Point of Care Ultrasound Gastric Assessment

Stephanie Kay Cox, Whitney Hintze, and Christina Sanchez

Department of Nurse Anesthesia, AdventHealth University

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Christina Mandalis-Defour, DNP, CRNA, APRN

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Abstract

Aspiration pneumonia is one of the most prevalent causes of morbidity and mortality in anesthesia, responsible for almost half of all airway-related anesthesia complications (Perlas et al., 2018; Sharma et al., 2018; Warner et al., 2021). Current practice utilizes *nil per os* (NPO) guidelines to determine the patient's stomach content; however, a review of the literature reveals that maintaining rigid fasting guidelines has little correlation with gastric volumes, leading to misdiagnosis of aspiration risk (Miller et al., 2021; Ohashi et al., 2018). Compared to current NPO guidelines, point-of-care ultrasound (POCUS) gastric assessment identifies high-risk patients, enhancing sensitivity and specificity. Mainstreaming POCUS gastric assessment as a standard tool to identify high-risk aspiration patients in the preoperative phase may allow the anesthesia team to modify the plan of care. This can help providers tailor the anesthesia plan to individual patient status and comorbidities, allowing for decreased risk of aspiration and subsequent consequences. The literature promotes POCUS gastric assessment as the new standard of care, potentiating a safer anesthesia plan in up to 50% of procedures (Delamarre et al., 2021; Shorbagy et al., 2021; Van de Putte et al., 2018). This project aims to create a continuing education (CE) module on utilizing POCUS gastric assessment and submission for approval by Echelon and the American Association of Nurse Anesthesiology (AANA) accreditation.

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Utilizing Point of Care Ultrasound - Gastric Assessment

Aspiration pneumonia is known to cause a multitude of respiratory problems, including pneumonitis, acute lung injury, acute respiratory distress syndrome, multiple organ dysfunction, or even brain damage (Perlas et al., 2018; Sharma et al., 2018; Warner et al., 2021). The current accepted prevention is having patients fast for anywhere from 6-8 hours prior to surgery (Delamarre et al., 2021). Even when this protocol is followed, high-risk patients can prompt subjective changes in anesthesia plans that may not be necessary. Point-of-care ultrasound (POCUS) gastric assessment may offer a quick, cost-effective, objective method to prevent aspiration during surgery, improve patient outcomes, and decrease anesthesia costs (Evain et al., 2022a; Ohashi et al., 2018; Van de Putte et al., 2018).

Section One: Problem and PICOT Questions

Significance & Background of Clinical Problem

For aspiration to occur, there must be a substantial volume in a patient's stomach with superseded pressures of the upper and lower airway reflexes (Van de Putte & Perlas, 2017). Anesthetic procedures regularly blunt the airway reflexes, increasing the risk of aspiration; therefore, the only other controllable factor is the amount of gastric volume in patients undergoing surgery (Delamarre et al., 2021; Howle et al., 2020; Moake et al., 2022). Unfortunately, it is not possible to control gastric volume with certainty.

Several factors place surgical patients at risk for higher stomach volumes, such as trauma, an incomplete history, special populations, such as obstetrical patients, or noncompliance, including a known lack of fasting (Desgranges et al., 2021; Nascimento et al., 2019; Sharma et al., 2018; Shorbagy et al., 2021). These high-risk patient populations may have a modified anesthesia plan or canceled procedures, leading to increased risks and costs and decreased patient outcomes (Desgranges et al., 2021; Schwisow et al., 2021; Shorbagy et al., 2021). Numerous

studies support the use of POCUS gastric assessment's accuracy in measuring gastric volumes and, therefore, identifying high-risk full-stomach patients (Evain et al., 2022a; Evain et al., 2022b; Ohashi et al., 2018; Van de Putte et al., 2018). This project aims to close the knowledge gap with a CE module on POCUS gastric assessment, helping to educate providers and help implement the practice in the preoperative setting.

PICOT Evidence Review Questions

Two questions were developed in PICOT format to guide the literature review. The first question addresses the clinical problem: Among certified registered nurse anesthetists (CRNA) and student registered nurse anesthetists (SRNA) utilizing point-of-care ultrasound gastric assessment (P), what is the effect of a continuing education module on the knowledge base (I), and is there a knowledge gap for further education (O)?

The second question addresses clinical innovation: Can AdventHealth University (P) SRNAs who develop an evidence-based educational module regarding point-of-care gastric assessment (I) for publication in AdventHealth University (AHU) Echelon receive AANA CE credit approval by December 2023 (T)?

Section Two: Literature Review

Search Strategies

The search strategy included online databases CINAHL Complete and PubMed Complete. Initially, 199 articles were returned, with 19 deemed relevant to the scope of the problem and 180 eliminated. Key search terms and MeSH combinations included point of care ultrasound AND gastric AND anesthesia. Inclusion criteria were clinical trials and systematic literature reviews. The search limits were English language, articles after 2018, and research articles. Articles not focused on gastric ultrasound or gastric ultrasound before anesthesia were

excluded.

