Measuring Adherence to High-Flow Nasal Cannula in Obese Patients During Esophagogastroduodenoscopy

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Abstract

Problem: Esophagogastroduodenoscopy (EGD) is a common procedure used to diagnose and treat various gastrointestinal disorders. Certain patient populations, such as those with obesity where BMI $\geq$ 30 kg/m^2, have a higher risk of hypoxia while under anesthesia for EGDs. Evidence shows that using high-flow nasal cannula (HFNC) during similar procedures decreases the risk of hypoxia (defined as SpO_2 < 90%) as compared to using other oxygen delivery devices. In the Endoscopy Unit at a large academic tertiary care hospital, only 12% of obese patients received HFNC during EGDs between October 2023 and February 2024. **Purpose:** The purpose of this quality improvement initiative was to promote the utility of HFNC in reducing the risk of hypoxia in obese patients undergoing EGDs. **Methods:** Using fliers, educational emails, and presentations, the project team informed the Anesthesia Department of the evidence promoting this practice change. Any anesthesia provider (including anesthesiologists, certified registered nurse anesthetists, and anesthesiologist assistants) caring for a patient scheduled for an EGD with a BMI $\geq$ 30 kg/m^2 was encouraged to utilize HFNC. Weekly retrospective chart audits of the electronic medical record were performed to record HFNC use and incidence of hypoxia during EGDs of eligible patients. **Results:** The quality improvement initiative was implemented over a 15-week period in the Fall of 2024 and impacted 332 patients and approximately 140 anesthesia providers. During the project implementation, 21.5% of patients received HFNC during EGDs and 23 total hypoxic events occurred. Only one hypoxic event occurred when HFNC was used. **Conclusions:** Data from this project is consistent with broader research and demonstrates the benefit of using HFNC to prevent hypoxia in obese patients during EGDs.

Keywords: high-flow nasal cannula, obesity, esophagogastroduodenoscopy, hypoxia

Measuring Adherence to High-Flow Nasal Cannula in Obese Patients During Esophagogastroduodenoscopy

Esophagogastroduodenoscopy (EGD) is a common procedure used to diagnose and treat gastrointestinal disorders such as gastroesophageal reflux disease, dysphagia, peptic ulcer disease, and celiac disease. To perform an EGD, an endoscope is inserted into the oropharynx and advanced through the esophagus, stomach, and duodenum (Ahlawat et al., 2024). Anesthesia providers (APs) administer sedation during EGDs, which is associated with a risk of adverse events including respiratory distress and subsequent hypoxia (Hung et al., 2022). Certain patient populations are associated with a higher risk of hypoxia while under sedation, such as those with obesity. These patients have a decreased functional residual capacity and are more prone to airway obstruction and respiratory depression (Yan et al., 2023). EGDs also limit the AP's access to the airway, which places the patient at an increased risk of hypoxia. Prolonged hypoxia can lead to cardiopulmonary complications and extended hospitalization (Carron et al., 2022).

The use of high-flow nasal cannula (HFNC) has grown in popularity for EGDs and similar procedures performed under anesthesia (Gu et al., 2022). HFNC can deliver oxygen concentrations up to 100% and flows up to 70 liters per minute (LPM), which increases positive airway pressure, reduces dead space, and decreases atelectasis (Carron et al., 2022 & Shukla et al., 2021). Conversely, a standard nasal cannula can only accommodate flows up to six LPM and a maximum oxygen concentration of 45% (Sharma et al., 2024).

In the Endoscopy Unit (EU) at an academic tertiary care hospital, chart audits performed from October 2023 to February 2024 revealed that 12% of patients with a body mass index (BMI) ≥ 30 kg/m^2 experienced hypoxia (defined as $SpO_2 < 90\%$) during EGDs. This problem had multiple root causes as listed in Appendix A, including the oxygen delivery system in place, patient acuity, and commitment to the current anesthesia workflow (see Appendix B). The process map in Appendix C demonstrates the desired workflow after implementing HFNC as the preferred oxygen delivery device for obese patients undergoing EGDs.

Available Knowledge & Specific Aims

The database PubMed was used to gather evidence-based research on the use of HFNC during EGDs for obese patients under anesthesia. The search terms “endoscopy”, “high flow nasal”, and “high flow oxygen” were used, which resulted in a total of 51 studies. The studies were then filtered out by publication date, population, intervention, and relevance, which left a total of seven studies for review. A PRISMA diagram of this screening process is displayed in Appendix D.

