Marian University

Leighton School of nursing

Doctor of Nursing Practice

Final Project Report for Students Graduating in May 2024

Education for Student Registered Nurse Anesthetists on Preoperative Ultrasound Guided Assessment of Gastric Content

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Table of Content

Abstract

Background: Since its introduction by Mendelson in 1946, preoperative fasting has been utilized to produce an empty stomach and decrease the risk of aspiration in the surgical patient. Patient adherence to NPO recommendations, certain comorbidities, and/or medications that can decrease gastric motility increases the risk of aspiration. Additionally, anesthesia induction drugs blunt airway reflexes making patients susceptible to reflux and possible aspiration, resulting in adverse outcomes. Identification of patients at increased risk and prevention of aspiration is therefore imperative for the CRNA to achieve successful perioperative outcomes. Ultrasonography, a safe noninvasive tool frequently used by anesthesiologist can be utilized in identification of patients at increased risk of aspiration. It is however currently underutilized.

Purpose: This DNP project aims at teaching SRNAs how to perform an ultrasound gastric assessment as well as develop a check sheet to guide performance of the gastric ultrasound scan (GUS) in order to increase use and patient safety. **Method:** A 30 minute voice over instructional PowerPoint together with a pretest/posttest survey was deployed to all registered Marian University SRNAs with instructions to complete the pretest prior to reviewing the PowerPoint tutorial and the post test afterwards. **Results:** Participant's knowledge based scores significantly increased from the pretest ($M = 50.5$, $SD = 14.4$) to the post test ($M = 93.8$, $SD = 9.3$; $t = -11.1$, $p < .001$, $d = -2.86$). Additionally SRNA confidence in performing a GUS significantly increased from the pretest ($M = 6.6$, $SD = 18.5$) to the post test survey ($M = 57.2$, $SD = 19.6$; $t = -7.99$, $p < .001$, $d = -2.06$). **Conclusion:** Student participation in the DNP project significantly increased their knowledge on the gastric ultrasound assessment procedure and their confidence for performing the procedure.

Keywords: Gastric ultrasound, gastric content, gastric volume

Education for Student Registered Nurse Anesthetists on Preoperative Ultrasound Guided Assessment of Gastric Content

This project is submitted to the faculty of Marian University Leighton School of Nursing as partial fulfillment of degree requirements for the Doctor of Nursing Practice, CRNA track.

Anesthesia induction drugs blunt the airway reflexes and diminish the tone of the lower esophageal sphincter (LES) making patients increasingly susceptible to reflux of abdominal content and possible aspiration into the lungs. Pulmonary aspiration of gastric content is a potentially fatal complication of anesthesia during surgical procedures (Reed & Haas, 2020). Pulmonary aspiration is defined as "the entry of liquid or solid material into the trachea and lungs, anesthesia-related aspiration occurs when patients without sufficient laryngeal protective reflexes passively or actively regurgitate gastric contents" (P.302). Almost half of all patients who aspirate during surgery develop a related lung-injury, such as hypoxia and aspirational pneumonia (Nason, 2015). 10% to 30% of anesthesia related deaths are attributed to aspiration (Reed & Haas, 2020). Per the definition of pulmonary aspiration, increased gastric content resulting in intra procedure emesis can result in pulmonary aspiration, hence should be prevented. Reduction of pulmonary aspiration in surgical patients is a key component of anesthesia practice and the primary goal of preoperative fasting. Fasting guidelines are aimed at producing an empty stomach to reduce the risk of emesis and aspiration. However, adherence to these guidelines is self-reported, which poses some level of uncertainty. Furthermore, specific patient medical and physiological conditions such as diabetes, GERD, hiatal hernia, gastrointestinal obstruction, obesity, sympathetic activation, pain, anxiety and some specific medication therapy can delay the gastric transit time or increase gastric secretions thereby increasing the risk of emesis and/or aspiration under anesthesia even with sufficient fasting. For these reasons, the assessment of risk of intra-operative emesis while under anesthesia is somewhat challenging, necessitating a more objective method of assessment. Gastric ultrasonography is a noninvasive and reliable method that can be utilized to assess the qualitative and quantitative nature of gastric content. This method will provide objective information that will inform the anesthesia practitioner on how best to prevent aspiration in patients found to be at high risk. Currently this proven and reliable method of qualitative and quantitative gastric assessment is underutilized in practice. Practicing anesthesia providers agree ultrasound is a great tool for assessing gastric content, but view it as an additional step in their routine and hence do not utilize it. A new approach is therefore needed to improve the utility of this valuable assessment tool. By teaching student registered nurse anesthetists (SRNAs) the knowledge and skills to perform ultrasound guided gastric assessments, newly graduated CRNAs will go out into various practice settings equipped and ready to use their skills, and advocate for its use.

The aim of this DNP project is to develop a procedure checklist and teach SRNAs the necessary knowledge and skills to perform an ultrasound guided gastric content assessment.

Background

According to Reed & Hass (2020), the incidence of pulmonary aspiration varies in the literature from 0.1% to 19% in the adult population. Although the incidence is low, pulmonary aspiration is a serious complication of anesthesia, accounting for 10% to 30% of anesthesia related deaths (Reed & Haas, 2020). Other aspiration related complications including hypoxia and pneumonitis results in prolonged hospital stays, increased healthcare cost, and a decreased quality of life (Reed & Haas, 2020). Historically, the practice of preoperative fasting originated from Mendelson's 1946 study of 44,016 patients showing a 0.15% incidence of pulmonary aspiration (LaSala et al., 2020). The current ASA practice guidelines (2017) for preoperative fasting recommends fasting periods ranging from 2 to 8 hours depending on types of food consumed, (Reed & Haas, 2020). In an ideal situation the ASA fasting guidelines provides sufficient time for the stomach to be empty, so as to prevent emesis and/or aspiration during surgical procedures under anesthesia. However, medical and physiological conditions as well as certain medications that delay the gastric emptying time or increase gastric secretions may render patients in a state of increased gastric content with an increased risk for aspiration. According to Nason (2015), the severity of lung parenchyma damage is dependent on the degree of acidity, the volume of the aspirate, and the presence or absence of particulate matter in the aspirated fluid. As little as 50 ml of very low PH regurgitated gastric contents or aspirated material containing particulate matter can be considered a ‘severe’ aspiration risk. Feighery et al. (2023) also concluded that retained food, the use of monitored anesthesia care (MAC) and general anesthesia (GA) were associated with significantly increased risk of aspiration in patients undergoing esophagogastroduodenoscopies (EGD).

Anesthesia related aspiration can be fatal, as such; strategies for preventing occurrence are imperatives for the anesthesia provider. A range of preventive measures including proton pump inhibitors, antihistamine, antacid and gastric pro-kinetic medications as well as rapid sequence induction (RSI) can be employed by anesthetists to prevent pulmonary aspiration and decrease sequelae. In order to inform the anesthesia provider what strategies best suits a particular patient, an objective assessment method is needed. Point of care ultrasonography is a technique familiar to anesthesia providers in the area of regional anesthesia. Ultrasound has been shown as a safe, non-invasive and reliable technique for assessment of gastric content (Evain et al., 2022). Routine use of point of care gastric ultrasound in the preprocedure assessment will provide valuable information about the volume and/or quality of gastric content and enable the anesthesia provider to assess the risk of aspiration and better inform the anesthesia provider on the most appropriate aspiration preventive measure. Gastric ultrasound adds objectivity to the subjective, self-reported NPO status and introduces another layer to maintaining patient safety during the perioperative assessment of aspiration risk.

