The Utility of Perioperative Point of Care Ultrasound

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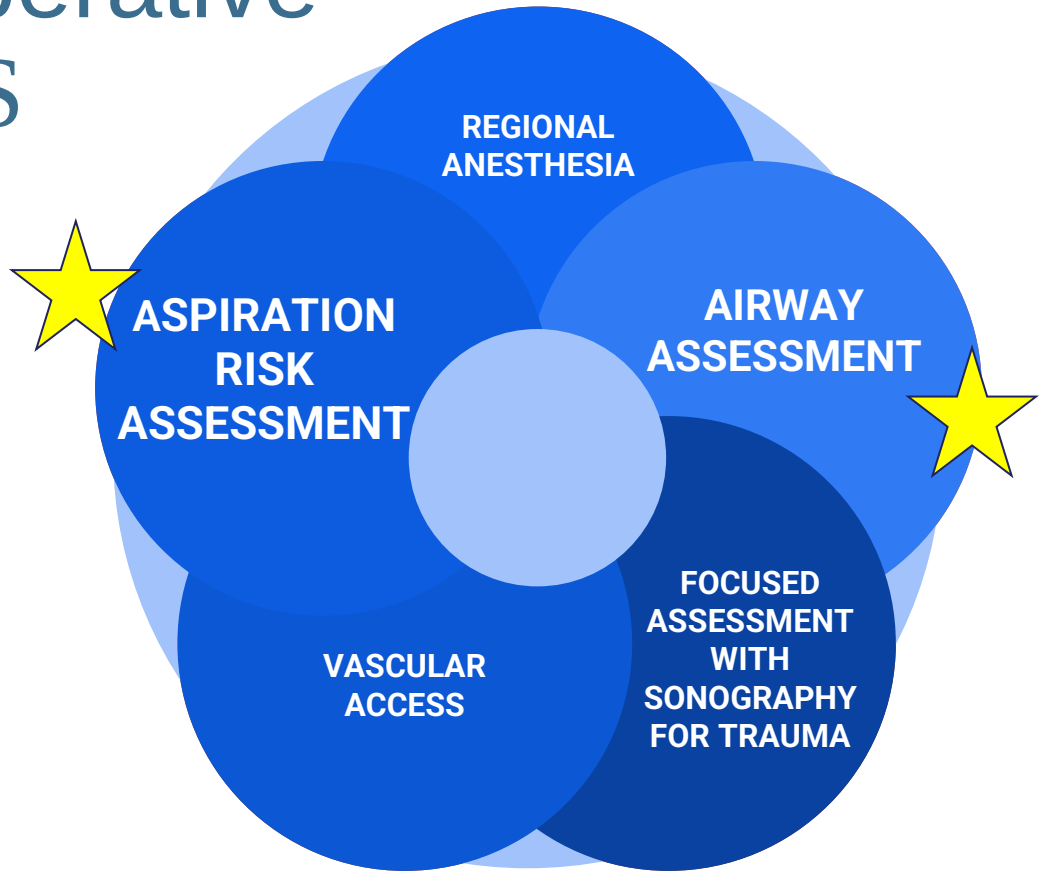
Objectives/Road Map

- Intent of NMCP SRNA Class of 2025 Evidenced Based Practice (EBP) Projects
- Utility of airway point of care ultrasound (POCUS) for difficult airway identification
- Overview of airway POCUS imaging techniques and assessment interpretation
- Discuss utility of gastric POCUS for aspiration risk assessment
- Overview of gastric POCUS imaging techniques and assessment interpretation
- Preliminary Results Review
- Organizational Impact and Recommendations

Perioperative POCUS



NMCP Class of 2025 EBP Projects

The Dilemma of Difficult Airways: Utilizing Ultrasound in the Perioperative Area

Gastric Point of Care Ultrasound: When Clinical Judgement is Not Enough

Project Design: Pre- and post-education intervention evaluation designed using the Johns Hopkins Nursing Evidence-Based Practice Model

Education Design: Indication- Acquisition Interpretation and Medical Decision Making Framework

Project Goals:

- Increase knowledge of POCUS techniques and their use in perioperative assessment
- Provide an opportunity for hands-on practice of ultrasound skills
- Assess knowledge gained with pre- and post-education evaluations

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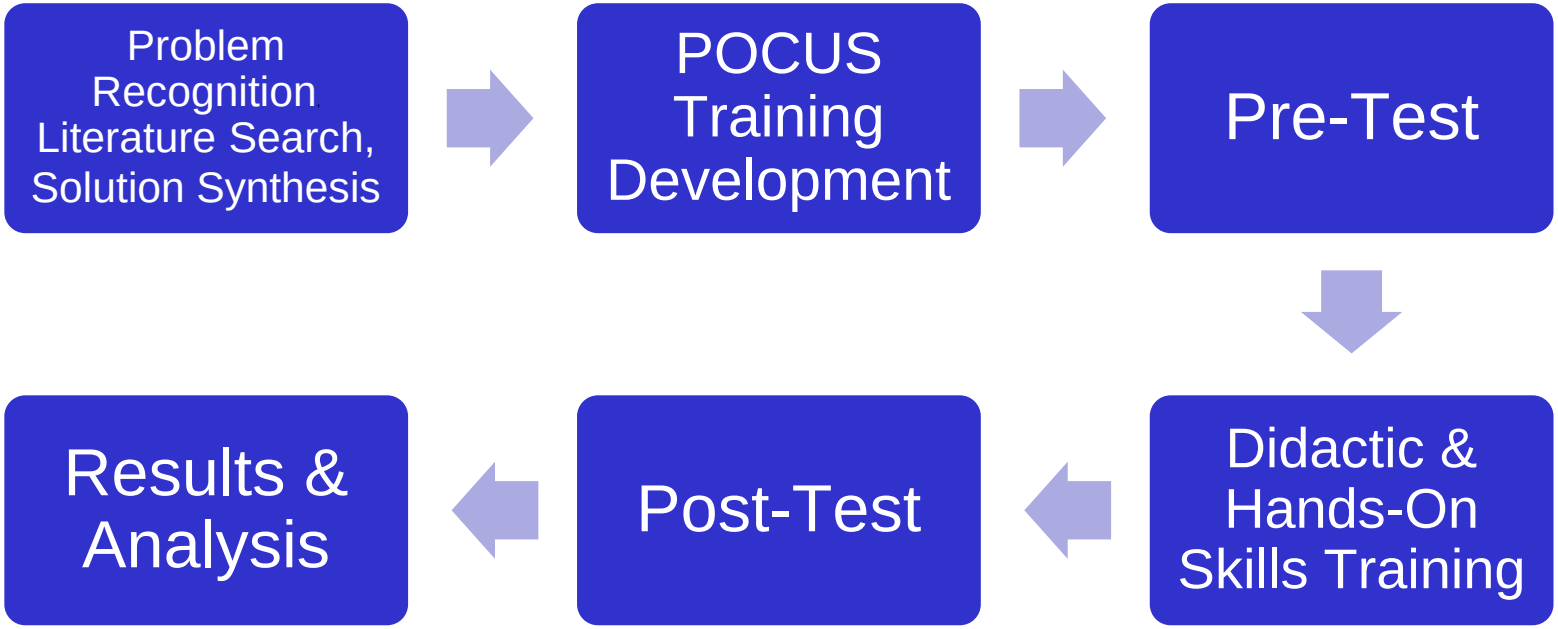
Project Overview