The seven studies included four meta-analyses and systematic reviews of randomized controlled trials (RCTs), two RCTs, and one randomized comparative pilot study. Carron et al. (2022), Gu et al. (2022), Hung et al. (2022), and Khanna et al. (2023) found in their meta-analyses and systematic reviews that the risk of desaturation during gastrointestinal endoscopic procedures was significantly less when using HFNC over conventional oxygen therapy, such as nasal cannula. In the RCTs carried out by Mazzeffi et al. (2021) and Nay et al. (2021), there was a significantly lower incidence of desaturation in the group using HFNC as compared to conventional oxygen therapy during gastrointestinal endoscopic procedures. Notably, Nay et al. (2021) defined hypoxia as $SpO_2 \leq 92\%$ and Mazzeffi et al. (2021) defined hypoxia as $SpO_2 \leq 92\%$ for greater than or equal to 15 seconds.

Conversely, in their pilot study, Shukla et al. (2021) found that the use of HFNC during endoscopic ultrasound did not significantly reduce a patient’s risk of desaturation. However, Shukla et al. (2021) did not specifically focus on an obese patient population (the average BMI in the HFNC group was 23.83) and all patients with diagnosed respiratory disorders such as obstructive sleep apnea were excluded from their study. The researchers also chose to define hypoxia as SpO2 ≤ 92% for greater than 10 seconds.

Among the studies included in the systematic reviews, only Riccio et al. (2019) investigated the use of HFNC in obese patients who underwent colonoscopies rather than EGDs. Still, the available evidence points to a lack of research in the obese patient population surrounding hypoxia during EGDs and optimal oxygen delivery devices. Also, while only one study out of the seven investigated oxygenation practices during EGDs exclusively (Mazzeffi et al., 2021), the gastrointestinal endoscopic procedures included in the other six studies were similar to EGDs in terms of airway instrumentation, risk of hypoxia, and the anesthetic administered. See Appendix E for the Evidence Review Table and Appendix F for the Evidence Review Synthesis Table.

The purpose of this quality improvement (QI) project was to implement the use of HFNC to reduce the risk of hypoxia in obese patients undergoing EGDs within the EU. The literature search performed to retrieve, appraise, and synthesize evidence identified HFNC as a viable and evidence-based solution to ameliorating this identified problem.

Rationale

The framework chosen to describe the implementation of this QI project was the Promoting Action on Research Implementation in Health Services (PARIHS) framework (see Appendix G). This framework unveils a project implementation in terms of evidence, context, and facilitation (Bergström et al., 2020). Evidence includes research, clinical knowledge, and patient experience as it relates to the project. For this project, evidence promoting HFNC as a beneficial practice change was shared with the project team and EU along with the chart audit data to support the reasoning behind the practice change.

Context refers to the site where the project will be implemented and takes into consideration the culture and leadership found within the environment. Considering this, the project team assessed the context of the EU and the anesthesia staff for receptiveness to a change in practice prior to project implementation. Finally, facilitation describes the methods used and personnel involved to implement the project. Through the dissemination of evidence and educational content, APs were empowered to choose HFNC as the oxygen delivery system of choice for their obese patients undergoing EGDs.

In this way, the three framework components (evidence, context, and facilitation) were considered simultaneously rather than in succession (Kitson et al., 1998). Additionally, the PARIHS framework aided in identifying barriers and enablers that impacted the implementation and success of the project. This allowed the project team to determine how successful the QI project would be within the environment's current context and how certain factors could be optimized to allow for the greatest chance of project success.

Methods

Understanding the context and culture of an environment was key to understanding how the QI implementation would progress. The Organizational Culture Assessment Questionnaire (OCAQ) was used to survey the context and culture of the EU in preparation for project implementation (Sashkin & Rosenbach, 1996). This questionnaire incorporated four functions when evaluating the culture of an organization: managing change, achieving goals, coordinating teamwork, and building a strong culture. The context in question, the EU at this hospital, scored 100 which is considered high by OCAQ standards.

The EU scored highest on questions that concerned overall goals and expectations but scored lower on managing change and coordinating teamwork. There appeared to be a disconnect between the practitioners and the administrators, where change occurred with insufficient input from staff. This was evident when a new wing of the hospital was opened without adequate education for staff on new workflows. This resulted in staff feeling they have little say in large-scale changes within the hospital. Additionally, there was a lack of coordinated teamwork within the anesthesia group. Anesthesia as a specialty can leave providers feeling isolated, which can lead to a lack of collaboration within a group. This particular institution also encounters a constant rotation of anesthesia trainees, which can contribute to a sense of instability. Additionally, APs practice within care areas across the institution (such as the operating room, EU, MRI, labor and delivery, and interventional radiology) which can lead to APs feeling sequestered and lacking resources.