Problem statement

Anesthesia related aspiration can be fatal; as such, strategies for preventing occurrence are imperatives for the anesthesia provider. Even patients who adhere to the preprocedure fasting guidelines may have medical conditions, take medications and/or be in a physiological state that decreases gastric motility or increases gastric secretions. Without a quantitative and qualitative method of determining gastric content, a true assessment of the risk for emesis/aspiration is therefore challenging for the anesthesia provider during the pre-procedure assessment. Gastric ultrasound offers a safe, non-invasive and reliable technique for assessment of gastric content. A barrier to the use of US guided gastric assessment is the knowledge and skill set needed to perform a proper assessment. This leads to my PICOT... does providing SRNAs with a procedure checklist and teaching needed skills improve student knowledge and confidence to perform an US guided gastric content assessment?

Gap Analysis/Needs Assessment

Anesthesia providers including SRNAs are keenly aware of the potential danger of an aspiration event during anesthesia. Pre-procedure fasting is the current standard method used to allow time for the stomach to empty before a surgical procedure. However patient comorbidities, physiology and medications can slow gastric motility resulting in residual food, or increase secretions, both of which increase the risk of aspiration even in seemingly healthy people. Despite patients reportedly adhering to overnight pre-procedural fasting guidelines, gastric residual food was identified in more than 3% of all patients attending for EGD (Feighery et al., 2022). CRNA education curriculum includes the ASA NPO guidelines, which patients must adhere to decrease the risk for aspiration. However, compliance is self-reported. Based on information provided by the patient of their adherence to NPO, medical diagnoses, and medications taken, anesthesia providers must predict a patient’s risk for an aspirational event. An objective method for assessing risk of aspiration eliminates these challenges to the anesthesia provider, improving the determination of risk, as well as patient safety overall. According to Tankul et al. (2022), various studies have shown gastric sonography to be highly satisfactory as a reliable source of valuable information of the quality and quantity of gastric content when used by experienced providers, and is also relatively easy to learn.

Currently a full tutorial dedicated to use of ultrasound to assess gastric content is not included in the curriculum at the project site. Providing students with the knowledge and skills needed to perform the gastric ultrasound assessment will enhance the curriculum at the project site, improve students’ confidence, and enhance patient safety in practice during the perioperative period. Point of care ultrasound is a standard of practice with anesthesia providers in the area of regional anesthesia and is a tool that is frequently used with a high level of proficiency. Hence the use of point of care ultrasound applied to assessment of gastric content in the context of pre-procedure evaluation of aspirational risk can easily be taught to SRNAs.

Literature Review

A literature review was conducted in December 2023 using the PUBMED and CINAHL databases, for studies involving the use of ultrasonography for assessment of gastric content. The search words *"gastric ultrasound"*, *"assessment of gastric volume"* and *"measurement of gastric volume"* as well as the BOOLEAN phrase "ultrasound" AND "gastric volume" was also used.

Inclusion and Exclusion Criteria

The various combinations of searchers yielded more than 302 results from 2017 to 2023. The article titles and abstracts were screened for inclusion of studies on preoperative ultrasound assessment of gastric content in relation to NPO fasting guidelines. Articles included in this literature review were primary research carried out in the pediatric and adult population that evaluated preprocedure gastric content using ultrasonography. Duplicate search results were removed and studies with indication other than preoperative gastric volume assessment were excluded. Studies related to pregnancy, neonates and infants < 2 years old were also excluded. A total of 19 articles were included in the literature review (Appendix C is a PRISMA chart of search results).

Outcomes measured

The studies in the literature measured the preoperative gastric antral cross sectional area, this was used in calculating the gastric volume. Some studies also reported a qualitative assessment of gastric content that graded the stomach as empty, or having clear fluid, thick fluids or solids. Secondary outcomes such as emesis, gastric PH, patient anxiety and pain were also reported

Summary of the Literature

A total of 57 articles were screened for inclusion, of which 19 were included in the literature review (see Appendix C). A breakdown of the included articles is as follows; three (3) articles representing 15.8% of the articles included in the review assessed the accuracy of using ultrasound to determine gastric volume as compared to gastric suctioning. One (1) article (5.3%) studied using ultrasound to assess the volume of ingested fluid, and another 5.3% (1 article) assessed ultrasound versus NPO patients. Three (3) articles (15.8%) studied ultrasound assessment of volume of an ingested fluid over a time period. Three (3) articles (15.8%) studied ultrasound of NPO status versus ingested fluid volume, 3 articles (15.8%) studied ultrasound assessment of NPO patients with conditions that delay gastric emptying versus NPO patients without delayed gastric conditions, 2 articles (10.5%) used ultrasound to assess gastric volume after different periods of fasting (gastric volume from time of last intake), 2 articles (10.5%) studied ultrasound gastric assessment of NPO patients after a period of chewing gum and 1 article studied gastric volume and PH of gastric content.

Support for Use of Ultrasound for Gastric Assessment

All the studies reviewed utilized ultrasound as a comparative measure for assessing gastric content and/or volume. In fact all the articles reviewed supported the use of ultrasound and concluded that ultrasound is either equally accurate, or a superior tool for assessment of gastric content or volume as compared to NPO or gastric suctioning. This was indicated by Kruisselbrink et al. (2017). They studied the accuracy of ultrasound at determining gastric volume by calculating the gastric volume by ultrasound and comparing it to the volume suctioned out. They determined that there was a strong correlation between ultrasound measured gastric volume and the volume of gastric content aspirated via a gastric tube.

Van de Putte et al. (2017) also concluded that a larger antral CSA is consistent with higher qualitative grades and therefore an increased risk for aspiration. Their study further indicated that the use of ultrasound was capable of consistently discriminating between different gastric volumes at various time intervals following ingestion of fluids. Tankul et al. (2022) also identified that the diagnostic accuracy of qualitative gastric ultrasound assessment was as high as 96% when performed by trained anesthesiologists.

For patents with comorbidities that affect gastric motility, Ultrasound continues to be a tool that can be used to assess or discriminate differences in gastric volume. Sabry et al. (2019) determined that patients with diabetes showed higher median antral CSA and aspirated gastric volume versus control (nondiabetics) and concluded that there was a good correlation between ultrasound calculated gastric volume and volume aspirated via a gastric tube. According to Bouvet et al. (2020), gastric suctioning did not provide a more accurate estimate of residual gastric volume as compared with ultrasound calculated volume.

Joshi & Dhamija, (2021) used Gastric ultrasound to quantify gastric volume comparing patients who had fasted overnight to patients who ingested 200ml of clear apple juice 2 hours prior to their assessment. Gastric PH assessed in both groups were not significantly different. Gastric volume in the overnight fasting group was 29.7 ± 8.0 ml. In the group that ingested 200 ml of clear fluid 2 hours prior to their assessment, the gastric volume was 19.2 ± 4.9 ml. The statistically significant reduction in gastric volume after ingesting 200ml of fluid, strongly supported fasting guidelines which help in reducing the preoperative discomfort of long fasting time and dehydration of patients without significantly impacting gastric PH.