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Airway POCUS

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Clinical/System Question

Among anesthesia providers at Naval Medical Center Portsmouth (P), can didactic education combined with hands-on skills simulation of POCUS (I), when compared to provider baseline clinical ability (C), increase anesthesia providers' knowledge and demonstration of competency in post-training evaluation on airway POCUS (O)?

Determining a Difficult Airway

- Assessments to identify a difficult airway have been used since 1980s
  - Mallampati
  - Thyromental Distance
  - Mouth Opening
  - Inter-incisor distance
- Current practices have been shown to have poor specificity and sensitivity
- Airway POCUS has been shown to accurately identify patients with a difficult airway
  - Promotes safe and competent care and overcomes limitations with traditional physical examinations
- Examination of 406 insurance closed claims -> 46 cases revealed poor airway management
  - 74% of the patients received a preoperative airway assessment
    - 19 difficult airways and 11 non-difficult airways
    - 89% elective surgeries
    - ⅔ ASA 1 or 2

Balkal et al., 2021

Solution Synthesis

- Literature Review: Difficult airway prediction utilizing the distance of skin to epiglottis (DSE) cutoff:
  - >1.85 cm (sensitivity 80%, specificity 70.8%)
  - **>2.54 cm (sensitivity 91%, specificity 83%)**
  - >2.65 cm (predicted 100% of difficult airways)
- 2 hours of training (didactic, reading, educational videos, PowerPoint) produced success (identifying the correct landmark) in airway, gastric, lung, and cardiac US.
  - 88.3% success rate at an average of 36.9 seconds (after initial training)
  - 86.7% success rate at an average of 47.7 seconds (3 months post-training)

Haskins et. al (2021)

Airway POCUS Technique

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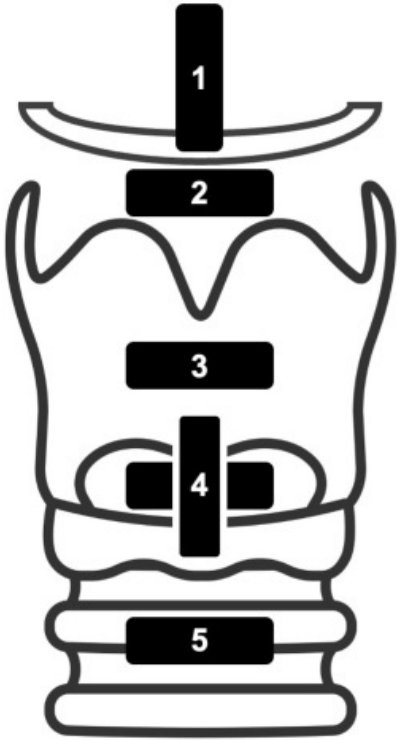
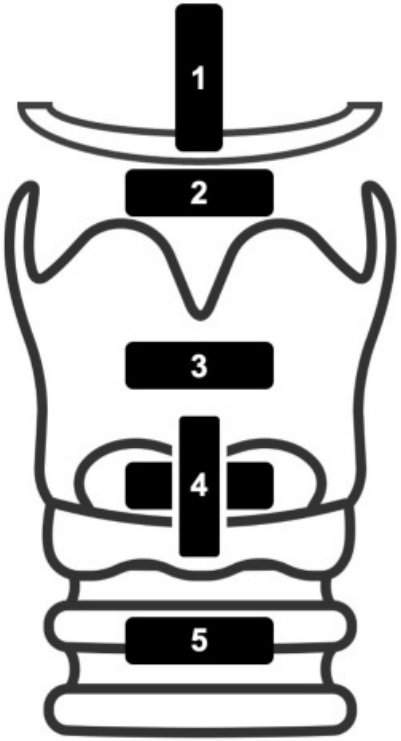
How to Ultrasound the Airway