Grade Criteria

GRADE criteria were used to evaluate the quality of evidence regarding utilizing POCUS gastric assessment in the preoperative period (see Appendix A). Overall, the quality of the evidence was very low, rated at a one due to methodological flaws, limitations in study design, imprecision of data collected, inconsistencies, and publication bias. Recent literature consisted primarily of observational studies and literature reviews. Methodological flaws in the literature reviews included a lack of databases and reviewers listed and an absence of clear inclusion and exclusion criteria for articles selected for review. Limitations in the research studies included the inability to establish a control group of pulmonary aspiration due to patient harm. Inconsistencies included the inability to control the experience of the person performing the ultrasound and the inability to track the participants' actual time fasted versus their reported time fasted. Imprecisions included inadequate sample size and lack of confidence intervals or p values. Publication bias was present in one study. Overall, the quality of the evidence was low, but practical recommendations should still be regarded as relevant due to the relationship between POCUS gastric assessment and improved accuracy of clinical judgment (Evain et al., 2022a; Ohashi et al., 2018; Schwisow et al., 2021; Van de Putte et al., 2018).

Literature Review & Synthesis of Evidence

This scholarly project is a focused review of the literature for the creation of a CE module on POCUS gastric assessment. This project was not based on a formal research methodology. Therefore, it did not follow a theoretical framework or an evidence-based practice model. For this reason, there were no formal variables pulled from our PICOT question. Instead, this program was created following the Echelon CE module creation guidelines and will also be

formatted to fit the AANA accreditation guidelines.

Current standards for fasting guidelines prior to surgical procedures include fasting from solid foods for at least 6-8 hours and fasting from clear liquids for 2 hours (Miller et al., 2021; Moser et al., 2017; Zhou et al., 2019). This protocol is utilized when assessing a patient for surgery to reduce the risk of aspiration. However, when determining gastric content, these current NPO guidelines are not always an accurate predictor of prandial status or delayed gastric emptying; people who have fasted from 10-15 hours have been found to have significant gastric content, resulting in postponed or unnecessarily modified anesthesia care (Delamarre et al., 2021; Perlas et al., 2018; Sharma et al., 2018; Van de Putte et al., 2018). The NPO guidelines are a good generalization of gastric content status. However, they are a subjective measurement. By contrast, bedside POCUS gastric assessment provides an objective, noninvasive, real-time assessment of the patient's gastric contents.

Multiple studies revealed that as many as 50% of surgical anesthesia plans could have been optimized with POCUS gastric assessment (Delamarre et al., 2021; Shorbagy et al., 2021; Van de Putte et al., 2018). Delamarre et al. (2021) found that when using clinical judgment to assess empty stomachs, as many as 15% of patients had high-risk volumes despite being assessed as having an empty stomach, and 16% of full stomach assessments were false positives.

POCUS gastric assessment utilizes PERLA, a three-grade scale, to assess the gastric content and volume by measuring the cross-sectional area of the antrum in both the supine and right lateral decubitus (RLD) position; it ranks a patient from 0 (empty stomach or low-risk volume) to 2 (full stomach, high-risk volume) (Perlas et al., 2018; Perlas et al., 2016). The ability to quickly measure actual gastric content makes it an effective assessment tool for mitigating aspiration risks. When patient comorbidities or scenarios can make it impossible to achieve an

RLD position, a semi-recumbent position with the head of the bed elevated to 45 degrees is an acceptable second-best option (Perlas et al., 2018). However, the RLD is the gold standard for accurate POCUS gastric assessment.

Specialty populations are particularly at risk of being misdiagnosed. In the non-laboring parturient, an average of only 4% were found to have actual full stomachs, and in the laboring parturient, only about 13% had full stomachs (Howle et al., 2020; Van de Putte et al., 2019; Zieleskiewicz et al., 2018). Multiple studies support that trauma patients have a higher risk for full stomachs, but the literature also reveals that as many as 20% of this population has been misdiagnosed as high-risk (Evain et al., 2022b; Miller et al., 2021; Moake et al., 2022; Shorbagy et al., 2021). Patients with medical conditions thought to delay gastric emptying, such as diabetes, obesity, renal disease, or appendicitis, were assessed with high-risk stomachs less than 50% of the time. This population is regularly over diagnosed (Evain et al., 2022a; Schwisow et al., 2021; Zhou et al., 2019). POCUS gastric assessment allows anesthesia providers to determine a full or empty stomach, leading to a more accurate diagnosis in all specialty populations.

Generalized changes in anesthesia plans to prevent aspiration may cause unforeseen problems. With the use of tools like POCUS gastric assessment, individualized patient plans can be implemented, including postponing surgical procedures until the stomach is empty instead of canceling procedures or changing to more conservative airway management techniques (Evain et al., 2022a; Schwisow et al., 2021; Van de Putte et al., 2018). Consequences of cancellations include staffing changes, surgical team availability, or potential delays that may be unsafe for a patient with urgent/emergent surgical needs (Schwisow et al., 2021; Van de Putte et al., 2018). A common change in suspected high-risk stomachs is to perform a rapid sequence induction. This technique commonly includes a controversial drug, succinylcholine, that has an increased risk for

allergic reactions and electrolyte imbalances (Bohringer et al., 2019) and is unsafe in various populations, such as patients with renal diseases or muscular dystrophies (Moake et al., 2022). A more accurate diagnosis would allow the anesthesia provider to make changes judiciously while contemplating each patient scenario.