Patient safety

In the last decade the guidelines for preoperative fasting has seen some changes with a push to liberalize preoperative fasting to enhance patient recovery, with ERUS protocols recommend, ingestion of carbohydrate containing drinks two hours prior to surgery. Shin et al. (2022) utilized gastric ultrasound to evaluate the safety of drinking carbohydrate containing fluids two hours prior to surgery in older adults. Their study determined that gastric volume was not significantly different between the fasting group (NPO) and the carbohydrate ingestion group (30.2 mL *vs* 28.4 ml). Mean difference was −1.9 mL (95% confidence interval, −17.9 to 14.2) and concluded that drinking carbohydrate containing fluid two hours prior to surgery is safe.

Sanders et al. (2023), conducted a prospective observational study in healthy pediatric patients using gastric ultrasound to quantify the time taken to achieve a gastric volume < 1.5 $mL \cdot kg^{-1}$ (the upper limit of normal gastric volume in a fasted patient) after ingesting clear fluid. In this study, participants consumed 250 mL of a clear fluid followed by gastric US at four time intervals: 30, 60, 90, and 120 minutes to calculate gastric volume using the validated equation. They concluded that the total gastric fluid volume was < 1.5 $mL \cdot kg^{-1}$ after 60 min, suggesting that the fasting guidelines for the healthy pediatric population was safe and furthermore can be liberalized.

Overall the review of the literature strongly supports ultrasound assessment as an accurate method of measuring gastric content in both the adult and pediatric population as well as healthy patients and patients with comorbidities the decrease gastric motility. The literature shows that GUS is able to discriminate between changes in gastric volume over time as well as between patients who have fasted and those who have ingested fluids. The literature also shows that gastric ultrasound has been used to evaluate the safety of recent changes in preprocedure fasting guidelines and furthermore provides both a quantitative and qualitative noninvasive method of assessing gastric content and volume. As supported by the evidence in literature, the accuracy of gastric sonography eliminates any guess work in identifying patients with increased risk of aspiration that anesthesia providers may encounter by having a validated quantitative method of assessment, thus improving patient safety. The evidence behind the use of gastric ultrasound in anesthesia practice strongly suggests that acquiring the knowledge and the skills to perform the gastric ultrasound procedure would be highly beneficial to SRNAs.

Conceptual framework

The conceptual framework that will be used to serve as a guide in the development of this project will be the Knowledge-to-Action (KTA) model. This model was developed by the University of Ottawa as a way to merge the creation of knowledge and its application (White, 2016). The KTA uses a *funnel* to visually represent the movement of knowledge into higher stages until it is ready to be fully adopted (White, 2016). The KTA model is a planned action theory that is used to plan activities and facilitate change (White, 2016). This project will use the KTA model to compile and condense the existing knowledge on the use of ultrasonography, gastric anatomy and evidence based procedures in the education of SRNAs.

The KTA model consists of seven phases that facilitate translation of knowledge to actionable practice (White, 2016). The first phase involves the identification of a problem that needs to be addressed and relevant research. The problem that was identified for this project is that there is a knowledge deficit amongst SRNAs for US guided gastric content assessment. The second phase of the KTA model involves adapting existing knowledge for use in practice. The use of point of care ultrasound which is often used in regional anesthesia as well as in other medical specialties will be adapted for use in assessing gastric content and risk of aspiration. In step three of the model, developers address barriers to knowledge use. In this case, SRNAs have to learn to apply ultrasound for assessment of gastric content. In step four the assessment method and tools are tailored to simplify its application by SRNAs by providing an easy to follow checklist for performing the procedure as well as an instructional PowerPoint/video. Levels five through seven of the KTA model monitor use, evaluate outcomes of knowledge use, and sustained use of knowledge. Evaluation of use and outcomes will be addressed through a survey of the effect of the education on SRNA knowledge. By providing SRNAs with the knowledge and skills to perform an UG gastric assessment, student will incorporate this skill into their practice in the clinical setting as well as pass on their knowledge to others.

The benefit to using the KTA model is that the seven phases are interconnected (White, 2016). Because of this, the knowledge creation and action cycles can continue to develop to meet the goals of the researchers and their target population.

Goals and Objectives

The purpose of this DNP project is to improve the quality of care of surgical patients during pre-procedure assessment by educating SRNAs on how to perform an Ultrasound guided gastric content assessment.

Project Aims: To develop a procedure checklist and teach SRNAs the skills needed to successfully perform an US guided gastric assessment.

The objectives of the DNP project include the following:

1. Develop a checklist for US guided gastric content assessment.
2. Develop a PowerPoint/video teaching material on how to perform a US gastric assessment
3. Develop pre and post teaching survey
4. Deploy teaching material and survey to SRNAs
5. Analyze survey results

SWOT Analysis

A SWOT analysis was conducted to identify strength, weakness, opportunity and threats to this DNP project. The analysis is as follows:

Strengths: Ultrasound has been used in anesthesia and other medical specialties to provide reliable objective patient data. It is a tool that anesthesia providers including SRNAs are familiar with and use often. It is a skill that is also easy to learn and master by the novice practitioner Tankul et al. (2022). Teaching SRNA's the procedure for gastric assessment will improve identification of patients at risk of aspiration during pre-procedure assessment, enhancing patient safety under anesthesia care, decrease hospital length of stay and cost related to aspirational pneumonitis.

Weaknesses: Learning a new skill can always be challenging especially for novice practitioners such as SRNAs. There is also less opportunity for students to practice and maintain the skill as it is not an institutional requirement which could make the skill redundant. Additionally, while it is hoped that this new skill will be utilized in practice and potentially lead to a practice change where preprocedure US gastric assessment becomes a routine, it is not guaranteed.

Opportunities: This project provides an opportunity to improve current practice and potentially encourage students to pursue additional research studies for use of gastric ultrasound assessment.

Threats: Since this project is not conducted in conjunction with an institutional curriculum, there is less incentive to learn the skill, thus, students may pushback, student participation may be low or the project may be rejected altogether.

Project Design and Methods

The project is designed as an independent study education for student registered nurse anesthetists on US guided gastric content assessment. It involves the use of different instructional modalities to meet different learning needs of student including but not limited to PowerPoint presentation, video, audio, pictorial images, schematics and a procedural checklist. A pretest and posttest survey with multiple choice knowledge check and likert scale questions was used to assess participant knowledge and confidence for performing the US guided gastric content assessment before and after the education and to determine if there is a significant difference between students pretest and posttest score.

Methods

The project was deployed by the Marian University DNP nurse anesthesia department administrator to all registered SRNAs as an independent study 30 minute voice over instructional PowerPoint and pretest/posttest surveys. Participants were instructed to take the pretest prior to reviewing the PowerPoint and the posttest afterwards. The pretest and posttest questionnaire surveyed 3 areas, 14 questions assessed students' knowledge on anatomy and procedures involved in performing a GUS, 1 question assessed students confidence level for performing a GUS and 1 question assessed whether students have ever performed a GUS, this question was only asked in the pretest survey and not repeated in posttest for relevance. Students were also asked to provide the last 4 digits of their student ID number only for the purpose of linking pre and post test surveys (Appendix E). The survey results data collected was analyzed for statistical differences in the pretest/posttest scores to determine if there has been a change in student's knowledge and confidence for performing the US guided gastric content assessment.