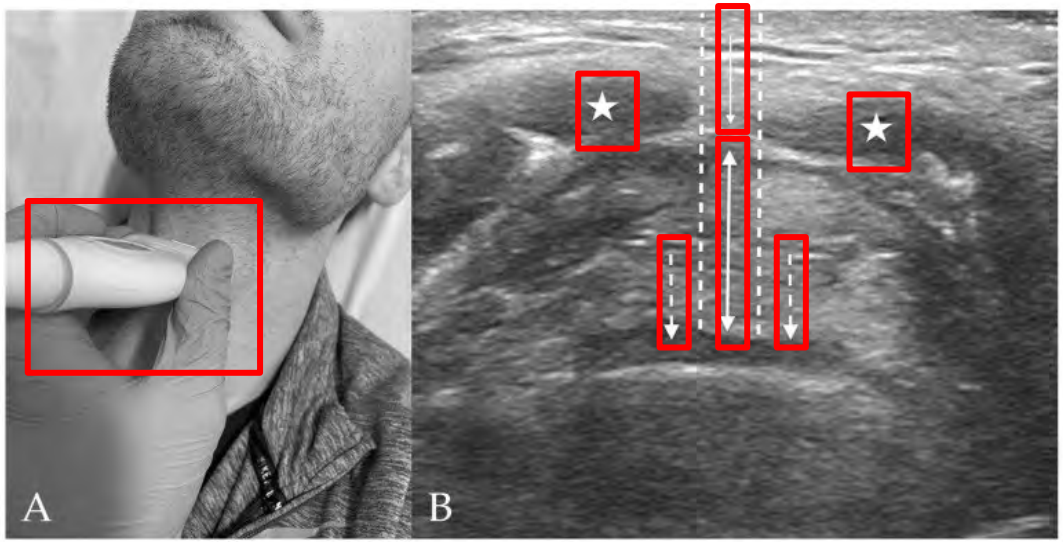


Upper Airway POCUS Views and Main Function
1. Suprahyoid: Oral space assessment
2. Thyrohyoid: Epiglottis identification
3. Thyroid: Vocal cord function
4. Cricothyroid: CTM identification
5. Suprasternal: ETT Confirmation

Lin et al., 2023

2: Thyrohyoid View





Lin et al., 2023

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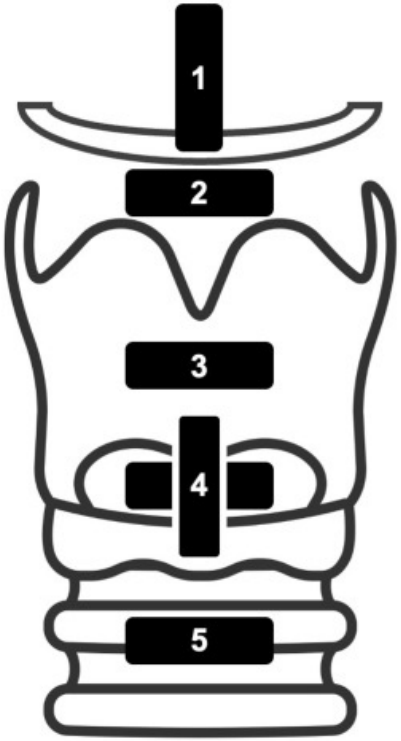
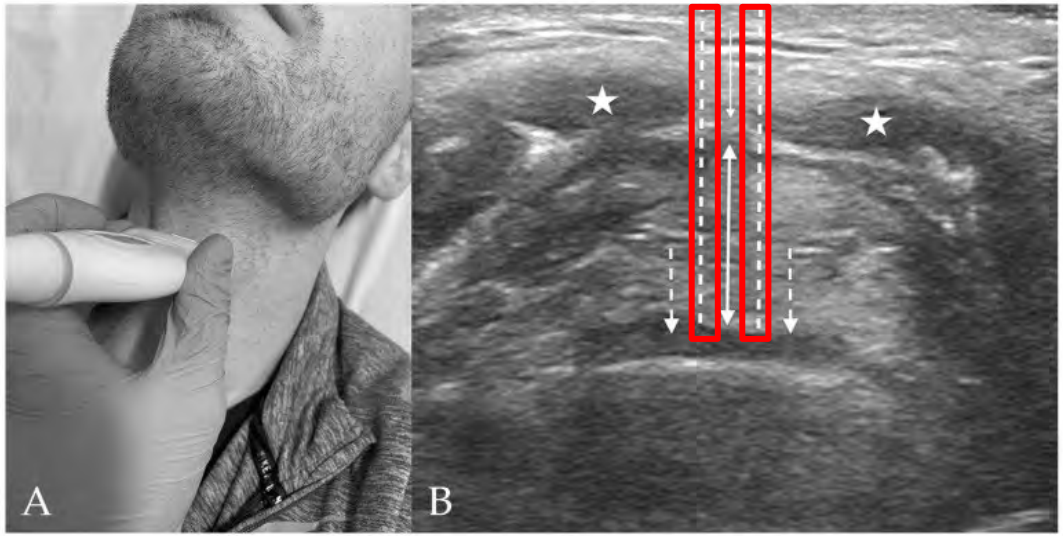
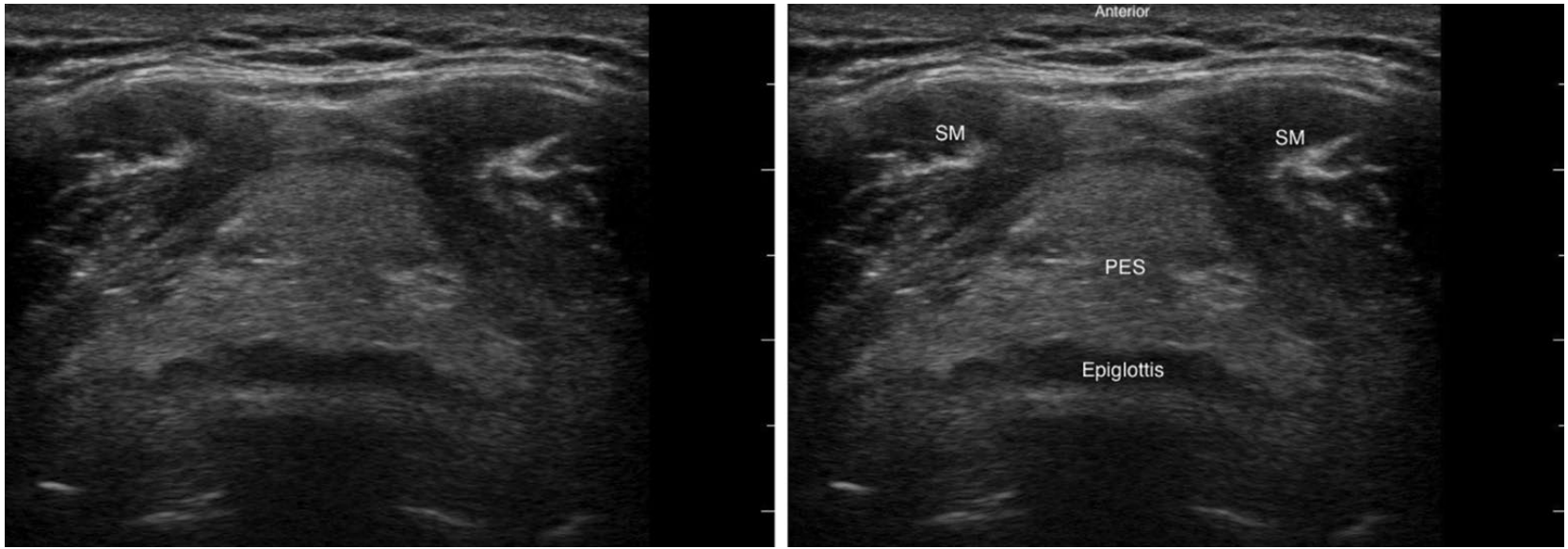