Introducing new ideas into medical practice is commonly plagued by barriers, and POCUS gastric assessment is no exception. There is a lack of research with significant sample sizes concerning the use of POCUS gastric assessment (Evain et al., 2022a; Shorbagy et al., 2021). Additional costs may be incurred to the patient and insurance as the use of POCUS involves a billable test that is not currently included as a standard. Even though POCUS gastric assessment is a rapid bedside test, this will still increase the preoperative assessment time, which is a point of contention for some providers (Delamarre et al., 2021; Howle et al., 2020; Miller et al., 2021; Ohashi et al., 2018). The availability of ultrasound equipment in the preoperative area is unknown, and providers must be trained in using POCUS gastric assessment. The number of scans deeming a provider proficient has been identified to be up to 30 (Howle et al., 2020). However, even with practice, providers, including CRNAs, still commonly express discomfort with using ultrasound due to its complexity and dependence on provider skill and training experience (Schwisow et al., 2021).

A notably used method called indication, acquisition, interpretation, and medical decision-making (I-AIM) facilitated the learning and proper clinical application of POCUS. I-AIM is a framework used for teaching the conceptual steps of POCUS, including gastric assessment, to help standardize the approach utilized by healthcare professionals (Perlas et al., 2018). This four-step process to improve user skills allows for a structured method for incorporating POCUS. In current practice, this helps to prevent user error and provides the most

accurate patient assessment to ensure the best outcomes (Perlas et al., 2016).

POCUS gastric assessment is a method that is gaining popularity within the anesthesia community (Evain et al., 2022a; Evain et al., 2022b; Ohashi et al., 2018; Van de Putte et al., 2018). POCUS gastric assessment has proven safer, demonstrates increased effectiveness, and allows individualized patient care. Incorporating this knowledge into a CE module to support and implement gastric assessment using the POCUS modality allows end users to become educated on the benefits of POCUS gastric assessment and how it may guide anesthetic and airway management. The AANA is accountable for promoting best-practice standards and updating guidelines to constantly challenge current practices for safer, optimal patient care (AANA, 2022). A CE module is an effective method to distribute information on POCUS gastric assessment and its benefits. With enough involvement and dissemination, there may be a correlation between implementation and improved patient outcomes, including an overall decrease in morbidity and mortality.

Section Three: Methodology

Project Aims

The primary aim of the proposed project is to create an AHU SRNA-developed 1-hour CE module on POCUS gastric assessment to be reviewed for CE credit approval by the AANA. The specific objectives of this scholarly project are:

1. Identify the budget and resources needed for project development by conducting interviews by June 2022.
2. Obtain photographs for inclusion in the educational model by October 2022.
3. Complete the consent to accredit form and a formal program planning document by December 2022.

4. Complete a research and educational planning document by July 2023.
5. Submit the CE module and application for CE credit approval with the AANA by April 2024.

Methods

This scholarly project does not follow a formal research design or use a certain methodology. Instead, this project demonstrates the project developers' ability to complete a CE module for accreditation and dissemination of new practices. The Echelon CE module creation guidelines will be used to complete this process. The information collected from the literature review will create a formal CE module submitted for approval by the AANA and Echelon. The process of CE module creation will include consent to be accredited and the creation of a preliminary program planning document. The information obtained initially will be shaped into an educational planning table and a course transcript document, which will outline the intended material for the class. Outcomes will be addressed by creating a post-course reflection and learner assessment examination.

The site for this location includes the AANA and Echelon, where this CE module is posted for purchase. There will be no specific recruitment for this project. The target population for this class includes any healthcare professionals involved in preoperative care. This list includes but is not limited to CRNAS, SRNAs, MDs, Nurse Practitioners, physician assistants, or Preoperative nurses. The recommended prerequisite is a basic understanding of ultrasound equipment. Any participant who is unwilling to take or purchase this class will be excluded. Vulnerable populations will not be specifically targeted, and there are no additional ethical considerations for participation in this CE module. Participants in this CE module will not allow the participants to be anonymous as successful completion will be linked to the participant with

official accreditation. Risks to the participant include the time and monetary investment needed for successful course completion. The benefits of taking this class include CE accreditation for the re-licensure of eligible providers.

Data collected from this class will aim to show an increase in knowledge, comprehension, and application by the provider. Otherwise, demographical information will be collected by the participants to review participation statistics. The collection of the above information is outside this scholarly project's scope, and no formal data analysis will be included. For this reason, there will be no data storage, need to protect participants' confidentiality, or computer programs utilized to complete this project. This CE module was verified through six peer reviewers to ensure its validity and appropriate rigor.

Planning and Procedures

Key players were identified early when the project was decided to be a CE module. Echelon Director Lori Polizzi and Julie Talamadge, DNP, APRN, FNP-BC, were the AHU Echelon creation coordinators. Charlotte Henningsen, MS, RT(R), RDMS, RVT, FSDMS, FAIUM, is an esteemed Ultrasound specialist connected with the AHU lab. These crucial interviews informed the development of a knowledge gap and a budget (see Appendix B) and suggested a lab session to obtain educational photographs.

