to query PubMed was ((Obesity) OR Bariatrics)) AND ((Laryngoscopy) OR (Airway management)) AND (Nurse anesthetist). This search strategy pulled in the MeSH terms obesity, bariatrics, laryngoscopy, airway management, and nurse anesthetist. CINAHL was searched using a combination of keywords and subject headings identified using the previously mentioned concepts. The search strategy used with Google Scholar was the same as was used with PubMed. Limits applied to these searches included publication within the last five years (2018-2023), English language, full text, and peer-reviewed. The initial search of all three sources yielded a total of 98 articles that were reviewed by title and abstract. Inclusion criteria for full text review included articles related to factors influencing obese airway relevant to anesthesia providers and studies with the purpose of

assessing and/or improving airway assessment and/or management practices in the perioperative setting. Articles unrelated to airway management of patients with obesity in the surgical setting as well as articles related to pediatric patient populations were excluded.

After review and deduplication at the title and abstract level, 32 articles were chosen for full text review (Appendix B). After full text review, eight articles were identified as pertinent to this project (Appendix C). Based on Melnyk and Fineout-Overholt's (2019) levels of evidence, these selected items included one systematic review (Level I), three articles on their respective cohort studies (Level V), and four expert opinion pieces (Level VII).

Selected Literature Synthesis

This literature synthesis includes eight recently published, peer-reviewed articles addressing airway assessment of patients who are obese in order to understand the factors that might facilitate or hinder airway assessment. The highest level of evidence, a systematic review, included 46 studies with a cumulative total of 32,260 participants (Smith et al., 2022). The second highest level of evidence included in the synthesis were three articles addressing their respective cohort studies (Level V), that included 56 participants, 8,641 participants, and 293 participants, respectively (Glāzniece-Kagane et al., 2022; Mehta et al., 2022; Smith et al., 2019). Finally, the four expert opinion pieces (Level VII) selected for the literature synthesis discussed various aspects of airway assessment and management in obese patients, and each was published by a reputable publication in the field of surgery or anesthesia (Kaye et al., 2022; Liew et al., 2022; Pouwels et al., 2019, Seyni-Boureima et al., 2022). Each source focuses on slightly different aspects of the airway assessment, but several common themes were identified. These themes will be discussed to better understand what the literature supports for safe airway assessment and management for patients with obesity.

All reviewed articles discussed assessment tools to grade an airway through evaluation of different criteria with a resulting score that corresponds to a level of difficulty during intubation. The Mallampati and Cormack Lehane scales are the most prevalent airway assessment scales to score and predict difficult intubation. Several of the articles discussed that these tools are not reliable enough when evaluating patients with obesity, especially considering these patients are a high-risk group for perioperative complications (Kaye et al., 2022; Liew et al., 2022; Smith et al., 2022). One suggestion to augment current airway assessments, in order to accurately identify more difficult intubation, include measuring the hyomental distance in neutral and extended positions with ultrasound and calculating the ratio of those distances. The hyomental distance ratio (HMDR) was shown to be a weak predictor of difficult laryngoscopy, with lower HMDR in the difficult laryngoscopy group (1.12 ± 0.04) compared to the easy laryngoscopy group (1.24 ± 0.06) and a p-value of <0.001 (Glazniece-Kagane et al., 2022). The HMDR was also shown to have higher sensitivity and specificity than the Mallampati score for predicting difficult laryngoscopy. Recommendations for using the HMDR for preoperative airway assessment were included in the systematic review and cohort study (Glāzniece-Kagane et al., 2022; Smith et al., 2022).

Another theme found in the literature was how unidentified comorbidities can hinder obtaining an accurate preoperative assessment of the patient with obesity which can compromise their airway during induction and maintenance of general anesthesia. Obstructive sleep apnea (OSA) was the most common undiagnosed comorbidity that was found in numerous articles to predict difficult intubation and other perioperative complications (Pouwels et al., 2019; Seyni-Boureima et al., 2022; Smith et al., 2022). OSA is very common among patients with obesity, with an incidence of nearly 20% meeting criteria for severe OSA if BMI> 35 kg/m2 (Pouwels et

al., 2019). OSA is associated with worse postoperative oxygen desaturation, respiratory failure, and adverse cardiac events when it is undiagnosed and untreated prior to surgery.

The STOP-Bang questionnaire is another screening tool for undiagnosed OSA in patients presenting for surgery. Numerous studies included in the systemic review by Smith et al. recommended postponing surgery to allow initiation of CPAP treatment in patients with OSA discovered during preoperative workup to optimize the patient for surgery (2022, pp. 4-5). Because OSA is an independent risk factor for postoperative complications, and it is very common in patients with obesity, identification of patients with diagnosed and undiagnosed OSA should be included in the preoperative airway assessment of this patient population.

Lastly, a common thread observed throughout the literature were descriptions of anatomical changes related to obesity that affect airways and ease of intubation. One anatomical change is an increased neck circumference. A neck circumference >17 inches (>40 cm) has been used as a criterion for identifying a difficult airway (Mehta et al., 2022). An increased neck circumference can increase difficulty of airway management due to decreasing range of motion when the patient has significant musculature in the neck. The other cause of increased neck circumference is the presence of adipose deposits in the neck. It is important to note that not all patients with obesity have a neck circumference >40 cm. The distribution of adipose may be in the lower part of the body and not affect the upper airway structures. This highlights the importance of assessment of the patient and tailoring a patient-specific anesthetic plan.

Additional anatomical changes are significant adipose deposits within the pharyngeal structures and excess fat in the posterior region of the neck. These deposits may result in narrowing of the airway as the fatty tissue protrudes into the lumen. Additionally, excess fat in the posterior region of the neck makes the chin tip towards the chest, which interferes with

placing the patient in the sniffing position for airway insertion (Seyni-Boureima et al., 2022). This position optimizes mask ventilation and increases laryngoscope view of the airway. The sniffing position is considered the ideal position for intubation because it aligns the pharyngeal and laryngeal axis through extension of the atlanto-occipital joint and flexion at the base of the neck, which is made more difficult with excess adipose tissue in that region. Therefore, the patient with obesity should optimally be positioned so that the "external auditory meatus lies in the same horizontal plane as the sternal notch" (pp. 5). Referred to as the ramp-up position, the use of blankets, pillows, or wedges beneath the patient's shoulders improves airway insertion by increasing visualization, allows easier use of bag-mask ventilation, and is used to put a patient with obesity in the sniffing position. (Seyni-Boureima et al., 2022). These findings are useful in understanding why certain assessment criteria can inform anesthesia providers' decision making when predicting difficult mask ventilation and laryngoscopy.

As the prevalence of obesity increases, it is important for anesthesia providers to adapt their assessment methods following the recommendations of evidence-based practice. The themes included in this literature review serve as a basis for those recommendations. There are numerous assessment tools used to grade a patient's airway to predict difficulty of intubation. None have proven to be highly effective as a stand-alone assessment tool, but using a combination of measurements can improve the accuracy of predicting potentially difficult airway insertions. The ones identified in this literature review include Mallampati score, Cormack Lehane scale, neck circumference, the hyomental distance ratio, and identification of diagnosed and undiagnosed OSA. Additionally, patients with obesity have anatomical changes associated with their airway that can impede visualization and hinder insertion of an artificial airway. Positioning techniques and use of fiberoptic devices can mitigate the challenges of anatomical

changes. Together, these assessment and positioning techniques can be utilized to create a singular quick reference guide for nurse anesthetists to use during a patient centered airway assessment. This information will be used to inform and develop a quick reference guide for nurse anesthetists in the partnering medical facility.

Project Framework

The framework followed for this quality improvement project was the Institute for Healthcare Improvement's (2021) model for improvement. The plan-do-study-act (PDSA) cycle is a four-stage problem-solving tool that guided the systematic process of this project. First, a "plan" was developed to set the goals and direction of the project. This included deciding on a protocol, timeframe for completing the project, and the target population. The "do" portion consisted of distributing a pre-implementation survey to the target population, distributing the educational intervention, and distributing a post-implementation survey. The "study" phase involved review and analysis of the survey results. Finally, the "act" portion consisted of drawing conclusions from these results. The purpose of this project was to assess nurse anesthetists' perception of adequacy of a newly developed quick reference guide (QRG) as a useful tool for their practice as it pertains to assessment of the airway of patients with obesity. The findings could inform a subsequent project's intervention to address this clinical issue. The steps of the PDSA model appropriately supported the design of this project as the goal involved a cycle of providing a small change (e.g., providing education), surveying nurse anesthetists to assess their perceptions of the QRG, and summarizing what was learned so that it could be applied in the next cycle in another quality improvement project.

Ethical Considerations and Protection of Human Subjects

The potential benefits of this project apply equitably to all nurse anesthetists, who are the target population. No risks have been identified. There is no potential harm to the target population beyond that of their normal work activities or any potential that they would be taken advantage of during this project implementation. Participation of the nurse anesthetists was voluntary, and consent was through their active participation, with no formal documentation of consent completed. No patients were used to complete this QI project. To prepare for the formal approval processes, the project lead completed the Collaborative Institutional Training Initiative (CITI) training program on research ethics and compliance (https://about.citiprogram.org/courses/?reset=true). Upon completion of an internal review process for student projects with the project lead's College of Nursing and University and Medical Center Institutional Review Board (UMCIRB), this project was deemed quality improvement and thus exempt from full review (Appendix D). This project also received complete facility approval through the research office of the partnering facility in conjunction with the UMCIRB. Approval from the partnering facility to collect data was granted and documented.

Section III. Project Design

Project Setting

This study was conducted at a prominent Level 1 Trauma Center located in northeastern North Carolina, boasting 974 beds and 37 anesthetizing locations. The facility offers a wide spectrum of inpatient and outpatient surgical procedures, encompassing endoscopic, gastrointestinal, general surgical, gynecologic, ophthalmologic, orthopedic, podiatric, and urologic specialties. An anesthesia care team, consisting of nurse anesthetists, anesthesia associates (AAs), and anesthesiologists, delivers anesthesia services and patient care during procedures requiring anesthesia. Barriers to implementation of this QI project related to the setting, include the high patient volume as this facility serves 29 counties and 1.4 million people in eastern NC. The time it requires for the nurse anesthetists to reference the QRG could slow their workflow in a setting in which the nurse anesthetists are already pressed for time. A preexisting collaboration between the facility and the university facilitated the implementation of this project.

Project Population

The primary population for this quality improvement endeavor was the nurse anesthetists practicing at the partnering medical center. All anesthesia providers at this facility possess expertise in anesthesia management, patient monitoring, and the ventilatory and hemodynamic management of patients undergoing a wide range of medical and surgical procedures. These anesthesia providers exhibit a range of expertise, years of experience, age, and they operate autonomously. Within this cohort, experienced leaders familiar with the facility's perioperative practices and workflow played a pivotal role in facilitating the integration of this quality improvement project. Nurse anesthetists work in a demanding, high-acuity, fast-paced, and often

stressful environment. Given the physical and mental demands of their work, there was the potential for reluctance to allocate additional time for participation in this project. Nevertheless, considering their presence in a teaching hospital and their history of collaborating with students, it was reasonable to anticipate that some nurse anesthetists might be inclined to support the success of a student-led quality improvement project.

Project Team

The quality improvement project team comprised a nurse anesthesia student team leader, three additional nurse anesthesia students, a project chair, a site contact, a nurse anesthetist faculty clinical contact, the course director, and the nurse anesthesia program director. The four student registered nurse anesthetists (SRNAs), including the author, were responsible for developing the protocol, and then each student implemented the project, individually, at their respective site (medical facility). The project chair, a doctorally-prepared CRNA and faculty member of the program, provided ongoing support and guidance in the project's development. The primary SRNA and author led the implementation of the project at the project site. A representative from the partnering facility provided formal acknowledgment for data collection at their site. The clinical contact, a nurse anesthetist, was responsible for guiding student clinical experiences, providing mentorship, and lending clinical expertise during the project. The Doctor of Nursing Practice (DNP) project course director, a non-nurse anesthetist faculty member with a doctoral degree, offered guidance and feedback throughout the project's development and completion. The program director facilitated coordination between the team and the partnering facility, providing leadership and oversight to all project team members for all aspects of the project.