Lin et al., 2023

2: Thyrohyoid View



Kolli, S., 2021

Gastric POCUS

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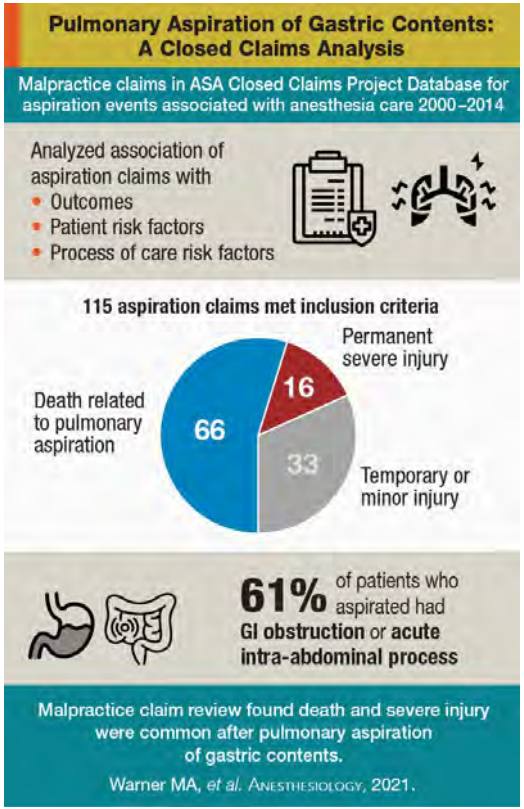
Problem Significance

- Pulmonary aspiration is a rare but serious perioperative complication
- Aspiration of gastric contents accounted for **115 of the 2,496 (5%)** claims in 2021 ASA Closed Claims Project
- Military Treatment Facility Data Review
  - Anesthesia complications from 2014-2023
  - **Reported suspected aspiration events**
  - Hospital admissions and mechanical ventilation requirements



Internal review of data, 2023 and Warner et al., 2021

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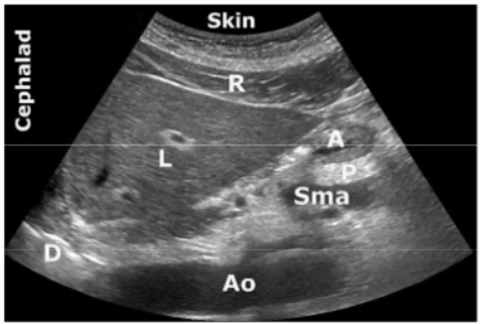
Solution Synthesis

- **How do we improve accuracy aspiration risk assessment?**
  - Evaluation tools: nasogastric or orogastric decompression, endoscopy and scintigraphy
  - Comparatively, gastric POCUS is a noninvasive, easily learned-skill and readily available in the perioperative environment
    - Existing anesthesia provider ultrasound proficiency
    - Average assessment time 3 minutes, 35 seconds
    - Providers required an average of 33 ultrasound examinations to achieve 95% accuracy



Upper abdominal sonographic image showing empty gastric antrum. (Perlas, et al., 2017)

Cieslak et al., 2020, Flynn et al., 2022 , Kruisselbrink et al., 2019 and Zhang et al., 2020

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Clinical/System Question

Among anesthesia providers at Naval Medical Center Portsmouth (P), can didactic education combined with hands-on skills simulation of point-of-care gastric ultrasound (I), when compared to provider baseline clinical ability (C), increase anesthesia providers' knowledge and demonstration of competency in a post-training evaluation on gastric POCUS (O)?

Gastric POCUS Technique

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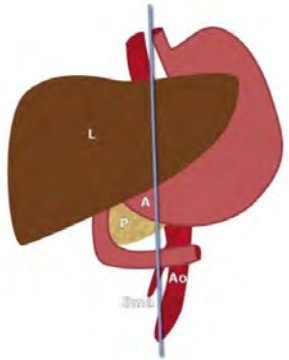
Technique Basics