A formal program planning document was completed showing the need for a CE module on POCUS gastric assessment. The literature review was then converted into a transcript and an education planning table. Pictures were taken in AHU’s ultrasound lab to aid the CE module. The final documents were formatted and submitted for accreditation. After accreditation approval, the CE module was sent out to six selected candidates to be peer-reviewed.

The major facilitators were the strength of the Echelon CE module creation team and

access to the AHU ultrasound lab. Barriers mainly included time, necessary personnel, financial cost for the CE module, and the potential issues of bringing a new technique into the preoperative area. A grant will support the anticipated financial needs. The SRNAs supplied time requirements for the creation of the CE module. Limitations to the acceptance of a new practice will be thoroughly reviewed and addressed in the CE module.

The completed project has approval for accreditation by both Echelon and AANA. These accreditations speak to the validity of this class and will help sustain its use for education by providers. These interventions will ensure the sustainability of this CE module.

This project's final timeline (Appendix C) was as follows: the consent to accredit form, and a formal program planning document be completed by December 2022. Photographs for inclusion in the educational model were obtained in January 2023. While this was later than originally planned, the SRNAs found that it was important to have the completed transcript before taking photographs to help as a visual aid to the transcript. Material from the literature review and key player interviews was formed into an educational planning document by March 2023. The final transcript, including design and development, was submitted by March 2023. The final creations of the educational planning document and the final transcripts were completed ahead of schedule. This allowed an expedited completion of AANA approval and final CE module completion by June 2023 rather than April 2024.

Section Four: Discussion & Implications

Discussion, Applicability to Practice, and Contribution to Professional Growth

This project addressed the knowledge gap in POCUS gastric assessment with provider awareness of the diagnostic tool and education on performing and reading a POCUS gastric assessment. Where POCUS has been implemented as a standard of care, its use has been shown

to improve patient outcomes (Howle et al., 2020; Miller et al., 2021; Moser et al., 2017; Zieleskiewicz et al., 2018). Understanding when to utilize POCUS gastric assessment will strive to reduce unnecessary aspiration risks. The review of the literature identifies POCUS as a noninvasive trainable method.

The creation and acceptance of an educational module will allow providers nationwide to address this potential gap and modify their practice to continue striving for safer, individualized patient care. The recent increase in POCUS gastric assessment has led to the ability to diagnose patients quickly at the bedside. An absolute gastric value can confirm or rule out a suspected full stomach, allowing more personalized anesthesia care plans and decreased pulmonary aspirations. Although there are still limitations to POCUS gastric assessment access in the preoperative setting, these are necessary barriers to overcome to supply the most accurate and up-to-date patient care. Though NPO continues to be the standard of care for preventing aspiration, creating a CE module on POCUS gastric assessment will help reduce the potential knowledge gap related to this approach and perhaps shift the standard of care.

Conclusion

Aspiration in the anesthetic setting is a major risk due to the decreased airway reflexes the patient experiences when receiving anesthesia. However, with current technology, it can be a preventable risk. This quick, noninvasive diagnosis can catch preventative aspirations and enhance patient safety. POCUS Gastric assessment is a well-rounded tool that can be implemented in the perioperative setting to guide providers on decision-making for an anesthetic plan individually tailored to the patient. With current NPO guidelines, a patient is informed about fasting for 6 to 8 hours; depending on the patient’s comorbidities, these fasting hours can lead to false results, with patients having higher stomach content than expected.

This project's PICO aimed to create an AANA-accredited CE module published through AHU based on the knowledge gap identified in the POCUS gastric assessment literature review. This project addressed this issue by closing the knowledge gap on provider awareness and educating providers on completing a POCUS gastric assessment and subsequently interpreting the results. Ultimately, this project represents an evidence-based practice that should be accepted into regular use preoperatively. Providing this education can increase provider comfort with its utilization and increase awareness of POCUS gastric assessments' benefit to patient safety.

Dissemination

This process involved developing a CE module over the course of 2 years during a CRNA graduate program. This CE module strived to close the knowledge gap on POCUS gastric assessment, aiming to educate providers and assist with implementing it into routine practice. This scholarly project was initially shared with the class of 2025 in a presentation during the project developers' fifth trimester. The CE module received accreditation approval in the seventh trimester from the AANA for educational credit for CRNAs nationally. This scholarly project will be officially disseminated in the ninth trimester as a formal presentation to AHU and the class of 2025 and 2026. This CE module is currently published on the Echelon website for any interested provider.