Project Population and Site

The project was conducted at Marian University, a tertiary Midwestern institution of higher education with over 100 SRNAs at different levels of their training. The project was deployed to all registered SRNAs in nurse anesthesia department of the institution by the departmental administrator to maintain anonymity. Participation by SRNAs was voluntary.

Statistical Tests

The study utilize a paired sample T-test to analyze the Pre and Post educational survey within the same cohort to determine a difference in the participant's knowledge score as well as their confidence score for performing the US guided gastric content assessment.

Ethical Considerations and Data Collection

The DNP project is designed as an education for SRNAs including a pretest and posttest survey. The survey was conducted through Qualtrics, the Marian University recommended survey engine. No identifiable or demographic information was collected for this project. For the purposes of linking participant pretest and posttest surveys', the last 4 digits of the participant's student ID number were requested. These are not expected to pose any significant harm to participants requiring ethical consideration. To maintain credibility of survey results, an assessment of the appropriateness of collected data will be conducted. An audit trail will also be used to ensure dependability and confirmability of the survey results (Meadows-Oliver, 2019). Data points that contradict the majority will be analyzed to help eliminate any bias to make sure that the survey findings reflect the data collected and statistical analysis and not the researchers' viewpoint (Meadows-Oliver, 2019).

Results and Data Analysis

After deployment of the DNP PowerPoint presentation and surveys, a period of 4 weeks was used to collect data during which reminders were sent to SRNAs for completion. A total of 17 responses were obtained. 2 of the respondents did not provide the last 4 digits of their students ID and was excluded from the final results. As is customary for SRNA exam scoring, the 14 knowledge based questions on the survey were scored as all or nothing, with no partial credit for multiple selection questions. For each respondent, their score on the knowledge based questions was reported as a percentage. The question on students' confidence for performing GUS was coded and scored as follows: Not at all confident = **0**; Somewhat not confident = **33**; Somewhat confident = **66**; Very confident = **100**. The question on whether students have ever performed a GUS was a yes/no type question which was reported as a percentage of participants.

Q: Have you ever performed an ultrasound assessment of gastric content

All participants (100%) reported that they have never performed a GUS assessment

Q: How confident are you that you can perform an ultrasound assessment of gastric content

In the pretest survey 86.7% of respondents (13) indicated they were not at all confident in performing a GUS assessment. 1 of respondents (6.7%), indicated they were "somewhat not confident" and another 6.7% indicated they were "somewhat confident". In the posttest 1 participant (6.7%) indicated they were not at all confident (no change from pretest). 2 participants (13.3%) indicated they were somewhat not confident, both a change from not at all confident in the pretest survey. 12 participants (80%) indicated they were somewhat confident, of which 1(6.7%) had not changed from the pretest response and 1(6.7%) had changed from somewhat not confident. 10 of these responses (66.7%) were a change from not at all confident in the pretest survey.

The paired T test showed that the participants' perceived level of confidence in performing a GUS had significantly increased from the pretest ($M = 6.6$, $SD = 18.5$) to the post test survey ($M = 57.2$, $SD = 19.6$; $t = -7.99$, $p < .001$, $d = -2.06$).

Q: Students' knowledge based score

The students pretest knowledge based scores ranged from a low of 21.43% to a high of 71.43% with a mean class score of 50.5%. Post test scores ranged for a low of 71.4% to a high of 100% and a mean class score of 93.8%. All 15 (100%) respondents scored below 83% (B grade) in the pretest. In the post test survey 2 participants (13.3%) scored below 83% while 13 participants (86.7%) scored above 83%.

A paired T test showed that the participant's knowledge based score had significantly increased from the pretest ($M = 50.5$, $SD = 14.4$) to the post test score ($M = 93.8$, $SD = 9.3$; $t = -11.1$, $p < .001$, $d = -2.86$).

Discussion

Participants this DNP project were instructed to complete the pretest survey prior to reviewing the GUS PowerPoint presentation to provide a baseline of students' knowledge before being exposed to the tutorial. The pretest results were then compared to the post test survey results to determine if there has been a change in students' knowledge and confidence to perform the GUS assessment.

In the pretest survey, participants' knowledge based scores ranged from a low of 21.43% to a high of 71.43% with a mean class score of 50.5%. This is a low score profile considering that the passing grade for SRNA exams is 83% (B) or above. Participants were also asked in the pretest survey if they had ever performed a GUS assessment. All participants (100%) responded "no" to this question. This indicated that the procedure involved in GUS assessment was a fairly new concept and a reflection of the low pretest knowledge based scores. In the post test survey, the participants scores for the knowledge based questions significantly increased ($t = -11.1$, $p < .001$). In the post test, 2 participants (13.3%) scored below 83% while 13 participants (86.7%) representing the majority of participants scored above 83%.

Student confidence for performing the GUS assessment also significantly increased from the pretest ($M = 6.6$, $SD = 18.5$) to the post test ($M = 57.2$, $SD = 19.6$; $t = -7.99$, $p < .001$, $d = -2.06$). In the pretest survey 86.7% of respondents (13) indicated they were not at all confident in performing a GUS assessment, whereas in the post test, 12 participants (80%) indicated they were somewhat confident in performing the GUS assessment after reviewing the PowerPoint. 1 (6.7%) participant who indicated they were not at all confident in the pretest had no change in their confidents in the post test after reviewing the tutorial. 1 (6.7%) participant who responded in the pretest that they were somewhat not confident changed to somewhat confident in the post test survey and 1 (6.7%) participant who responded that they were somewhat confident in the pretest had no change in the post test.

As indicated by these results, the information provided to SRNAs in the PowerPoint presentation significantly increased both their knowledge on the GUS procedure as well as their confidence to perform the procedure. While these results are an indication that this DNP project was successful at achieving its aims, the sample size of 15 respondents may be no the smaller size to provide a true indication and will have to be tested on a larger sample. This may require a different strategy to increase SRNA participation in the future.

Conclusion

During the SRNAs training program students learn the intricacies of providing anesthesia care to patients. It is a rigorous period of intense learning when students acquire knowledge on many concepts and hands on skills that are indispensable to anesthesia providers as well as shapes the students future practice. Patient safety is the paramount responsibility of the anesthesia provider and students must learn all and any skills that enhance their ability to maintain the patients’ safety. The ultrasound assessment of gastric content and volume is no exception. It provides a qualitative and quantitative means to assess gastric content and volume and improves the provider’s ability to identify patients at increased risk of aspiration which then allows the anesthesia provider to tailor their anesthetic to prevent aspiration, delay or postpone the case. As indicated by the results of this DNP project providing SRNAs with a tutorial on the procedure increases their knowledge and confidence for performing the GUS assessment.

Incorporating such a tutorial in the SRNAs study will better prepare students to perform the GUS assessment and thus increase utility in practice.