Methods and Measurement

The primary objective of this project was to enhance understanding of nurse anesthetists' perceptions of a QRG outlining airway assessment methods for patients with obesity. This was achieved through the development of a new airway assessment quick-reference guide and evaluation of participants' perceptions of the guide (Appendix E). A pre-test/post-test methodology was employed to assess changes in perceptions, with the results serving as valuable insights for informing future studies and initiatives aimed at improving the identification of difficult airway issues, particularly in patients with obesity. The educational intervention, which consists of the QRG(Appendix E) and accompanying PowerPoint presentation (Appendix F), and links to the pre- and post-implementation Qualtrics surveys (Appendix G) were delivered to participating nurse anesthetists via email. Participants were identified and recruited by the program director (Appendix H). This project encompassed a single Plan-Do-Study-Act (PDSA) cycle.

In the "Plan" phase, a literature review identified a lack of a comprehensive airway assessment tools incorporating multiple predictive scales for difficult airways in patients with obesity. Recognizing nurse anesthetists' significance in perioperative care, their perceptions were considered invaluable for understanding current practices related to airway assessment and management. The project aimed to deepen the understanding of nurse anesthetists' views on airway assessment methods and the utility of educational interventions for patients with obesity.

To achieve this, pre- and post-implementation surveys were conducted and developed by SRNAs and the project chair. Pre-implementation questions focused on current airway assessment practices, views on accuracy, and confidence in knowledge. Post-implementation questions aligned with pre-implementation questions, assessing changes following the

educational intervention. Topics included effectiveness of previous practices, correlation between predictions and difficulty of airway management, barriers to preoperative assessments on obese patients, and feedback on the educational tool's usefulness. The surveys utilized Likert-type questions and open-ended inquiries, collecting data at nominal, ordinal, and ratio levels.

An evidence-based educational resource, a single-page QRG, summarized best-practice airway assessment methods. It emphasized the importance of employing multiple techniques and specific criteria for identifying patients at risk for obstructive sleep apnea. SRNAs, with input from the project chair, created an educational presentation using PowerPoint and the voiceover tool, aiming for quick access and reference in practice.

The overarching goal was to identify nurse anesthetists' perceptions of the usefulness of the QRG after the educational intervention, without imposing predetermined changes. The university and partnering facility approved the project as quality improvement, exempting it from Institutional Review Board approval. Participants were recruited through communication between the clinical contact team member and nurse anesthetists at the partnering facility, who agreed to participate in the pre-survey, educational content, and post-survey. The project team received a list of participant names and emails for coordination, led by the clinical contact nurse anesthetist.

In the "Do" phase of the PDSA cycle, the project team lead sent emails to participating nurse anesthetists, each containing a link to the Qualtrics pre-implementation survey. No identifying information was collected as part of the questionnaire. Participants were requested to complete the pre-implementation survey, watch the educational video provided in the email, and download the educational resource for reference in their practice. Two weeks later, participants received an email prompting them to complete the post-implementation questionnaire through

the provided Qualtrics link. Responses to the Qualtrics questionnaires remained confidential, with results electronically collected, analyzed, and reported in an aggregate format.

In the "Study" phase, all survey responses were collected using Qualtrics and analyzed with Microsoft Excel. Pre-survey responses were examined to gain insight into airway assessment practices at the partnering hospital from the perspective of participating nurse anesthetists. These responses were also scrutinized to understand how nurse anesthetists perceived the effectiveness of current practices and their baseline confidence in their knowledge of effective airway assessment techniques. These results were compared to post-survey responses to assess the impact of the educational intervention on their perceived knowledge, confidence in the efficacy of their practices, and the self-reported estimated percentage of patients they cared for with obesity. Results were also evaluated in relation to any reported changes in practice by nurse anesthetists. Nominal, ordinal, interval, and ratio data was collected with the pre- and post-implementation surveys. The achievement of these results and conclusions fulfilled the project's objective.

In the "Act" phase, the project team deliberated on the insights gained and the conclusions drawn from this single PDSA cycle. Findings, along with responses to the post-survey open-ended question concerning how the QRG could be enhanced, will inform the next PDSA cycle. The project team considered how the process and results of this project could be applied to subsequent cycles and future initiatives aimed at preventing unanticipated difficult airways in patients with obesity. These conclusions and recommendations were presented to the university through a poster presentation.

Section IV. Results and Findings

Results

The purpose of this quality improvement (QI) project was to assess nurse anesthetists' perceptions of a newly developed quick reference guide (QRG) as a useful tool for their practice as it pertains to assessment of the airway of patients with obesity. This quality improvement project utilized a pre-test/post-test methodology and completed a single PDSA cycle. Prior to any intervention, the participants completed a survey that included seven questions aimed at gathering insight into the nurse anesthetists' current airway assessment practices, their perception of the accuracy of these practices, in predicting difficult airway in patients that have obesity, and what proportion of their patient load has obesity (see Appendix G).

Seven nurse anesthetists at the partnering facility completed the pre-implementation survey. These responses were collected over nine days. After completing the first survey, the nurse anesthetists were asked to view a PowerPoint presentation with audio, providing information on airway assessment practices and management, with a focus on airways of patients with obesity. They were provided an electronic, printable, one-page resource summarizing the information presented in the PowerPoint presentation. They were invited to keep the resource readily available and use it as an evidence-based resource to support their clinical practice over the course of two weeks. After this two-week implementation period, the nurse anesthetists were asked to complete a post-implementation survey that addressed their perceptions of the effectiveness of their airway assessment practices in predicting difficult intubation in obese patients. It explored their opinion about the correlation between the presence of obesity and difficulty in airway management, and sought feedback on the QRG, including its usefulness in their practice. Four nurse anesthetists completed the post-implementation survey. These

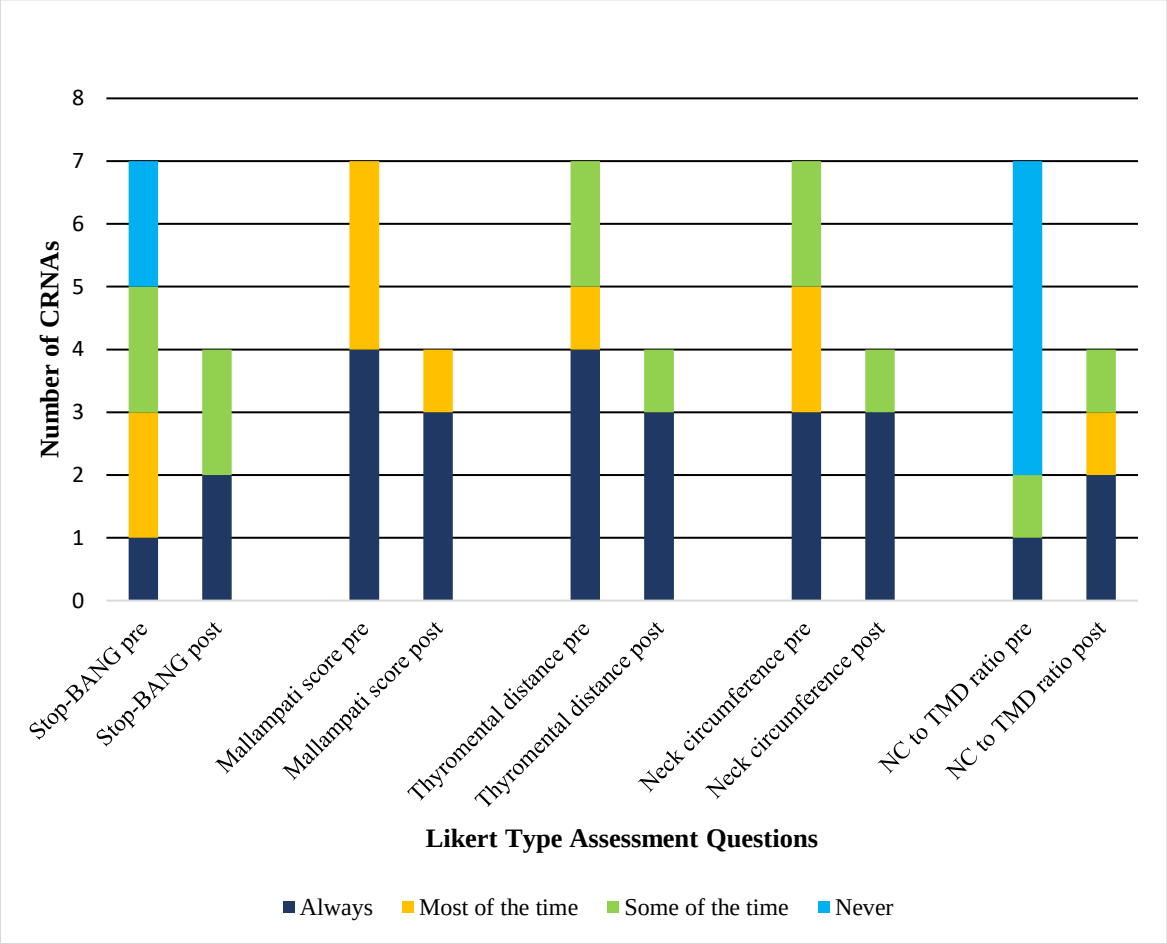
responses were collected over nine days. The data was collected from the pre- and post-implementation surveys using Qualtrics and were analyzed using Microsoft Excel.

Data Presentation

In the pre-implementation survey, the nurse anesthetists were first asked how often they used one of five common airway assessment tools in patients with obesity. The results of this question are depicted in Figure 1. In response to how often they currently used the Stop-BANG questionnaire, one out of seven nurse anesthetists responded *Always*, two responded, *Most of the time*, two responded, *Some of the time*, and two responded, *Never*. In response to how often they currently used the Mallampati score, four out of seven nurse anesthetists responded, *Always*, and three responded, *Most of the time*. In response to how often they currently used the thyromental distance, four out of seven nurse anesthetists responded, *Always*, one responded, *Most of the time*, and two responded, *Some of the time*. In response to how often they currently assessed neck circumference, three out of seven nurse anesthetists responded, *Always*, two responded, *Most of the time*, and two responded, *Some of the time*. In response to how often they currently use the Neck circumference to Thyromental distance ratio (NC/TMD ratio), one out of seven nurse anesthetists responded, *Always*, one responded, *Some of the time*, and five responded, *Never*. See Figure 1.

Figure 1.