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Appendix A: Matrix Tables

Ohashi, Y., Walker, J.C., Zhang, F., Prindiville, F.E., Hanrahan, J.P., Mendelson, R., & Corcoran, T. (2018). Preoperative gastric residual volumes in fasted patients measured by bedside ultrasound: A prospective observational study. *Anaesth Intensive Care. 2018 Nov;46(*6):608-613. doi: 10.1177/0310057X1804600612. PMID: 30447671. Schwisow, S., Falyar, C., Silva, S., & Muckler, V.C. (2021). A protocol implementation to determine aspiration risk in patients with multiple risk factors for gastroparesis. *Journal of Perioper Pract. 2021 Jul 12*:1750458921996925. doi: 10.1177/1750458921996925. Epub ahead of print. PMID: 34251910.					
Objective/Purpose	**Variables/Metric/Forms of Data**	**Setting/Participants**	**Measurement Instruments**	**Results**	**Evidence Quality**
Study One: **Primary objective:** Evaluate clinical judgment for full stomach in urgent patients compared to POCGUS. **Secondary objective:** Find risk factors associated with US full stomach in urgent patients. **Study Two:** **Primary objective:** Measure gastric volumes in fasted patients using bedside gastric Ultrasound. **Secondary objective:** None **Design & Sampling Strategy** **Study One**: Prospective observational study **Study Two:** Prospective observational study	**Study One:** **Primary outcome:** Clinical judgment showed poor-to-moderate performance versus Gastric PoCUS **Secondary outcomes:** Very few risk factors, including fasting durations, seem useful in clinical settings. **Study Two:** **Primary outcome: to** identify patients with risk factors for gastroparesis. **Secondary outcomes:** None	**Study One:** **Setting:** University Hospital of Toulouse, France. **Subjects**: 196 patients undergoing urgent surgery. **Study Two:** **Setting:** An unspecified hospital **Subjects:** 222 patients presenting for non-emergency surgery. fasted >6 hours, ASA 1-3.	**Study One:** Kolmogrov–SmiRNOV test, skewness, and Kurtosis coefficients, Mann–Whitney U test, t-test, Exact Fisher test. sensitivity, specificity, positive predictive value, negative predictive value, and 95% CI were used to compare data. **Study Two:** Univariate (chi-squared) analysis, ANOVA, Correlation, and multivariable analyses. A P-value less than 0.05 was taken to indicate statistical significance.	**Study One:** Clinical and PoCUS full stomach in was 29% and 27%, Positive and negative p-values were 42% (95% CI: 32.3–52.6%) and 79% (95% CI: 74.9–83.4%), Patients with PoCUS full stomach were misdiagnosed 55%. Fasting with PoCUS low-risk gastric content (OR 0.4, 95% CI: 0.20.9, P = 0.03). **Study Two:** No significant relationship between 'at risk' GRV and obesity, diabetes mellitus, gastroesophageal reflux disease, or opioid use. Compliance with fasting may still increase pulmonary aspiration risk. **Implications** **Study One:** Clinical judgment is unreliable in diagnosing a full stomach in urgent surgery. Very few risk factors, including fasting durations, seem useful in clinical settings. **Study Two:**It is possible that POCUS may assist anesthetists in identifying at risk patients.	**Study One** **Methodological flaws:** None. **Inconsistency:** None. **Indirectness:** None. **Imprecision:** Inability to calculate a sample size due to lack of prior data. **Publication bias:** None. **Study Two** **Methodological flaws:** None. **Inconsistency:** insufficient power to exclude 'at risk' factors. **Indirectness:** Inability to link data with aspiration risk. **Imprecision:** No qualitative observations were used. **Publication bias:** None.

Moser, J.J., Walker, A.M., & Spencer, A.O. (2017). Point-of-care paediatric gastric sonography: Can antral cut-off values be used to diagnose an empty stomach. *Br J Anaesth. 2017 Nov 1;119*(5):943-947. doi: 10.1093/bja/aex249. PMID: 29028915.
Moake, M.M., Presley, B.C., Hill, J.G., Wolf, B.J., Kane, I.D., Busch, C.E., & Jackson, B.F. (2022). Point-of-care ultrasound to assess gastric content in pediatric emergency department procedural sedation patients. *Pediatr Emerg Care. 2022 Jan 1;38*(1):e178-e186. doi: 10.1097/PEC.0000000000002198. PMID: 32769837; PMCID: PMC7854775.