The context assessment indicated that while there is a strong sense of direction and purpose within the institution, there is also a lack of collaboration and cohesion. APs were accustomed to practicing in their specific way, which made it difficult to spearhead changes in practice. This made the impact of good and consistent evidence paired with support from stakeholders both key parts to implementing this QI project.

This evidence-based intervention was aimed to empower staff to choose HFNC for oxygen delivery in obese patients undergoing EGDs during the 15-week implementation period from September 2024 to December 2024. In order to ensure a successful roll-out of this intervention, Specific, Measurable, Achievable, Relevant and Time-bound (SMART) goals were used to guide the project's progress. Two SMART structure goals were to distribute HFNC informational flier to 100% of staff and to ensure availability of HFNC equipment by the first week of implementation. These goals were continually assessed by ensuring the HFNC protocol was distributed to all members of the Anesthesia Department. A SMART process goal was to ensure 100% of all eligible patients received HFNC during their EGDs. This was tracked by performing retrospective chart audits to determine percentage of eligible patients receiving HFNC. Finally, the SMART outcome goal was to aim for a 0% incidence of hypoxic events during EGDs by the end of project implementation. This outcome goal was also assessed via retrospective chart audits in the same manner.

Various members of the project team were responsible for directing and assessing different SMART goals. The clinical site representative (CSR) and doctor of nursing practice project lead (DNP PL) were responsible for educating staff, distributing informational handouts, and ensuring equipment availability. Both the CSR and DNP PL used implementation strategies and tactics as described by Bingham & Main (2010) and Powell et al. (2015), such as collaborating with early-adopters, identifying project champions, scheduling regular meetings and discussions, conducting ongoing trainings, and developing and distributing educational materials.

The DNP PL was responsible for performing chart audits to track applicable goal progress on a weekly basis. See Appendix H for a Gantt chart detailing the timeline of the various phases of the implementation.

Measures

Data was collected using a chart audit tool developed in REDCap software. The chart audit tool allowed tracking of patient demographic information, use of intraprocedural oxygen devices, and outcomes such as hypoxia. All data entered into this chart audit tool was gathered via retrospective chart audits of the anesthesia records of eligible patients. This tool allowed the

DNP PL to input data for each patient that fits the criteria for the intervention (i.e., has BMI ≥ 30 kg/m^2 undergoing EGDs). As seen in Appendix I, the chart audit tool developed by the DNP PL was comprised of several fields. The first fields concerned demographic information, such as the patient medical record number, date of procedure, type of procedure (EGD or EGD/colonoscopy), age, and BMI. The next field asked if there was a hypoxic event during the procedure, with an SpO2 reading on the anesthesia record less than 90%. The DNP PL either input “no”, which stopped the form, or “yes”, which opened a field that asks to input the lowest oxygen saturation recorded during the procedure. The final question asked the DNP PL to select the method of oxygen delivery utilized during the procedure. This field is a select-all-that-apply, and the DNP PL can choose nasal cannula, face mask, HFNC, laryngeal mask airway, and endotracheal tube. Patient records were reviewed individually by the DNP PL to ensure all eligible patients were included.

Analysis

Data analysis was performed to draw inferences from the collected data and assess the overall success of the implementation. Data was collected weekly as described above via retrospective chart audits. As the data was collected, it was important to account for variability in the results and to determine whether this variability is random or due to an intentional contextual factor. The data was tabulated, entered in REDCap, and added to a run chart on a weekly basis. The presence of runs, shifts, or trends on the run charts would demonstrate evidence of a statistically significant change due to the intervention. The first run chart depicted the adherence to HFNC during EGDs on a weekly basis (see Figure 1). The second run chart showed the incidence of hypoxia during EGDs on a weekly basis (see Figure 2).

Other data analysis techniques included running descriptive statistics such as frequencies, percentages, medians, and means. These results revealed meaningful information, such as average BMI of the patients undergoing EGDs. In Table 1, the frequency of procedures performed (whether EGD alone or a combination EGD/colonoscopy) is shown, as well as the frequency of each oxygen device used. As seen in the data in Table 2, hypoxic events are divided out by procedure performed and oxygen device used.

Ethical Considerations

In compliance with HIPAA, planned actions were put in place to protect patients and their information and privacy and confidentiality during implementation and data collection. Chart audits were conducted using a password-protected virtual private network and the data was collected in REDCap, a HIPAA-compliant program. Additionally, the data was de-identified and only accessed on a need-to-know basis by immediate members of the project team. No threat of physical or psychological harm was inflicted on the patients on behalf of the intervention.