Evaluation of the AIRWAYS of patients with OBESITY (BMI>30) with various assessment methods



In the second pre-implementation question, they were asked how useful they found those assessment methods at predicting difficult airways in patients with obesity. In response to how useful the Stop-BANG questionnaire is at predicting difficult airways in patient with obesity, one out of seven nurse anesthetists responded, *Very useful*, one responded, *Mostly useful*, three responded, *Somewhat useful*, and two responded, *I do not use this tool*. In response to how useful the Mallampati score is at predicting difficult airways in patients with obesity, three out of seven nurse anesthetists responded, *Very useful*, two responded, *Mostly useful*, and two responded, *Somewhat useful*. In response to how useful the thyromental distance is at predicting difficult airways in patients with obesity, four out of seven nurse anesthetists responded, *Very*

useful, two responded, *Mostly useful*, and one responded, *Somewhat useful*. In response to how useful the neck circumference is at predicting difficult airways in patients with obesity, four out of seven nurse anesthetists responded, *Very useful*, and three responded, *Somewhat useful*. In response to how useful the NC/TMD ratio is at predicting difficult airways in patients with obesity, one out of seven nurse anesthetists responded, *Very useful*, one responded, *Somewhat useful*, and five responded, *I do not use this tool.*

In the third question of the pre-implementation survey, the nurse anesthetists were asked to estimate the percentage of patients that they care for in a typical two-week period that have obesity (BMI>30). Two out of seven responded, *76%- 99%,* four responded, *51%-75%,* and one responded, *26%-50%*. Part 1 of question four asked how true do they believed that patients with obesity are more difficult to mask-ventilate. Three out of seven responded, *Entirely true*, three responded, *Somewhat true*, and one responded, *Neither true nor false*. Part 2 of question four asked how true do they believed that patients with obesity are more difficult to intubate. One out of seven responded, *Entirely true*, four responded, *Somewhat true*, and two responded, *Neither true nor false.*

The last three questions were not duplicated in the post-survey. Question five and six asked the participants if they were trained to use point-of-care ultrasound (POCUS) to assess patients' airways and how often they used POCUS for this purpose. None of the participants had been trained to use POCUS for this purpose and therefore, also responded that they had *Never* used it. The seventh and final question of the pre-implementation survey asked how often did they use "ramping" for patients with obesity to optimize intubation conditions. Four out of seven responded, *Most of the time*, two responded, *Some of the time*, and one responded, *Never.*

In the post-implementation survey, after using the Quick Reference Guide for two weeks, the nurse anesthetists were asked how often they used one of five common airway assessment tools. There were four respondents. See Figure 1. In response to how often they currently used the Stop-BANG questionnaire, two out of four responded, *Always*, and two responded, *Some of the time*. In response to how often they currently used the Mallampati score, three out of four responded, *Always*, and one responded, *Most of the time.* In response to how often they currently used the thyromental distance, three out of four responded, *Always,* and one responded, *Some of the time.* In response to how often they currently assessed neck circumference, three out of four responded, *Always*, and one responded, *Some of the time.* In response to how often they currently used the Neck circumference to Thyromental distance ratio (NC/TMD ratio), two out of four responded, *Always*, one responded, *Most of the time*, and one responded, *Some of the time.*

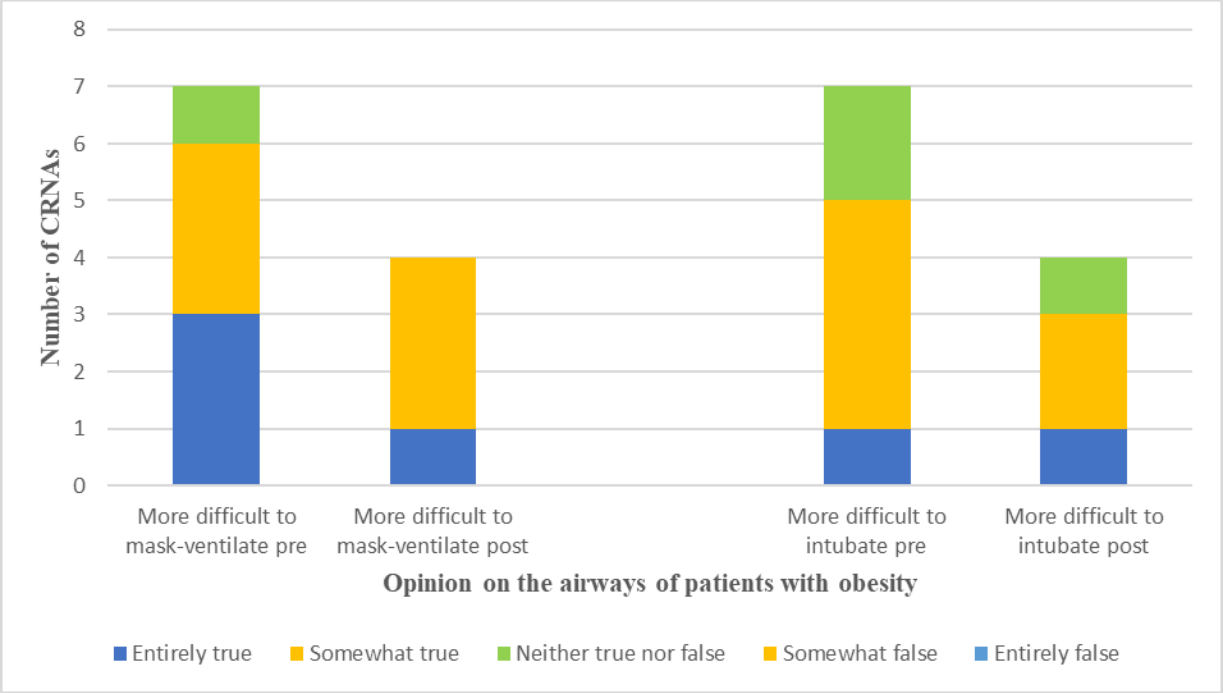
In the second question of the post-implementation survey, the nurse anesthetists were asked how useful they found those same assessment methods were at predicting difficult airways in patients with obesity. In response to how useful the Stop-BANG questionnaire is at predicting difficult airways in patient with obesity, two out of four responded, *Very useful*, and two responded, *Somewhat useful.* In response to how useful the Mallampati score is at predicting difficult airways in patients with obesity, three out of four responded, *Very useful*, and one responded, *Somewhat useful.* In response to how useful the thyromental distance is at predicting difficult airways in patients with obesity, three out of four responded, *Very useful*, and one responded, *Somewhat useful.* In response to how useful the neck circumference is at predicting difficult airways in patients with obesity, three out of four responded, *Very useful*, and one responded, *Somewhat useful.* In response to how useful the NC/TMD ratio is at predicting

difficult airways in patients with obesity, two out of four responded, *Very useful*, and two responded, *Mostly useful.*

For the third question of the post-implementation survey, the nurse anesthetists were asked to estimate the percentage of patients that they care for in a typical two-week period have obesity (BMI>30). One out of four responded, *76%- 99%,* and three responded, *51%-75%.* Part 1 of the fourth question asked how true they believed that patients with obesity are more difficult to mask-ventilate. One out of four responded, *Entirely true,* three responded, *Somewhat true.* Part 2 of question four asked how true they believed that patients with obesity are more difficult to intubate. One out of four responded, *Entirely true,* two responded, *Somewhat true,* and one responded, *Neither true nor false.* The results from this question were illustrated in Figure 2, comparing pre- and post-implementation perceptions.

Figure 2.

AIRWAY MANAGEMENT DIFFICULTY for patients with OBESITY (Pre: n= 7, Post: n= 4)



The fifth post-implementation question asked how often they used POCUS for assessing airways in patients with obesity. All four responded that they "never" used it. The sixth question asked how interested they would be in attending an in-service on the use of POCUS for preoperative airway assessment, and all four reported they were "Somewhat interested." The seventh question asked how often did they use "ramping" for patients with obesity to optimize intubation conditions, to which all four responded, "Never." Question eight asked how useful the participants found the quick reference guide. Three out of four responded, "Mostly useful," and one CRNA responded, "Somewhat useful." Question nine asked how often they used the QRG in the last two weeks. One responded, "Most of the time," and three responded, "Some of the time." The last two questions were free form questions in which the participants could type in their responses. Question 10 asked them which aspect(s) of the QRG was/were most useful to their practice. One participant wrote, "Pictures of different methods of assessment." Another

mentioned the "3-3-2 rule," while another wrote, "1) The fact that it summarized multiple tools and scores. 2) Illustrations." The last question asked which aspect(s) of the QRG was/were least useful to their practice and what change(s) would they make to the guide. One participant wrote that the STOP-BANG was least useful. Another participant wrote that they thought that the illustration about the neck circumference was not clear enough and could be improved upon.

Analysis

These data present several inferences for the use of a QRG on airway assessment and management of patients with obesity. After being presented with the quick-reference guide, participants were more likely to use the Stop-BANG questionnaire and the neck circumference to thyromental distance ratio than when they responded to the pre-intervention survey. In the pre-implementation survey, two out of seven nurse anesthetists responded that they "Never" use the STOP-Bang questionnaire, while five responded that they "Never" use the neck circumference to thyromental distance ratio. In the post-implementation survey, there were four responses. None of the nurse anesthetists responded that they "Never" use the STOP-Bang or the neck circumference to thyromental distance ratio. See Figure 1. This suggests that there may have been an increase in awareness in the utility of these assessment tools and that at least some of the participants gained valuable information from the quick-reference guide. This speaks to the potential this QRG could have in future interventions or projects.

Compared to the pre-implementation survey responses to the above questions, it seems that after the implementation, two participants were generally less concerned about patients with obesity being more difficult to ventilate or intubate. This might be due to an increased awareness in correctly assessing these patients' airways or awareness of the benefits of ramping to improve visibility after being presented with the quick-reference guide. Alternatively, it could also mean

that the participants who believe obese patients to be more difficult to ventilate or intubate were among those who did not complete the post-implementation survey.

It is doubtful that a true representation of how the participants' opinions changed was obtained, as three out of the seven that responded to the pre-implementation survey did complete the post-implementation survey. These inconsistent numbers of survey responses make interpretation of the results challenging. The number of participants in this pilot project are low, yet the results could be used to inform additional quality improvement projects.

Section V. Implications

Financial and Nonfinancial Analysis

If the partnering organization replicates this project, it would be cost-effective, requiring only employee time. One anesthesia provider would need to serve as the project advocate, responsible for disseminating, collecting, and analyzing data. This role would not demand significant time outside normal work hours. Students who completed this project maintained a typical 40-plus hour clinical week, indicating the feasibility of the project leader using on-call hours and about two hours weekly outside normal hours. The hospital would incur weekly costs equivalent to twice a CRNA's hourly wage.

The survey software, Qualtrics, is available by subscription without additional usage costs. Alternatively, free survey options could be used. Putting the pre- and post-surveys into Qualtrics took less than thirty minutes. Communication via email incurred no extra costs beyond existing internet access. Microsoft PowerPoint and Excel, used for the project and data analysis, are already available at the facility, incurring no additional costs. Mobile-friendly Qualtrics surveys and educational resources were distributed electronically, eliminating printing costs. Since the project does not require CRNAs to change their practice, no workflow changes or new equipment purchases are needed.

Results from the project may have demonstrated that increased access to current information about airway assessment for obese patients, including evidence-based practices supported by AANA and ASA, clinical guidelines, and contribute to increased confidence among CRNAs in their knowledge of airway assessment. CRNAs also indicated a higher likelihood of using various airway assessment methods. Improving airway prediction accuracy can reduce prolonged PACU stays, hospital days, and postoperative intubations, and lower healthcare costs.

Overall, potential savings from preventing catastrophic airway management-related issues outweigh the project's costs, resulting in a positive return on investment. If sustainable, insights from this initial PDSA cycle could guide future quality improvement projects, further reducing potential negative patient outcomes and financial burdens.

Implications of Project

Practice standards for CRNAs, as set by the AANA, require nurse anesthetists to conduct anesthesia-focused physical assessments including a physical examination of the airway (AANA, 2019). The newly developed quick reference guide compiles current evidence-based assessment practices, displaying them in an easy to read, visually appealing, one-page reference, with the aim of assisting CRNAs in upholding the AANA's standard. This tool was specifically developed with a specific type of patient in mind; patient's with obesity who have special concerns regarding their airway and airway management.

The results of this project suggest an increased awareness of this standard, thereby supporting the delivery of patient-centered, consistent, high-quality, and safe anesthesia care as intended by the AANA. Current literature supports that obese patients are likely to have more comorbidities than non-obese patients. Although experienced anesthesia providers may rely on anecdotal evidence regarding the best preoperative assessment tools for managing obesity-related anatomical changes, care should be based on best available evidence. This ensures patients receive the highest quality care backed by well-designed studies. It is evident that the quick-reference guide and accompanying PowerPoint were able to help the CRNAs at the partnering facility review the various airway assessment methods that are supported by current evidence.

Sustainability

If the partnering organization chose to use the strategies of this pilot study to implement a larger quality improvement project, there is not a financial constraint foreseen that would limit the sustainability of the project. If, however, the project was altered to include materials with a monetary cost, such as assessing the effects of utilizing point-of-care ultrasound to assess patients' airways or hiring a staff member to provide in-person training, for example, these costs may potentially affect long term sustainability of project implementation.

While our pilot project did not require financial support, its sustainability hinges on a committed project advocate willing to dedicate time and effort to ensure its success and longevity. This could be challenging given the hospital's high case load and productivity focus. The involvement of CRNA participants, who are crucial to the project's success, would be the key determinant of its sustainability. The partnering facility could incentivize participants to enhance engagement and commitment.