Objective/Purpose	**Variables/Metric/Forms of Data**	**Setting/Participants**	**Measurement and Instruments**	**Results**	**Evidence Quality**
Study One: This study's purpose was to establish the sensitivity and specificity of a single cross-sectional area in the supine and right lateral decubitus positions in the diagnosis of an empty antrum in pediatric patients. **Study Two:** Evaluation of the gastric content of pediatric emergency department patients undergoing PSA using POCUS **Design & Sampling Strategy** **Study One:** Prospective observational cohort study. **Study Two:** Prospective Observational Study	**Study One:** **Primary outcome:** The successful use of POCUS for a single cut off cross-sectional area image in the supine vs. RLD position to diagnose an empty antrum in pediatric patients. **Secondary outcomes:** The optimal position of supine vs. RLD to obtain a diagnostic POCUS image to diagnose the empty antrum. **Study Two:** **Primary Outcome:** Question regarding delay of procedural sedation based upon fasting status **Secondary Outcome:** Lends support to a more comprehensive risk-benefit approach when planning pediatric procedural sedation	**Study One:** **Setting:** Not mentioned **Subjects:** separate secondary analysis, 100 patients, children, and adolescents between 11months and 17years of age, under specified fasting guidelines With a focus on empty endoscopy suctioned antrum. **Study Two:** A convenience sample of pediatric patients presenting to the pediatric ED at a single tertiary care hospital. **Subjects:** 93 patients. Inclusion criteria included ages six months or greater, English speaking, and ASA physical status I-III.	**Study One:** Shaprio-Wilk test, mean standard deviation or median IQR, Spearman's Rho, Wilcoxon signed ranked tests. Nonparameter receiver operator characteristic curves. 95% CI, used Youden Index. SPSS 19.0 software. **Study Two:** standard deviations and interquartile ranges. Clopper-Pearson, for a 95%CI. Wilcoxon rank sum test. Univariate logistic regression model. 95% CIs for cvAUC calculated using the LeDell et al. method, QPath for ultrasound image evaluation, and Fleiss's kappa.	**Study One:** Differences between pre-suctioned and post-suctioned CSA values. The cut-off CSAs were 2.19cm2 (sensitivity 75%, specificity 36%) and 3.07cm2 (sensitivity 76%, specificity 67%). **Study Two:** in 92 patients, 79.3% had "high risk" content at the time of procedural sedation and analgesia. Fasting duration had a weak to moderate ability to predict the "risk" category (area under curve=0.73). **Implications** **Study One:** CSA values can be determined with POCGUS **Study Two:** Fasting is unreliable.	**Study One:** **Methodological flaws:** None. **Inconsistency:** None. **Indirectness:** None. **Imprecision:** None. **Publication bias:** None. **Study Two:** **Methodological flaws:** Convenience sampling is not representative of the full population. **Inconsistency:** Reliance on patient or parent report of last PO intake. A single investigator with significant US experience performed all POCUS assessments. **Indirectness:** None. **Imprecision:** None. **Publication bias:** None.

Van de Putte, P., Vernieuwe, L., Perlas, A. Term pregnant patients have similar gastric volume to non-pregnant females: A single-centre cohort study. (2019). *Br J Anaesthesia. 2019 Jan;122(*1):79-85. doi: 10.1016/j.bja.2018.07.025. Epub 2018 Aug 29. PMID: 30579409.
Desgranges, F.P., Vial, F., Zieleskiewicz, L., Boghossian, M.C., Bouaziz, H., Leone, M., Chassard, D., & Bouvet, L. (2022). Ultrasound assessment of gastric contents prior to placental delivery: A prospective multicentre cohort study. *Anaesth Crit Care Pain Med. 2022 Feb;41*(1):100993. doi: 10.1016/j.accpm.2021.100993. Epub 2021 Dec 7. PMID: 34890858.

Objective/Purpose	**Variables/Metric/Forms of Data**	**Setting/Participants**	**Measurement and Instruments**	**Results**	**Evidence Quality**
Study 1: To compare the gastric volume of a non-laboring pregnancy patient to a non-pregnant female. **Study 2:** Ultrasound assessment of gastric contents before placental delivery. **Design & Sampling Strategy** **Study 1:** A cohort study. **Study 2:** A prospective multicenter cohort study.	**Study 1:** **Primary outcomes:** to characterize the range of gastric-fluid volume in fasting non-laboring pregnant patients at term. **Secondary outcomes:** Determine the 95th percentile of antral CSA and gastric-fluid volumes and distribution of antral grades. **Study 2:** **Primary outcomes:** (to evaluate gastric contents before delivery and before placental delivery). **Secondary outcomes:** Determine if gastric emptying is preserved during vaginal delivery)	**Study 1:** **Setting:** Hospital AZ Monica, Campus Deurne, Belgium. **Subjects:** 59 non-laboring pregnant females and 81 non-pregnant females. **Study 2:** **Setting:** August 2018 and August 2020 in three level-3 maternity units, after approval from the Institutional Review Board **Subjects:** 26 pregnant women.	**Study 1:** There were measurements: Perla's grade (semi-quantitative), the type of content (qualitative), and measuring the volume (quantitative). **Study 2:** Each patient had two ultrasound examinations of the antrum (1) at full cervical dilatation, within 30 minutes of expulsive efforts, and (2) after vaginal birth, before placental delivery. Measuring the antral cross-sectional area in the semi-recumbent position (45°), SR-CSA.	**Study 1:** Total gastric volume (P=0.96); volume per body weight (P=0.78); not significantly different. Volume (115 ml vs. 136 ml) and per body weight (1.4 ml kg vs. 2.0 ml kg) = the 95th percentile. **Study 2:** Decrease in proportion with solid gastric content and the SR-CSA. 21 patients (80.8%) with a decrease in the SR-CSA (vaginal delivery). Pulmonary aspiration was significantly lower (vaginal delivery) (23.1% vs. 57.7%, P = 0.0004). **Implications** **Study 1:** Pregnant and non-pregnant females had similar gastric contents. **Study 2:** Gastric emptying is at least partially preserved during vaginal birth. almost a quarter of women did have high-risk gastric content in the immediate postpartum period. The US is good for fast assessment.	**Study One:** **Methodological flaws:** None. **Inconsistency:** None. **Indirectness:** None. **Imprecision:** None. **Publication bias:** None. **Study Two:** **Methodological flaws:** None, study exclusions listed. **Inconsistency:** None. **Indirectness:** None. **Imprecision:** Small sample size. **Publication bias:** Arthur contributions.

