CRNA Airway Assessment in Patients with Obesity: A Quality Improvement Project

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Abstract

Over 40% of adults in the United States are categorized as obese. Although obesity alone is not an independent risk factor for difficult airway, CRNAs may have more difficulty with perioperative airway management due to changes in physiology and development of comorbidities. There are many different techniques that can be used to properly assess the airway in the preoperative period, but no single source succinctly incorporates this information for managing potential difficult airways in patients with obesity. The purpose of this quality improvement project was to assess CRNAs' perception of adequacy of a quick reference guide (QRG) as a useful tool for their practice as it pertains to assessment of the airway of patients with obesity. CRNAs at an outpatient center were asked to complete a pre-implementation survey, watch an educational video, use the QRG for two weeks, and complete a post-implementation survey. Results revealed that almost all CRNAs were already using at least two preoperative assessment techniques when assessing the airway of patients with obesity, currently recommended by the literature. The overall perception of the QRG was mostly positive, as all respondents to the post-implementation survey found the QRG to be at least *mostly useful*. Limitations of this project include a small sample size and lack of full participation in the pre- and post-implementation surveys. Recommendations for future studies include a larger number of participants and a longer implementation period.

Keywords: obesity, airway management, airway assessment, anesthesia, nurse anesthetist

Table of Contents

Section I. Introduction

Background

According to the Centers for Disease Control and Prevention (CDC, 2022), nearly 42% of American adults are considered obese. Obesity is measured by body mass index (BMI), a formula that divides weight in kilograms by height in meters squared. An individual with a BMI greater than or equal to 30 kg/m^2 is categorized as class 1 obesity, and a BMI over 40 kg/m^2 is categorized as class 3 obesity or morbidly obese. BMI does not factor in muscle or distribution of adipose tissue; however, BMI is still considered a reliable calculation to define obesity (CDC, 2022; Poorsattlar & Manuel, 2023).

Adults with obesity are at an increased risk for developing comorbidities due to an increased metabolic demand on the body (Narra et al., 2022; Poorsattlar & Manuel, 2023). As BMI increases, the risk of developing diseases like diabetes mellitus or coronary artery disease also increases (Poorsattlar & Manuel, 2023). Within the last 20 years, the prevalence of American adults with class 3 obesity (BMI > 40 kg/m^2) has almost doubled from 4.7% to 9.2% (CDC, 2022). Patients with obesity are now more commonly seen in the health care field and they are now a major concern for providers due to the profound systemic effects obesity can have on the body (Poorsattlar & Manuel, 2023).

Although BMI alone is not a specific predictor of encountering a difficult airway, more than 14% of patients with obesity are considered to have challenging airways upon intubation (Menon et al., 2017). Problems encountered during intubation are associated with more than 50% of intraoperative cardiac arrests and significantly increase the patient's mortality risk. The increased risk of airway complications in patients with obesity during elective and nonelective

surgeries requires special considerations by anesthesia providers (Siddiqui et al., 2022; Thota et al., 2022).

Nurse anesthetists perform a thorough preoperative evaluation that includes a systems assessment, past surgical history, problems with previous anesthesia, and an airway assessment on every patient (Poorsattlar & Manuel, 2023). The airway assessment is of particular importance in patients with obesity due to an increased risk for hypoxia and apnea (Narra et al., 2022; Siddiqui et al., 2022). Maintaining a patent airway and proper ventilation can be especially difficult in patients with a BMI over 30 kg/m^2, depending on the distribution of adipose tissue and presence of other morbidities **(**Poorsattlar & Manuel, 2023). A more central or cephalad distribution of adipose tissue may diminish lung volumes and impair ventilation when patients are supine. According to Sharma & Arora (2020), patients with obstructive sleep apnea (OSA) have an increased risk of complications during anesthesia. This is concerning because OSA is a common disorder that affects over 40% of adults with obesity. Therefore, a detailed preoperative airway assessment by a nurse anesthetist is especially important in anesthesia management of patients with obesity (Poorsattlar & Manuel, 2023)

Several preoperative airway assessment techniques used by anesthesia providers are reliable for all patient populations, such as the modified Mallampati score (MMS) and measurement of thyromental distance (TMD; Narra et al., 2022; Thota et al., 2022). However, additional assessments and physical measurements not typically utilized, such as the STOP-Bang tool, neck circumference (NC), or the NC: TMD ratio, may provide a more thorough preoperative airway assessment in obese patients (Narra et al., 2022; Sharma & Arora, 2020; Thota et al., 2022). Using appropriate preoperative airway assessment techniques can help nurse

anesthetists adequately prepare for intubation and mitigate potential complications in patients with obesity (Narra et al., 2022; Sharma & Arora, 2020).

The increasing prevalence of obesity has sparked many studies on the reliability of preoperative airway assessment techniques in patients with obesity (Emik et al., 2021; Narra et al., 2022; Thota et al., 2022). There are many different strategies for airway assessment, yet the American Association of Nurse Anesthesiology (AANA, 2023) does not recommend any specific strategy for patients with obesity. The American Society of Anesthesiologists (ASA) does not provide additional assessment recommendations for patients with obesity beyond standard preoperative screening (ASA, 2023; Committee on Economics, 2020). The ASA physical status classification system helps anesthesia providers assess potential intraoperative risks to the patient based on comorbidities, with a higher ASA class correlating to a higher perioperative risk for the patient. Individuals with a BMI of 30 kg/m^2 to less than 40 kg/m^2 are classified as ASA 2. Individuals with a BMI greater than or equal to 40 kg/m^2 are classified as ASA 3.

There are numerous assessment techniques that can be used by anesthesia providers, such as the ASA physical status classification system, TMD, and MMS (Committee on Economics, 2020; Emik et al., 2021; Narra et al., 2022). Although some assessment techniques may be used less often, several studies show combining several techniques when evaluating the airway of patients with obesity improves reliability in predicting a “difficult airway” (Mahmoud et al., 2021; Moon et al., 2019; Narra et al., 2022; Siddiqui et al., 2022). Despite research advancements, there are no national standards for preoperative airway assessments in patients with obesity, though it remains imperative that anesthesia providers utilize patient-appropriate

airway assessment techniques to minimize complications and improve outcomes in patients with obesity (AANA, 2023; ASA, 2023; Narra et al., 2022).

Organizational Needs Statement

The partnering organization serves more than 1.4 million people in eastern North Carolina. According to the CDC (2022), the prevalence of obesity in North Carolina is 34% of the total adult population; therefore, this organization sees almost half a million people with a BMI equal to or greater than 30 kg/m^2. Although not all patients will have surgery, ensuring a thorough airway assessment for patients with obesity is extremely important at this facility, especially given these numbers.

The partnering organization is also nationally accredited by the American Society for Metabolic and Bariatric Surgery and Quality Improvement Program as a comprehensive care facility. This organization has a specialized bariatric team that offers two types of bariatric surgeries with 2-year post-surgery reductions in BMI that surpass the national average. The number of surgical interventions for individuals with obesity completed at this hospital, as well as the potential for additional surgeries, increases the number of patients with obesity cared for by anesthesia providers. Therefore, using a variety of airway assessments in patients with obesity should be a priority for CRNAs.

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 (CDC, 2022). Subsequently, there are more patients with obesity presenting for surgery and anesthesia. The increased adiposity in patients with obesity alters anatomy and physiology and places them at higher risk for difficult perioperative airway management (Narra et al., 2022; Poorsattlar & Manuel, 2023). 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 is to assess CRNAs' 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 review was completed to examine current anesthesia practices and recommendations concerning airway assessment techniques in patients with obesity. The PICOTS question used to direct the search was: In obese patients, how do airway assessment techniques used by CRNAs affect airway management during surgery? This PICOTS question identified three key concepts used throughout the search: obese, airway, and CRNAs.

The literature search was completed using the databases PubMed and Cumulative Index to Nursing and Allied Health Literature (CINAHL) and the search engine Google Scholar. The search strategy used for PubMed and Google Scholar was (obesity) AND (airway management OR airway assessment) AND (anesthesia OR nurse anesthetist). This search utilized all three key concepts with Boolean operators used to combine similar keywords. PubMed used the MeSH terms obesity, airway management, anesthesia, and nurse anesthetist. The keyword airway assessment was not associated with a MeSH term but produced more relevant search results when utilized in the search strategy. The results of both PubMed and Google Scholar were limited to articles published within the last 5 years (2018-2023). The search strategy used for CINAHL also included all three key concepts, with additional keyword terms like morbid obesity, artificial airway management, and general anesthesia. The results from CINAHL were limited to the last 10 years (2013-2023). See Appendix A for further information on keywords, MeSH terms, and subject headings used in the literature search.

Inclusion criteria included discussion of preoperative setting, airway assessment tools or questionnaires, anatomical measurements, and patients with obesity or discussion of patients with major risk factors. Exclusion criteria included discussion of pediatric patients, airway management devices, and obesity plus an additional unrelated comorbidity. After application of

these additional limitations, 24 articles from PubMed, 6 articles from CINAHL, and 20 articles from Google Scholar were identified for full text review. See Appendix B for further details on search strategies and articles found. After application of the exclusion criteria, the remaining articles were fully reviewed, and six were chosen based on their overall relevance to the PICOTS question. An additional two articles were found outside of this search strategy by review of resources from chosen articles and other pertinent professional publications.

The level of evidence for each paper was assigned using the Melnyk and Fineout-Overholt (2019) level of evidence categories, ranging from Level I, with the least chance of bias, to Level VII, with the highest chance of bias (p.131). A total of eight articles were retained: one random control trial pilot study (Level II), three cohort studies (Level IV), three observational studies (Level VI), and one expert opinion (Level VII). For more details on the articles retained for this project, see the Literature Matrix in Appendix C.

Selected Literature Synthesis

The literature included in this synthesis addressed many airway assessment techniques as they relate to difficult airways in a patient with obesity. A “difficult airway” can be described by difficult intubation (DI) and/or difficult mask ventilation (DMV), both of which can create significant problems in any patient (Moon et al., 2019).

Throughout the literature, DI is defined by the Intubation Difficulty scale (IDS) or the Cormack-Lehane grading system. Pradeep et al. (2023), Mahmoud et al. (2021), and Moon et al. (2019) use IDS, while Prathep et al. (2022), Siddiqui et al. (2021), and Hasanin et al. (2020) use the Cormack-Lehane grade to determine DI. Narra et al. (2022) discussed both grading scales throughout the article, and Sinha et al. (2020) used the difficult airway score (DASc) to define DI. The DASc includes factors like DMV, number of intubation attempts, Cormack-Lehane

grade, and if assistance was needed during intubation. Mahmoud et al. argued that the IDS is the best marker for DI because it is scored based on number of intubation attempts, presence of cricoid pressure, use of multiple intubation techniques, and the Cormack-Lehane grading system. Despite the tool used to define DI, several preoperative factors were found to be independently predictive for DI throughout the literature reviewed (Hasanin et al., 2020; Mahmoud et al., 2021; Moon et al., 2019; Narra et al., 2022; Pradeep et al., 2023; Prathep et al., 2022; Siddiqui et al., 2021; Sinha et al., 2020).

Moon et al. (2019) used the mask ventilation grading scale to define DMV. The mask ventilation grading scale considers mask ventilation as either easy, moderate, very difficult, or impossible, scored from 1 to 4, respectively. Mahmoud et al. (2021) did not use a standardized grading scale for DMV and instead scored mask ventilation from 1 to 3, with difficult or impossible mask ventilation scored as a 3. Both Moon et al. and Mahmoud et al. considered mask ventilation of moderate difficulty, with a score of 2, as DMV.

Sinha et al. (2020) were the only authors that used the Difficult Airway Score (DASc) to define DI. The DASc includes factors like DMV, number of intubation attempts, Cormack-Lehane grade, and if assistance was needed during intubation. Sinha et al. confirmed many of the same assessment techniques, when used alone, were just as predictive for DI as articles that use the Cormack-Lehane grade or IDS. However, the authors concluded that BMI can be predictive of DI, which is controversial. Only two articles included in this literature review found that BMI was a predictor for DI (Pradeep et al., 2023; Sinha et al., 2020). The authors of the remaining four articles stated that BMI was not predictive of DI (Mahmoud et al., 2021; Moon et al., 2019; Narra et al., 2022; Prathep et al., 2022). Moon et al. (2019) indicated that BMI was only

predictive for DMV. Mahmoud et al. (2021) found that BMI was a risk factor for DMV but ultimately was not predictive of DMV in patients with obesity.