Without a dedicated and motivated project leader focused on championing airway management issues, the sustainability of this quality improvement project remains uncertain. The hospital could employ strategies to address this issue to provide safe, high-quality care while reducing healthcare costs. Nurse anesthetists, who are personally and professionally invested in patient safety and high-quality anesthesia care, may consider leading the next phase of this project. Their involvement could positively influence the project's sustainability and the longevity of its benefits. If they are unable to take on additional responsibilities, future students in the nurse anesthesia program might continue this quality improvement initiative.

Dissemination Plan

The design, outcomes, and implications of this quality improvement project were provided in a poster and oral presentation for the students and faculty of the East Carolina University Nurse Anesthesia program. Student Registered Nurse Anesthetist of the other cohort were invited to attend virtually. Additionally, both the final paper and poster were archived in The Scholarship, East Carolina University's digital repository.

Section VI. Conclusion

Limitations

The primary limitations of this quality improvement project were its small sample size and brief implementation period. With only seven participants completing the pre-implementation survey and four in the post-implementation survey, the generalizability of the findings to the healthcare organizations is restricted. The project was conducted within a large anesthesia team made up of nurse anesthetists of varying years of experience. The short data collection period further limited the potential data obtained. Additionally, ensuring that the post-implementation survey responses were from the same nurse anesthetists who participated in the pre-implementation survey would have enabled a clearer and more meaningful interpretation of the results.

Recommendations for Future Implementation and/or Additional Study

If this project were to be repeated, ongoing communication with participants throughout the implementation phase is recommended. Maintaining a strong rapport with the nurse anesthetists at the facility will enhance participation. Cost-effective methods, such as electronically disseminated educational interventions, Qualtrics surveys for data collection, and Microsoft Excel for data analysis, should be continued. Using consistent questions in pre- and post-implementation surveys aids in data analysis, and its continued use is recommended.

Given the positive outcomes of educational interventions in this project and other studies, education should remain a core component of future interventions aimed at promoting evidence-based airway assessment methods. Additional implementation strategies could include in-person education and training, creating a checklist based on clinical practice guidelines, and integrating education into pre-existing department meetings to boost participation.

Further research is needed to understand if and how obesity independently increases intubation difficulty, considering the interconnected comorbidities in obese patients. As the prevalence of obesity rises, it is essential for anesthesia providers to continually evaluate and refine their practices to meet the evolving needs of this patient population. Therefore, airway assessment methods for obese patients will require ongoing investigation and may include the use of new technology such as POCUS.

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surgery. *Anaesthesia and Intensive Care. 47*(6), 522-531. https://doi.org.10.1177/0310057X19887976

Smith, N. A., Martin, G., & Marginson, B. (2022). Preoperative assessment and prehabilitation in patients with obesity undergoing non-bariatric surgery: A systematic review. *Journal of Clinical Anesthesia, 78*, 110676. https://doi.org10.1016/j.jclinane.2022.110676

Appendix A

Literature Concepts Table

	Concept 1 Obesity	Concept 2 Airway	Concept 3 CRNA
Keywords	Obesity Obese patients Bariatric	Difficult Airway Airway assessment Laryngoscopy	CRNA Nurse Anesthetist Anesthesia providers
PubMed MeSH	"Obesity" OR "Bariatrics"	"Laryngoscopy" OR "Airway management"	"Nurse anesthetist"
CINAHL Subject Headings	(MH "Obesity") OR (MH "Bariatric Surgery")	(MH "Airway Management") OR (MH "Laryngoscopy")	(MH "Certified Registered Nurse Anesthetist") OR (MH "American Association of Nurse Anesthetists")
Google Scholar	Obesity Obese patients Bariatric	Difficult Airway Airway assessment Airway management Laryngoscopy	CRNA Nurse Anesthetist Anesthesia providers

Appendix B

Literature Search Log

Search date	Database or search engine	Search strategy	Limits applied	Number of citations found/kept	Rationale for inclusion/exclusion of items
9/24/2023	PubMed	("Obesity" OR "Bariatrics") AND ("Laryngoscopy" OR "Airway management") AND "Nurse anesthetist"	Published in English Last 5 years (Actual- years: 2019-2023)	91/3	Articles that focused on children were excluded.
9/24/2023	CINAHL	(Bariatric Surgery OR Obesity) AND (Laryngoscopy OR Airway Management) AND (Certified Registered Nurse Anesthetist OR American Association of Nurse Anesthetist (AANA))	Published in English Last 5 years (Actual years: 2019-2023)	5/2	Articles that focused on children were excluded.
9/24/2023	Google Scholar	(Obesity OR Bariatrics) AND (Laryngoscopy OR Airway assessment) AND (Nurse anesthetist)	Published in English Last 5 (Actual years: 2019-2023)	9/3 pages	Results were not very specific. 9 articles were found to be pertinent to the project aim.

Appendix C

Literature Matrix

Year	Author, Title, Journal	Purpose & Conceptual Framework or Model	Design & Level of Evidence	Setting	Sample	Tool/s and/or Intervention/s	Results
2022	Glāzniece-Kagane, Z., Bērziņš, A., Kagans, A., Grigorjevs, S., Ozoliņa, A., & Mamaja, B. (2022). Prediction of the difficult laryngoscopy with ultrasound measurements of hyomental distance. *Proceedings of the Latvian Academy of Sciences, 76*(3), 372-376. https://doi.org/10.2478/prolas-2022-0057	The aim was to assess HMDR < 1.2 cm measured by ultrasound as a predictive value for predicting difficult laryngoscopy affecting difficult airway management strategy.	Cohort Study/ Descriptive and Correlational Statistics/ Level V	Surgical setting, Riga East Clinical Hospital Gailezers, Riga, Latvia.	56 patients Patients scheduled for elective surgery between October 1st 2020- Dec 31st 2020 requiring general anesthesia and tracheal intubation. Inclusion criteria: >18 years of age, and ASA score of I-III Exclusion criteria: planned fiberoptic intubation,	Mallampati scores were compared to HMDR measurement as a tool for predicting difficult laryngoscopy (DL).	HMDR showed higher sensitivity and specificity (86.7% and 85.4%) with strong statistical significance $p < 0.05$, compared to the modified Mallampati score (66.7% and 53.7%, and not statistically significant) for predicting difficult laryngoscopy. Critique: DL and EL groups were determined by CL score, not by number of intubation attempts which would describe difficulty during the actual intubation. Limitations: Patient selection bias and small sample size, therefore we cannot conclude that HMDR is correlated with difficult laryngoscopy in the general population. Study was done at a singular medical center, with just one experienced anesthesiologist performing all intubations of the DL group.

					patients with head and neck deformities, patients after head and neck operations, urgent patients with suspected full stomach and ASA score IV		
2022	Kaye, A. D., Lingle, B. D., Brothers, J. C., Rodriguez, J. R., Morris, A. G., Greeson, E. M., & Cornett, E. M. (2022). The patient with obesity and super-super obesity: Perioperative anesthetic considerations. *Saudi Journal of Anaesthesia*, *16*(3), 332–338. https://doi.org/10.4103/sja.sja_235_22	The purpose of this article was to investigate the risks related to anesthesia for obese patients specifically, and the assessment and management techniques important to safe delivery of anesthesia to this patient population.	Expert opinion piece/Level VII	N/A	N/A	N/A	Obesity contributes to increased adipose tissue that not only increases the oxygen consumption requirements of the patient but also contributes to airway obstruction when the excess adipose tissue is found in the tongue, pharynx, and neck.

2022	Liew, W. J., Negar, A., & Singh, P. A. (2022). Airway management in patients suffering from morbid obesity. *Saudi Journal of Anaesthesia*, *16*(3), 314–321. https://doi.org/10.4103/sja.sja_90_22	The purpose of this article is to describe different airway management techniques in the morbidly obese and review current evidence on this topic	Expert opinion piece/Level VII	N/A	N/A	N/A	An adequate preoperative airway assessment involves "examining the face and cheeks, degree of mouth opening, presence of any facial hair, Mallampati scoring, thyromental distance, range of movement of the neck, mandibular movement, and neck circumference." Pp. 316
2022	Mehta, A. R., Maldonado, Y., Abdalla, M., Roessler. J., Schmidt, M., Pu, X., Skubas, N. J., & Ruetzler, K. (2022). Association between body mass index and difficult intubation with a double lumen tube: A retrospective cohort study. *Journal of Clinical Anesthesia*, *83*, Article 110980. https://doi.org/10.1016/j.jclinane.2022.110980	"The purpose was to study the association between BMI and difficult tracheal DLT intubation." Pp. 83	Retrospective cohort study/Level V research evidence	Cleveland Clinic between 2008-2021	8641 patient records Electronic records of adults having cardiac and thoracic surgery, requiring general anesthesia and intubation with DLT at the Cleveland Clinic between 2008-2021	This paper looked at the association between BMI and difficult tracheal intubation	"Difficulties during intubation are among the principal cause of anesthesia-related morbidity and mortality" Pp. 83 The rate of difficult intubation was high with this study. (17% , n = 1459). There was a statistically significant increase in risk of difficult intubation at higher BMI (increase of ^% risk with every 5kg/m squared increase in BMI), but the effect size was small with a OR of 1.06 (1.002, 1.11) (95% CI) and p-value = 0.040. Therefore, BMI is a weak predictor of difficult intubations. Limitations: Anesthesia providers who perform intubation with DLT are specially trained, experienced anesthesiologists which would cause bias of having less intubations requiring more than

							one attempt which makes the results not generalizable to the general population. Confounders were corrected for in the statistical analysis, but the study was limited by the study design because one cannot control for confounding variables with a retrospective analysis.
2022	Seyni-Boureima, R., Zhang, Z., Antoine, M. M. L. K., & Antoine-Frank, C. (2022). A review on the anesthetic management of obese patients undergoing surgery. *BMC Anesthesiology, 22*, 1-13. https://doi.org/10.1186/s12871-022-01579-8	"Discuss the clinical management of obese patients undergoing surgery as a means of providing anesthesiologist with the necessary information needed to properly prepare and manage these patients before, during and after surgery" pp. 22	Expert Opinion Piece/Level VII	N/A	N/A	BMI, STOP-Bang questionnaire, PaCO2, expiratory reserve volume (ERV), functional residual capacity (FRC), and overall total lung capacity (TLC), Obesity Surgery Mortality Risk Stratification score (OS-MRS)	Excellent review of each part of the perioperative preparation and anesthesia delivery. Would have appreciated a discussion on where the field can improve or where there is a lack in research or literature.