Shorbagy, M.S., Kasem, A.A., Gamal Eldin, A.A., & Mahrose R. (2021). Routine point-of-care ultrasound (POCUS) assessment of gastric antral content in traumatic emergency surgical patients for prevention of aspiration pneumonitis: An observational clinical trial. *BMC Anesthesiology. 2021 May 8;21*(1):140. doi: 10.1186/s12871-021-01357-y. PMID: 33964867; PMCID: PMC8106174. Sharma, G., Jacob, R., Mahankali, S., & Ravindra, M.N. (2018). Preoperative assessment of gastric contents and volume using bedside ultrasound in adult patients: A prospective, observational, correlation study. *Indian Journal of Anaesthesia. 2018 Oct;62*(10):753-758. doi: 10.4103/ija.IJA_147_18. PMID: 30443057; PMCID: PMC6190418.					
Objective/Purpose	**Variables/Metric/Forms of Data**	**Setting/Participants**	**Measurement and Instruments**	**Results**	**Evidence Quality**
Study 1: POCUS gastric assessment in traumatic emergency surgical patients to prevent aspiration pneumonitis. **Study 2:** Preoperative assessment of gastric contents and volume using an ultrasound. **Design & Sampling Strategy** **Study 1:** Observational clinical trial. **Study 2:** Prospective observational, correlational study.	**Study 1:** **Primary outcomes:** PERLA measurement in the supine and right lateral decubitus position. Included changes in aspiration risk after gastric US assessment compared to clinical assessment. **Secondary outcomes:** NG tube inserted to confirm gastric content. **Study 2:** **Primary outcomes:** Determine if there was a correlation between fasting times and gastric content and estimated gastric volume. **Secondary outcomes:** To determine if the gastric contents and gastric volume were any difference in patients with conditions that supposedly predispose them to delayed gastric emptying like diabetes, chronic kidney disease, and obesity compared to those without	**Study 1:** **Setting:** Ain Shams University Hospital Emergency Department. **Subjects:** 45 patients undergoing emergency surgery under general anesthesia were carried out. **Study 2:** **Setting:** None **Subjects:** 100 adults receiving elective surgery who had fasted more than 6 hours.	**Study 1:** Gastric US was performed for qualitative and quantitative (PERLA) assessment of the gastric antrum in a supine and right lateral decubitus. Measuring the antral cross-sectional area (CSA). Placement of the NG tube to calculate the volume of the stomach contents. **Study 2:** A US scan was done in the supine and right lateral position. Gastric contents were noted, and gastric volume was calculated at the level of the gastric antrum by antral cross-sectional area (CSA). Gastric volume in the right lateral decubitus (RLD) position was taken as the final reading.	**Study 1:** 10 with an empty stomach (22.2%). 35 patients (77.7%) will have full stomachs, 29 with solid content. **Study 2:** 6/100 with solid gastric contents; 16 had >1.5 ml/kg clear liquids despite fasting (10-15 hours). Diabetes and CKD had an increase in CSA and in estimated gastric volume with BMI. **Implications** **Study 1:** In anesthesia, gastric ultrasound provides more accurate information about gastric contents than general assumption based on fasting hours **Study 2:** Our study showed that fasting for more than 6–10 hours does not guarantee an empty stomach. Those with DM, obesity, and CKD have a higher risk of unsafe gastric contents.	**Study 1:** Methodological Limitations: Sample size and control groups. **Inconsistency:** None **Indirectness:** None **Imprecision:** None **Financial support:** None **Publication Bias:** **Study 2:** **Inconsistency:** None **Indirectness:** None **Imprecision:** None **Financial support:** None