- **Transducer:** Curvilinear low frequency (2-5 mHz)
- **Setting:** Abdominal exam
- **Transducer Position:** Scan in sagittal orientation beginning just below the xiphoid process
- **Position:** Supine followed by right lateral decubitus (RLD)
- **Goal:** Visualize the **gastric antrum** (GA) and distinguish between the following:
  - **Qualitative:** Empty or full, liquid or solid content
  - **Quantitative:** Baseline gastric secretions vs. increased gastric content

gastricpocus.org



Flynn et al, 2022 and Haskins et al, 2021, and Van de Putte & Buvet, 2023

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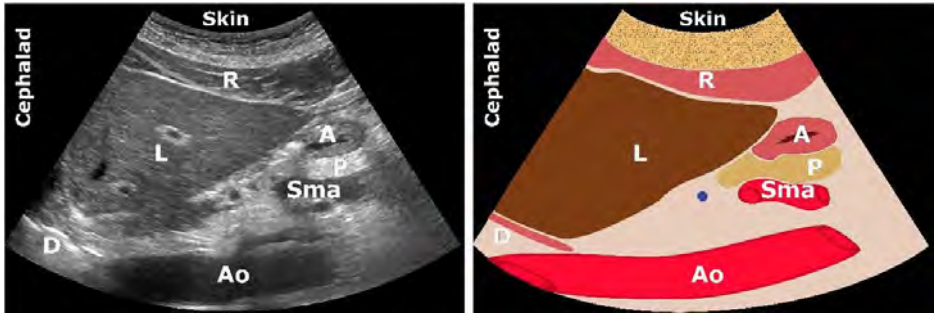

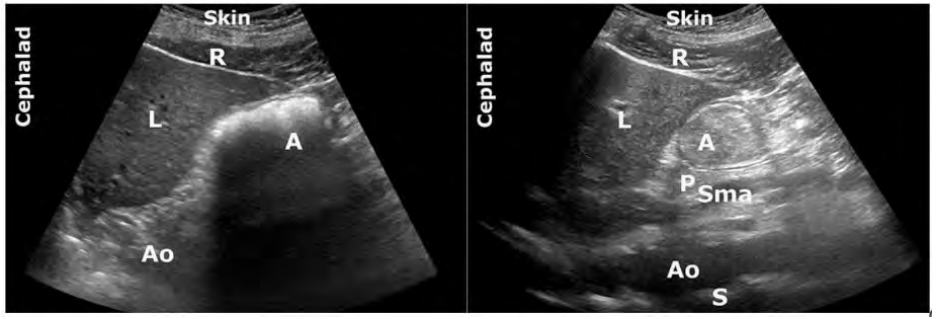

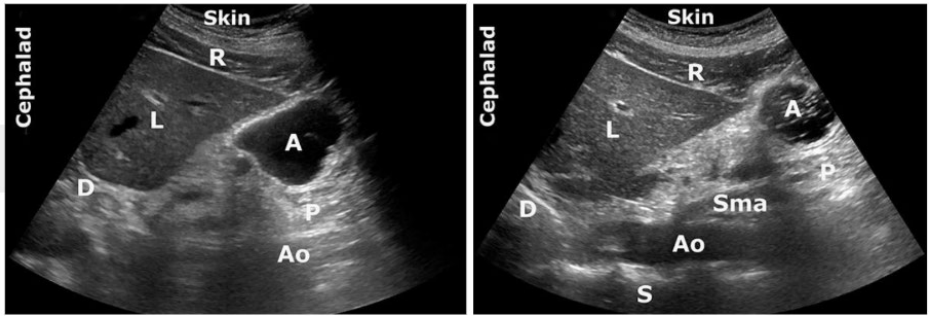

Qualitative Assessment: Empty

- Flat and collapsed or characteristic “bulls-eye” shape

Qualitative Assessment: Solid Content

- Frosted glass or hyperechoic appearance

Qualitative Assessment: Liquid Content

- Anechoic or hypoechoic appearance
- Starry night appearance

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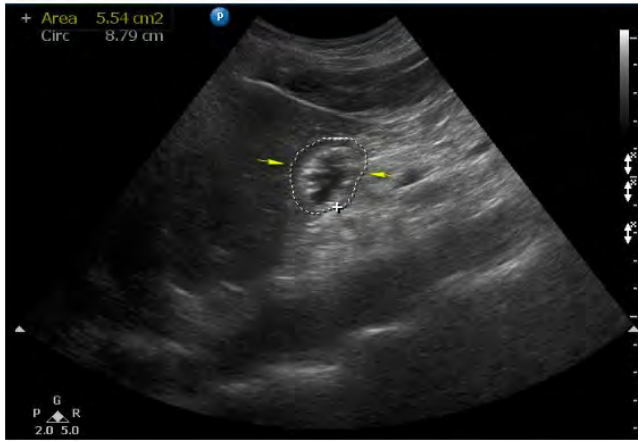
Flynn et al, 2022 and Haskins et al, 2021

Quantitative Assessment of Liquid Content

Goal: **Quantify** the amount of liquid content by measuring the cross sectional area (CSA) of the gastric antrum

VOLUME (ML) = 27.0 + (14.6 X RIGHT-LAT CSA) – 1.28 X AGE

Cutoff: < 1.5 ml/kg



Van de Putte & Buvet, 2023

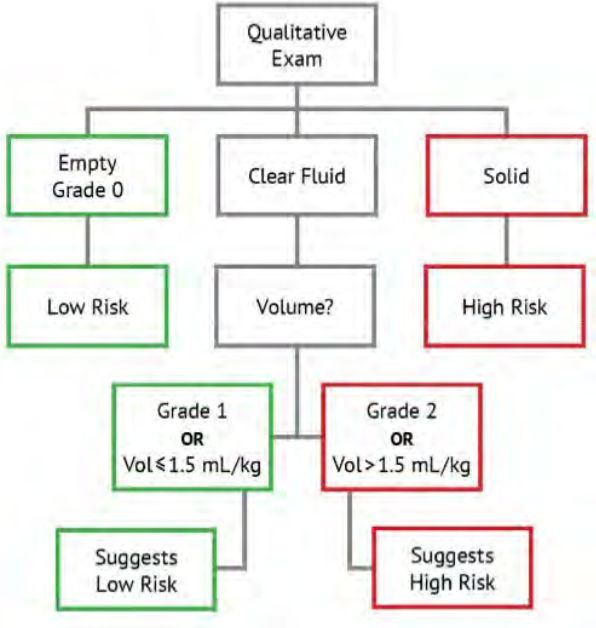
Right lat CSA (cm^2)	Age(y) 20	30	40	50	60	70	80
2	31	18	5	0	0	0	0
3	45	32	20	7	0	0	0
4	60	47	34	21	9	0	0
5	74	62	49	36	23	10	0
6	89	76	63	51	38	25	12
7	103	91	78	65	52	40	27
8	118	105	93	80	67	54	41
9	133	120	107	94	82	69	56
10	147	135	122	109	96	83	71
11	162	149	136	123	111	98	85
12	177	164	151	138	125	113	100
13	191	178	165	153	140	127	114
14	206	193	180	167	155	142	129
15	220	207	194	182	169	156	143
16	235	222	209	200	184	171	158
17	249	236	224	211	198	185	173
18	164	251	239	226	213	200	187
19	278	266	253	240	227	214	202
20	293	281	268	255	242	229	217
21	307	295	282	269	256	244	231
22	323	310	297	284	271	259	246
23	337	324	311	298	285	273	260
24	352	339	326	313	301	288	275
25	366	353	340	327	315	302	289
26	381	368	355	343	330	317	304
27	395	382	369	357	344	331	318
28	410	397	385	372	359	346	333
29	424	411	398	386	373	360	347
30	439	427	414	401	388	375	363