2022	Smith, N. A., Martin, G., & Marginson, B. (2022). Preoperative assessment and prehabilitation in patients with obesity undergoing non-bariatric surgery: A systematic review. *Journal of Clinical Anesthesia, 78*, 110676. https://doi.org.10.1016/j.jclinane.2022.110676	"The aims of this review are to provide anaesthetists with evidence-based recommendations for best practice regarding 1) preoperative assessment, and 2) prehabilitation in this patient group." Pp. 78 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines	Systematic Review/ Level I	Six electronic databases for clinical studies, limited to papers published between January 2000 and October 2020	21 papers (2090 participants) for assessment review, and 25 papers (30,170 participants) for prehabilitation review Patients with obesity scheduled for surgery of any type were included.	OSA screening tool: STOP-Bang questionnaire	Screening for OSA should occur in all patients with obesity, regardless of the type of surgery, with a low threshold for polysomnography. Identification and treatment of OSA prior to surgery has shown to counteract the postoperative respiratory complications seen with this patient population. Prehabilitation programs have not been proven to show any improvement in postoperative outcomes for patients with obesity. Weight loss of at least 20 lbs does improve outcomes, but very few accomplish this prior to surgery, and any weight loss less than 20lb does not improve outcomes. Limitations: The smaller size, observational nature, and heterogeneity of many of the included studies contributed to the difficulty of finding meaningful differences due to either preoperative assessments or prehabilitation programs.
2019	Pouwels, S., Buise, M.P., Twardowski, P. et al. (2019). Obesity surgery and anesthesiology risks: A review of key	The purpose was to discuss the perioperative risk factors and the need for advanced care of obese	Expert Opinion Piece/Level VII	N/A	N/A	N/A	Certain risk factors for difficult intubation that are associated with obesity include: OSA, Obstructive hypoventilation syndrome, reduced neck mobility, limited mouth opening, altered

	concepts and related physiology. *Obesity Surgery*, *29*, 2670–267. https://doi.org/10.1007/s11695-019-03952-y	patients needing general anesthesia for surgical procedures					physiology leading to reduction of lung volumes Facilitators: STOP-Bang to screen for OSA and pretreat with CPAP for weeks before surgery (to also decrease risk of developing Afib associated with OSA. Mortality risk rates increase for higher BMI as age increases.
2019	Smith, N. A., Batterham, M., Peoples, G. E., & Shulman, M. A. (2019). The clinical, functional and disability characteristics of patients with severe obesity presenting for non-bariatric surgery. *Anaesthesia and Intensive Care*, *47*(6), 522-531. https://doi.org/10.1177/0310057X19887976	Patients with severe obesity presenting for surgery require careful preoperative evaluation, because only relying on patient self-reported information means that anesthesia providers could miss undiagnosed medical conditions of perioperative importance. More detailed laboratory analysis, in addition to considering functional capacity and disability could help identify	Prospective Single Centre Cohort Study/ Level V Evidence	2016-2018 at Wollongong Hospital, New South Wales, Australia	293 patients. Patients 18 years and older, scheduled for elective surgery, with BMI> 35 kg/meters squared, between 2016-2018 at Wollongong Hospital, New South Wales, Australia, barring no medical contraindications for	Surgical severity scores calculated using Portsmouth-Physiological and Operative Severity Score for the Enumeration of Morbidity and mortality (P-POSSUM) Before surgery, patients complete the World Health Organization Disability Assessment Schedule 2.0 (WHODAS)	Evaluation of functional capacity by 6MWT, disability by WHODAS questionnaire, and daytime hypoventilation (OHS) by HCO3 level could increase awareness for potential severe adverse postoperative outcomes and minimize those complications by modifying patient management preoperatively and intraoperatively. Limitations: Study does not discuss or measure postoperative outcomes, but simply measures and discusses characteristics of obese patients that might increase bad surgical outcomes.

		comorbidities that are not usually assessed preoperatively but could make a big difference in postoperative outcomes. Obesity hypoventilation syndrome being one of these conditions to identify			completing the 6MWT	to measure disability. Six-minute walk test (6MWT) evaluates cardiorespiratory function that correlates to the functional capacity of the individual.	

Note: Key to Levels of Evidence: I: Systematic review/meta-analysis of randomized controlled trials (RCTs); II: RCTs; III: Nonrandomized controlled trials; IV: Controlled cohort studies; V: Uncontrolled cohort studies; VI: Descriptive or qualitative study, case studies, EBP implementation and QI; VII: Expert opinion from individuals or groups. Adapted from Evidence-based practice in nursing and healthcare: A guide to best practice (4th ed.), by B. M. Melnyk and E. Fineout-Overholt, 2019, p. 131. Copyright 2019 by Wolters Kluwer.

Key to abbreviations used in chart:

HMDR: hyomental distance ratio

DL: difficult laryngoscopy

EL: easy laryngoscopy

DLT: difficult tracheal intubation

(Chart adapted from Brown, S. J. (2018) Evidence-based nursing: The research-practice connection. (3rd ed.). Jones & Bartlett Learning.)

Appendix D: IRB Approval

Click "download PDF" to save a copy of this page for your records.
Note: The IRB Office does not maintain copies of your responses.

Below is a summary of your responses

Download PDF

Quality Improvement/Program Evaluation Self-Certification Tool

Purpose:
Projects that do not meet the federal definition of human research pursuant to 45 CFR 46 do not require IRB review. This tool was developed to assist in the determination of when a project falls outside of the IRB's purview.

Instructions:
Please complete the requested project information, as this document may be used for documentation that IRB review is not required. Select the appropriate answers to each question in the order they appear below. Additional questions may appear based on your answers. If you do not receive a STOP HERE message, the form may be printed as certification that the project is "not research", and does not require IRB review. The IRB will not review your responses as part of the self-certification process. For projects being done at Vidant Health, site support will be required. Please email crg.quality@vidanthealth.com to obtain site support from Vidant Health.

Name of Project Leader:

Sarah McGuire

Project Title:

Assessing CRNA's Perceptions of the Adequacy of a Quick-Reference Guide (QRG) for Evaluating Airways of Patients with Obesity: A Quality Improvement Project.

Brief description of Project/Goals:

The purpose of this quality improvement project is to assess anesthesia providers' perceptions of adequacy of a newly developed quick-reference guide (QRG). Knowledge gained from this pilot project could be used in future quality improvement and policy efforts aimed at improving anesthesia care of patients with obesity. Process: A quick-reference perioperative guide on airway assessment methods, based upon accepted national guidelines, will be developed. Anesthesia providers at one of ECU Health's medical facilities (site) will be asked several questions (through Qualtrics) about their perceptions of the adequacy of their current practice. An educational video about the use of a newly developed QRG will be made available to them, and they will be asked to use the QRG for two weeks. Upon completion of the two-week utilization period, they will be asked to complete a questionnaire about their perceptions of the adequacy of the QRG and their current practice. Qualtrics survey software will be used to deliver the intervention link and gather participant perceptions prior to and post implementation of the project. No patient information will be recorded or maintained during this project.

Will the project involve testing an experimental drug, device (including medical software or assays), or biologic?

- ○ Yes
- ● No

Has the project received funding (e.g. federal, industry) to be conducted as a human subject research study?

- ○ Yes
- ● No

Is this a multi-site project (e.g. there is a coordinating or lead center, more than one site participating, and/or a study-wide protocol)?

- ○ Yes
- ● No

Is this a systematic investigation designed with the intent to contribute to generalizable knowledge (e.g. testing a hypothesis; randomization of subjects; comparison of case vs. control; observational research; comparative effectiveness research; or comparable criteria in alternative research paradigms)?

- ○ Yes
- ● No

Will the results of the project be published, presented or disseminated outside of the institution or program conducting it?

- ● Yes

○ No

Would the project occur regardless of whether individuals conducting it may benefit professionally from it?

● Yes
○ No

Does the project involve "no more than minimal risk" procedures (meaning the probability and magnitude of harm or discomfort anticipated are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests)?

● Yes
○ No

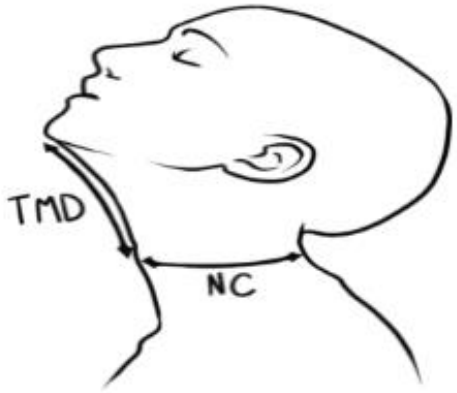
Is the project intended to improve or evaluate the practice or process within a particular institution or a specific program, and falls under well-accepted care practices/guidelines?

● Yes
○ No

Based on your responses, the project appears to constitute QI and/or Program Evaluation and IRB review is not required because, in accordance with federal regulations, your project does not constitute research as defined under 45 CFR 46.102(d). If the project results are disseminated, they should be characterized as QI and/or Program Evaluation findings. Finally, if the project changes in any way that might affect the intent or design, please complete this self-certification again to ensure that IRB review is still not required. Click the button below to view a printable version of this form to save with your files, as it serves as documentation that IRB review is not required for this project. 11/8/2023

Appendix E: Quick-reference Guide (Intervention)

Airway Assessment of the Patient with Obesity



Increased risk for DI if:

NC (>40cm)[1,2]
- Measure at cricothyroid cartilage in sitting position

TMD (<6cm)[1,2]
- Measure from thyroid notch to mentum with head extended and mouth closed

NC:TMD Ratio (>5)[1,3]
- Better reflects distribution of adipose tissue around neck

Mallampati Score

- **Class III or IV correlated with difficult airway** (Hung et al., 2023; Roth et al., 2019)
- **Only moderate sensitivity when used alone - many events missed** (Roth et al., 2019)
- **Many different possible combinations:**
  - **Mallampati score III or IV with an increased NC predictive for DI** (Emik et al., 2021)
  - **Enhances 3-3-2 Rule sensitivity** (Sharma et al., 2023)

3-3-2 Rule

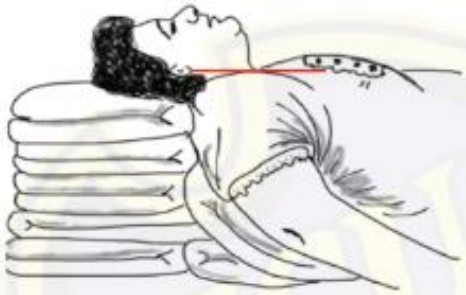
Increased risk for DI if:

A) <3 fingers between upper and lower incisors	**B) <3 fingers in the hyomental distance**	**C) <2 fingers in the hyo-thyroid cartilage distance**

Enhanced results with Mallampati Score (Sharma et al., 2023)

Difficult Mask Predictors [7]

Age>55, BMI>26, beard, lack of teeth, history of snoring, Mallampati III or IV, male



Ramping

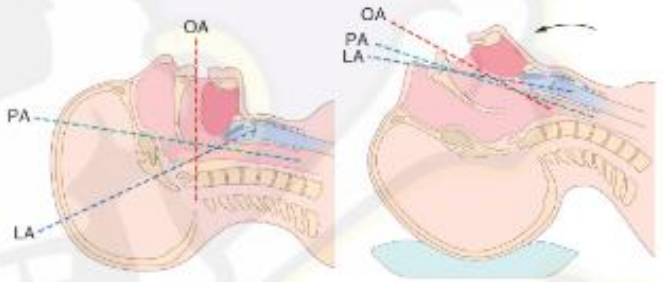
Ear level with sternal notch. [2]

- Aligns the 3 axes in patients with obesity - improved laryngoscopy view
- Decreases dependent atelectasis
- Improves V/Q
- Increases safe apnea time

STOP-Bang Questionnaire for OSA Screening

S	**Snoring:** Do you snore loudly?	Yes or No
T	**Tiredness:** Do you often feel tired, fatigued, or sleep during the day?	Yes or No
O	**Observed apnea:** Has anyone observed you stop breathing during sleep?	Yes or No
P	**Blood pressure:** Do you have, or have you been treated for high blood pressure?	Yes or No
B	**Body mass index (BMI):** BMI>35 kg/m²	Yes or No
A	**Age:** Age> 50 yr?	Yes or No
N	**Neck circumference:** Neck circumference >43.18 cm (17 in) in males or >40.64 cm (16 in) in females?	Yes or No
G	**Gender:** Male?	Yes or No

Low risk:	Medium risk:	High risk:
<3 yes	3-4 yes	≥5 yes



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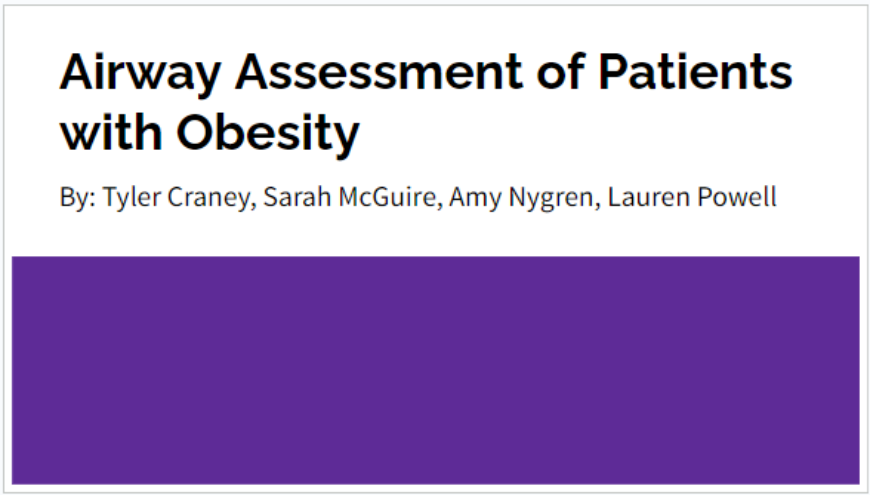
10.