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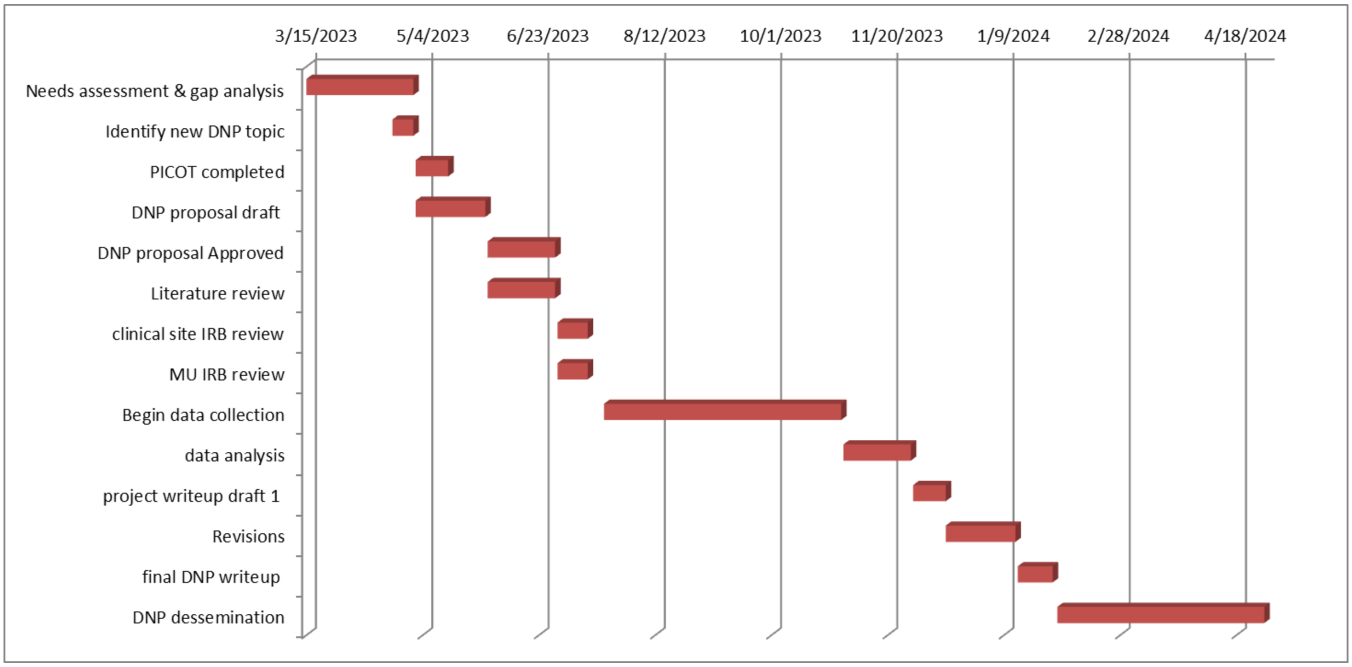
Appendix A

DNP PROJECT GANTT CHART



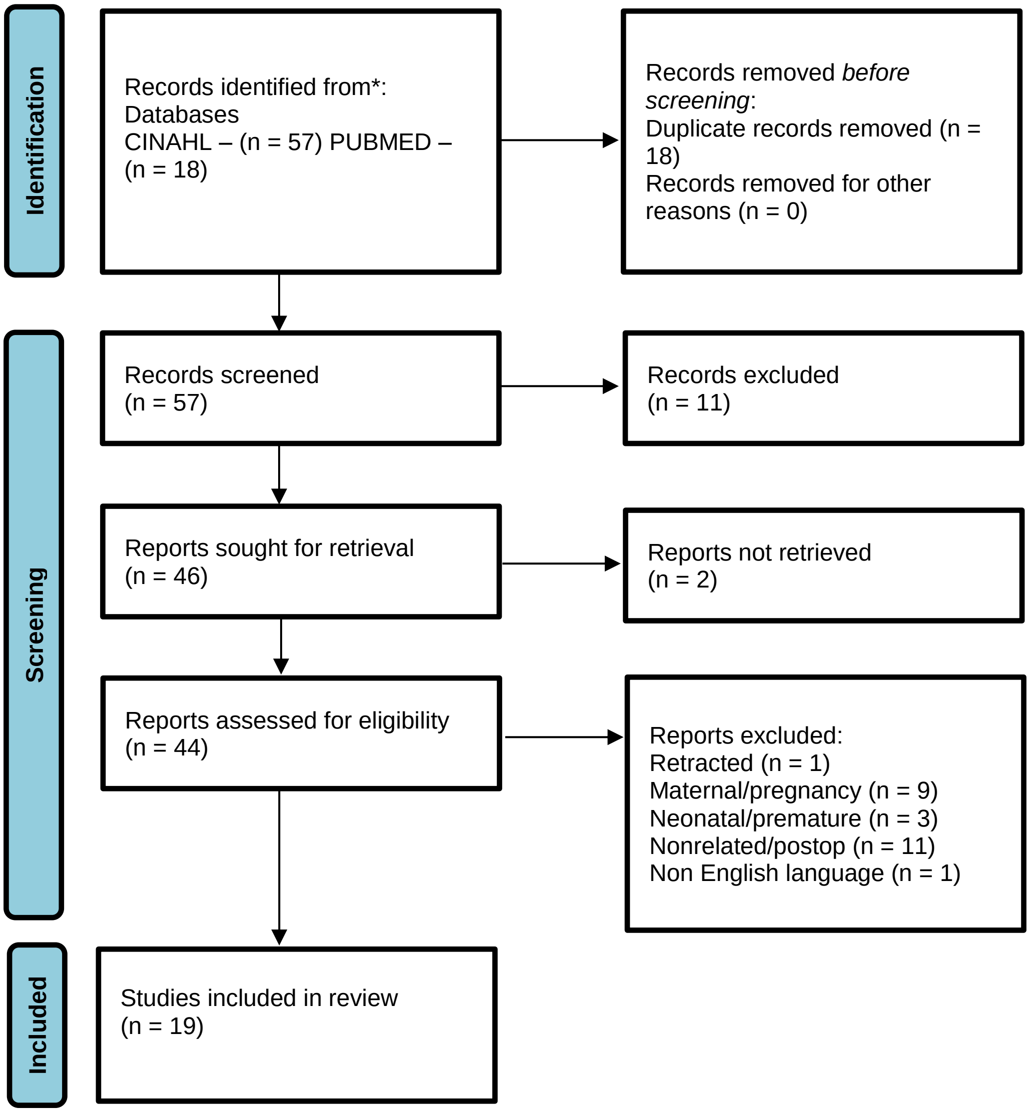
Appendix B

SWOT Chart

Strengths	• Use of ultrasound is familiar to anesthesia providers including students. • It is an easy skill to learn and master even for novice practitioners • Potential to improve patient safety, hospital length of stay and cost if utilized.
Weaknesses	• Challenge for students learning a new skill • Possibility for skill to become redundant without it being an institutional requirement.
Opportunities	• Improvement of current practices • More research studies to strengthen need for use of gastric ultrasound assessment.
Threats	• Pushback by students to learn a new skill that is not part of the institutional curriculum.