Now that the tools used to define DI and DMV in the literature have been explained, the reliability of individual airway assessment techniques can be compared. Overall, the MMS appeared to be the most widely studied and had the best predictive results of all airway assessment factors identified in the literature (Mahmoud et al., 2021; Moon et al., 2019; Narra et al., 2022; Pradeep et al., 2023; Siddiqui et al., 2021; Sinha et al., 2020). The MMS, when used alone, was found to be predictive of DI in four articles (Mahmoud et al., 2021; Moon et al., 2019; Pradeep et al., 2023; Sinha et al., 2020). Narra et al. (2022) and Siddiqui et al. (2021) found the MMS was most sensitive for DI when used with at least one other assessment technique. One article, which used the Cormack-Lehane grading system, found the MMS was not statistically significant in predicting DI (Prathep et al., 2022). Two articles that looked at DMV factors concurred that the MMS was one of the best predictors for DMV in patients with obesity (Mahmoud et al., 2021; Moon et al., 2019).

Another airway assessment screening tool used to determine a challenging airway, especially for patients with obesity, is the STOP-Bang (Mahmoud et al., 2021). The STOP-Bang tool is used to evaluate patients for OSA. It includes BMI, NC, age over 50 years, and male gender. Many risk factors for OSA considered in the STOP-Bang are also risk factors for DI. Mahmoud et al. (2021) and Sinha et al. (2020) found a high STOP-Bang score to be predictive of DI in patients with obesity. Mahmoud et al. also found this assessment tool to be predictive of DMV. Unfortunately, there is limited research on the STOP-Bang as an indicator for DI or DMV in patients with obesity, but the two articles that did use the STOP-Bang found this tool to

be predictive regardless of how DI or DMV was measured. Mahmoud et al. used IDS as an indicator for DI, and Sinha et al. used the DASc, which combined DI and DMV.

Several airway assessment measurements can be used preoperatively by anesthesia providers, such as the NC, TMD, and NC: TMD (Narra et al., 2022). The TMD appears to be the best independent predictor of DI out of these three measurements (Mahmoud et al., 2021; Moon et al., 2019; Narra et al., 2022; Pradeep et al., 2023; Prathep et al., 2022; Siddiqui et al., 2021; Sinha et al., 2020). However, Narra et al. (2022) addressed the inconsistencies found throughout the literature for TMD cut off values as a predictor for DI. For example, Prathep et al. (2022) found that a TMD < 6.8 cm was the best indicator of DI, but Moon et al. (2019) found that a TMD < 6cm was most predictive of DI in patients with obesity. Meanwhile, Pradeep et al. (2023) established a TMD < 7.25 cm was statistically significant in patients with a BMI ≥25 kg/m^2, which would also consider some non-obese patients according to the CDC (2022) guidelines. This variability in TMD may be due to different patient ethnicities or gender (Narra et al., 2022). Another common measurement used to assess DI is NC. Pradeep et al. and Sinha et al. (2020) both found that NC could indicate DI, but again predictive values varied by more than 6 cm between the two articles. Narra et al. discussed the use of NC with other airway assessment tools to be more reliable for DI. However, Prathep et al. found that NC was not at all related to DI. Due to contradicting results throughout the literature, Narra et al. suggested that NC: TMD may be a better predictor of DI as it more accurately shows the distribution of fat in the neck region. Pradeep et al. stated that a NC: TMD > 5.05 cm is the best predictor for DI with the highest sensitivity of either NC, TMD, or SMD when used alone. There is limited research on this assessment technique, especially throughout varying patient populations; therefore, more

studies need to be completed before a more definitive cut off value can be recommended for NC: TMD.

Despite some variability throughout the research on specific cut off measurements, there does seem to be a consensus on combining various airway assessment tools to improve DI prediction in patients with obesity. Unfortunately, none of the literature synthesized or reviewed for this project offered anesthesia providers any educational resource on the various assessment tools addressed (Hasanin et al., 2020; Mahmoud et al., 2021; Moon et al., 2019; Narra et al., 2022; Pradeep et al., 2023; Prathep et al., 2022; Siddiqui et al., 2021; Sinha et al., 2020). Most of the studies were observational or required blinding of the anesthesia provider; thus, a reference guide could not be given out. In one cohort study completed by Mahmoud et al. (2021), the preoperative assessments were completed per the facility's standards and not adjusted based on patient population. Another common finding among the literature was the use of anesthesiologists for preoperative airway assessments and intubations. The target population of this QI project, CRNAs, was not included in any of the studies. Therefore, providing a QRG for CRNAs filled a current educational need.

Project Framework

This QI project used the model for improvement via the plan-do-study-act (PDSA) cycle described by the Institute for Healthcare Improvement (IHI, 2023). After reviewing the literature on CRNAs' airway assessments for patients with obesity, a *plan* was developed to create a QRG for CRNAs containing several different assessment techniques, recommendations from the literature, and common cut off values for physical measurements found to be predictive of DI and DMV. Pre-implementation and post-implementation survey questions were developed along with a short PowerPoint presentation to highlight and review techniques found in the literature

search and included on the QRG. During the *do* phase, the pre-implementation survey, short PowerPoint presentation, and post-implementation survey questions were sent out as links to the CRNAs via email. The pre-implementation survey was to be completed prior to viewing the short presentation and implementation of the QRG. The post-implementation survey was completed after the CRNAs used the QRG for 2 weeks. The results of those surveys were collected and analyzed during the *study* phase to assess the CRNAs' perception of this QRG. During the *act* phase, the survey results guided any further adjustments or recommendations for the use of a QRG within the facility.

Ethical Considerations and Protection of Human Subjects

This QI project posed no risk of harm for the target population, CRNAs working within the organization. Additionally, there were no special ethical considerations for the target population, and no patients were directly involved in this project. The ethical impact of this project was considered and reviewed via training modules through the Collaborative Institutional Training Initiative (CITI; https://about.citiprogram.org).

This project received organizational approval before implementation of the intervention. First, the College of Nursing (CON) at East Carolina University (ECU) and the University and Medical Center Institutional Review Board (IRB) approved this project as a QI project. Therefore, full review from the IRB was not needed. The local facility where this intervention was to be implemented also approved the project and collection of data from the target population. See Appendix D for forms and further details on the approval process.

Section III. Project Design

Project Setting

This QI project was implemented in a small outpatient surgical center. The location provided care for many patients each day, which increased the potential for use of the QRG by CRNAs. However, to ensure their safety, patients had to meet certain health standards to be cared for at this outpatient facility. Patients with a BMI ≥ 40 kg/m^2 were not always accepted for procedures at this location. Although patients with morbid obesity, considered an ASA 3, were still seen at this facility, their risk of anesthetic complications were considered by the anesthesiologists and may have been canceled the day of surgery due to increased risk of anesthetic complications. Therefore, the CRNAs may see fewer patients at high risk for DI, and the QRG may not be as useful in this target population.

Due to the fast pace of this location, there were more alternative anesthesia techniques used, like regional anesthesia or monitored anesthesia care, that did not require intubation. In these cases, the QRG would still be beneficial to help CRNAs assess for potential DI in patients with obesity, as all patients undergo an airway assessment during the preoperative evaluation. However, it is possible the QRG may not be referenced since intubation was not the primary plan for these patients. The fast pace may limit CRNAs' time to reference the QRG prior to or during the airway assessment of patients with obesity, which is hopefully overcome by the creation of a pocket sized QRG.

Additional barriers may include limited participant numbers, as the core staff at this facility includes only seven CRNAs. Some of these CRNAs may be part-time, per-diem, or on vacation as the implementation period of this project is right at the start of summer. These factors will ultimately limit the overall use of the QRG and responses to the pre- and post-

implementation surveys. If other students are completing their QI project at this facility, there may be further limitations in participant responses to either the pre- or post- implementation surveys as the target population for both projects would be the same core staff of CRNAs.

Project Population

The pre-implementation survey, post-implementation survey, and PowerPoint presentation were sent to the target populations' work email. The surveys were sent out with individual links to each participant so that conclusions could be drawn from changes in responses before and after project implementation. The CRNAs at this location deal with a very fast pace, which can be beneficial, as stated earlier, but may also hinder the use of the QRG. In this fast-paced environment, CRNAs may resort back to their daily routine and forget to use the QRG in their perioperative assessment of patients with obesity. The QRG is pocket sized and laminated to help improve CRNA use of the guide and allow for cleaning between patients. The target population at this location agreed to implement this QI project for 2 weeks.

Project Team

The author of this paper worked with three other students to develop this QI project; however, this student worked independently as the team lead to implement the project in a different setting than the other students. At the assigned project implementation site, data was independently collected and analyzed by the team lead. The project chair, CRNA program director, and course director assisted throughout the planning and implementation of this project. A site contact person at the implementation site signed a letter of acknowledgement for data to be collected at that location. A clinical contact person was also available throughout the implementation of this project.

Methods and Measurement

The purpose of this QI project was to assess CRNAs' perception of adequacy of a newly developed QRG as a useful tool for their practice as it pertains to assessment of the airway of patients with obesity. The goal was to collect and synthesize from the literature, the best airway assessment tools for CRNAs to better predict DI in patients with obesity and then present this information in a condensed, handheld reference guide. See Appendix E for the QRG created as the intervention for this QI project.

The PDSA cycle was used to guide this QI project (IHI, 2023). First, a literature search was completed to assess the current recommendations and evidence-based practice utilized by CRNAs to assess the airways of patients with obesity. After excluding articles given certain parameters discussed in Section II, the remaining literature was synthesized, and a QRG was developed by four students, including this author. The QRG included guidelines, facts, and pictures on airway assessment techniques, recommended positioning, and cut off values found to be predictive of DI or DMV for patients with obesity. The pre- and post-implementation survey questions were then developed by the project team to assess participant perceptions on current airway assessment tools and their impression of usefulness of this QRG. The questionnaires were completed by the CRNAs via Qualtrics. See Appendix F for the pre- and post- implementation survey questions.

A short PowerPoint presentation was developed by the project team to discuss the QRG and present other pertinent information found in the literature but not included in the QRG (see Appendix G). To note, the PowerPoint included audio on each slide which is not included in Appendix G. An email was also constructed during the *plan* stage to send to the participants of this QI project. The email contained a description of the QI project along with instructions on

how and when to complete the pre-and post-implementation surveys, a link to the surveys via Qualtrics, the PowerPoint presentation with audio, information on the QRG, and an electronic copy of the QRG. See Appendix H for a copy of the email sent to the target population of this project.

Before advancing to the second phase of the PDSA cycle, approval for the QI project was sought from the CON at ECU and the University and Medical Center IRB. Approval to implement the project was obtained through agreement between the University and Medical Center IRB, and the participating organization. Once these approvals were obtained, the intervention could be implemented at the project site.

The *do* phase was started once consent to implement the QRG at the project site was received from the IRB and the site contact person. The email that was constructed in the *plan* phase was then sent out to the CRNAs at the implementation site. The pre-implementation survey, which consisted of seven questions, was to be completed by the CRNAs via Qualtrics prior to watching the PowerPoint presentation and before implementation of the QRG. After the short 10-minute presentation was viewed, the target population was asked to use the QRG for 2 weeks. An electronic copy of the QRG was provided in the email, and a laminated copy was provided in the anesthesia workroom. The post-implementation survey, consisting of 11 questions, was also completed via Qualtrics after the 2-week implementation period.

The data from Qualtrics was collected for the *study* phase of the PDSA cycle and the responses remained confidential. The data was predominately ordinal data, with responses graded on a Likert-scale. There were two questions in the pre-implementation survey that presented a different level of data: one was ratio level data, and one was nominal data. In the post-implementation survey, there were three questions that presented a different level of data:

one was ratio level data, and two were free response. The data were synthesized independently by the team lead. Similar levels of data were compared to adequately assess the outcomes of this QI project as noted above. The data were analyzed using Excel to obtain values for certain measures such as airway assessment tool utilization and the CRNAs' perceptions of usefulness of the QRG on the unit.

The last phase of the PDSA cycle, the *act* phase, included determining and sharing suggestions for future QI projects or policy efforts aimed at improving anesthesia care of patients with obesity. This may be extremely useful as the healthcare industry and CRNAs will likely continue to see increases in surgeries and other procedures for patients with obesity (Sharma & Arora, 2020; Thota et al., 2022).

Section IV. Results and Findings

Results

The purpose of this QI project was to assess CRNAs' perception of adequacy of a newly developed QRG as it pertains to airway assessment in patients with obesity (see Appendix E). Pre-and post- implementation surveys were sent to seven participants at a small outpatient surgical center via email. There was a two-week period between the pre- and post-implementation survey distribution, during which the participants could use the QRG. A total of five responses were collected via Qualtrics for the pre-implementation survey, and three responses were collected via Qualtrics for the post-implementation survey. The data were then analyzed with Excel.