Appendix F:

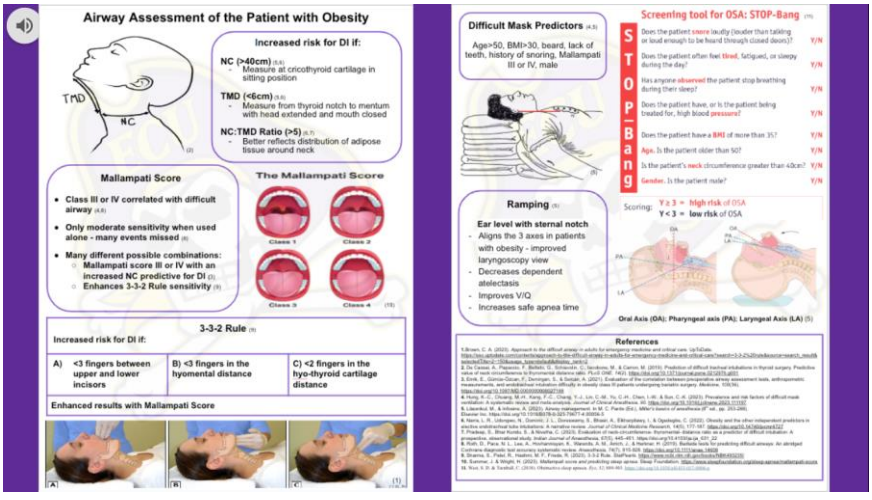
Educational Presentation with Script

Title Slide



Script: Hello and thank you for your participation in this quality improvement project titled "Airway Assessment of Patients with Obesity".

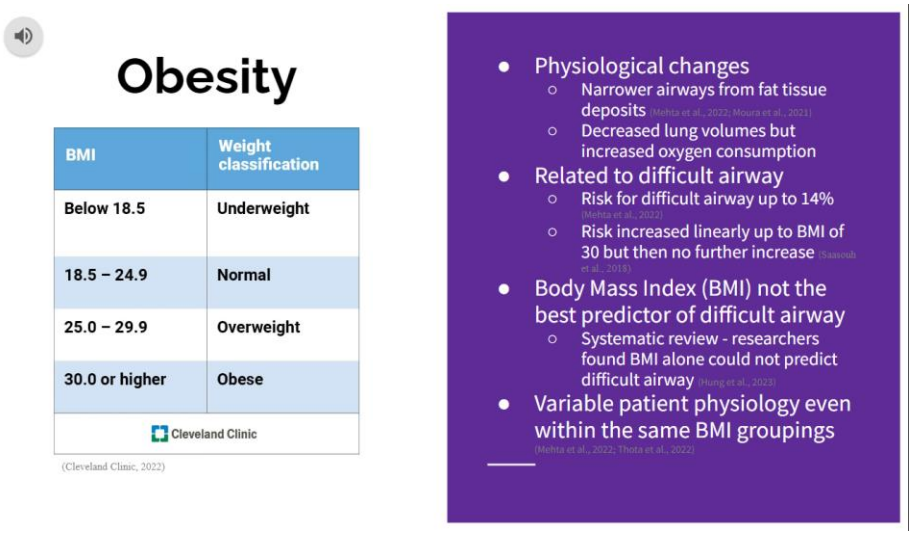
Slide Two



Script: We created a quick-reference guide (QRG) for airway assessment of the patient with obesity. After reviewing the literature, we compiled several screening tools, measurements, and positioning techniques in one convenient document. We are asking that you use this QRG for 2

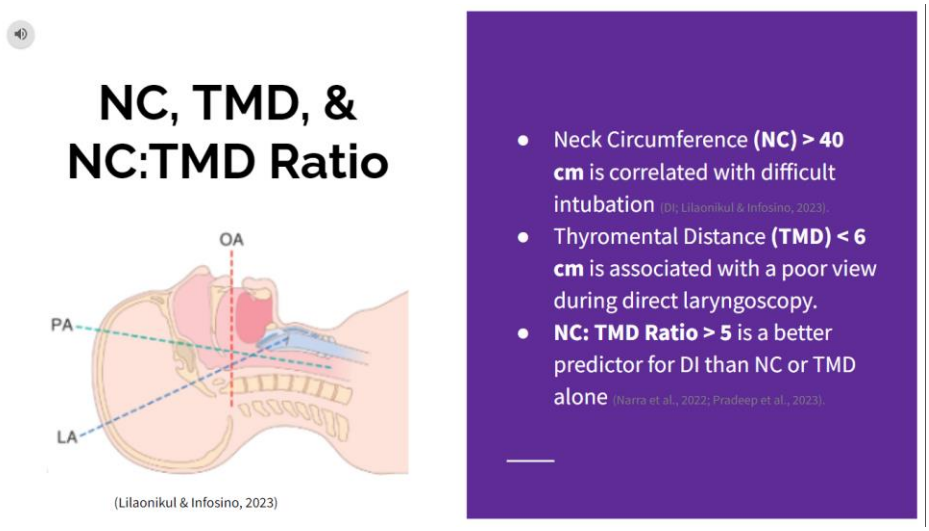
weeks, then complete a survey which will allow us to assess your perception of the adequacy of this guide in predicting difficult airways in patients with obesity. In the following PowerPoint, we will briefly review each of the topics covered on the QRG.

Slide 3



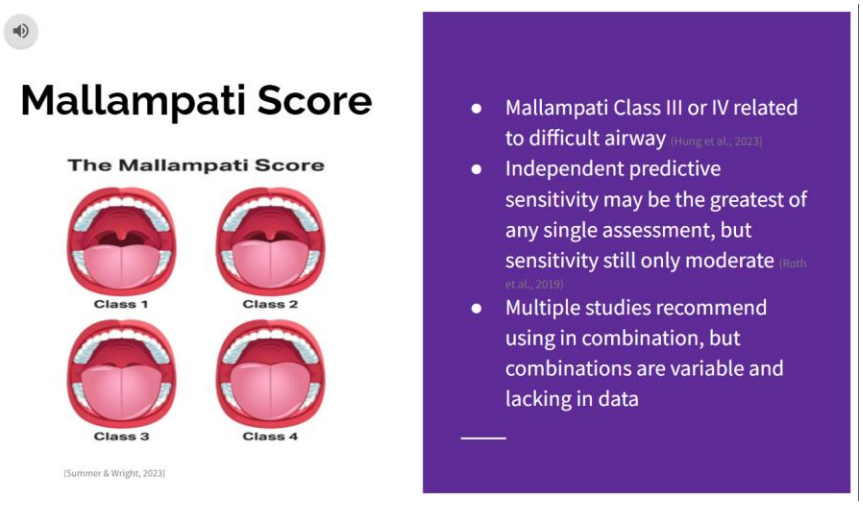
Script: You all have a lot of experience with patients that have obesity and know that obesity can make airway access more difficult. Obesity can obscure the view by narrowing airways with fat deposition. Obesity also decreases Functional Residual Capacity (FRC) while increasing Oxygen consumption, so you have less time to get an airway in place. In patients with obesity, the incidence of difficult airway ranges up to 14%, compared to 8% in patients who are not obese. However, our literature review indicated that BMI is not the best predictor for a difficult airway because patient physiology varies considerably even within the same BMI groupings. Better predictors of difficult airways are related to physiology of the patient because people carry their weight differently.

Slide 4



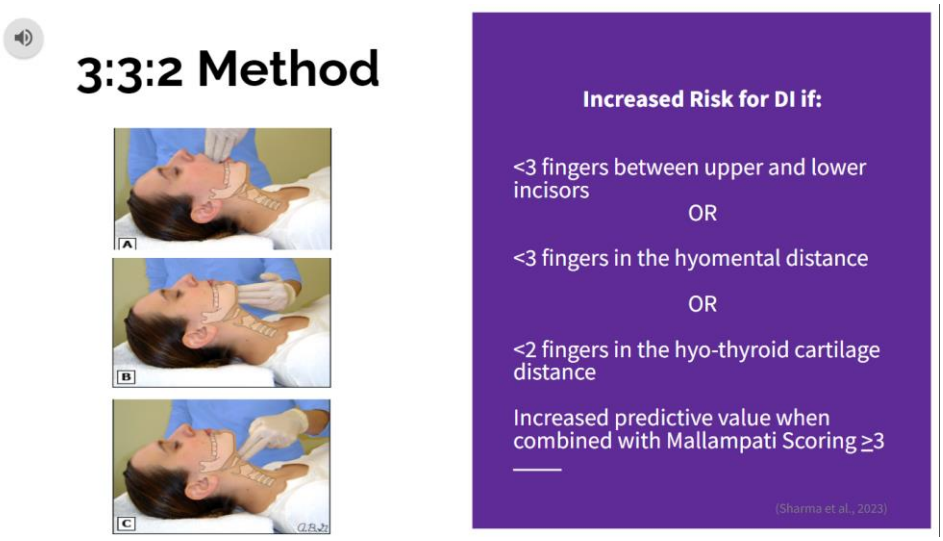
Script: Neck Circumference (NC) is measured at the cricoid cartilage while the patient is in sitting position. There is some variability in the research on the exact predictive value for NC and DI, but this seems largely due to different study populations. Per most research, and our Anesthesia textbook, a NC greater than 40 cm is correlated with a difficult intubation. Thyromental Distance (TMD) is measured from the top of the thyroid notch to the mentum while head is extended and mouth closed. A TMD less than about 6cm, or 3 fingerbreadths, may be predictive of a poor laryngoscopic view due to increased difficulty aligning the patient's oral and pharyngeal axis. To better reflect the distribution of adipose tissue around the neck, the Neck Circumference to Thyromental Distance ratio can be calculated. Overall a NC:TMD ratio greater than 5 was been found to be predictive of difficult intubation in patients with obesity. For example, my NC is 32 cm and my TMD is 7.5cm so my NC:TMD ratio would be 4.3.

Slide 5



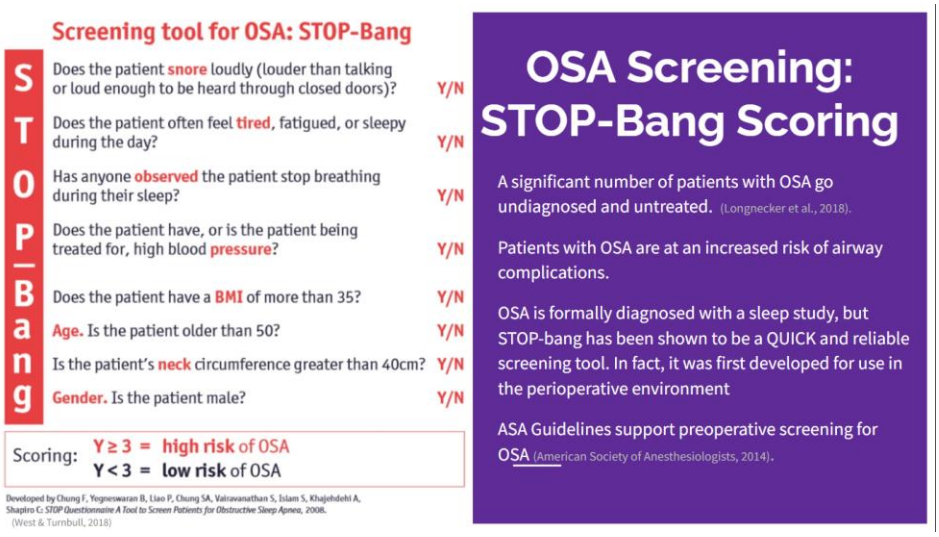
Script: A Mallampati Score of III or IV is related to difficult airways, but our literature review did not find that the Mallampati Score has the best independent predictive sensitivity. Although it does have the best sensitivity of any other assessment method used alone, its sensitivity is still only moderate. Many difficult airways will not be predicted using only the Mallampati score. Multiple studies recommend using the Mallampati score in combination with other assessment methods to increase the sensitivity for a difficult airway. However, combination methods vary and no single best combination has been identified. The Quick Reference Guide includes the 3-3-2 rule, neck circumference, and the NC:TMD ratio, which have each been indicated to improve the accuracy of the Mallampati Score in predicting difficult airways in individual studies.