This project underwent a review process through the Human Research Protections Office (HRPO) of the Institutional Review Board (IRB) at the University of Maryland School of Medicine and was determined to be non-human subject's research. Furthermore, the project was assessed to be conforming with all ethical responsibilities.

The author has no conflicts of interest to disclose and is up to date on all CITI and HIPAA certifications. At the conclusion of the project, aggregated data was disseminated to site and externally with permission.

Results

Over the 15-week implementation period, 339 patients were eligible to receive HFNC during their procedure in the EU. Of those 339 patients, HFNC was used in 74 patients (21.8%).

The results were displayed in a run chart by week as seen in Figure 1, with each data point displaying the percentage of eligible patients who received HFNC during their procedure. The target goal was for 100% of all eligible patients to receive HFNC. The run chart in Figure 1 revealed a positive upward trend through week eight, indicating a correlation between the implementation and increased HFNC use. However, the run chart indicated a negative trend after week ten, which revealed the waning effects of the implementation's educational techniques.

According to the post-implementation data, the average HFNC use across the 15-week implementation period was 21.8%. This is a significant increase from the pre-implementation data which averaged HFNC use at 12%. The incidence of hypoxia was depicted by a run chart seen in Figure 2, with the percentage of hypoxic events displayed each week. The target goal for hypoxic events was 0%, but data showed that across the implementation period the average incidence of hypoxic events during eligible procedures was 8%. There was no pre-implementation data to compare this metric against. While the goal of 100% compliance with HFNC was not reached, the data demonstrates that the implementation strategies were effective in increasing the use of HFNC among APs for these procedures. There was no clear relationship depicted between the run charts in Figure 1 and Figure 2, as the run chart in Figure 2 included an aggregate of all hypoxic events regardless of oxygen device used.

Of the 339 eligible patients, the average BMI was 35.06, with a minimum and maximum BMI of 30.04 and 73.02, respectively. As seen in Table 1, 205 patients (60.5%) underwent EGDs and 134 (39.5%) underwent a combination EGD and colonoscopy procedure. During these procedures, nasal cannula was the most commonly used oxygen device (68%) followed by HFNC (21.8%). During the remaining procedures, the oxygen devices used include endotracheal tube (5.6%), LMA (3%), face mask (0.9%), and Jackson-Rees circuit (0.3%). There was one missing value where the oxygen device was not documented on the anesthesia record (0.3%).

The incidence of hypoxic events divided out by procedure type and oxygen device used was depicted in Table 2. Over the implementation period, there were 27 hypoxic events that occurred during EGDs, or 8% of all procedures. Of the 27 hypoxic events, 12 occurred during EGDs (44.4%) and 15 occurred during EGD/colonoscopies (55.6%). According to this data, there was not a meaningful difference by procedure when hypoxic events occurred. During these 27 hypoxic events, nasal cannula was used during 23 of them (88.5%). An endotracheal tube was the oxygen device used during two hypoxic events (7.7%), with a face mask (3.8%) and HFNC (3.8%) being used during one hypoxic event each. Most notably, only one hypoxic event occurred when the patient was administered HFNC by the AP. This demonstrates the effectiveness of HFNC in reducing the risk of desaturations during EGDs for obese patients, which correlates with available evidence on the subject.

The facilitators of this project included the CSR, DNP PL, and NP who promoted and assisted in education surrounding HFNC use. Additionally, several of the APs frequently used HFNC during their cases in the EU and became resources for other APs who felt inclined to use the device as well. Barriers included the frequent turnovers of APs and students who provided anesthesia in the EU. New anesthesia students rotated through the site on a monthly basis, which made it difficult to ensure all APs were adequately educated on the HFNC device. Another reported barrier was having only one HFNC available between six procedural suites. Additionally, the disposable nasal cannula portion of the device was not always kept in stock, which prevented the APs from using the HFNC. This indicated that increased communication is needed between anesthesia leadership and the support staff responsible for restocking equipment.