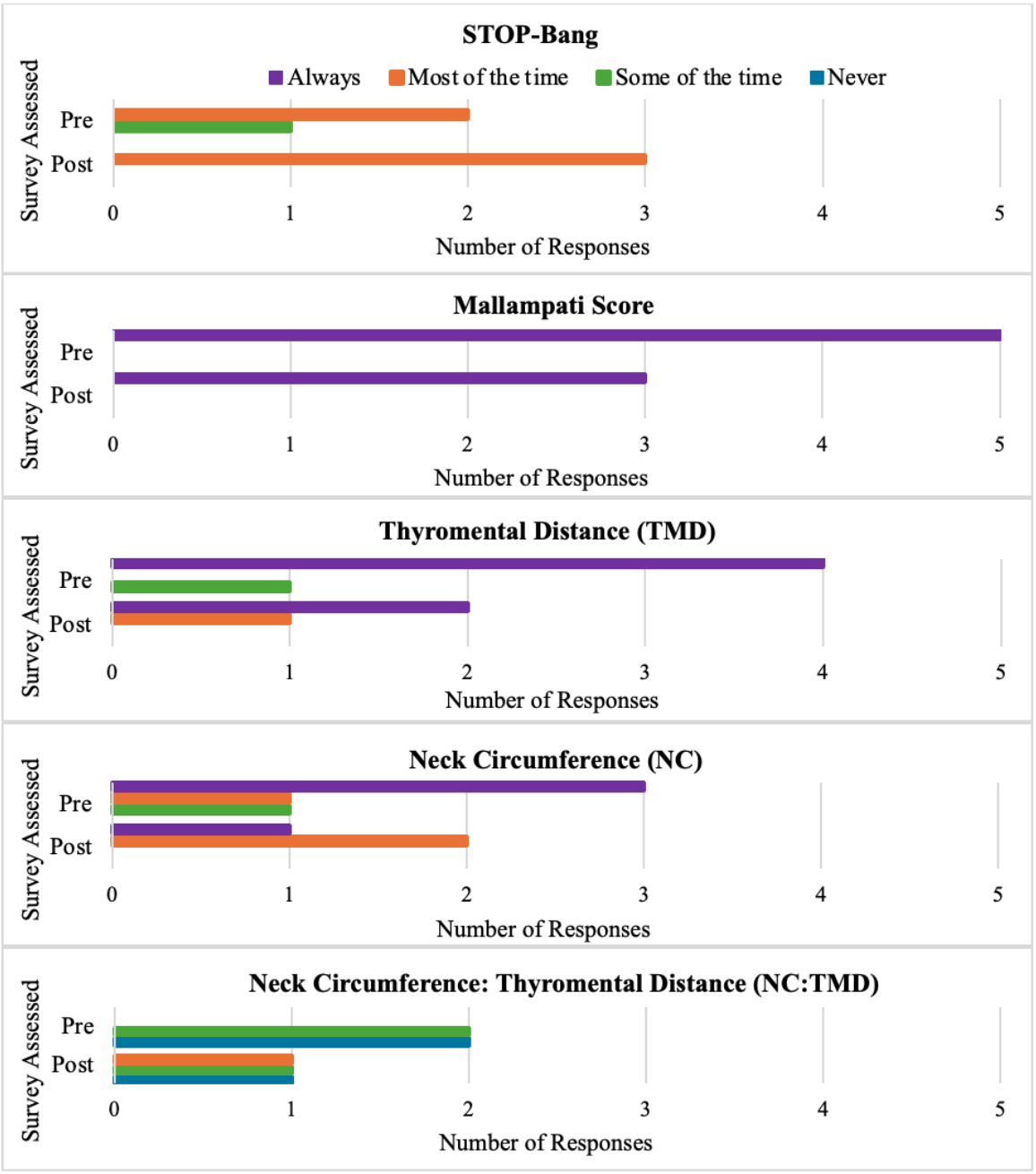
Data Presentation

In the pre- and post- implementation survey, participants were asked about their use of five airway assessment methods in patients with obesity. These assessment methods included the STOP-Bang, Mallampati, TMD, NC, and NC: TMD. In the pre-implementation survey, two of five participants reported they use the STOP-Bang score *most of the time* when completing an airway assessment in a patient with obesity, while one participant reported they only use the STOP-Bang score *some of the time*. Two respondents did not answer this section of the question, so only three responses were collected for the STOP-Bang score. Five participants reported they *always* use the Mallampati score. Four participants reported they *always* use the TMD when assessing the airway in a patient with obesity and one participant reported they used this measurement *some of the time*. Three participants reported they *always* used the NC, while one used it *most of the time* and another used it *some of the time*. Two participants reported they *never* used the NC: TMD, and two participants used it *some of the time*. One participant did not

respond to this part of the question, so there were only four responses recorded for the NC: TMD. After implementation of the QRG, in the post-implementation survey, all three respondents reported they used the STOP-Bang score *most of the time* and *always* used the Mallampati score when assessing the airway of a patient with obesity. Two of the three respondents reported they *always* used the TMD after implementation of the QRG, and one participant reported they used the TMD *most of the time*. The NC was used *most of the time* by two participants and *always* used by one participant. The responses were split regarding the use of the NC: TMD ratio, with one respondent stating they *never* used this measure, one stating they used it *some of the time*, and one stating they used it *most of the time*. The responses of this question for both pre- and post- implementation surveys can be seen in Figure 1.

Figure 1

When evaluating the airways of patients with obesity, to what extent do you use the following assessment methods? (pre-implementation survey n=5, post-implementation survey n=3)



Note. In the pre-survey two respondents did not answer the STOP-Bang question, and one respondent did not answer the NC:TMD ratio question.

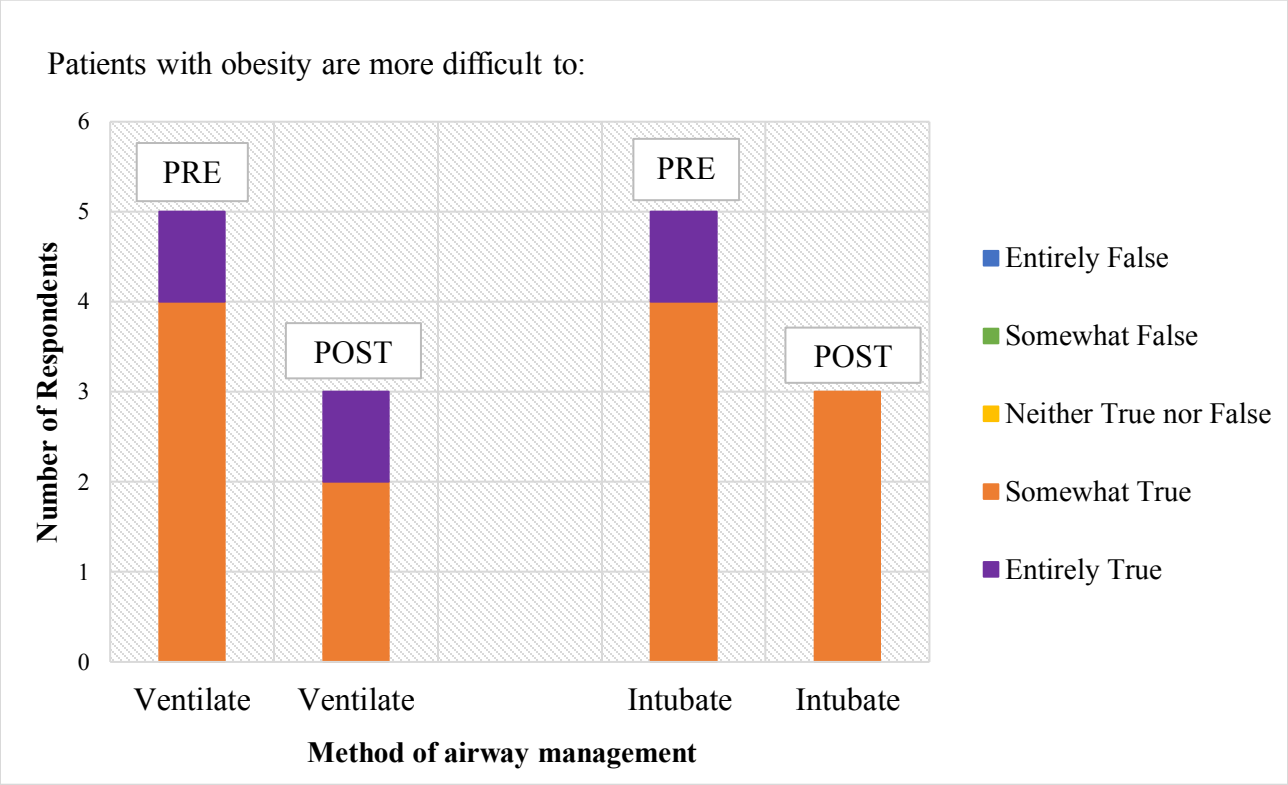
The next question in both the pre- and post- implementation survey asked participants about their perception of the usefulness of these five airway assessment techniques in predicting a difficult airway in patients with obesity: the STOP-Bang, Mallampati score, TMD, NC, and NC: TMD. In the pre-implementation survey, two participants responded they found the STOP-Bang score to be *very useful* in predicting a difficult airway in a patient with obesity, while one participant found it to be *mostly useful*. Two participants did not answer this portion of the question, so only three responses were collected for the STOP-Bang score. Four participants responded that the Mallampati score was *very useful* in predicting a difficult airway and one responded it was *mostly useful*. The TMD was *very useful* in predicting a difficult airway for three participants and *mostly useful* for two participants. Three participants responded that the NC was *very useful,* and two participants responded it was *mostly useful*. Regarding the NC: TMD, two participants responded they *did not use this tool* when assessing the airway of a patient with obesity, one participant responded it was *somewhat useful*, and another participant responded it was *mostly useful*. One participant did not respond to this part of the pre-implementation survey question, so only four responses were collected for the NC: TMD. After implementation of the QRG, three participants responded to the post-implementation survey. All three respondents found the STOP-Bang score and Mallampati score to be *very useful* in predicting a difficult airway in patients with obesity. The TMD was found to be *very useful* in predicting a difficult airway by two participants and *mostly useful* by one participant. Two participants responded that the NC was *mostly useful,* and one participant responded it was *very useful*. Regarding the NC: TMD, two participants responded that they *did not use this tool* when predicting a difficult airway in a patient with obesity, and one participant responded it was *mostly useful*.

Participants were then asked to estimate the percent of patients with obesity they typically cared for in a 2-week period. Three participants in the pre- implementation survey and one participant in the post- implementation survey estimated that *51% to 75%* of their total patient population within a two-week period were obese. Two participants in both the pre- and post- implementation survey estimated that *76% to 99%* of their total patient population within a two-week period were obese.

Next, participants were asked how true they found patients with obesity to be more difficult to mask-ventilate and intubate. In the pre-implementation survey, four participants believed that the statement "patients with obesity are more difficult to mask ventilate" to be *somewhat true*, and one participant found this statement to be *entirely true*. Four participants found the statement "patients with obesity are more difficult to intubate" to be *somewhat true*, while one participant found this statement to be *entirely true*. In the post- implementation survey, two participants found the statement "patients with obesity are more difficult to mask ventilate" to be *somewhat true* after the QRG was implemented, and one participant found this statement to be *entirely true*. After the 2-week implementation period, all three respondents found the statement "patients with obesity are more difficult to intubate" to be *somewhat true*. Figure 2 shows the participants' responses for this question on both the pre- and post- implementation survey.

Figure 2

CRNA perception of the difficulty of intubating and/or ventilating patients with obesity. (pre-implementation survey n=5; post-implementation survey n=3)



Participants' use of "ramping" to optimize intubation conditions for patients with obesity was assessed in both the pre- and post- implementation survey. Prior to implementation of the QRG, in the pre- implementation survey, four of five participants reported they used ramping *some of the time*, and one participant responded they *never* use ramping in patients with obesity. After implementation of the QRG, in the post- implementation survey, all three responded they use ramping *some of the time* to optimize intubation conditions for patients with obesity.

In the pre-implementation survey, participants were asked if they were trained to use POCUS to assess patients' airways and how often they used this method to assess the airway of

any patient, not just patients with obesity. Five participants responded *no,* they were not trained to use POCUS and had *never* used this method to assess any patient's airway. In the post-implementation survey, all three respondents replied they *never* used POCUS to assess patients' airways during the two-week implementation period. When participants were asked about their interest in attending an in-service on the use of POCUS for patient airway assessment in the post-implementation survey, two participants responded they were *very interested,* and one participant responded they were *somewhat interested* in attending an in-service on this information.

After implementation of the QRG, in the post- implementation survey, two participants responded they found the QRG to be *very useful* and one participant found the QRG to be *mostly useful.* When asked how often they used the QRG during the two-week implementation period, all three respondents replied they used the guide *some of the time*. The following two questions on the post- implementation survey were open ended questions and asked participants which aspect(s) of the QRG were most, or least, useful to their practice and if there are any recommended changes to the QRG. One participant responded "the information on POCUS" was found to be most useful to their practice. Another participant found the information on "NC: TMD" to be most useful in their practice. One participant suggested the QRG should be "put in every room or be online" and one participant responded "none" when asked what was least useful about the QRG or what changes should be made regarding the QRG. One participant left these two questions blank.