Slide 6



Script: The 3-3-2 method is an easy way to rapidly evaluate an airway that requires no special tools. First, 3 fingers can be placed in the mouth to give an approximation of mouth opening. This measurement can be indicative of ease of oral access needed for the laryngoscope blade and view of the glottis. Second, the hyomental distance can be measured with another 3-finger measurement. This measurement is indicative of the submandibular space and approximates the volume allowed for tongue displacement. Third, the hyo-thyroid distance is the distance between the thyroid cartilage and hyoid bone. This 2-finger measurement measures the approximate location of the larynx in relation to the base of the tongue. If it is < 2 fingers, the patient can have an acute angle between the base of the tongue and the larynx, making it difficult to visualize the larynx.

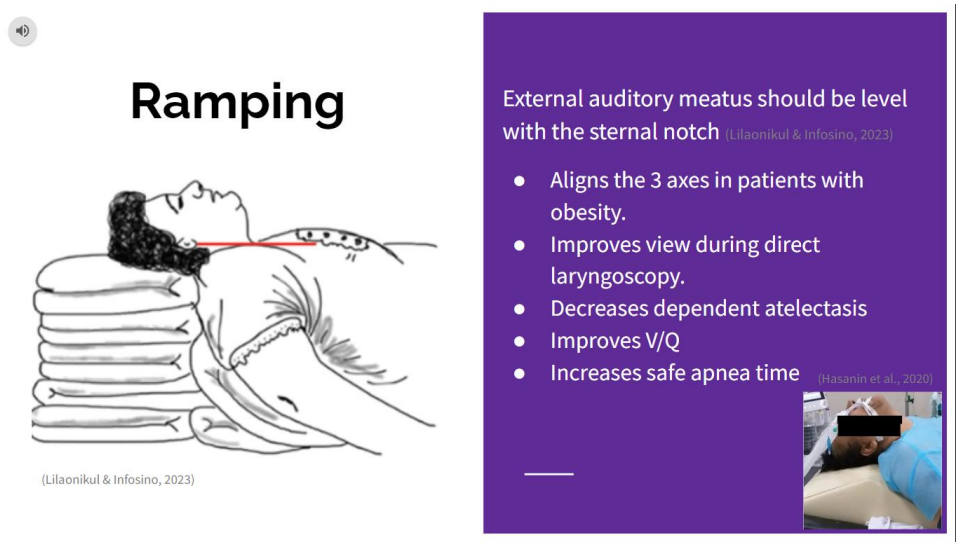
Slide 7



Script: Obstructive sleep apnea (OSA) is defined as a cessation of airflow for more than 10 seconds five or more times per hour of sleep despite continuous respiratory effort against a closed glottis in combination with a decrease in arterial oxygen saturation of greater than 4%. A significant number of patients with OSA are undiagnosed, which poses various perioperative challenges for us as anesthesia providers. We can use the STOP-Bang questionnaire, as it is a concise and easy-to-use screening tool for OSA. Many items in the questionnaire are already a part of the preop interview & assessment. Adding the first 3 questions to the preop assessment can support our accurate evaluation of their airway and prediction of difficult airway management. It is beneficial to identify patients with undiagnosed OSA as it can inform on whether the patient is a good candidate for a MAC case with local or regional anesthetic. Patients with OSA have a propensity for airway obstruction and collapse with use of central depressant drugs (benzodiazepines, opioids, volatile anesthetics), which reduce the action of pharyngeal dilator muscles and cause pharyngeal collapse. Patients with OSA are at an increased risk of airway complications, like difficult mask ventilation, difficult direct laryngoscopy and endotracheal intubation, difficult fiber-optic visualization of the airway, rapid oxygen

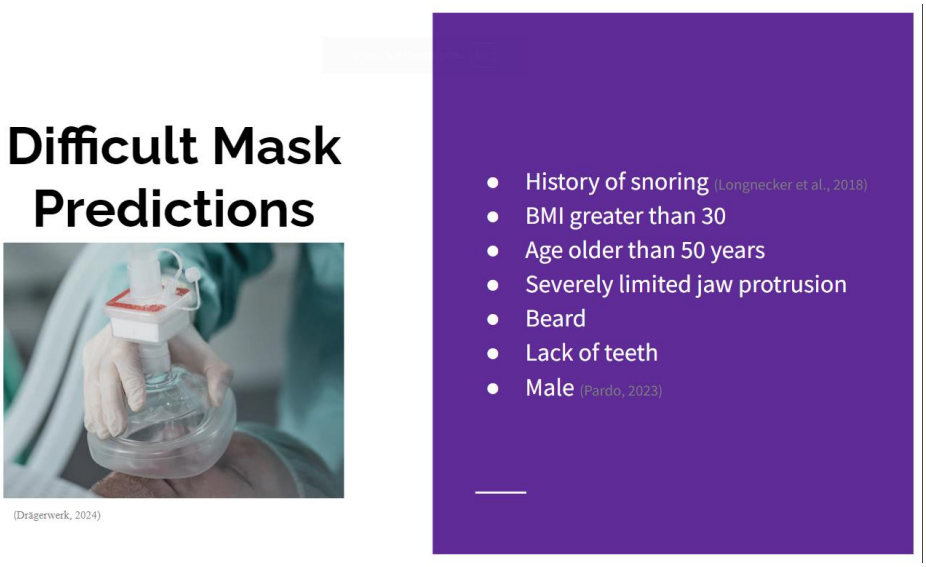
desaturation, and postoperative desaturation events. They are also at a higher risk of perioperative cardiac events. If the patient meets 3 of the STOP Bang criterion, they are at a high risk of OSA. With a score >5, the research supports postponing elective procedures. The patient should receive treatment with CPAP for optimization before surgery. This method is part of the standards the ASA has put forth. Anesthesia providers should be aware that this is best-practice and should support a decision that is in the best interest of the patient. Just as undiagnosed cardiac issues may delay surgery for a cardiac consult, a STOP-bang screening revealing high risk of undiagnosed and untreated OSA should cause us to pause and consider whether this patient can withstand the stress of the surgery. If surgery cannot be delayed, the identification of possible OSA still provides us with valuable information to better care for the patient. Pre-oxygenating longer, having the GlideScope handy, avoiding deep extubations, minimizing opioids to reduce respiratory depression at the end of the case, and using a multimodal approach to providing analgesia should be considered. These patients would not be candidates for outpatient procedures where resources are limited and should be admitted for overnight observation.

Slide 8



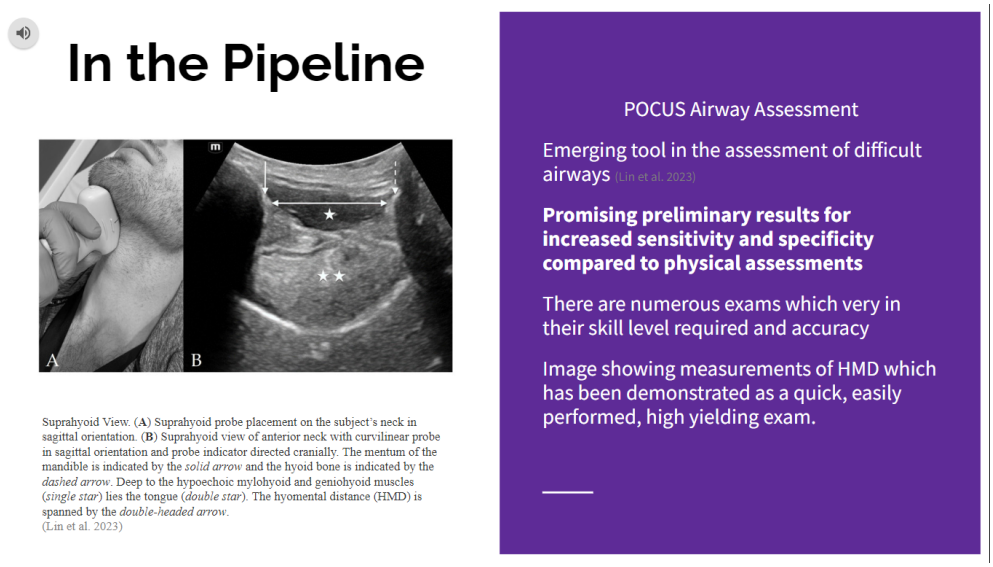
Script: The external auditory meatus should align with the sternal notch in order to better align the oral, pharyngeal, and laryngeal axis' in a patient with obesity and improve visualization during direct laryngoscopy. This position can help reduce dependent atelectasis, improve the ventilation/perfusion ratio, and increase safe apnea time. The ramping position can be accomplished with blankets or pillows, and while it does take extra time to set up and later remove, ramping has many benefits, especially for those who are morbidly obese. If ramping is not an option or there is not enough time available, raising the head of the bed up to 25 degrees is also recommended, but is not as effective. One RCT pilot study looked at the benefits of using a special pillow, called the Hasanin pillow, seen in the lower right hand corner. This pillow allowed for a modified-ramping position in obese females which helped to move the breasts away from the laryngoscope and improve visualization of the airway during direct laryngoscopy.

Slide 9



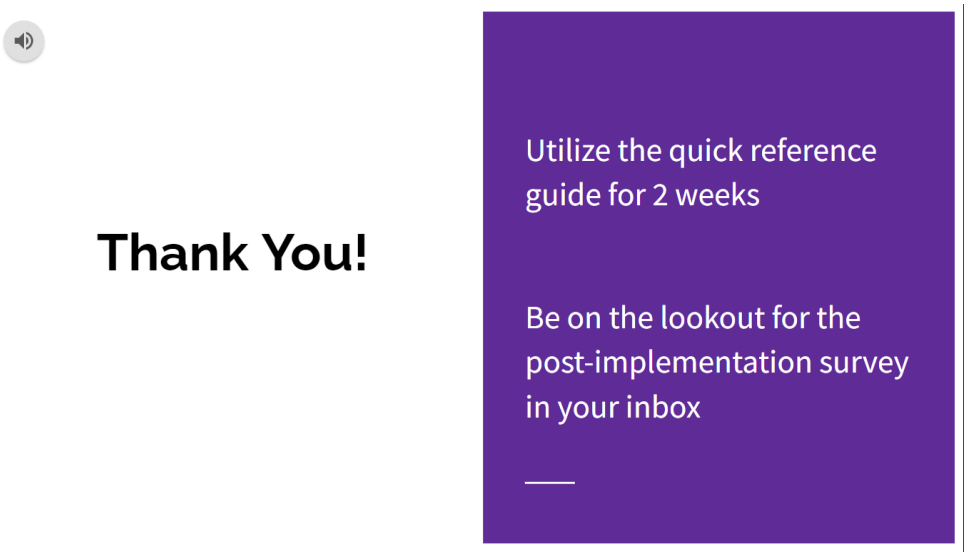
Script: Successful laryngoscopy followed by endotracheal intubation is considered definitive management for an unconscious and apneic patient. However, when there is difficulty with intubation, being able to ventilate by mask can save the patient's life. Despite this fact, research on predicting a difficult airway has historically focused on laryngoscopy alone. Given the potentially lifesaving importance of mask ventilation, investigators have begun to stress both laryngoscopy and mask ventilation in their predictive strategies. There is some dispute among studies on the criteria for these predictors. The listed predictors of difficult mask ventilation include a history of snoring, BMI>30, age >50, severely limited jaw protrusion, the presence of a beard, a lack of teeth, and male gender. Determining fixed cutoff values for determining risk for difficult masking in patients with obesity is difficult because of variability in study results. For example, some studies report age greater than 50 can be used as a difficult mask predictor while others use age greater than 55. To be conservative with our estimate, and because age greater than 50 is also a component of the STOP Bang score, we utilized Age>50 on our QRG.