Discussion

Pre-implementation data of the site showed that only 12% of patients with a BMI greater than or equal to 30 were administered HFNC during EGDs. A root case analysis revealed multiple reasons behind APs not choosing HFNC as their primary choice for oxygen delivery. First, there was only one HFNC device available in the EU to share between six procedural suites. Also, the combination of the prolonged set-up and takedown time of the device paired with quick turnover between cases in the EU discouraged many APs from utilizing HFNC. After the implementation strategies were put into effect, post-implementation data revealed that HFNC increased to 21.8% over the 15-week period. Additionally, only one of the hypoxic events recorded occurred when HFNC was used, demonstrating the efficacy of HFNC in preventing hypoxia. Promoting the use of HFNC for EGDs is in accordance with evidence-based practices. Current evidence shows that the risk of desaturations during procedures like EGDs are significantly reduced when HFNC is used (Carron et al, 2022; Gu et al., 2022; Hung et al., 2022; Khanna et al., 2023; Mazzeffi et al., 2021; and Nay et al., 2021). Therefore, the increased use of HFNC by APs follows the evidence in optimizing patient outcomes during EGDs.

The strategies implemented by the project team to increase HFNC use did not result in additional financial costs for the Anesthesia Department. Furthermore, the HFNC device was already available and ready for use in the EU, it was just a matter of encouraging APs to utilize it for certain patients and procedures. Some providers were unfamiliar with the HFNC device, particularly on how to set it up in the procedural suite, which discouraged them from using it. By educating the department on the simple measures required to set up the device, the project team hoped to empower APs to use HFNC more often in their practice. Another major barrier was the single HFNC that was shared among the entire Anesthesia Department. Even if an AP was empowered to use the device, it may already be in use by another AP or off the EU entirely being used in another anesthetizing location. Of note, after the implementation period a second HFNC device was obtained by the department, leaving two total HFNC devices to be used by the EU exclusively. Hopefully this empowers more APs to use the device for their patients who would benefit from it most.

Conclusion

The use of HFNC in select patient populations and procedures is growing within the field of anesthesia as a promising strategy to optimize patient outcomes both during and after surgery. The benefits of using such an oxygen delivery device is well-described in the literature as well as within the results of this QI project. While the goal of 100% compliance with HFNC was not reached, there was still a significant increase in its use for obese patients undergoing EGDs. This increase improved perioperative safety and postoperative outcomes for the 74 patients who received HFNC during the implementation period. With the addition of another HFNC device within the EU, hopefully many more patients can benefit from this newer technology in the future at this site.

The promising results of this QI project hopefully can be used to empower future APs and their anesthesia trainees to use HFNC for their patients. With the acquisition of even more HFNC devices, its use can become even more widespread and commonplace. The benefits of quality improvement and translation of evidence into practice by advance practice providers was clearly demonstrated here, and hopefully the results will lead to the implementation of other quality improvement projects in the future. Additionally, education on alternative oxygenation techniques should be implemented in anesthesia training programs, so future APs are familiar with and empowered to use HFNC in their regular practice.

References

Ahlawat, R., Hoilat, G. J., & Ross, A. B. (2024). Esophagogastroduodenoscopy. In StatPearls. StatPearls Publishing. http://www.ncbi.nlm.nih.gov/books/NBK532268/

Bergström, A., Ehrenberg, A., Eldh, A. C., Graham, I. D., Gustafsson, K., Harvey, G., Hunter, S., Kitson, A., Rycroft-Malone, J., & Wallin, L. (2020). The use of the PARIHS framework in implementation research and practice—A citation analysis of the literature. *Implementation Science*, *15*(1), 68. https://doi.org/10.1186/s13012-020-01003-0

Bingham, D. & Main, E. (2010). Effective implementation strategies and tactics for leading change on maternity units. *Journal of Perinatal and Neonatal Nursing*, *24*(1), 32-42.

Carron, M., Tamburini, E., Safaee Fakhr, B., De Cassai, A., Linassi, F., & Navalesi, P. (2022). High-flow nasal oxygenation during gastrointestinal endoscopy: Systematic review and meta-analysis. *British Journal of Anaesthesia*, *4*(C), 100098. https://doi.org/10.1016/j.bjao.2022.100098

Gu, W. J., Wang, H. T., Huang, J., Pei, J. P., Nishiyama, K., Abe, M., Zhao, Z. M., & Zhang, C. D. (2022). High flow nasal oxygen versus conventional oxygen therapy in gastrointestinal endoscopy with conscious sedation: Systematic review and meta-analysis with trial sequential analysis. *Digestive Endoscopy*, *34*(6), 1136–1146. https://doi.org/10.1111/den.14315

Hung, K. C., Chang, Y. J., Chen, I. W., Soong, T. C., Ho, C. N., Hsing, C. H., Chu, C. C., Chen, J. Y., & Sun, C. K. (2022). Efficacy of high flow nasal oxygenation against hypoxemia in sedated patients receiving gastrointestinal endoscopic procedures: A systematic review and meta-analysis. *Journal of Clinical Anesthesia*, 77, 110651. https://doi.org/10.1016/j.jclinane.2022.110651