Analysis

Although the number of respondents was not equal in the pre- and post- implementation surveys (n= 5 & 3, respectively), and some of the questions were left blank in the pre-implementation survey, this QI project still provided some valuable insight into CRNAs' perceptions of the QRG provided. It was initially believed that the outpatient setting of this QI project may limit the number of patients presenting with obesity. However, the estimated percent of patients with obesity seen by all the respondents was between 51% and 75%. Therefore, these CRNAs likely have much experience in the airway assessment of patients with obesity. Regardless, these CRNAs still reported the QRG to be *mostly useful* to *very useful* at this facility.

The brief video sent to participants, along with the QRG, addressed many different airway assessment techniques used in patients with obesity, commonly accepted cut-off values for these assessments in predicting difficult airways, and additional information such as patient positioning. The Mallampati score was reportedly *always* used and *very useful* in both the pre- and post- implementation surveys by all those who responded. There is significant data that supports the use of the MMS, a shortened version of the Mallampati score, to have the best predictive results of all airway assessment techniques discussed within this paper (Mahmoud et al., 2021; Moon et al., 2019; Narra et al., 2022; Pradeep et al., 2023; Siddiqui et al., 2021; Sinha et al., 2020). Additionally, all but one respondent reported *always* using at least two airway assessment techniques in their preoperative evaluation of patients with obesity in both the pre- and post- implementation surveys. The use of the MMS and an additional assessment technique were found to be the most sensitive for DI by Narra et al. (2022) and Siddiqui et al. (2021). All respondents found the STOP-Bang, TMD, and NC, in addition to the Mallampati score, to be either *mostly useful* or *very useful* in predicting a difficult airway in patients with obesity. These

airway assessment techniques are commonly taught and relatively quick to complete in the preoperative assessment period and may be the reason they are most often performed by CRNAs.

CRNAs' perception of DI in patients with obesity did not change from the pre-implementation survey to the post- implementation survey, as the same three participants that responded to both surveys reported this statement to be *somewhat true*. Although research shows that obesity alone is not a predictor of DI, it is difficult to conclude why the perception remains that patients with obesity can sometimes be a more DI. Perhaps this is due to additional comorbidities present in many patients with obesity or less than optimal patient positioning.

Ramping is described as a useful positioning tool in patients with obesity to better align the oral axis, pharyngeal axis, and laryngeal axis to provide better visualization during intubation and increase safe apnea time (Lilaonikul & Infosino, 2023). Two of the three participants that responded to both the pre- and post- implementation surveys responded they used ramping *some of the time* on both surveys. One participant said they *never* used ramping on the pre-implementation survey, but after use of the QRG, which covers the benefits of ramping, responded they used ramping *some of the time.* The use of ramping does take additional preparation and resources, which may be difficult in a fast-paced environment.

Section V. Implications

Financial and Nonfinancial Analysis

This QI project had very little overhead cost and may provide additional financial benefit by minimizing the risk of DI or by better predicting DI in patients with obesity, thereby decreasing intraoperative patient harm due to an anesthetic airway complication. The organization could distribute the QRG via email, which would be free, or print out a hard copy and laminate each pocket-sized copy, which would cost an average of 25 cents per handout. This cost includes the cost of the paper, ink, and laminate used. As this organization already has means of printing and laminating in large quantities, additional supplies do not need to be purchased which helps minimize the overall cost of this project. Distribution of the QRG to each OR would likely fall under a current administrative employee's job description. Assuming 200 copies of the QRG are made, it would cost the organization about $50 for supplies. The PowerPoint video and additional QRG's could be sent to each anesthesia provider via email; therefore, only the only cost of reproducing this QI project to the organization would be about $50 for materials.

There would be minimal change to the workflow, as anesthesia providers already complete a preoperative evaluation using several of the airway assessment techniques discussed in the QRG. The Mallampati and TMD are already auto populated for the anesthesia preoperative evaluation note within the electronic health record (EHR). The NC, STOP-Bang, and NC: TMD could be included in the provider's note by manually adding this information or by creating a new smart note to be used by that anesthesia provider for patients with a BMI ≥ 30 kg/m^2. The creation of an individualized smart note would take about five minutes of the anesthesia provider's time. A standardized smart note within the EHR could also be created by

the information and technology team responsible for all programming changes within the EHR charting system. Again, these individuals are already employed by the organization and would likely not have any additional cost to create a new standardized smart note. A template would need to be created for the team to follow but is a relatively easy update that could be available in the next EHR update. Disposable tape measures are already provided in the preoperative area to allow CRNAs to more accurately assess the NC of patients with obesity, but with routine use, a larger supply may be needed.

This QI project has further benefit to this organization, as it may help prepare anesthesia providers to anticipate a DI in patients with obesity. Although patients with obesity have a relatively small risk of DI, the results of encountering a DI can be devastating to the patient and anesthesia providers. In the worst-case scenario, a cardiac arrest could occur due to sustained hypoxia from inability to ventilate the patient. On average, patients that have intra-operative cardiac arrests require an additional 5 days in the hospital, costing upwards of $13,000 per patient (Fielding-Singh et al., 2020). These patients often require additional procedures in the operating room, further adding to the overall hospital cost. Patients that had an intra-operative cardiac arrest also had a significantly higher in-hospital mortality rate at 35% compared to 1.3% for those admitted without an intra-operative cardiac arrest (Fielding-Singh et al., 2020). The increased mortality rate also carries potential costs for the hospital.

Overall, the cost and time required to implement this QI project would be minimal to the organization. The benefit of implementing the QRG far outweighs the potential cost of intra-operative cardiac arrest or mortality due to DI. As the number of patients with obesity increases, it is necessary to better prepare anesthesia providers and offer resources that may improve their

ability to predict and prevent DI. By better predicting DI, CRNAs can potentially minimize the use of otherwise unnecessary equipment and improve patient outcomes.

Implications of Project

It is estimated that 42% of the United States population is obese, with a BMI equal to or greater than 30 kg/m^2 (CDC, 2022). Despite this number, neither the AANA nor the ASA have standardized recommendations for preoperative airway assessment specifically for patients with obesity (AANA, 2023; ASA, 2023). The literature varies in which airway assessment techniques may better predict DI in patients with obesity; however, the consensus is the use of several preoperative airway assessment techniques should be used to more reliably predict DI (Mahmoud et al., 2021; Moon et al., 2019; Narra et al., 2022; Siddiqui et al., 2022).

The MMS was most researched in the literature and was found to be moderately sensitive for DI when used alone (Mahmoud et al., 2021; Moon et al., 2019; Narra et al., 2022; Pradeep et al., 2023; Siddiqui et al., 2021; Sinha et al., 2020). TMD was found to be the next best independent predictor of DI (Mahmoud et al., 2021; Moon et al., 2019; Narra et al., 2022; Pradeep et al., 2023; Prathep et al., 2022; Siddiqui et al., 2021; Sinha et al., 2020). NC and NC: TMD were reviewed in the literature with varying results, as the predictive value for these measurements may be dependent upon factors such as race or gender.

Overall, the pre- and post- implementation surveys revealed that most CRNAs at this location used the Mallampati score, TMD, NC, and STOP-Bang most of the time, if not always. The CRNAs found the Mallampati score to be the most useful, followed by the STOP-Bang and TMD. The NC was still considered mostly useful by the majority of the CRNAs, and the NC: TMD was often reported as not used. Although this is a very small sample size, the findings on

reported usefulness in predicting DI in patients with obesity corresponds to most of the findings in the literature.

New information included in the PowerPoint video, not the QRG, was the use of POCUS in assessing the airway of patients with obesity in the preoperative period. Two of the three respondents said they would be *very interested* in attending a class on POCUS and one participant said they would be *somewhat interested* in this information. If the organization was to provide a class on POCUS for the CRNAs this would have a cost. The class would have to be over several weeks to allow all the CRNAs ample time to learn and apply the knowledge. If there was enough interest, the organization would need to provide more ultrasounds in the preoperative setting, which would have a significant financial impact on the organization. This type of preoperative assessment is now emerging and, in the future, may become a common practice in anesthesia and even a standard of care. The early training and implementation of POCUS for airway assessment could set the organization apart from others.

It was initially believed that the location of implementation for this QI project may yield lower numbers of patients with obesity. However, all CRNAs responded that they estimated at least 51% to 99% of their patients to be obese. As 34% of adults in North Carolina are reportedly considered obese, there can be large numbers of patients with obesity served each day in this outpatient facility. Therefore, this QI project has implications not only in this facility but in other facilities within the health system that likely see more patients with higher levels of obesity and additional comorbidities, further increasing the risk of DI. Providing a QRG to CRNAs within the organization could help prepare providers to better predict DI and perform these airway assessment techniques throughout their career.

Sustainability

The organization should be able to afford the cost of continuing to evaluate the CRNAs' perception of a QRG for assessing the airway of patients with obesity in the perioperative setting. This project can be done at a very low cost to the organization, even if it was enlarged to further assess CRNAs at other locations within the organization. However, for this project to succeed at each facility, the organization would need to have a CRNA at each location to remind anesthesia providers about the ongoing project and to answer any questions that may arise. The point CRNA at each location would not need to undergo any extra training, as all information included in the QRG is review, with updated cut off values for predicting DI in patients with obesity. Most anesthesia providers have a base set of questions they ask each patient, so any newer assessment technique or measurement, such as the NC: TMD or POCUS, may be more challenging to work into CRNAs' preoperative evaluation. Therefore, having a resource person at each location could be helpful to remind CRNAs of additional preoperative evaluation techniques available without increasing costs to the organization.

An additional QI project on the use of ramping in patients with obesity and the overall perception on ease of ventilation and intubation could be beneficial to this project. There were few responses to the post-implementation survey, but only one reported change in the use of ramping after the QRG. Ramping is supported in the literature to improve direct laryngoscopy view in patients with obesity (Lilaonikul & Infosino, 2023). It could be beneficial to see if perceptions of ramping change at other locations that have less production pressure, have additional resources to ramp patients, and have patients with higher levels of obesity, such as class 3 obesity. This would not be a large additional cost to the organization, as these questions could be taken from the pre- and post- implementation surveys and expanded to specifically

assess the perception of CRNAs on ramping and changes in airway view during direct laryngoscopy.

There are many benefits to expanding and continuing this QI project, especially at locations within the organization where CRNAs practice more independently. There are some facilities where the CRNAs are the only anesthesia providers that complete the preoperative evaluation. This QI project could be especially useful in these locations. Predicting a DI, if possible, may prevent adverse effects. Given the low cost of the QI project and the increasing number of patients with obesity, implementing this project throughout the organization could be beneficial on many fronts.

Dissemination Plan

A poster was created with the results of this QI project and presented in person to members of the department of nurse anesthesia, along with students within this program. The poster presentation was also available as a live stream so that additional faculty, students, and project participants were able to view the results of this project. The poster and final paper were uploaded to The Scholarship, which is the East Carolina University digital repository.

Section VI. Conclusion

Limitations

The main limitation identified during this project included lack of full participation in the pre- and post- implementation survey (n= 5 & 3, respectively). A few of the core staff were on vacation or out for several days during the implementation period. CRNAs that were not present for the entire implementation period expressed interest in participating in the project, but did not want to participate partially. Given the already small number of core staff, this was a potentially significant limitation that may have resulted in a reduced number of responses.

The initial, reminder, and final emails with links to the PowerPoint and pre- and post-implementation surveys were sent out to the participants on Fridays. There were only two responses to the pre-implementation survey within the first week, and no responses were recorded over the weekend. The outpatient surgical center is not open on the weekend, and this likely resulted in many of the participants not checking their email. The fast pace of this location may also have contributed to individuals not being able to check their email or complete the survey during the workday. Some of the participants are per diem or part time and are not at the facility five days a week. These CRNAs are less likely to check their work email and be present to utilize the QRG in their preoperative evaluation. The participants that were seen during the week were reminded in person of the ongoing project and encouraged to complete the pre-implementation survey. This likely accounted for the higher number of responses on the pre-implementation survey.

Barriers to completion of the post-assessment could include lack of student presence after the implementation period and immediate initiation of another student's QI project the following week. After completion of this QI project, an email with the post-implementation survey was

sent out to all participants after leaving this location. There was no in-person reminder for the participants to complete the post-implementation survey. Additionally, another student was implementing a different QI project at this location with the same participants. The initial email for this QI project was likely sent within the same period as the final email with the post-implementation survey. It is possible that participants became confused with multiple QI projects starting and finishing or had too many emails or surveys to complete in their already limited time. The other student was at this location for the next two weeks, and participants may have been too preoccupied with the subsequent QI project to complete the post- implementation survey for this QI project.