Appendix C

PRISMA flow chart of literature search results



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

Appendix D

Synthesis Matrix

Citation	**Research Design & Level of Evidence**	**Theoretical / Conceptual Framework**	**Purpose / Aim**	**Population / Sample size n=x**	**Major Variables**	**Instruments / Data collection**	**Results**
Kruisselbrink, R., Arzola, C., Jackson, T., Okrainec, A., Chan, V., & Perlas, A. (2017). Ultrasound assessment of gastric volume in severely obese individuals: a validation study. *BJA: The British Journal of Anaesthesia*, *118*(1), 77–82. https://doi.org/10.1093/bja/aew400	Randomized blinded experimental study Level 2	N/A	Evaluate performance of model in predicting gastric volume in severely obese subjects (BMI > 35)	N = 38	BMI, Antral CSA of pre and post gastric volume after predetermined fluid ingestion (0 – 400 ml)	Ultrasound; Antral CSA, qualitative grading; NG suction volume	Strong correlation between predicted sonographic gastric volume and suctioned volume (concordance correlation coefficient of 0.82 and Pearson's correlation coefficient of 0.86) in severely obese people

Tankul, R., Halilamien, P., Tangwiwat, S., Dejarkom, S., & Pangthipampai, P. (2022). Qualitative and quantitative gastric ultrasound assessment in highly skilled regional anesthesiologists. *BMC Anesthesiology*, *22*(1), 1–9. https://doi.org/10.1186/s12871-021-01550-z	Prospective cohort study Level 4	N/A	Asses interrater agreement between anesthesiologist performing US gastric content measurement	N = 47	Empty stomach, 100ml ,200ml, 300ml clear fluid and solid food	Ultrasonography, antral CSA	Overall success rate of all gastric content categories was 96%. Tendency for deviation of results between raters increased with increasing gastric volume
Sabry, R., Hasanin, A., Refaat, S., Abdel Raouf, S., Abdallah, A. S., & Helmy, N. (2019). Evaluation of gastric residual volume in fasting diabetic patients using gastric ultrasound. *Acta Anaesthesiologica Scandinavica*, *63*(5), 615–619. https://doi.org/10.1111/aas.13315	prospective observational study Level 4		Evaluate residual gastric volume in fasting diabetics	N = 50	Antral CSA, calculated gastric volume, aspirated gastric volume	Ultrasonography, aspiration of gastric volume via NG tube	Diabetic group showed higher median antra CSA and aspirated gastric volume versus control. Good correlation between calculated gastric volume and aspirated content
Van de Putte, P., Vernieuwe, L., Jerjir, A., Verschueren, L., Tacken, M., & Perlas, A. (2017). When fasted is not empty: a retrospective cohort study of gastric content in fasted surgical patients†. *BJA: The British Journal of Anaesthesia*, *118*(3), 363–371. https://doi.org/10.1093/bja/aew435	retrospective cohort study Level 2	N/A	Evaluate the incidence of full stomach in a population of fasted patients presenting for elective surgery, using bedside gastric ultrasound.	N = 538	Gastric volume, Antral CSA,	Ultrasonography, antral CSA, full or empty stomach, antral grade	6.2% of elective surgical patients present with a full stomach. Increasing antral grade was correlated with larger antral cross-sectional area and higher gastric volume (P<0.001).

Sander, T., Urmson, K., Langford, L., O'Brien, J., Bajwa, J. S., Walker, M. E., & Leswick, D. (2023). Determining residual gastric volume in healthy children using ultrasound. *Canadian Journal of Anaesthesia / Journal Canadien d'Anesthésie*, *70*(8), 1323–1329. https://doi.org/10.1007/s12630-023-02526-y	prospective observational study Level 4	N/A	Quantify the time to achieve a gastric volume < 1.5 $mL \cdot kg^{-1}$ after clear fluid ingestion in healthy children	N =33	Gastric volume, time elapsed	Ultrasound guided antral CSA at 30, 60, 90 and 120 mins	Mean gastric volume per weight ($mL \cdot kg^{-1}$) at baseline was 0.51 $mL \cdot kg^{-1}$ (95% CI, 0.46 to 0.57). The mean gastric volume was 1.55 $mL \cdot kg^{-1}$ (95% CI, 1.36 to 1.75) at 30 min, 1.17 $mL \cdot kg^{-1}$ (95% CI, 1.01 to 1.33) at 60 min, 0.76 $mL \cdot kg^{-1}$ (95% CI, 0.67 to 0.85) at 90 min, and 0.58 $mL \cdot kg^{-1}$ (95% CI, 0.52 to 0.65) at 120 min. Total gastric volume was < 1.5 $mL \cdot kg^{-1}$ after 60 min
Shin, H. J., Koo, B. W., Lim, D., & Na, H.-S. (2022). Ultrasound assessment of gastric volume in older adults after drinking carbohydrate-containing fluids: a prospective, nonrandomized, and noninferiority comparative study. *Canadian Journal of Anaesthesia / Journal Canadien d'Anesthésie*, *69*(9), 1160–1166. https://doi.org/10.1007/s12630-022-02262-9	Nonrandomized and non-inferiority comparative study Level 4	N/A	Evaluate the safety of drinking carbohydrate-containing fluids two hours prior to surgery in older adults using ultrasonography.	N = 60	Gastric content and volume	Ultrasound guided gastric antral CSA, Gastric volume	Mean (standard deviation) gastric volume was not significantly different between the fasting group and the carbohydrate ingestion group (30.2 mL *vs* 28.4 ml). Mean difference was −1.9 mL (95% confidence interval , −17.9 to 14.2), and the upper limit of the 95% CI was lower than the pre-specified non-inferiority limit (δ = 50 mL)

Jae Yong Jeong, Jin Hee Ahn, Jae-Geum Shim, Sung Hyun Lee, Kyoung-Ho Ryu, Sung-Ho Lee, Eun-Ah Cho, Jeong, J. Y., Ahn, J. H., Shim, J.-G., Lee, S. H., Ryu, K.-H., Lee, S.-H., & Cho, E.-A. (2021). Gastric emptying of preoperative carbohydrate in elderly assessed using gastric ultrasonography: A randomized controlled study. *Medicine*, *100*(37), 1–7. https://doi.org/10.1097/MD.0000000000027242	Randomized controlled study Level 2	N/A	Assess the safety of drinking carbohydrate-containing fluids two hours prior to surgery in older adults by comparing the residual GV between patients who fasted and patients who ingested carbohydrate-containing fluids two hours preoperatively.	N = 58	Gastric content grades 0, 1, 2, antral CSA and aspirated gastric volume	Ultrasound guided Antral CSA	Incidence of grade 2 stomach was 13.8% in NPO group and 17.2% in carbohydrate group (*P* = .790). Antral CSA in the supine position was larger in carbohydrate group than in NPO group (4.42 [3.72–5.18] cm^2 vs 5.31 [4.35–6.92] cm^2, *P* = .018). Antral CSA in the RLD position was not different in NPO and carbohydrate groups (*P* = .120). There was no difference in gastric volume (2 [0–7.5] vs 3 [0–13.4], *P* = .331) in NPO group versus carbohydrate group.
Abdul Kadir, M. Z., Cheah, S.-K., Mohamad Yusof, A., Mohd Zaki, F., & Teo, R. (2022). Ultrasound-Determined Residual Gastric Volume after Clear-Fluid Ingestion in the Paediatric Population: Still a Debatable Issue. *Children*, *9*(5), 639–N.PAG. https://doi.org/10.3390/children9050639	Non randomized comparative study Level 3	N/A	Evaluate the RGV after 1 and 2 h of clear fluid fasting. and parents' satisfaction concerning clear fluid fasting time at 1 and 2 h.	N = 99	Antral CSA. Residual gastric volume (RGV), Time (1hr & 2hr). parent satisfaction	Ultrasound guided Antral CSA after 1 and 2 h of clear fluid. $ point satisfaction Likert scale.	RGV was significantly higher at T_1 compared to T_2 ($p < 0.001$). No significant difference was seen between T_0 and T_2 ($p = 0.30$). Parental satisfaction was similar at T_1 and T_2 ($p = 0.158$).