gastricpocus.org

Perlas et al., 2017, Flynn et al., 2022 and Delamarre, 2021

Interpretation and Summary

- Additional tool for assessment of patients at high risk for aspiration events
- Allows for qualitative and quantitative evaluation of gastric contents
- Provides information to incorporate into anesthetic management plan



Van de Putte & Buvet, 2023

Haskins et al., 2021 and Van de Putte et al., 2017

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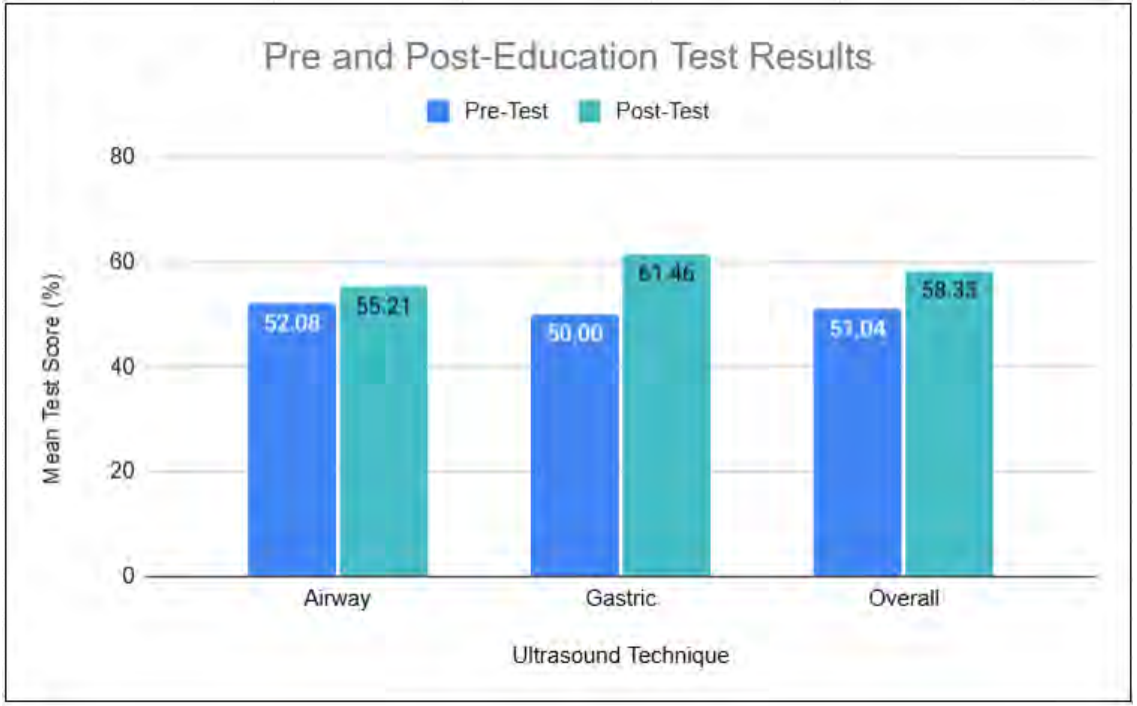
Findings

Preliminary Statistical Analysis



- Data findings
- Statistical analysis
- **Limitations**
- Future Steps

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Organizational Impact & Recommendations

Continuing Education	Collaboration with departmental POCUS training programs, involvement with MD and RNA residency programs, hands on skills practice
Practice Improvement	Via increased knowledge of techniques, potential for increased utilization in perioperative patient assessment
Patient Outcomes	Potential for more accurate identification of difficult airways and aspiration risk, expected improved patient outcomes and satisfaction

Thank you!

- NMCP Anesthesia Department
- CDR Katherine Kiddé, DNP, MSN, CRNA, USN, Senior Mentor
- CDR Stephanie Bonner, DNP, CRNA, USN, Project Mentor
- CDR Kenneth Barber, DNP, CRNA, USN, Project Mentor
- Andrea McGlynn, MS, NMCP Biostatistician
- VANA Winter Workshop Attendees

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References- Airway (Airway POCUS)

Abdelhady, B. S., Elrabiey, M. A., Abd Elrahman, A. H., & Mohamed, E. E. (2020). Ultrasonography versus conventional methods (Mallampati score and thyromental distance) for prediction of difficult airway in adult patients. *Egyptian Journal of Anaesthesia*, *36*(1), 83–89. https://doi.org/10.1080/11101849.2020.1768631

Alerhand, S. (2018). Ultrasound for identifying the cricothyroid membrane prior to the anticipated difficult airway. *The American Journal of Emergency Medicine*, *36*(11), 2078–2084. https://doi.org/10.1016/j.ajem.2018.07.027

Ambrose, R. S., Pannirselvam, S., & U, T. (2022). Measurement of neck circumference, tongue thickness and skin to epiglottis distance as predictors of difficult intubation: A prospective study. *Journal of Pharmaceutical Negative Results*, *13*(4), 1181–1185. https://doi.org/10.47750/pnr.2022.13.04.166