It is possible that participation may have been improved if the implementation period could have been extended, along with time spent at the facility to serve as an in-person reminder for participants. This would have allowed for CRNAs that did not work as frequently, or were on vacation, to use the QRG.

Recommendations for Future Implementation and/or Additional Study

Assessing perceptions of CRNAs about the adequacy of a QRG in assessing airways of patients with obesity has implications throughout any health care system. Future implementation of this QI project may be strengthened by increasing implementation period and number of participants to maximize response rates.

A physical copy of the QRG should be available, along with electronic access either on the provider's cell phone or via the electronic health record. The laminated handout of the QRG was not frequently used by the CRNAs at this location, but that may be due to the location of the copies in the anesthesia workroom. Having the QRG available in the preoperative area or even several locations may be more useful for future implementation.

The pre- and post- implementation surveys had drop down boxes within the first two questions if accessed via mobile device. Two of the participants of this QI project did not complete some of these sections on the pre-implementation survey. It is recommended that these questions be expanded so they are more visible on a mobile device to ensure complete responses. The survey could also be changed to require participant completion prior to submission, but this may limit overall responses if participants are unable to find the drop-down boxes.

Many hospitals use video laryngoscopy, such as the McGrath blade, as a standard for all patients. The use of these devices by anesthesia providers may expand throughout healthcare settings and may alter items used on this QRG; however, further research is needed to determine these correlations. It is important for anesthesia providers to be proficient in essential airway assessment techniques. Technological devices are evolving, and CRNAs must also expand their skills with all airway devices. As artificial intelligence continues to advance, it will be interesting to see if the input of measurements discussed throughout this paper may help predict DI in patients, especially those with obesity.

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Appendix A

Literature Concept Table

	Concept 1 Obese	**Concept 2** Airway	**Concept 3** CRNAs
Keywords	Obese Obesity	Airway Airway assessment Airway management	CRNAs Anesthesia Nurse Anesthetist
PubMed MeSH Terms	“obesity” [MeSH Terms]	“airway management” [MeSH Terms]	“anesthesia” [MeSH Terms] OR “nurse anesthetists” [MeSH Terms]
CINAHL Subject Headings	(MH "Obesity") OR (MH "Obesity, Morbid")	(MH "Airway Management") OR (MH "Clinical Assessment Tools")	(MH "Anesthesia Nursing") OR (MH "Anesthesia") OR (MH "Anesthesia, General")
Google Scholar	Obese OR Obesity	Airway OR Airway assessment OR Airway management	Anesthesia OR Nurse Anesthetist

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
9/17/23	PubMed	(obesity) AND (airway management OR airway assessment) AND (anesthesia OR nurse anesthetist) (("obeses"[All Fields] OR "obesity"[MeSH Terms] OR "obesity"[All Fields] OR "obese"[All Fields] OR "obesities"[All Fields] OR "obesity s"[All Fields]) AND ("airway management"[MeSH Terms] OR ("airway"[All Fields] AND "management"[All Fields]) OR "airway management"[All Fields] OR (("airway"[All Fields] OR "airway s"[All Fields] OR "airways"[All Fields]) AND ("assess"[All Fields] OR "assessed"[All Fields] OR "assessement"[All Fields] OR "assesses"[All Fields] OR "assessing"[All Fields] OR "assessment"[All Fields] OR "assessment s"[All Fields] OR "assessments"[All Fields]))) AND ("anaesthesia"[All Fields] OR "anesthesia"[MeSH Terms] OR "anesthesia"[All Fields] OR "anaesthesias"[All Fields] OR "anesthesias"[All Fields] OR ("nurse anaesthetist"[All Fields] OR "nurse anesthetists"[MeSH Terms] OR ("nurse"[All Fields] AND "anesthetists"[All Fields]) OR "nurse anesthetists"[All Fields] OR ("nurse"[All Fields] AND "anesthetist"[All Fields]) OR "nurse anesthetist"[All Fields]))) AND (2018:2023[pdat])	5 years (actual years 2018-2023)	300 found/24 kept	**Inclusion:** Preoperative setting discussed, airway assessment tools, anatomical measurements, anesthesia providers, obese or super-obese patient population. **Exclusion:** Incorrect setting (only perioperative or post operative discussed), obesity with another disease, obese pediatric or obese obstetric populations.
9-20/23	CINAHL	((MH "Obesity, Morbid") OR (MH "Obesity") OR "Obese") AND ((MH "Artificial Airway Management (Iowa NIC)") OR (MH "Airway Management") OR (MH "Airway Management (Iowa NIC)")) AND ((MH	10 years (actual years 2013-2023)	37/6	Inclusion: Obese population included/mentioned in literature, airway assessment tools or anatomical measurements discussed, anesthesia providers.

		"Certified Registered Nurse Anesthetists") OR (MH "Anesthetists") OR "nurse anesthetists" OR (MH "Anesthesia") OR (MH "Anesthesia, General"))			**Exclusion:** Incorrect patient population (including obstetrics or pediatrics), airway management devices, incorrect setting or without discussion of preoperative assessment techniques.
9/20/23	Google Scholar	(obesity) AND (airway management OR airway assessment) AND (anesthesia OR nurse anesthetist)	5 years (actual years 2018-2023)	17,200/20 (reviewed 10 pages of results)	**Inclusion:** Preoperative setting discussed, airway assessment tools, anatomical measurements, assessment questionnaire, obese patient population or discussed as it relates to major risk factors. **Exclusion:** Airway monitoring tools, obese endotracheal/tracheal intubation only, obese obstetric patient population, obese pediatric population, only discussed perioperative or postoperative management.

Appendix C

Literature Matrix

Year	Author, Title, Journal	Purpose & Conceptual Framework or Model	Design and Level of Evidence	Setting	Sample	Tool/s and/or Intervention/s	Results
2023	Pradeep, S., Bhar Kundu, S., & Nivetha, C. (2023). Evaluation of neck-circumference-thyromental-distance ratio as a predictor of difficult intubation: A prospective, observational study. *Indian Journal of Anaesthesia*, *67*(5) , 445–451.	Assess the reliability of NC/TMD in predicting DI in both obese and non-obese patients. No conceptual framework or model noted.	A prospect-ive observ-ational study (Level VI)	Calcutta National Medical College and Hospital-Operating room	100 obese and non-obese individuals.	NC/TMD, NC, SMD, and TMD as reliable tools to predict DI in both obese and non-obese patients. DI was determined using IDS	This study found the NC/TMD was the best predictor for DI with a high sensitivity. NC/TMD was better than NC, TMD, or SMD alone in predicating DI in obese patients. **Limitations:** patients with a BMI >25kg/m2 were considered obese, yet this paper considers BMI >30kg/m2 as obese. No description of patient characteristics and relatively small sample size.
2022	Prathep, S., Jitpakdee, W., Woraathasin, W., & Oofuvong, M. (2022). Predicting difficult laryngoscopy in morbidly obese Thai patients by ultrasound	Assess the cut-off value for predicting DI in two different ultrasound measurements in obese Thai patients.	A prospect-ive observ-ational study (Level VI)	Operating room in Songklan-agarind Hospital in Thailand.	88 obese Thai patients with BMI $\geq$ 35kg/m^2 Mean BMI 45kg/m^2. 70% female, 30% male.	BMI, NC, SMD, TMD, MMS, UPBT, inter incisor distance, distance from skin to epiglottis by ultrasound, history of snoring or diagnosis of OSA. DI	Found that TMD <6.8cm, age over 43, and skin to epiglottis distance >13cm were predictive of DI. Skin to epiglottis measured at thyrohyoid membrane while patient was supine. No statistically significant correlation with DI & any of the other measurements used, like OSA, MMS, NC. Interesting to see TMD predictive among several ethnicities throughout studies used in this paper. **Limitations:** single hospital conducting study. All participants of Thai decent, therefore caution

	measurement of distance from skin to epiglottis: A prospective observational study. *BMC Anesthesiology*, *2 2*(1), 145.	No conceptual framework or model noted.			96% w/ history of snoring.	determined using Cormack-Lehane.	needed when extending results to other ethnicities d/t differences in adipose distribution and anatomical features. Small sample size.
2022	Narra, L. R., Udongwo, N., Dominic, J. L., Doreswamy, S., Bhasir, A., Elkherpitawy, I., & Ogedegbe, C. (2022). Obesity and the other independent predictors in elective endotracheal tube intubations: A narrative review. *Journal of Clinical Medicine Research, 14*(5), 177-187.	Discuss the reliability of various studies on both preoperative and intraoperative airway assessment techniques in patients with obesity. No conceptual framework or model noted.	Narrative review-expert opinion (Level VII)	Intra-operative and pre-operative settings (exact locations unknown)	50 published papers. RCT's to observational studies included.	Review of papers discussing BMI, Mallampati score, MMS, SMD, TMD, NC, NC: TMD, patient positioning. Discussion of DI and difficult airway, defined by both Cormack-Lehane & IDS.	Discussion of several preoperative airway assessment techniques for patients with obesity. Combines contrasting papers and assesses potential issues and further need for research. Found SMD to be a more predictive tool for DI but recommends combining assessment tools for best predictive value. BMI alone is not indicative of DI. **Limitations**: Broad question answered, years of articles not included in methods used. Minimal discussion about anesthesia providers directly or patient population included in the various papers discussed.
2021	Siddiqui, K. M., Hameed, F., & Ali, M. A. (2021). Diagnostic accuracy of combined Mallampati and	Establish the accuracy of predicting DI when using both the Mallampati and Wilson score in	A descript-ive cross-sectional study (Level VI)	Hospital operating room	300 individuals. Age 18-70 years old. 52% males; 48%	Use of Mallampati score and Wilson score to predict DI determined using Cormack-Lehane classification	Found 14% of participants were DI. The overall accuracy of the Mallampati and Wilson score combined was about 98%, with more accuracy in participants with a BMI of 31-35kg/m2. Looks at a different score other than the MMS in the preoperative setting.

	Wilson score to predict difficult intubation in obese patients: A descriptive cross-sectional study. *Anesthesiology and Pain Medicine*, *11*(6), e118626.	individuals with class I and class II obesity. No conceptual framework or model noted.			females; 71% had BMI 31-35kg/m2; 29% had BMI 35.1-39kg/m2		**Limitations:** Airway assessments completed by different providers, no standardization. Does not provide accuracy or sensitivity measurements of screening tools individually. None of the findings are statistically significant. No post hoc power analysis reported.
2021	Mahmoud, M., Hasanin, A. M., Mostafa, M., Alhamade, F., Abdelhamid, B., & Elsherbeeny, M. (2021). Evaluation of super-obesity and super-super-obesity as risk factors for difficult intubation in patients undergoing bariatric surgery. *Surgery for Obesity and Related Diseases, 17*(7), 1279-1285.	Assess the predictive value for DI among different risk factors in obese patients. No conceptual framework or model noted.	Controlled cohort study (Level IV)	Operating room in a large Egyptian hospital	651 obese individuals Obese defined as BMI ≥ 30kg/m^2 205 with BMI≥ 50kg/m^2; 52 with BMI≥ 60kg/m^2	Use of Mallampati score, NC, TMD, mouth opening, mandibular protrusion, STOP-Bang score. DI determined using IDS and number of intubation attempts.	Study assessed multiple risk factors for DI discussed throughout this paper. Found independent risk factors for DI to be high STOP-Bang score (≥ 1.9) and Mallampati score (≥ 3), confirming that BMI alone is not predictive for DI. Also found these two scores plus limited neck extension to be predictive of DMV. Defines DMV and DI, several graphs that break down risk factors into 95% CI and predictive value. **Limitations:** single center hospital in middle east, so caution extending to various ethnicities d/t differences in anatomical structures and adipose distribution.
2020	Hasanin, A., Tarek, H., Mostafa, M. M. A., Arafa, A., Safina, A. G.,	Examine if the modified-ramped position would improve	RCT pilot study (Level II)	Operating room in Cairo	60 female patients with BMI≥ 35kg/m^2 &	BMI, DMV, difficult laryngoscopy, vocal cord	Found the modified-ramped position, utilizing the Hasanin Pillow, had less incidence of DMV & difficult laryngoscopy compared to standard ramping position. This resulted in faster vocal cord