Valero Castañer, H., Vendrell Jordà, M., Sala Blanch, X., & Valero, R. (2021). Preoperative bedside ultrasound assessment of gastric volume and evaluation of predisposing factors for delayed gastric emptying: a case–control observational study. *Journal of Clinical Monitoring & Computing*, *35*(3), 483–489. https://doi.org/10.1007/s10877-020-00489-9	Case–control observational study Level 4	N/A	Assess differences in gastric fluid volume between fasted patients with or without predisposing factors for delayed gastric emptying.	N = 53	Gastric residual volume between patients with delayed gastric emptying (DGEF) versus patients without delayed emptying.	Ultrasound Antral CSA , gastric fluid volume	No differences were found between patients with or without delayed gastric emptying factors. Gastric fluid volume was 35.21 ± 32.69 mL in the DGEF versus 53.50 ± 30.72 mL in the non-DGEF group (p = 0.08). Average volume per unit of weight was 0.61 ± 0.46 mL/kg.
Bouvet, L., Zieleskiewicz, L., Loubradou, E., Alain, A., Morel, J., Argaud, L., Chassard, D., Leone, M., & Allaouchiche, B. (2020). Reliability of gastric suctioning compared with ultrasound assessment of residual gastric volume: a prospective multicentre cohort study. *Anaesthesia*, *75*(3), 323–330. https://doi.org/10.1111/anae.14915	Cohort study Level 4	N/A	Compare the reliability of aspiration via a nasogastric tube with ultrasound for assessment of residual gastric volume.	N = 61	Gastric residual volume, aspirated gastric volume	Ultrasound guided antral CSA, Gastric residual volume, aspirated gastric volume	Gastric suctioning did not provide an accurate estimate of residual gastric volume compared with ultrasound, with a mean bias of 66.6 ml and a 95% agreement band ranging from −218 ml to 351 ml.

Miller, A. F., Levy, J. A., Krauss, B. S., Gravel, C. A., Vieira, R. L., Neuman, M. I., Monuteaux, M. C., & Rempell, R. G. (2021). Does Point-of-Care Gastric Ultrasound Correlate With Reported Fasting Time? *Pediatric Emergency Care*, *37*(12), e1265–e1269. https://doi.org/10.1097/PEC.0000000000001997	Non randomized cross sectional study, Level 4	N/A	Assess gastric volumes in pediatric ED patients, with the goal of determining the feasibility of this technique and the relationship between gastric volume and reported last oral intake.	N= 103	Antral CSA, gastric residual volume, Time since last intake	Ultrasound guided antral CSA, Gastric residual volume, Time from last intake	A weak inverse correlation between fasting time (either liquid or solid) and estimated gastric volume ($\rho = -0.33$) was observed, with no significant difference based on type of intake (solids, $\rho = 0.28$; liquids, $\rho = 0.22$).
Demirel, A., Özgünay, Ş. E., Eminoğlu, Ş., Balkaya, A. N., Onur, T., Kılıçarslan, N., & Gamlı, M. (2023). Ultrasonographic Evaluation of Gastric Content and Volume in Pediatric Patients Undergoing Elective Surgery: A Prospective Observational Study. *Children*, *10*(9), 1432. https://doi.org/10.3390/children10091432	Prospective observational study Level 4	N/A	Evaluate the incidence of a "high risk stomach" characterized by ultrasound identification of solid matter and/or an estimated gastric fluid volume exceeding 1.25 mL/kg in elective procedures.	N=97	Gastric volume, Gastric content	Ultrasound guided Antral CSA, gastric volume, Gastric content, BMI and age	median fasting duration was 4 h for liquids and 9 h for thick liquids and solids. Solid content was absent in all the children. median antral CSA in the RLD was 2.36 cm^2, with a median gastric volume of 0.46 mL/kg. A moderate and positive correlation was observed between the antral CSA and BMI for Grade 0 patients. A strong and positive correlation was evident between the antral CSA and age,

Valencia, J. A., Cubillos, J., Romero, D., Amaya, W., Moreno, J., Ferrer, L., Pabón, S., & Perlas, A. (2019). Chewing gum for 1 h does not change gastric volume in healthy fasting subjects. A prospective observational study. *Journal of Clinical Anesthesia*, *56*, 100–105. https://doi.org/10.1016/j.jclinane.2019.01.021	Observational prospective analytical study Level 4	N/A	Investigate whether gum-chewing has significant impact on the gastric volume of healthy adults.	N = 55	Gastric volume, Gastric content	Ultrasound guided Antral CSA, gastric volume, Gastric content	The proportion of subjects who presented a completely empty stomach (Grade 0 antrum) was similar at baseline and after 1 h of gum-chewing [81% vs. 84%, p = 0.19, CI 95% (-12%, 16%)]. Among those subjects who had visible fluid at baseline, the volume remained unchanged
Dupont, G., J. Gavory, P. Lambert, N. Tsekouras, N. Barbe, E. Presles, L. Bouvet, and S. Molliex. 2017. “Ultrasonographic Gastric Volume before Unplanned Surgery.” *Anaesthesia* 72 (9): 1112–16. doi:10.1111/anae.13963.	Prospective cohort study Level 4	N/A	Ultrasound measurement of gastric antral cross-sectional area and estimate gastric volume in patients before unplanned surgery after at least a six-hour fast.	N = 300	Gastric antral CSA,	Ultrasound guided Antral CSA,	The median (IQR [range]) area was 333 (241-472 [28-1803]) mm2, a mean (SD) estimated volume of 45.8 (34.0) ml. CSA exceeded 410 mm2 in 92/263 (35%) measurements. Body mass index and morphine administration were associated with larger gastric areas on multivariable linear regression analysis, with beta coefficient (95%CI) 0.02 (0.01-0.04), p = 0.01, 0.23 (0.01-0.46), p = 0.04, respectively.

Leviter, J., Steele, D. W., Constantine, E., Linakis, J. G., Amanullah, S., & Macy, M. L. (2019). "Full Stomach" Despite the Wait: Point-of-care Gastric Ultrasound at the Time of Procedural Sedation in the Pediatric Emergency Department. *Academic Emergency Medicine*, *26*(7), 752–760. https://doi.org/10.1111/acem.13651	Prospective cohort study Level 4	N/A	to use gastric point-of-care ultrasound (POCUS) to assess gastric contents and volume, summarize the prevalence of "full stomach," and explore the relationship between fasting time and gastric contents at the time of procedural sedation	N = 116	Gastric antral CSA, Gatric Volume and content, fasting time	Ultrasound guided Gastric antral CSA, Gastric volume and qualitative gastric content, Fasting time	Median fasting time was 5.8 hours. 69% of evaluated scans (95% confidence interval [CI] = 60%–77%), were categorized as having a full stomach (solid content or volume >1.2ml/kg). Each hour of fasting was associated with lower odds (odds ratio = 0.79, 95% CI = 0.65–0) of a full stomach. However, the knowledge of fasting time alone provides little ability to discriminate between risk groups
Bouvet, L., Loubradou, E., Desgranges, F.-P., & Chassard, D. (2017). Effect of gum chewing on gastric volume and emptying: a prospective randomized crossover study. *BJA: The British Journal of Anaesthesia*, *119*(5), 928–933. https://doi.org/10.1093/bja/aex270	randomized observer-blind crossover trial Level 3	N/A	To assess whether gum chewing affects gastric emptying of 250 ml water and residual gastric fluid volume measured 2 h after ingestion of water	N = 20	Gastric antral CSA, gastric volume	Ultrasound guided, timed CSA and gastric volume after chew gum or not.	No significant difference between chewing gum and control. Mean (sd) was 23 min in the Control and 21 min in the Chewing gum session (P=0.52). Total gastric emptying time of water was 42 min in the Control session and 39 min in the Chewing gum session (P=0.25).