Perlas, A., Arzola, C., & Van de Putte, P. (2018). Point-of-care gastric ultrasound and aspiration risk assessment: A narrative review. *Can J Anaesth. 2018 Apr;65(4):*437-448. English. doi: 10.1007/s12630-017-1031-9. Epub 2017 Dec 11. PMID: 29230709. Van de Putte, P., Vernieuwe, L., Bouchez, S. Point-of-care ultrasound in pregnancy: Gastric, airway, neuraxial, cardiorespiratory. (2020). *Curr Opin Anaesthesiology*. *2020 Jun;33*(3):277-283. doi: 10.1097/ACO.0000000000000846. PMID: 32324656.					
Purpose/Objectives	**Search Strategy**	**Number and Type of Studies in the Review Including Sample Sizes**	**Results**	**Conclusions/ Implications**	**Evidence Quality**
Study One: TO summarize the current knowledge on point of care ultrasound (POCUS) of gastric contents to inform assessment of aspiration risk and guide anesthetic management at the bedside. **Study Two:** POCUS in the obstetric context for airway management and assessment of aspiration risk	**Study One:** MEDLINE database. MeSH terms included stomach, ultrasonography, and pneumonia. And aspiration, and combined with AND. Summarized and presented to an I-AIM framework **Study Two:** Search strategy in this review not included.	**Study One:** Number and type of studies in the review, including sample sizes not stated or specified within methods or search strategy. **Study Two:** Number and type of studies in the review, including sample sizes not stated or specified within methods or search strategy.	**Study One:** POCUS useful for risk assessment in unknown fasting status. Areas that need further investigation include the diagnostic accuracy of gastric POCUS and the impacts of POCUS on patient outcomes. **Study Two:** Gastric ultrasound is a useful aspiration risk assessment tool for the patient. Total gastric fluid assessment models and specific cut-offs between high-risk and low-risk stomachs are presented.	**Study One:** POCUS is likely most useful to define risks and guide patient management when prandial/ fasting status is uncertain or unknown. Further research is needed to establish diagnostic accuracy. **Study Two:** Gastric ultrasound is a useful aspiration risk assessment tool for the patient. Total gastric fluid assessment models and specific cut-offs between high-risk and low-risk stomachs are presented.	**Study One:** **Methodological flaws:** Failure to specify the number and type of studies in a narrative review. Sample sizes are not mentioned. **Inconsistency:** None **Indirectness:** None **Imprecision:** Lack of confidence intervals. **Publication bias:** None **Study Two:** **Methodological flaws:** Failure to specify the number and type of studies in a narrative review. Sample sizes are not mentioned. **Inconsistency:** None **Indirectness:** None **Imprecision:** None **Publication bias:** None

Appendix B: Budget

Cost Estimate for 1 Hour Enduring Media - SRNA Research Online CE						
Content Development *(does not include ARNA research time)*					$	2,957.50
On-Line Content Development					$	570.00
Media Production - Audio Recording, Design, Build, and Production QA					$	6,565.00
Project Management					$	1,040.00
Accreditation					$	684.00
Technical Support/Maintenance/Hosting					$	-
	Total Design and Development Cost				$	11,816.50
Content Development		**Hours**		**Rate**		**Cost**
Content/Curriculum Deliverables						
	Content Development *AHU SRNA Research ?*	0.0	$	45.00	$	-
	Content Deliverables: Transcript, Bibliography, Author(s) Bio	40.0	$	35.00	$	1,400.00
	Curriculum Layout: Bullets, Graphs, Charts	37.0	$	35.00	$	1,295.00
	Post Test Development	1.5	$	35.00	$	52.50
	Content QA and Final Review	6.0	$	35.00	$	210.00
	Estimated Hours for Content Development	84.5	$	-	$	2,957.50
On-line Content Development		**Hours**		**Rate**		**Cost**
On-Line Deliverables			$	-		
	Course Shell Development	4.0	$	30.00	$	120.00
	Script Editing	7.5	$	30.00	$	225.00
	Content QA	7.5	$	30.00	$	225.00
	Estimated Hours of On-Line Content Development	19.0			$	570.00
Media Production		**Hours**		**Rate**		**Cost**
Design/Build						
	Template Design	16.0	$	30.00	$	480.00
	Art direction/graphics	12.0	$	30.00	$	360.00
	HTML5 Video Build	160.0	$	30.00	$	4,800.00
	Upload to Production Files	3.0	$	30.00	$	90.00
	Estimated Hours for Design/Build	191.0			$	5,730.00
Audio		**Hours**		**Rate**		**Cost**
	Recording	2.0	$	35.00	$	70.00
	Voice	2.0	$	30.00	$	60.00
	Audio Editing	8.0	$	50.00	$	400.00
	Transfer to Wave File	1.5	$	30.00	$	45.00
	Estimated Hours for Audio	13.5			$	575.00
		Hours		**Rate**		**Cost**
Production QA						
	First run QA	2.0	$	30.00	$	60.00
	First run QA Fixes	4.0	$	35.00	$	140.00
	Final Client QA changes	2.0	$	30.00	$	60.00
	Estimated Hours for Production QA/Changes	8.0			$	260.00
	Total Media Production				$	6,565.00
Project Management		**Hours**		**Rate**		**Cost**
	Correspondence/Meetings/Project Coordination	16.0	$	35.00	$	560.00
	Program Information Build - Resources, Transcript, Program Info, Glossary	8.0	$	30.00	$	240.00
	Uploading files to LMS/testing functionality	8.0	$	30.00	$	240.00
	Estimated Hours for Project Management	32.0			$	1,040.00
Accreditation		**Hours**		**Rate**		**Cost**
Paperwork and accreditation manager's review						
	Doc/prep for accrediting for each board 1 CE	11.0	$	35.00	$	385.00
	Fee per 1 CE	0.0	$	299.00	$	299.00
	Estimated Hours for Accreditation	11.0			$	684.00
Technical Support/Maintenance/Hosting		**Hours**		**Rate**		**Cost**
	Hosting (fixed cost - for one year)				$	-
	Program maintenance (fixed cost - for one year)		$	-	$	-
	Client and technical support (fixed cost - for one year)		$	-	$	-
	Estimated Costs for LMS				$	-
	Total estimated hours for 1 hour enduring media	**359.0**	**hours**		**$**	**11,817**
	Questions contact: Lori Polizzi 407-303-9409 or lpolizzi@echeloned.com					

Appendix C: Timeline