	Elsherbiny, M. H., Hosny, O., Gado, A. A., Almenesey, T., Hamden, G. A., Mahmoud, M., & Amin, S. (2020). Modified-ramped position: A new position for intubation of obese females: A randomized controlled pilot study. *BMC Anesthesiology, 20*(1), 1-151.	intubation time & outcome compared to the standard ramped position in female patients with obesity. No conceptual framework or model noted.		University Hospital	>18 years old.	visualization & endotracheal tube insertion time, Cormack-Lehane grade with & without cricoid pressure.	visualization, faster intubation time, and better Cormack-Lehane grade without cricoid pressure in the modified ramped position. The same medication dose per kg and anesthesiologist were used among the two groups, allowing for consistent results. Possibly a more useful and quicker positioning technique than standard ramping with blankets which can take up valuable time prior to intubation. **Limitations:** Utilizing the same anesthesiologist allowed for potential bias since it was not blinded. Smaller patient sample size in a single facility.
2020	Sinha, A., Jayaraman, L., & Punhani, D. (2020). Predictors of difficult airway in the obese are closely related to safe apnea time. *Journal of Anaesthesiology, Clinical Pharmacology*, *36* (1), 25–30.	Determine the best predictive tools when considering DI and safe apnea time in obese patients. No conceptual framework or model noted.	Retro-spective cohort study (Level IV)	Operating room, undergoing laparoscopic bariatric surgery. Hospital/ region not listed.	834 obese individuals with BMI ≥ 35kg/m^2 Average age 41 years old and average BMI ≥ 48kg/m^2	Use of NC, BMI, STOP-Bang, Mallampati, OSA grade, and waist circumference recorded. DI determined using difficult airway score (DASc). Review of patient charts.	Found that NC ≥44.5cm and BMI ≥ 45kg/m^2 were most sensitive and best predictive value for DI, and NC being the best of those two. DI was defined as a DASc ≥ 6 which looks at mask ventilation, DI, personnel required. Found severe OSA had more of an effect on DASc than did mild or moderate OSA. New tool in determining DI still identifies NC as valuable but does state that BMI is predictive despite several other studies that say otherwise. **Limitations:** reports most sensitive measurements when combined w/ other factors, however, when looking through results most of these independent risk factors had statistical significance in predicting DI. Region and patient demographics not disclosed.
2019	Moon, T. S., Fox, P. E., Somasundaram, A., Minhajuddin,	Determine how morbid obesity alone impacts DMV and DI	Retro-spective cohort	Operating room in a large	45,447 cases in morbidly obese (BMI	Morbidly obese defined as BMI ≥ 40kg/m^2 & non-morbidly obese	Found that morbid obesity alone did not predict DI when placed in ramped position, but TMD >6cm, male sex, age over 46, and MMS ≥ 3 were predictive factors for DI. However, the study did find that

	A., Gonzales, M. X., Pak, T. J., & Ogunnaike, B. (2019). The influence of morbid obesity on difficult intubation and difficult mask ventilation. *Journal of Anesthesia*, *33*(1), 96.	when compared to non-morbidly obese patients. No conceptual framework or model noted.	study (Level IV)	teaching hospital- Hospital/ region not listed.	$\geq 40kg/m^2$) patients undergoing general, elective procedures.	considered BMI < $40kg/m^2$. Use of MMS, TMD, dentition, history of OSA, and neck ROM to determine DI or DMV. DI determined using modified IDS and DMV determined using a MVGS. Review of patient charts.	morbidly obese patients were more likely to have difficult mask ventilation, along with those who were older than 46 years of age, of male sex, and MMS ≥ 3. DI and DMV were both thoroughly defined in the study to improve consistency. Very large sample size. **Limitations:** retrospective study limited results to what was in the chart. DI defined on modified IDS d/t lack of information for full IDS in medical records. No consistency in intubation technique, providers of different experience levels including medical residents. Patient demographics not disclosed.

Appendix D

Project Approval Forms

Name of Project Leader: Lauren Powell
Project Title: Assessing CRNAs' 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 an implementation 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.

This information is important for documentation purposes, as the tool will produce a certification if the project does not constitute research requiring IRB review. The certification can be saved and printed for your records. The certification can also be given to individuals requesting documentation that IRB review of the project is not required (e.g. training programs, journals, conferences, funding sources and others, etc.) so the information provided here should include sufficient detail such that the certification can be matched to the project.

Questions:

Q1: Will the project involve testing an experimental drug, device (including medical software or assays), or biologic (i.e. vaccines, blood products, gene therapy, tissues)?

No

Q2: Has the project received funding (e.g. federal, industry) to be conducted as a human subject research study?

No

Q3: 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)?

No

Q4: 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)?

No.

Q5: Will the results of the project be published, presented or disseminated outside of the institution or program conducting it?

Yes

Q6: Would the project occur regardless of whether individuals conducting it may benefit professionally from it?

Yes

Q7: 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

Q8: 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

Human Subject Research Determination Form

This form should be completed and submitted for review by the service lines impacted by the work prior to project initiation (including, but not limited to, collection or analysis of baseline data). Projects that are "Not Human Subjects Research" are not required to submit an IRB application in ePirate. To help make that determination, you may utilize the Decision Chart provided by the Office for Human Research Protections along with this worksheet. For any project where there is a question as to whether it qualifies as Quality Improvement or Research, or if certification of "Not Human Subjects Research" is needed for publication, please route to the UMCIRB office via email: umcirb@ecu.edu.

Please check the Office of Clinical Research Website or UMCIRB website to make sure that you have the most recent version of this form.

Project Title	Airway Assessment of the Patient with Obesity
Project Leader	Lauren Powell, BSN, RN, SRNA
Project Leader Contact E-mail	POWELLLA22@students.ecu.edu
Department or Unit Affiliation	Anesthesia
Project Advisor (if applicable)[1]	Maura McAuliffe, PhD, CRNA, FAAN

Additional Faculty, Staff, and Trainees Involved (add more rows if needed):

Name	Department or Unit	Role	Check this box if this team member will access PHI or PII for the purposes of this project.
			☐
			☐
			☐
			☐
			☐
			☐
			☐
			☐
			☐
			☐
			☐
			☐
			☐

[1] All student, resident, and fellow projects must have a faculty or unit leader designated as the advisor for the project.

Please answer the following questions to the best of your ability. If the answers to these questions change during the course of the project, please resubmit this form for review:

End Goal / Desired Outcome:

The purpose of this quality improvement project is to assess anesthesia providers' perceptions of adequacy of a newly developed quick-reference guide addressing airway assessment in patients with obesity. The quick-reference guide addressing airway assessment in patients with obesity, will be developed based upon the most consistent findings within the literature as there are currently no nationally accepted guidelines on airway assessment in patients with obesity. Anesthesia providers at the Surgicenter will be administered a pre-survey asking about their familiarity with the/their current practice with airway assessment in patients with obesity including perceptions of adequacy and frequency of use for different assessment techniques. Then, a quick-reference guide addressing airway assessment in patients with obesity will be made available to them, and they will be asked to use the guide for two weeks. Upon completion of the two-week utilization period, they will be asked to complete a post-survey about their perceptions of the adequacy of the guide. Qualtrics survey software will be used to gather data. No patient information will be recorded or maintained during this project.

Methodology / Intervention:

The project will consist of a single Plan, Do, Study, Act cycle using a pre- and post-intervention survey design. The intervention for this project will be a newly created informational quick reference guide focused on airway assessment in patients with obesity, which is based on current evidence and falls within current accepted practice standards within the facility. CRNA participants will be contacted via email and asked to complete a pre-survey and then utilize this informational quick reference guide regarding airway assessment in patients with obesity. After two weeks they will then be asked to complete a post-survey addressing their perceptions of adequacy of this newly developed quick-reference guide addressing airway assessment in patients with obesity. The project lead will be available electronically, by phone, or in person to consult with participants as needed.

Data to be collected:

[Data will be gathered directly from participants through completion of Qualtrics pre- and post-surveys delivered and completed electronically. Aside from participant emails, no identifiable data will be gathered. Data of interest is participant opinions and perceptions of practice and the newly developed informational tool.
All data will be gathered using Qualtrics survey software then transferred to Excel for analysis. The only identifying information will be email addresses. Qualtrics survey software is accessed through ECU and involves multifactorial password protection. Data in Excel will be on a password protected spreadsheet and laptop. Email addresses will be deleted from Excel files after both surveys are completed and analysis of results begins. No PHI will be collected for this project. Data will be stored in Qualtrics and in Excel files (de-identified) until student graduation, anticipated to be spring of 2025. The deidentified data will be analyzed with results shared via a poster presentation to the ECU Nurse Anesthesia Program students and faculty, with participants invited to view the presentation remotely. If requested, a presentation of results to the participating department will be provided. Additionally, analysis of results will be addressed in a DNP Project Paper, completion of which is required for program graduation. This paper will be posted in the ECU digital repository, The Scholarship.

Complete the following questions to guide leadership's determination of this project's status:

	True	False
The PRIMARY purpose of the proposed activity or project is limited to: - implementing a standard practice to improve the quality of patient care and to collect data regarding that implementation for clinical, practical, or administrative purposes, and/or - delivering healthcare and measuring and reporting provider performance data for clinical, practical, or administrative uses.	X	☐
The activity or project would be carried out even if there was no possibility of publication in a journal or presentation at an academic meeting.	X	☐
The activity or project falls under well-accepted care practices/guidelines and are designed to bring about immediate improvements in health delivery or quality of care. If "true" and the project is related to clinical activity, please provide a citation below as evidence that project activities fall within standards of care. Projects not directly related to clinical activity, such as medical education, do not need to provide a citation. Narra, L. R., Udongwo, N., Dominic, J. L., Doreswamy, S., Bhasir, A., Elkherpitawy, I., Ogedegbe, C. (2022, May 31). Obesity and the other independent predictors in elective endotracheal tube intubations: A narrative review. *Journal of Clinical Medicine Research 14*(5), 177-187. https://doi.org/10.14740/jocmr4727	X	☐
The activity or project involves "no more than minimal risk" procedures. (i.e., 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).	X	☐

Please submit this form to your supervisor (or designee) for review and approval. Signature on this form certifies that that the below individual is in support of this project taking place and agrees with the project leader's answers to the above questions:

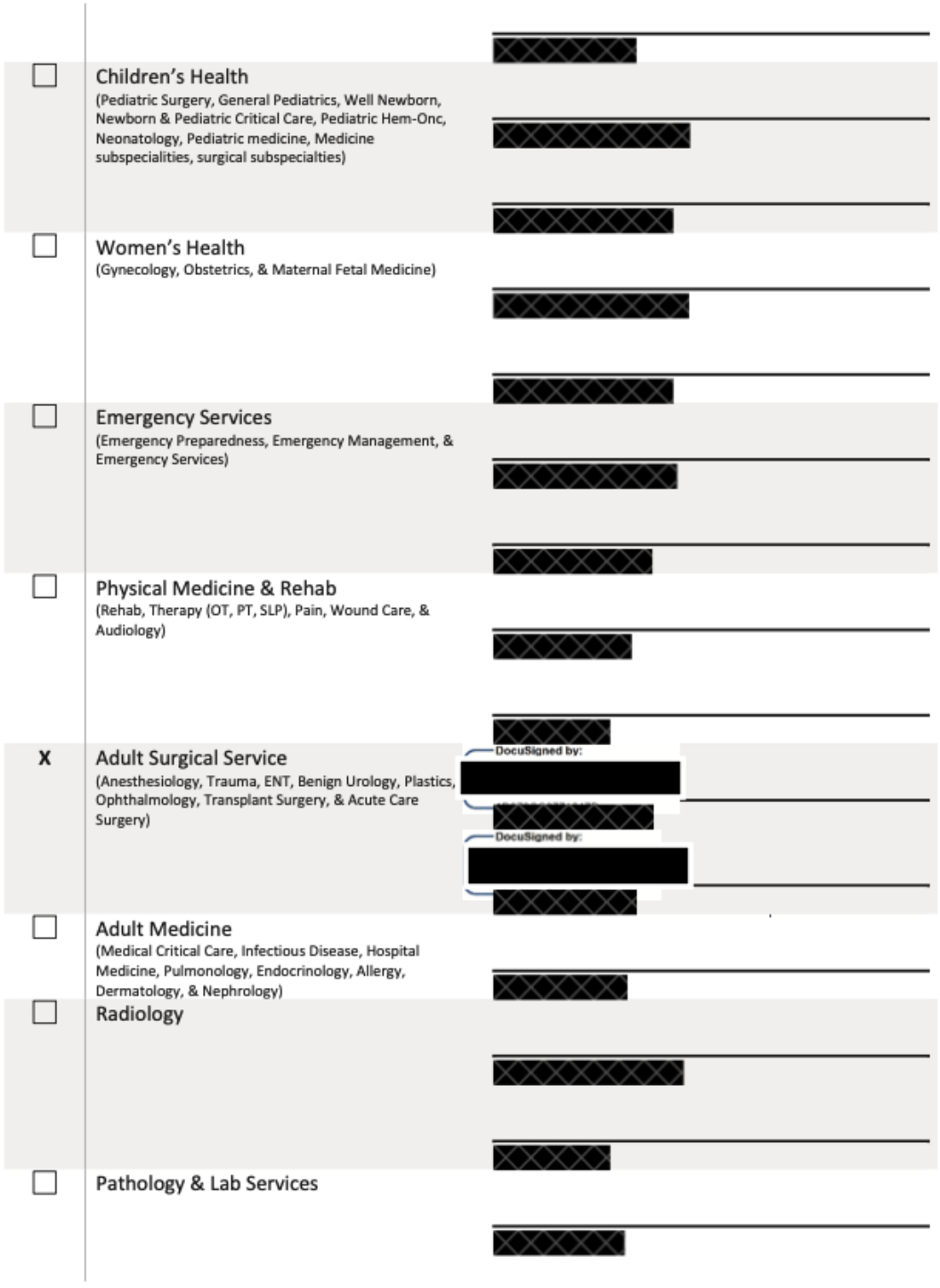
Supervisor's Name	[redacted]
Signature	DocuSigned by: [redacted] 5AB2E7BD53674F0...