Khanna, P., Haritha, D., Das, A., Sarkar, S., & Roy, A. (2023). Utility of high-flow nasal oxygen in comparison to conventional oxygen therapy during upper gastrointestinal endoscopic procedures under sedation: A systematic review and meta-analyses. *Indian Journal of Gastroenterology*, *42*(1), 53–63. https://doi.org/10.1007/s12664-022-01308-6

Kitson, A., Harvey, G., & McCormack, B. (1998). Enabling the implementation of evidence based practice: A conceptual framework. *Quality in Health Care : QHC*, *7*(3), 149–158.

Mazzeffi, M. A., Petrick, K. M., Magder, L., Greenwald, B. D., Darwin, P., Goldberg, E. M., Bigeleisen, P., Chow, J. H., Anders, M., Boyd, C. M., Kaplowitz, J. S., Sun, K., Terrin, M., & Rock, P. (2021). High-flow nasal cannula oxygen in patients having anesthesia for advanced esophagogastroduodenoscopy: HIFLOW-ENDO, a randomized clinical trial. *Anesthesia and Analgesia*, *132*(3), 743–751. https://doi.org/10.1213/ANE.0000000000004837

Nay, M.A., Fromont, L., Eugene, A., Marcueyz, J.L., Mfam, W.-S., Baert, O., Remerand, F., Ravry, C., Auvet, A., & Boulain, T. (2021). High-flow nasal oxygenation or standard oxygenation for gastrointestinal endoscopy with sedation in patients at risk of hypoxaemia: A multicentre randomised controlled trial (ODEPHI trial). *British Journal of Anaesthesia*, *127*(1), 133–142. https://doi.org/10.1016/j.bja.2021.03.020

Powell, B. J., Waltz, T. J., Chinman, M. J., Damschroder, L. J., Smith, J. L., Matthieu, M. M., Procter, E.K., & Kirchner, J. E. (2015). A refined compilation of implementation strategies: Results from the Expert Recommendations for Implementing Change (ERIC) project. *Implementation Science*, *10*(1), 21. Retrieved from https://implementationscience.biomedcentral.com/articles/10.1186/s13012-015-0209-1

Riccio, C. A., Sarmiento, S., Minhajuddin, A., Nasir, D., & Fox, A. A. (2019). High-flow versus standard nasal cannula in morbidly obese patients during colonoscopy: A prospective, randomized clinical trial. *Journal of Clinical Anesthesia*, 54, 19–24. https://doi.org/10.1016/j.jclinane.2018.10.026

Sashkin, M., & Rosenbach, W. E. (1996). *Organizational culture assessment questionnaire*. Ducochon Press.

Sharma, S., Danckers, M., Sanghavi, D. K., & Chakraborty, R. K. (2024). High-Flow Nasal Cannula. In StatPearls. StatPearls Publishing. http://www.ncbi.nlm.nih.gov/books/NBK526071/

Shukla, K., Parikh, B., Kumar, A., & Nakra, M. (2021). Comparative evaluation of efficacy of oxygenation using high flow nasal cannula vs. conventional nasal cannula during procedural sedation for endoscopic ultrasound: A pilot study. *Journal of Anaesthesiology, Clinical Pharmacology*, *37*(4), 648–654. https://doi.org/10.4103/joacp.JOACP_371_20

Yan, L., Wang, X., Du, K., & Liang, Y. (2023). Effect of inspiratory muscle training on hypoxemia in obese patients undergoing painless gastroscopy: Protocol for a single-center, double-blind, randomized controlled trial. *Frontiers in Medicine*, 10, 1269486. https://doi.org/10.3389/fmed.2023.1269486

Table 1

Procedure Type and Oxygen Device Use

Variable	n	%
Procedure type		
EGD	205	60.5
EGD/colonoscopy	134	39.5
Oxygen device used		
Nasal cannula	230	68.0
High-flow nasal cannula	74	21.8
Endotracheal tube	19	5.6
Laryngeal mask airway	10	3.0
Face mask	3	0.9
Jackson-Rees circuit	1	0.3
Missing value	1	0.3

Table 2

Incidence of Hypoxic Events By Procedure and Oxygen Device

Variable	n	%
Did a hypoxic event occur		
Yes	27	8.0
No	312	92.0
Hypoxic event by procedure		
EGD	12	44.4
EGD/colonoscopy	15	55.6
Hypoxic event by oxygen device		
Nasal cannula	23	88.5
Endotracheal tube	2	7.7
Face mask	1	3.8
High-flow nasal cannula	1	3.8
Laryngeal mask airway	0	0.0