Balkal, V. C., Srinivasarangan, M., Akkamahadevi, P., & Javali, R. H. (2021). Diagnostic accuracy of ultrasound measurements of anterior neck soft tissue in determining a difficult airway. *Journal of Emergencies, Trauma, and Shock*, *14*(1), 33–37. https://doi.org/10.4103/jets.jets_12_20

Carsetti, Sorbello, M., Adrario, E., Donati, A., & Falcetta, S. (2022). Airway Ultrasound as Predictor of Difficult Direct Laryngoscopy: A Systematic Review and Meta-analysis. *Anesthesia and Analgesia*, *134*(4), 740–750. https://doi.org/10.1213/ANE.0000000000005839

Council on Accreditation. (2020, January). Approved revisions to the Accreditation Standards. https://www.coacrna.org/wp-content/uploads/2021/02/COA-Presentation-on-Revisions-to-Standards-and-Policies.pdf

Domino, K. B. (2020). Death and brain damage from difficult airway management: A "Never event." *Canadian Journal of Anesthesia/Journal Canadien D'anesthésie*, *68*(2), 169–174. https://doi.org/10.1007/s12630-020-01847-6

Falcetta, S., Cavallo, S., Gabbanelli, V., Pelaia, P., Sorbello, M., Zdravkovic, I., & Donati, A. (2018). Evaluation of two neck ultrasound measurements as predictors of difficult direct laryngoscopy. *European Journal of Anaesthesiology*, *35*(8), 605–612. https://doi.org/10.1097/eja.0000000000000832

References- Airway (Airway POCUS)

Haskins, S. C., Bronshteyn, Y., Perlas, A., El-Boghdadly, K., Zimmerman, J., Silva, M., Boretsky, K., Chan, V., Kruisselbrink, R., Byrne, M., Hernandez, N., Boublik, J., Manson, W. C., Hogg, R., Wilkinson, J. N., Kalagara, H., Nejim, J., Ramsingh, D., Shankar, H., … Narouze, S. (2021). American Society of Regional Anesthesia and pain medicine expert panel recommendations on point-of-care ultrasound education and training for regional anesthesiologists and pain physicians—part II: Recommendations. *Regional Anesthesia & Pain Medicine*, *46*(12), 1048–1060. https://doi.org/10.1136/rapm-2021-102561

Kolli, S. (2021, August 1). *POCUS Spotlight: Airway Ultrasound* . ASRA. https://www.asra.com/news-publications/asra-newsletter/newsletter-item/asra-news/2021/08/02/pocus-spotlight-airway

Lee, S. C., Yang, E. C., Navarro, J. C., Minard, C. G., Huang, X., & Deng, Y. (2022). An Introductory Point-of-Care Ultrasound Curriculum for an Anesthesiology Residency Program. *MedEdPORTAL : the journal of teaching and learning resources*, *18*, 11291. https://doi.org/10.15766/mep_2374-8265.11291

Lin, J., Bellinger, R., Shedd, A., Wolfshohl, J., Walker, J., Healy, J., Taylor, J., Chao, K., Yen, Y. H., Tzeng, C. T., & Chou, E. H. (2023). Point-of-Care Ultrasound in Airway Evaluation and Management: A Comprehensive Review. *Diagnostics (Basel, Switzerland)*, *13*(9), 1541. https://doi.org/10.3390/diagnostics13091541

Lobiondo-Wood, G., & Haber, J. (2022). *Nursing research: Methods and critical appraisal for evidence-based practice*. Elsevier.

Military Health System. (2023, January 13). *Defense health agency campaign plan*. Retrieved January 29, 2023, from https://www.health.mil/About-MHS/OASDHA/Defense-Health-Agency/DHA-Campaign-Plan

Moucharite, M. A., Zhang, J., & Giffin, R. (2021). Factors and Economic Outcomes Associated with Documented Difficult Intubation in the United States. *ClinicoEconomics and outcomes research: CEOR*, *13*, 227–239. https://doi.org/10.2147/CEOR.S304037

Oliveira, K. F., Arzola, C., Ye, X. Y., Clivatti, J., Siddiqui, N., & You-Ten, K. E. (2017). Determining the amount of training needed for competency of anesthesia trainees in ultrasonographic identification of the cricothyroid membrane. *BMC Anesthesiology*, *17*(1). https://doi.org/10.1186/s12871-017-0366-7

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References (Airway POCUS)

Riddle, D. (2023, September 26). *American Association of Nurse Anesthesiology Urges VA to Issue Evidence-Based National Practice Standards*. https://www.Aana.com/News/American-Association-Of-Nurse-Anesthesiology-Urges-Va-To-Issue-Evidence-Based-National-Practice-Standards/. Retrieved September 27, 2023.

Ritter, W. (1942). Become a Nurse. photograph, National Archives. Retrieved November 20, 2023, from https://fdr.artifacts.archives.gov/objects/15120/become-a-nurse?ctx=08081b234f9e769c6ad9f016c7f0497764dc84b8&idx=1.

Servicemembers' Group Life Insurance (SGLI). Veterans Affairs. (n.d.). https://www.va.gov/life-insurance/options-eligibility/sgli/#:~:text=If%20you%20have%20SGLI%20coverage,Injury%20Protection%20coverage%20(TSGLI).