Date	3/4/2024 | 10:26 AM EST

For Project Leaders: From the list below, please check the boxes for each service line where interventions may take place or where data may be collected. For each selected area, please route for signature for both the physician leader and administrator (preferably via DocuSign). Send a completed copy of the form to qualityimprovement@ecu.edu.

For Service Line Leaders: Signature on this form certifies that you are in support of this project taking place and agree with the answers to the above questions. If you are not in support of the proposed project, please discuss with the project leader, supervisor, and UMCIRB as needed.

	SERVICE LINE	SIGNATORY
☐	Heart & Vascular (Interventional Cardiology, Electrophysiology, Cardiac Surgery, Advanced Heart Failure, Cardiac Critical Care, Vascular Surgery, Cardio pulmonary rehab, Structural heart, & Thoracic Surgery)	[redacted]
☐	Cancer (Breast cancer, Lung cancer, Gynecologic cancer, hematology, GI cancer, Urologic cancer, and Head & Neck cancer)	[redacted]
☐	Neuro Sciences (Neurology, Neurosurgery, Neuro Degenerative Disease, Neuro Critical Care, Stroke, Neuro Radiology, & Spine)	[redacted]
☐	Orthopedics (Joints, Orthopedic Surgery, Rheumatology, Sports medicine, Orthopedic medicine, & Orthopedic Trauma)	[redacted]
☐	Behavioral Health (Child / Adolescent Psychiatry, Behavioral medicine, & Adult Psychiatry)	[redacted]
☐	Primary Care (Family medicine, Med-Peds, General Internal Medicine, Palliative Care, Geriatrics, & Sleep Medicine)	[redacted]



☐	**Children's Health** (Pediatric Surgery, General Pediatrics, Well Newborn, Newborn & Pediatric Critical Care, Pediatric Hem-Onc, Neonatology, Pediatric medicine, Medicine subspecialities, surgical subspecialties)	[redacted]
☐	**Women's Health** (Gynecology, Obstetrics, & Maternal Fetal Medicine)	[redacted]
☐	**Emergency Services** (Emergency Preparedness, Emergency Management, & Emergency Services)	[redacted]
☐	**Physical Medicine & Rehab** (Rehab, Therapy (OT, PT, SLP), Pain, Wound Care, & Audiology)	[redacted]
X	**Adult Surgical Service** (Anesthesiology, Trauma, ENT, Benign Urology, Plastics, Ophthalmology, Transplant Surgery, & Acute Care Surgery)	DocuSigned by: [redacted] DocuSigned by: [redacted]
☐	**Adult Medicine** (Medical Critical Care, Infectious Disease, Hospital Medicine, Pulmonology, Endocrinology, Allergy, Dermatology, & Nephrology)	[redacted]
☐	**Radiology**	[redacted]
☐	**Pathology & Lab Services**	[redacted]

[redacted]

Optional Determination:
For any project where there is a question as to whether it qualifies as Quality Improvement or Research, or if certification of "Not Human Subjects Research" is needed for publication, please route to the UMCIRB office via email: umcirb@ecu.edu.

☒ **Not Human Subjects Research:** The UMCIRB office has determined that based on the description of the project, approval by the IRB is not necessary. Any changes or modifications to this project may be discussed with the UMCIRB office at that time to ensure those changes do not elevate the project to human research that would need IRB approval.

☐ **Human Subjects Research:** This project requires review by the IRB prior to initiation. An application in the electronic IRB submission system should be submitted.

UMCIRB Office Staff Signature: [redacted] **Date:** 3/14/2024

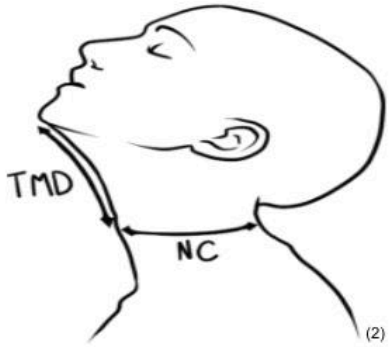
The UMCIRB office will contact you if any further information is needed to make this determination. Please note that if the UMCIRB office determines the activity is not human subjects research, then any presentation, publication, etc. should not refer to the activity as such.

Appendix E

Project Tool: Quick Reference Guide

Front:

Airway Assessment of the Patient with Obesity



(2)

Increased risk for DI if:

NC (>40cm) (5,6)
- Measure at cricothyroid cartilage in sitting position

TMD (<6cm) (5,6)
- Measure from thyroid notch to mentum with head extended and mouth closed

NC:TMD Ratio (>5) (6,7)
- Better reflects distribution of adipose tissue around neck

Mallampati Score

- **Class III or IV correlated with difficult airway** (4,8)
- **Only moderate sensitivity when used alone - many events missed** (8)
- **Many different possible combinations:**
  - **Mallampati score III or IV with an increased NC predictive for DI** (3)
  - **Enhances 3-3-2 Rule sensitivity** (9)

The Mallampati Score

(10)

3-3-2 Rule (9)

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**

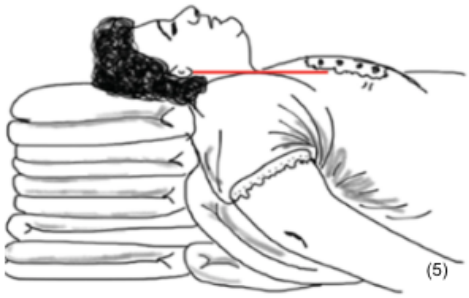
Enhanced results with Mallampati Score

(1)

Back:

Difficult Mask Predictors (4,5)

Age>50, BMI>30, beard, lack of teeth, history of snoring, Mallampati III or IV, male



(5)

Ramping (5)

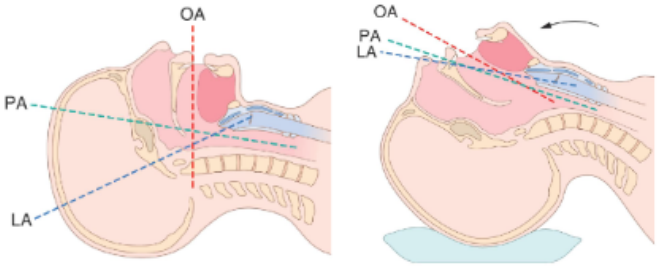
Ear level with sternal notch

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

Screening tool for OSA: STOP-Bang (11)

S	Does the patient **snore** loudly (louder than talking or loud enough to be heard through closed doors)?	Y/N
T	Does the patient often feel **tired**, fatigued, or sleepy during the day?	Y/N
O	Has anyone **observed** the patient stop breathing during their sleep?	Y/N
P	Does the patient have, or is the patient being treated for, high blood **pressure**?	Y/N
B	Does the patient have a **BMI** of more than 35?	Y/N
a	**Age.** Is the patient older than 50?	Y/N
n	Is the patient's **neck** circumference greater than 40cm?	Y/N
g	**Gender.** Is the patient male?	Y/N

Scoring: **Y ≥ 3 = high risk** of OSA
Y < 3 = low risk of OSA



Oral Axis (OA); Pharyngeal axis (PA); Laryngeal Axis (LA) (5)

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Appendix F

Pre- and Post-Implementation 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%
    - > 0% but δ 25%
    - > 25% but δ 50%
    - > 50% but δ 75%
    - > 75% but < 100%
    - 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%
    - > 0% but δ 25%
    - > 25% but δ 50%
    - > 50% but δ 75%
    - > 75% but < 100%
    - 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

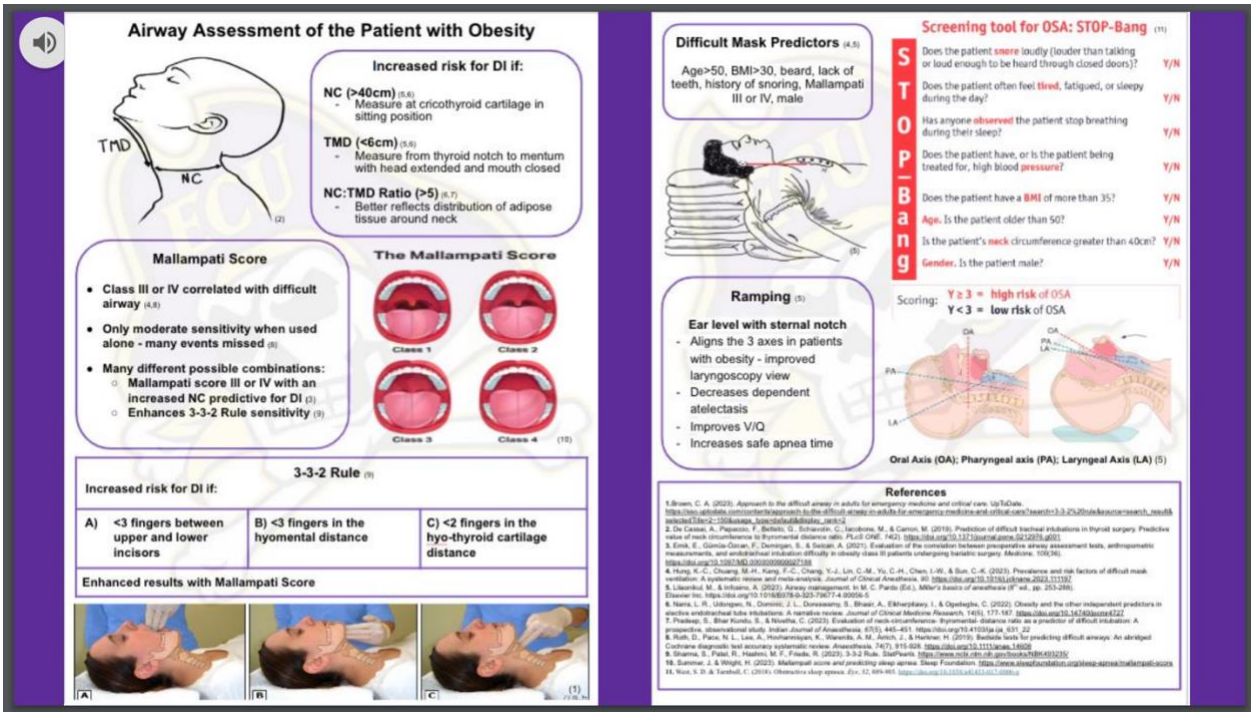
7. How often did you use "ramping" for patients with obesity to optimize intubation conditions?
    - Never
    - Some of the time
    - Most of the time
    - Always
8. Did you find the quick reference guide useful?
    - Not at all useful
    - Somewhat useful
    - Mostly useful
    - Very useful
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 G

Educational PowerPoint Video



Obesity

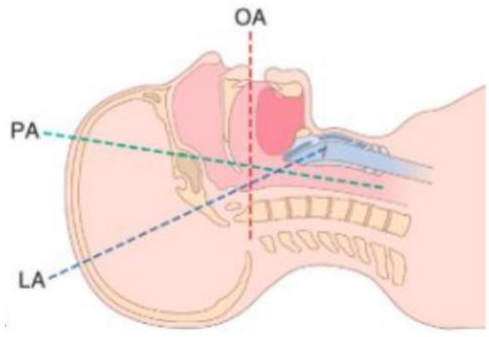
BMI	Weight classification
Below 18.5	Underweight
18.5 – 24.9	Normal
25.0 – 29.9	Overweight
30.0 or higher	Obese

Cleveland Clinic

(Cleveland Clinic, 2022)

- Physiological changes
  - Narrower airways from fat tissue deposits (Mehta et al., 2022; Moura et al., 2021)
  - Decreased lung volumes but increased oxygen consumption
- Related to difficult airway
  - Risk for difficult airway up to 14% (Mehta et al., 2022)
  - Risk increased linearly up to BMI of 30 but then no further increase (Saasouh et al., 2018)
- Body Mass Index (BMI) not the best predictor of difficult airway
  - Systematic review - researchers found BMI alone could not predict difficult airway (Hung et al., 2023)
- Variable patient physiology even within the same BMI groupings (Mehta et al., 2022; Thota et al., 2022)

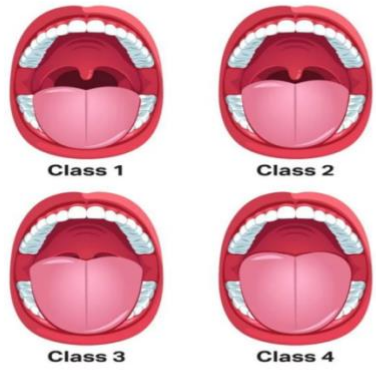
NC, TMD, & NC:TMD Ratio



(Lilaonikul & Infosino, 2023)

- Neck Circumference **(NC) > 40 cm** is correlated with difficult intubation (DI; Lilaonikul & Infosino, 2023).
- Thyromental Distance **(TMD) < 6 cm** is associated with a poor view during direct laryngoscopy.
- **NC: TMD Ratio > 5** is a better predictor for DI than NC or TMD alone (Narra et al., 2022; Pradeep et al., 2023).