Slide 10



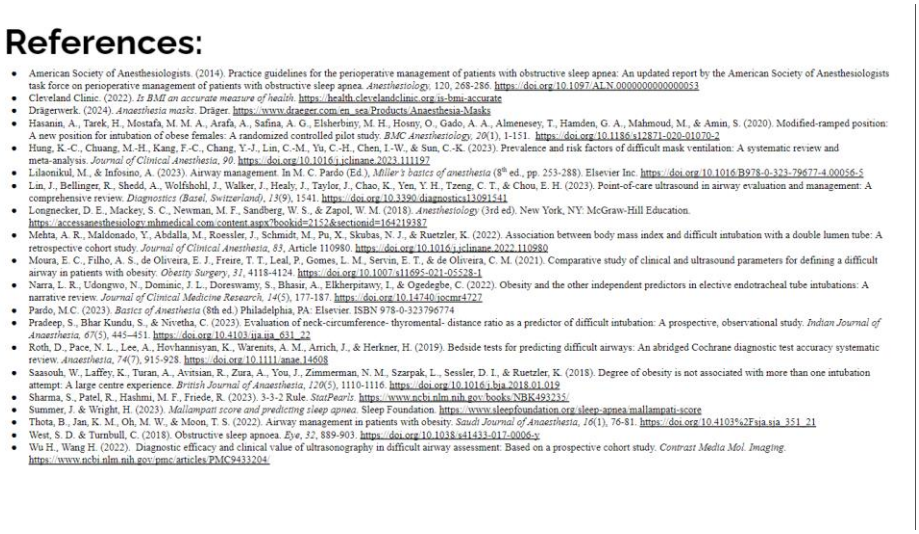
Script: Ultrasound (US) use is becoming more common in everyday clinical practice, including in the assessment and prediction of difficult airways. There are no current studies that compare the utilization of physical assessments/questionnaires to the use of Point-of-Care UltraSound (POCUS). However, there is a current study underway that is to be completed by the end of 2024. There are some promising preliminary results. While some exams require extensive training and US knowledge, there are some easier exams to conduct that require minimal training and are still high-yield. For example, the hyo-mental distance measurement using a curviliniar probe has been researched and requires minimal training. In a study conducted by Wu et. al. in 2022, there was a strong correlation between decreased hyo-mental distance and difficult airways. In patients with a HMD < 5.3 cm, there was a difficult airway predicted with 96.7% sensitivity with 71.6% specificity. While POCUS is becoming more popular, there is a larger barrier to entry with these airway assessments as anesthesia provider comfort with US varies widely. However, attending a workshop and learning some basic scanning skills and exams has the potential to greatly improve difficult airway identification.

Slide 11



Script: Thank you for taking the time to view our project. Over the next 2 weeks please utilize the quick reference guide as you see fit. Be on the lookout for the post survey link in your inbox after the two week period. Thanks again for your participation!

Slide 12



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Appendix G: Survey Questions

Pre-Implementation Survey:

1. When evaluating the airway of patients with obesity (BMI>30), to what extent do you use the following assessment methods?

   STOP-BANG:

   - Never
   - Some of the time
   - Most of the time
   - Always

   Mallampati score:

   - Never
   - Some of the time
   - Most of the time
   - Always

   Thyromental Distance:

   - Never
   - Some of the time
   - Most of the time
   - Always

   Neck Circumference:

   - Never
   - Some of the time
   - Most of the time
   - Always

   Neck Circumference: Thyromental Distance Ratio:

   - Never
   - Some of the time
   - Most of the time

- Always

2. How useful do you find the following assessment methods to be in predicting difficult airway in patients with obesity?

STOP-BANG:

- I do not use this tool
- Not at all useful
- Somewhat useful
- Mostly useful
- Very useful

Mallampati score:

- I do not use this tool
- Not at all useful
- Somewhat useful
- Mostly useful
- Very useful

Thyromental Distance:

- I do not use this tool
- Not at all useful
- Somewhat useful
- Mostly useful
- Very useful

Neck Circumference:

- I do not use this tool
- Not at all useful
- Somewhat useful
- Mostly useful
- Very useful

Neck Circumference: Thyromental Distance Ratio:

- I do not use this tool

- Not at all useful
- Somewhat useful
- Mostly useful
- Very useful

3. What percent of the patients that you care for in a typical two-week period would you estimate have obesity (BMI>30)?
    - 0%
    - 1% - 25%
    - 26% - 50%
    - 51% - 75%
    - 76% - 99 %
    - 100%
4. Please answer based on how true you believe the following statements to be:
    a. Patients with obesity are more difficult to mask-ventilate.
        - Entirely false
        - Somewhat false
        - Neither true nor false
        - Somewhat true
        - Entirely true
    b. Patients with obesity are more difficult to intubate.
        - Entirely false
        - Somewhat false
        - Neither true nor false
        - Somewhat true
        - Entirely true
5. Have you been trained to use point-of-care ultrasound (POCUS) to assess patients' airways?
    - No
    - Yes
6. How often do you use POCUS to assess any patient's airway?
    - Never

- Some of the time
- Most of the time
- Always

7. How often do you use "ramping" for patients with obesity to optimize intubation conditions?
    - Never
    - Some of the time
    - Most of the time
    - Always

Post-Implementation Survey:

1. After implementation of the quick reference guide, when evaluating the airway of patients with obesity (BMI>30), to what extent do you use the following measures?

   STOP-BANG:

   - Never
   - Some of the time
   - Most of the time
   - Always

   Mallampati score:

   - Never
   - Some of the time
   - Most of the time
   - Always

   Thyromental Distance:

   - Never
   - Some of the time
   - Most of the time
   - Always

   Neck Circumference:

   - Never
   - Some of the time
   - Most of the time
   - Always

   Neck Circumference: Thyromental Distance Ratio:

   - Never
   - Some of the time
   - Most of the time
   - Always

2. To what extent did you find each of these methods useful in predicting difficult airway in patients with obesity?

    STOP-BANG:

    - I did not use this tool
    - Not at all useful
    - Somewhat useful
    - Mostly useful
    - Very useful

    Mallampati score:

    - I did not use this tool
    - Not at all useful
    - Somewhat useful
    - Mostly useful
    - Very useful

    Thyromental Distance:

    - I did not use this tool
    - Not at all useful
    - Somewhat useful
    - Mostly useful
    - Very useful

    Neck Circumference:

    - I did not use this tool
    - Not at all useful
    - Somewhat useful
    - Mostly useful
    - Very useful

    Neck Circumference: Thyromental Distance Ratio:

    - I did not use this tool
    - Not at all useful
    - Somewhat useful

- Mostly useful
- Very useful

3. What percent of the patients that you cared for in this two-week period would you estimate had obesity (BMI>30)?
    - 0%
    - 1% - 25%
    - 26% - 50%
    - 51% - 75%
    - 76% - 99 %
    - 100%
4. After using the quick reference guide, how true do you believe the following statements to be?
    a. Patients with obesity are more difficult to mask-ventilate.
        - Entirely false
        - Somewhat false
        - Neither true nor false
        - Somewhat true
        - Entirely true
    b. Patients with obesity are more difficult to intubate.
        - Entirely false
        - Somewhat false
        - Neither true nor false
        - Somewhat true
        - Entirely true
5. How often did you use point-of-care ultrasound (POCUS) to assess patients' airways in the last two weeks?
    - Never
    - Some of the time
    - Most of the time
    - Always
6. Would you be interested in attending an in-service on the use of POCUS for preoperative airway assessment?
    - Not at all interested
    - Somewhat interested
    - Very interested

7. How often did you use "ramping" for patients with obesity to optimize intubation conditions?
    - Never
    - Some of the time
    - Most of the time
    - Always
8. Did you find the quick reference guide useful?
    - Not at all useful
    - Somewhat useful
    - Mostly useful
    - Very useful
9. How often did you use the quick reference guide in the last two weeks?
    - Never
    - Some of the time
    - Most of the time
    - Always
10. Which aspect(s) of the quick reference guide was/were most useful to your practice?

    _____

11. Which aspect(s) of the quick reference guide was/were least useful to your practice/what change(s) would you make to the guide?

    _____

Appendix H

Email to Participants

Initial Email to Participants

Dear CRNAs of [redacted],

Thank you for considering participating in a quality improvement project titled "Assessing CRNA's Perceptions of the Adequacy of a Quick-Reference Guide (QRG) for Evaluating Airways of Patients with Obesity." The focus of the project is CRNA perceptions on the adequacy of various airway assessment tools/techniques specifically for use in evaluating the airway of obese patients. My project group and I have developed a presentation with more information on our project focus.

Participation is voluntary but greatly appreciated, as it will aid in my education as a future CRNA. Below you will find a link to a survey and a presentation. Please complete the short pre-test survey followed by a viewing of a short presentation on a quick-reference guide. I will supply you with a hard copy of the quick-reference guide, and a link to a digital copy for your convenience. Please use this guide in your practice for two weeks, at your discretion, and then give your opinion on its adequacy by completing the short post-intervention survey.

Each questionnaire and the video should take less than 2-4 minutes to complete. The questionnaires were created and are completed using Qualtrics® survey software. The use of the Quick-Reference Guide (QRG) for Evaluating Airways of Patients with Obesity falls within currently accepted practice in your work area. Your participation is voluntary and confidential. We will share the results of this QI study with you upon completion.

First, please complete the pre-intervention questionnaire here. (link to survey here)

Next, please view the "Quick-Reference Guide (QRG) for Evaluating Airways of Patients with Obesity" resource and its accompanying PowerPoint presentation. These materials are attached to this email.

Again, thank you so much for your participation in our quality improvement project. I, Sarah McGuire, will be at [redacted] on [redacted] if you have any questions, but you may also reach out to me or Dr. Maura McAuliffe by email. Thank you again for your time and participation.

Sincerely,

Sarah McGuire BSN, SRNA
gills14@students.ecu.edu

Maura McAuliffe CRNA, PhD, FAAN
mcauliffem@ecu.edu

Pre-Intervention Survey Reminder Email to Participants

Good morning CRNAs of [redacted],

I just wanted to send a quick reminder about the ongoing DNP Project on airway assessment of the obese patient. If you've already filled out the pre-survey and viewed the video, thank you so much! If you haven't had a chance to yet, it is not too late and it would be very helpful and appreciated. Please complete the pre-survey in the link below. I have attached the "Quick-Reference Guide (QRG) for Evaluating Airways of Patients with Obesity" resource and its accompanying PowerPoint presentation for you to use at your discretion. After this week, I will begin sending out the post-surveys.

Pre-survey link

Please let me know if you have any questions and thank you again for your participation.

Sincerely,
Sarah McGuire, SRNA
ECU Nurse Anesthesia Program
Class of 2025

Post-Intervention Survey Email to Participants

Dear CRNAs of [redacted],

Thank you so much to everyone who has already completed my pre-survey and viewed the attached resources! It's now time to complete the brief post-survey here.

If you have not filled out a pre-survey, I would really appreciate your participation. The link to the pre-intervention survey is here.

If you would like, you can follow it up by viewing the attached "Quick-Reference Guide (QRG) for Evaluating Airways of Patients with Obesity" resource and its accompanying PowerPoint presentation.

If you've already completed the first survey, here is the link to the post-survey It should take less than 3 minutes.

If anyone has questions or issues with the links, please let me know. Again, thank you to everyone for your help and for being excellent preceptors. I look forward to coming back to [redacted] in the future.

Sincerely,
Sarah McGuire, SRNA
ECU Nurse Anesthesia Program
Class of 2025

Post-Intervention Survey Reminder Email to Participants

Good morning,

I hope you all are doing well and that your weeks are off to a great start! I wanted to thank you again for participating in the pre-intervention survey for my DNP project and ask if you would please consider filling out the post-intervention survey. If you have time, I would be extremely grateful for your responses.

Click here to access the post-survey

Thank you so much,
Sarah McGuire, SRNA
ECU Nurse Anesthesia Program
Class of 2025

Final Thank You Email to Participants

Dear CRNAs of [redacted],

I just wanted to say thank you so much to everyone for helping me out with my DNP Project! [redacted] was my only assigned site of implementation for this project, so your participation truly helped me tremendously. I now have enough data to perform data analysis and finish my paper. I am very grateful for your participation and everything each of you taught me as preceptors during my rotation in [specified rotation location]. I hope to work with you again in the future!

Warm regards,
Sarah McGuire, SRNA
ECU Nurse Anesthesia Program
Class of 2025