You-Ten, K. E., Siddiqui, N., Teoh, W. H., & Kristensen, M. S. (2018). Point-of-care ultrasound (pocus) of the Upper Airway. *Canadian Journal of Anesthesia/Journal Canadien D'anesthésie*, *65*(4), 473–484. https://doi.org/10.1007/s12630-018-1064-8

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References (Gastric POCUS)

American Society of Anesthesiologists. Practice guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: Application to healthy patients undergoing elective procedures. (2017). *Anesthesiology*, *126*(3), 376– 393. https://doi.org/10.1097/aln.0000000000001452

Bisinotto, F. M., Pansani, P. L., Silveira, L. A., Naves, A. de, Peixoto, A. C., Lima, H. M., & Martins, L. B. (2017). Qualitative and quantitative ultrasound assessment of Gastric Content. *Revista Da Associação Médica Brasileira*, *63*(2), 134–141. https://doi.org/10.1590/1806-9282.63.02.134

Cieslak, J. R., Rice, A. N., Gadsden, J. C., & Vacchiano, C. A. (2020). Does ultrasonographic measurement of gastric content influence airway management decisions? *AANA Journal*, *88*(2), 107–113.

Dang, D., Dearholt, S., Bissett, K., Ascenzi, J., & Whalen, M. (2022). Johns Hopkins evidence-based practice for nurses and healthcare professionals: Model and guidelines. 4th ed. Sigma Theta Tau International Defense Health Agency. (2019). Quadruple aim performance process: Transforming process improvement. https://health.mil/Reference-Center/Presentations/2019/02/11/Quadruple Aim-Performance-Process-Transforming-Performance-Improvement

Delamarre, L., Srairi, M., Bouvet, L., Conil, J.-M., Fourcade, O., & Minville, V. (2021). Anaesthesiologists' clinical judgment accuracy regarding preoperative full stomach: Diagnostic study in urgent surgical adult patients. *Anaesthesia Critical Care & Pain Medicine*, *40*(3), 100836. https://doi.org/10.1016/j.accpm.2021.100836

Haskins, S. C., Bronshteyn, Y., Perlas, A., El-Boghdadly, K., Zimmerman, J., Silva, M., Boretsky, K., Chan, V., Kruisselbrink, R., Byrne, M., Hernandez, N., Boublik, J., Manson, W. C., Hogg, R., Wilkinson, J. N., Kalagara, H., Nejim, J., Ramsingh, D., Shankar, H. & Narouze, S. (2021). American Society of Regional Anesthesia and pain medicine expert panel recommendations on point-of-care ultrasound education and training for regional anesthesiologists and pain physicians—part II: Recommendations. *Regional Anesthesia & Pain Medicine*, *46*(12), 1048–1060. https://doi.org/10.1136/rapm-2021-102561

Holtan-Hartwig, I., Johnsen, L. R., Dahl, V., & Haidl, F. (2021). Preoperative gastric ultrasound in surgical patients who undergo rapid sequence induction intubation. *Trends in Anaesthesia and Critical Care*, *38*, 30–35. https://doi.org/10.1016/j.tacc.2021.04.005

Joshi, G. P., Abdelmalak, B. B., Weigel, W. A., Harbell, M. W., Kuo, C. I., Soriano, S. G., Stricker, P. A., Tipton, T., Grant, M. D., Marbella, A. M., Agarkar, M., Blanck, J. F., & Domino, K. B. (2023). 2023 American Society of Anesthesiologists Practice Guidelines for preoperative fasting: Carbohydrate-containing clear liquids with or without protein, chewing gum, and pediatric fasting duration—a modular update of the 2017 American Society of Anesthesiologists Practice Guidelines for preoperative fasting. *Anesthesiology*, *138*(2), 132–151. https://doi.org/10.1097/aln.0000000000004381

References (Gastric POCUS)

Kruisselbrink, R., Gharapetian, A., Chaparro, L. E., Ami, N., Richler, D., Chan, V. W., & Perlas, A. (2019). Diagnostic accuracy of point-of-care gastric ultrasound. *Anesthesia & Analgesia*, *128*(1), 89–95. https://doi.org/10.1213/ane.0000000000003372

Melnyk, B., & Fineout-Overholt, E. (2019). The Johns Hopkins Nursing Evidence-Based Practice Model. *Evidence-based practice in Nursing & Healthcare: A guide to best practice* (4th ed., pp. 412–416). Wolters Kluwer.

Mohammad Khalil, A., Gaber Ragab, S., Makram Botros, J., Ali Abd-aal, H., & Labib Boules, M. (2021). Gastric residual volume assessment by gastric ultrasound in fasting obese patients: A comparative study. *Anesthesiology and Pain Medicine*, *11*(1). https://doi.org/10.5812/aapm.109732

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. *Anaesthesia and Intensive Care*, *46*(6), 608–613. https://doi.org/10.1177/0310057x1804600612

Perlas, A., Arzola, C., & Van de Putte, P. (2017). Point-of-care gastric ultrasound and aspiration risk assessment: A narrative review. *Canadian Journal of Anesthesia/Journal Canadien D'anesthésie*, *65*(4), 437–448. https://doi.org/10.1007/s12630-017-1031-9

Perlas, A., Arzola, C., Portela, N., Mitsakakis, N., Hayawi, L., & Van de Putte, P. (2024). Gastric Volume and Antral Area in the Fasting State: A Meta-analysis of Individual Patient Data. *Anesthesiology*, *140*(5), 991–1001. https://doi.org/10.1097/ALN.0000000000004914

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*, *62*(10), 753–758. https://doi.org/10.4103/ija.IJA_147_18

Sharma, S., Deo, A. S., & Raman, P. (2018). Effectiveness of standard fasting guidelines as assessed by Gastric Ultrasound Examination: A clinical audit. *Indian Journal of Anaesthesia*, *62*(10), 747. https://doi.org/10.4103/ija.ija_54_18

Van de Putte, P., & Bouvet, L. (2023). *A point-of-care tool for aspiration risk assessment*. Gastric UltraSound. https://www.gastricultrasound.org/

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. *British Journal of Anaesthesia*, *118*(3), 363–371. https://doi.org/10.1093/bja/aew435

Zhang, G., Huang, X., Shui, Y., Luo, C., & Zhang, L. (2020). Ultrasound to guide the individual medical decision by evaluating the gastric contents and risk of aspiration: A literature review. *Asian Journal of Surgery*, *43*(12), 1142–1148. https://doi.org/10.1016/j.asjsur.2020.02.008