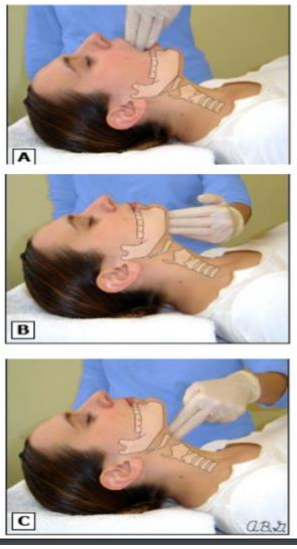
Mallampati Score



(Summer & Wright, 2023)

- Mallampati Class III or IV related to difficult airway (Hung et al., 2023)
- Independent predictive sensitivity may be the greatest of any single assessment, but sensitivity still only moderate (Roth et al., 2019)
- Multiple studies recommend using in combination, but combinations are variable and lacking in data

3:3:2 Method



Increased Risk for DI if:

<3 fingers between upper and lower incisors

OR

<3 fingers in the hyomental distance

OR

<2 fingers in the hyo-thyroid cartilage distance

Increased predictive value when combined with Mallampati Scoring ≥3

(Sharma et al., 2023)

Screening tool for OSA: STOP-Bang

S	Does the patient **snore** loudly (louder than talking or loud enough to be heard through closed doors)?	Y/N
T	Does the patient often feel **tired**, fatigued, or sleepy during the day?	Y/N
O	Has anyone **observed** the patient stop breathing during their sleep?	Y/N
P	Does the patient have, or is the patient being treated for, high blood **pressure**?	Y/N
B	Does the patient have a **BMI** of more than 35?	Y/N
a	**Age.** Is the patient older than 50?	Y/N
n	Is the patient's **neck** circumference greater than 40cm?	Y/N
g	**Gender.** Is the patient male?	Y/N

Scoring: **Y ≥ 3 = high risk** of OSA
Y < 3 = low risk of OSA

Developed by Chung F, Yegneswaran B, Liao P, Chung SA, Vairavanathan S, Islam S, Khajehdehi A, Shapiro C: *STOP Questionnaire A Tool to Screen Patients for Obstructive Sleep Apnea*, 2008.
(West & Turnbull, 2018)

OSA Screening: STOP-Bang Scoring

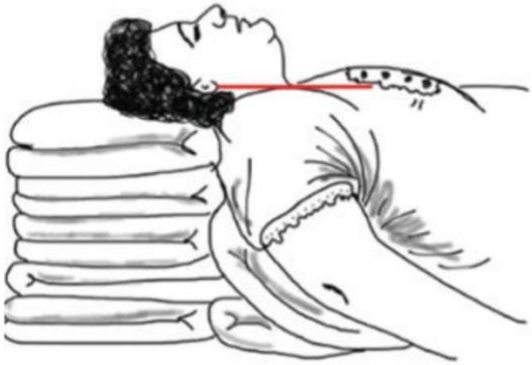
A significant number of patients with OSA go undiagnosed and untreated. (Longnecker et al., 2018).

Patients with OSA are at an increased risk of airway complications.

OSA is formally diagnosed with a sleep study, but STOP-bang has been shown to be a QUICK and reliable screening tool. In fact, it was first developed for use in the perioperative environment

ASA Guidelines support preoperative screening for OSA (American Society of Anesthesiologists, 2014).

Ramping



(Lilaonikul & Infosino, 2023)

External auditory meatus should be level with the sternal notch (Lilaonikul & Infosino, 2023)

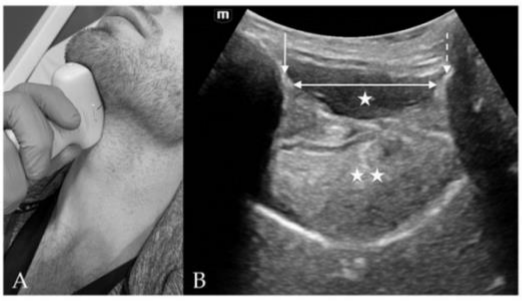
- Aligns the 3 axes in patients with obesity.
- Improves view during direct laryngoscopy.
- Decreases dependent atelectasis
- Improves V/Q
- Increases safe apnea time (Hasanin et al., 2020)

Difficult Mask Predictions

(Drägerwerk, 2024)

- History of snoring (Longnecker et al., 2018)
- BMI greater than 30
- Age older than 50 years
- Severely limited jaw protrusion
- Beard
- Lack of teeth
- Male (Pardo, 2023)

In the Pipeline



Suprahyoid View. **(A)** Suprahyoid probe placement on the subject's neck in sagittal orientation. **(B)** Suprahyoid view of anterior neck with curvilinear probe in sagittal orientation and probe indicator directed cranially. The mentum of the mandible is indicated by the *solid arrow* and the hyoid bone is indicated by the *dashed arrow*. Deep to the hypoechoic mylohyoid and geniohyoid muscles (*single star*) lies the tongue (*double star*). The hyomental distance (HMD) is spanned by the *double-headed arrow*.
(Lin et al. 2023)

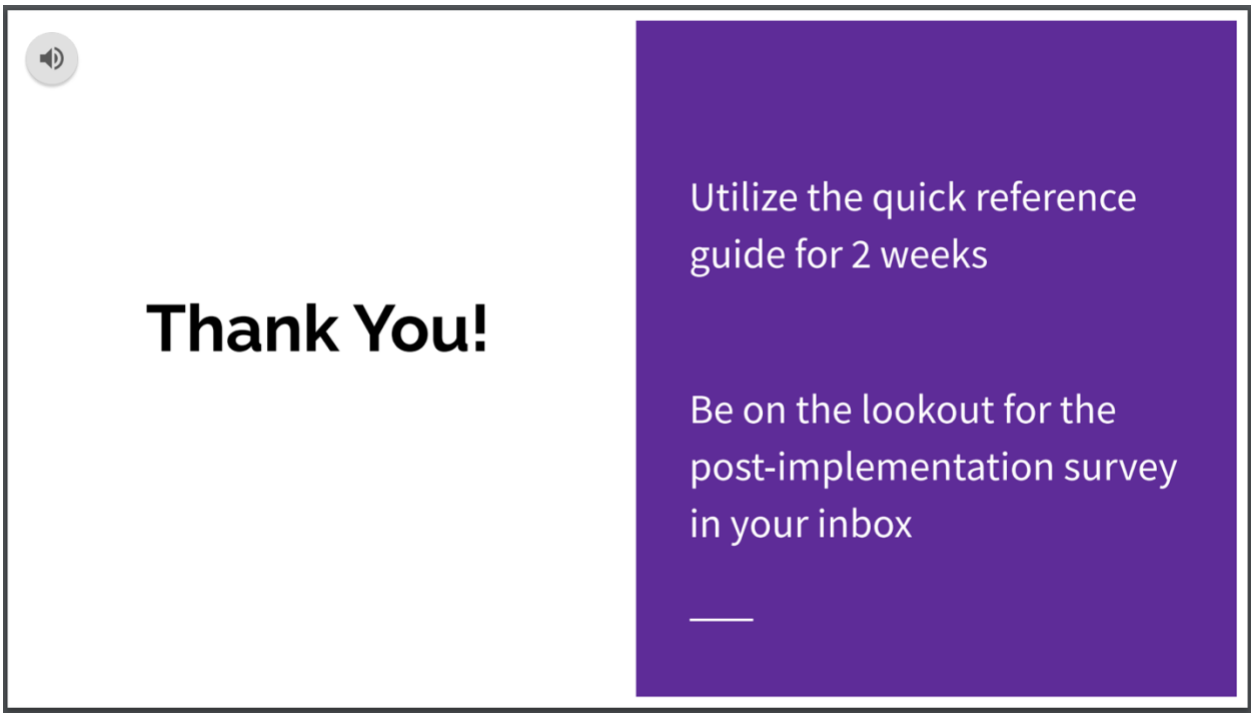
POCUS Airway Assessment

Emerging tool in the assessment of difficult airways (Lin et al. 2023)

Promising preliminary results for increased sensitivity and specificity compared to physical assessments

There are numerous exams which very in their skill level required and accuracy

Image showing measurements of HMD which has been demonstrated as a quick, easily performed, high yielding exam.



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Appendix H

Email to Participants

Initial Pre-Survey and Video Email to Participants (1)

ECU Nurse Anesthesia Program Class of 2025 DNP Project Pre-Survey & Information

Dear [redacted] CRNAs,

Thank you for considering participation in a quality improvement project titled "CRNA Airway Assessment in the Obese Patient." The purpose of this project is to assess CRNAs' perception of adequacy of a newly developed quick reference (QRG) guide as a useful tool for your practice as it pertains to assessment of the airway of patients with obesity at the [redacted]. The project will take place from April 8th to April 18th.

Participation is voluntary and will involve completing a short pre-intervention survey, viewing a brief PowerPoint presentation, utilizing the QRG in your CRNA practice for two weeks (at your discretion), and completing a short post-intervention survey when the two-week implementation period is over.

The brief PowerPoint presentation and survey should take less than 10 minutes to complete. The surveys are completed using Qualtrics® survey software. The use of the QRG 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, complete the pre-intervention survey located here.

Following completion of the survey, please see the attached file at the bottom of this email for the QRG. There will be laminated copies in the anesthesia work room starting April 8th if you would prefer a hard copy. Here is a brief presentation that reviews information found in the QRG located here.

Again, thank you for your participation in this quality improvement project. I will be at the [redacted] from April 8th to April 18th if you have any questions. You may also reach out to Dr. McAuliffe or myself by email at any time.

Sincerely,

Lauren Powell, BSN, RN, SRNA powellla22@students.ecu.edu
ECU Nurse Anesthesia Program
Class of 2025

Dr. Maura McAuliffe, CRNA, PhD, FAAN MCAULIFFEM@ecu.edu
Professor Emeritus and Founding Director
East Carolina University
College of Nursing
Nurse Anesthesia Program

Pre-Survey and Video Reminder Email to Participants (2)

Hello [redacted] CRNAs,

I just wanted to send a quick reminder about the ongoing DNP Project on CRNA Airway Assessment in the Obese Patient (original email below). If you've already filled out the pre-survey and viewed the brief PowerPoint presentation (video), thank you. If you haven't had a chance to do so yet, it's not too late and links to both are provided below. The script to the video is provided in the notes section if you are unable to listen to audio. A hard copy of the quick reference guide can be found in the anesthesia workroom by the white board and can be found below as an attachment. You may use these at your discretion. After April 18th, I will send out Qualtrics post-intervention surveys.

Links:
Pre-survey
Video Link

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

Sincerely,
Lauren Powell, BSN, RN, SRNA
ECU Nurse Anesthesia Program
Class of 2025

Post-Survey Email to Participants (3)

Dear [redacted] CRNAs,

Thank you to everyone who has already completed the pre-survey and viewed the brief PowerPoint presentation. It's now time to complete the brief post-survey.

If you have not filled out a pre-survey, I would truly appreciate your participation as it should not take more than 5 minutes of your time. The link to the pre-survey is here and you can follow it up by watching the introductory Powerpoint presentation here. The quick reference guide for airway assessment in obese patients is located here and in the anesthesia work room if you would like it, but use of the QRG is not mandatory for participation in this project.

If you've already completed the first survey, please complete the post-survey at this link. It should take less than 2 minutes.

If anyone has questions or issues with any of these 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 the [redacted] soon.

Sincerely,

Lauren Powell, BSN, RN, SRNA
ECU Nurse Anesthesia Program
Class of 2025

Final Thank You Email to Participants (4)

Dear [redacted] CRNAs,

I just wanted to say thank you to everyone for helping with my DNP Project. I have collected the data I need to proceed with data analysis and complete my paper. You may read the paper once it is finalized if you would like. If you found the quick reference guide useful, I have attached it to this email.

Thank you again! I look forward to working with you more in the future.

Sincerely,

Lauren Powell, BSN, RN, SRNA
ECU Nurse Anesthesia Program
Class of 2025