Figure 1

Run Chart of Adherence to High-Flow Nasal Cannula

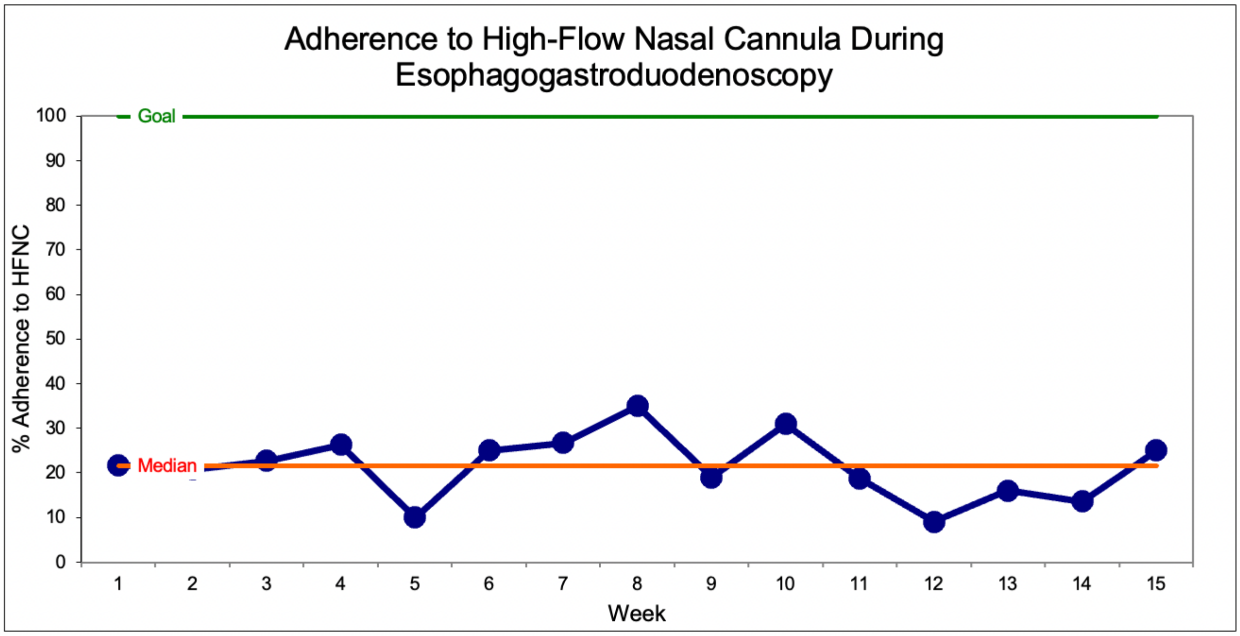