Joshi, Y., & Dhamija, S. (2021). Randomized Control Clinical Trial of Overnight Fasting to Clear Fluid Feeding 2 Hours Prior Anaesthesia and Surgery. *Indian Journal of Surgery*, *83*(1), 248–254. https://doi.org/10.1007/s12262-020-02369-7	Randomized control parallel group study. Level 3	N/A	Compare gastric volume using ultrasonography and pH of gastric aspirate by pH strip in patients after overnight fasting and after ingestion of 200 ml clear apple juice, 2 h prior to non-abdominal surgery as primary and secondary objective, respectively.	N = 60	Gastric volume and gastric PH	Ultrasound guided CSA, Gastric volume and gastric PH	Mean gastric volume was 29.7 ± 8.0 ml in overnight fasting (grp A) and 19.2 ± 4.9 ml in the 2h fluid group (grp B) which was statistically significant (p < 0.00001). Mean gastric PH was statistically insignificant $p < 0.1268$ (group A was 1.4 ± 0.5 and group B was 1.6 ± 0.5).
Arif, N. M., Nazihah Sayed Masri, S. N., Nur Yazmin Yaacob, Yeoh Chih Nie, Mahdi, S. N., & Izaham, A. (2021). Gastric Antrum Ultrasonography Measurement in Healthy Adults at 1 and 2-hours Fasting Time After Ingesting Glucose-loaded Clear Fluids...Malaysian Society of Anaesthesiologists & College of Anaesthesiologists, AMM, Annual Scientific Congress August 6-8, 2021.	Non randomized cohort study Level 4	N/A	compare gastric volume estimation in healthy fasting adults at different time interval after consuming lychee flavored beverage	N = 255	Gastric volume	Ultrasound guided CSA, Gastric volume at baseline (after 8H fastin and 1 and 2 hours post ingestion of 250ml fluid (grp 1 & 2)	Median of residual gastric volume per body weight after fasting for Group 1 was 1.3 (1.0 - 1.8) which was significantly higher than median of residual gastric volume in Group 2, with 1.1 (0.8 - 1.4) (p=0.001)

Okabe, T., Terashima, H., & Sakamoto, A. (2017). What is the manner of gastric emptying after ingestion of liquids with differences in the volume under uniform glucose-based energy content? *Clinical Nutrition*, *36*(5), 1283–1287. https://doi.org/10.1016/j.clnu.2016.08.014	Non Randomized study Level 4	N/A	Examine the effects of different volumes of liquids (200ml, 400ml, 600ml) with a uniform energy (200kcal) content on gastric emptying.	N = 8	Gastric CSA and volume	Ultrasound guided CSA, Gastric volume, Time after fluid ingestion	Mean gastric volume decreased exponentially to nearly 0 ml 70 min after ingestion of 200 ml, 90 min after 400 ml and 100 min after 600 ml .

Appendix E

Pretest Questionnaire

(Correct responses are highlighted)

1. Please Provide the last 4 digits of your Marian University ID# ……………………
2. Pulmonary aspiration accounts for what percentage of anesthesia related death
    a. 1 – 5%
    b. 5 – 10%
    c. 10 – 30%
    d. 20 – 40%
    e. 30 – 50%
3. The stomach has how many layers
    a. 2
    b. 3
    c. 4
    d. 5
    e. 6
4. CRNA responsibilities for preventing aspiration include (Choose 2)
    a. Identification of aspiration risk
    b. Ensuring patient NPO compliance
    c. Reduction of aspiration risk
    d. Canceling the case
5. Advantages of gastric ultrasound include
    a. Safe
    b. Noninvasive
    c. Accurate
    d. All of the above
6. Anatomical parts of the stomach include (Chose 3)
    a. Infundibulum
    b. Pyloric antrum
    c. Pyloric fundus
    d. Body
    e. Fundus
7. True/False. The pyloric antrum is the most proximal part of the stomach
    a. True
    b. False

8. The Antrum of the stomach is inferior to which organ on the ultrasound scan
    a. Aorta
    b. Pancreas
    c. Liver
    d. Sternum
    e. Colon
9. Ultrasound scanning should be done with the patient in what position (Choose 2)
    a. Supine
    b. Prone
    c. Right lateral decubitus
    d. Left lateral decubitus
10. Qualitative gastric assessment grade 0 corresponds with (Choose 2)
    a. Empty Antrum in supine position
    b. Empty antrum in RLD position
    c. Clear liquid in supine position
    d. Clear liquid in RLD position
    e. Thick fluid/solid in antrum
11. Qualitative gastric assessment grade 1 corresponds with (Choose 2)
    a. Empty Antrum in supine position
    b. Empty antrum in RLD position
    c. Clear liquid in supine position
    d. Clear liquid in RLD position
    e. Thick fluid/solid in antrum
12. Qualitative gastric assessment grade 2 corresponds with (chose)
    a. Empty Antrum in supine position
    b. Empty antrum in RLD position
    c. Clear liquid in the antrum
    d. Thick fluid/solid in antrum
13. True/false. The quantitative gastric assessment is validated for only non-pregnant adult
    a. True
    b. False
14. True/False. A full stomach is a high risk for pulmonary aspiration
    a. True
    b. False
15. The upper limit of normal gastric volume in the fasted individual is
    a. 0.5 ml/kg
    b. 1.0 ml/kg
    c. 1.5 ml/kg
    d. 2.0 ml/kg
    e. 2.5 ml/kg

16. How confident are you that you can perform an ultrasound assessment of gastric content
    a. Not at all confident
    b. Somewhat not confident
    c. Somewhat confident
    d. Very confident
17. Yes/No. Have you ever performed an ultrasound assessment of gastric content
    a. Yes
    b. No

Appendix F

Result Tables

Paired Samples T-Test pre vs post test knowledge score									
					95% Confidence Interval			95% Confidence Interval	
T value	df	p - value	Mean difference	SE difference	Lower	Upper	Effect Size	Lower	Upper
-11.1	14	< .001	-43.3	3.91	-51.7	-34.9	-2.86	-4.02	-1.69

	N	Mean	Median	SD	SE
pretest knowldge score	15	50.5	50	14.4	3.72
post test knowledge score	15	93.8	100	9.3	2.4

Paired Samples T-Test pre vs post test students confidence score									
					95% Confidence Interval			95% Confidence Interval	
T-value	df	p -value	Mean difference	SE difference	Lower	Upper	Effect Size	Lower	Upper
-7.99	14	< .001	-50.6	6.33	-64.2	-37	-2.06	-2.96	-1.14

	N	Mean	Median	SD	SE
pretest confidence score	15	6.6	0	18.5	4.78
post test confidence score	15	57.2	66	19.6	5.06