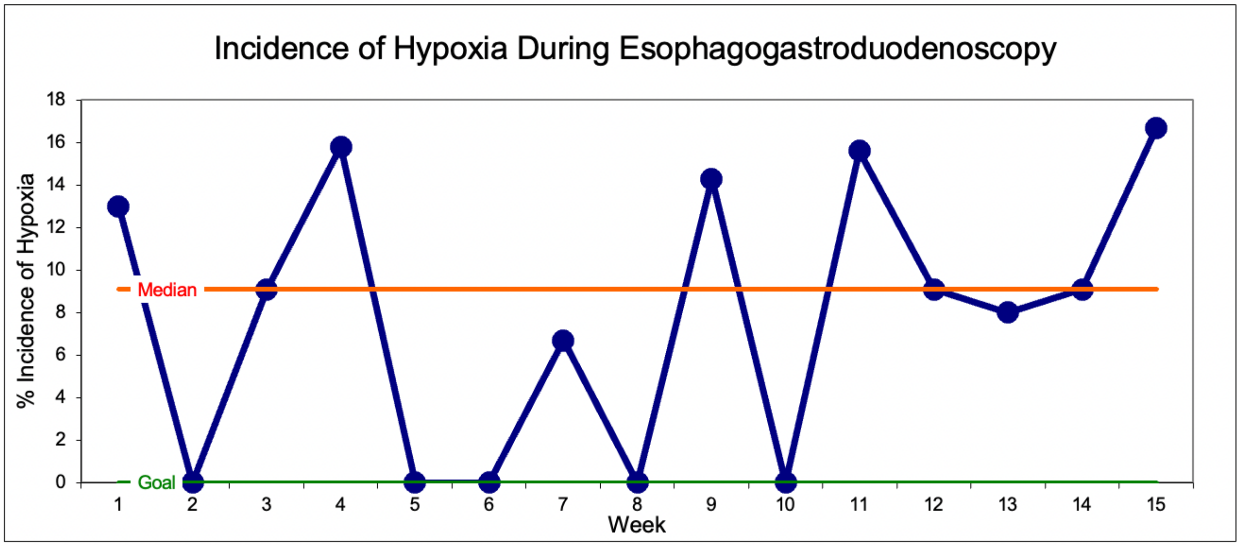
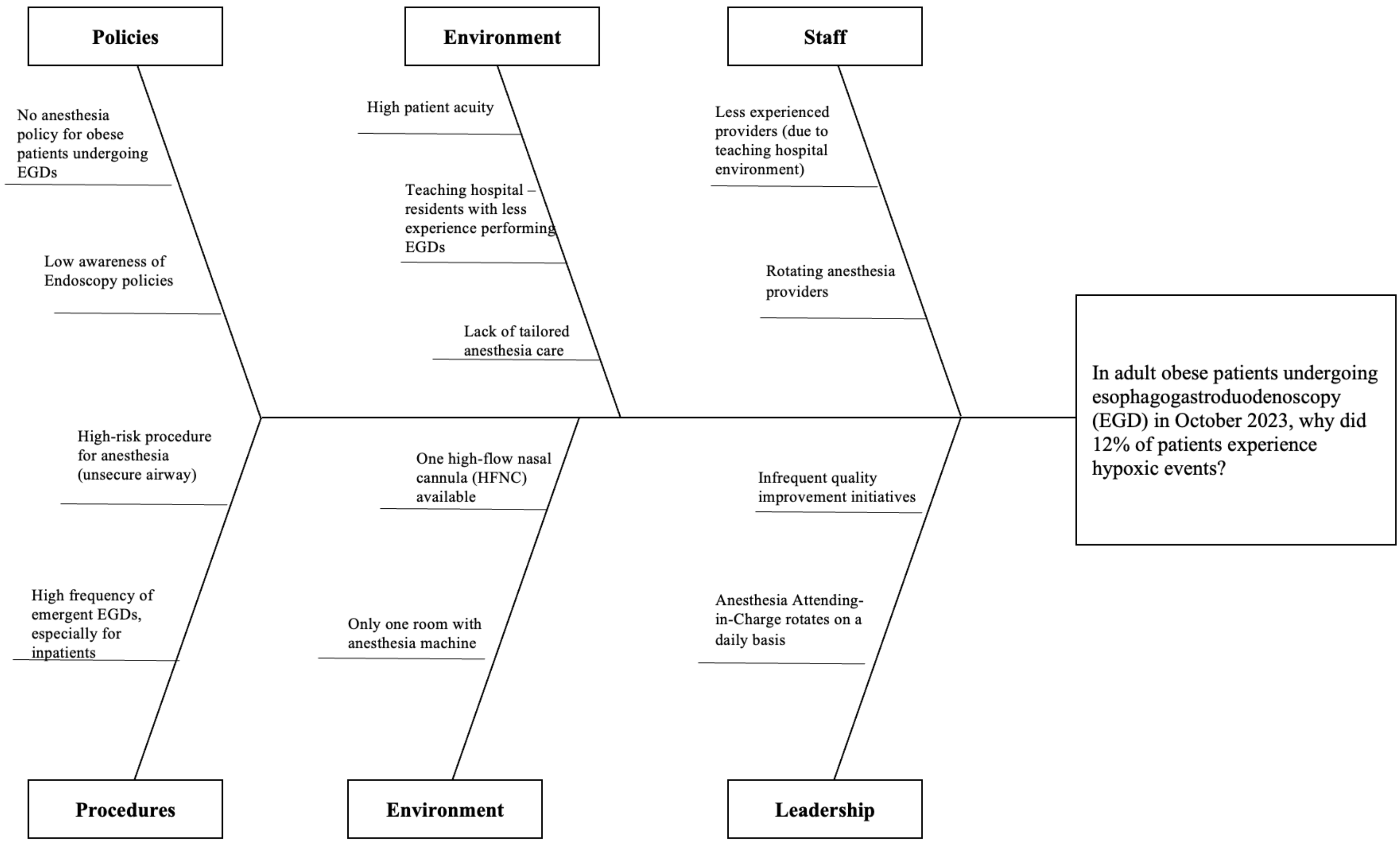


Figure 2

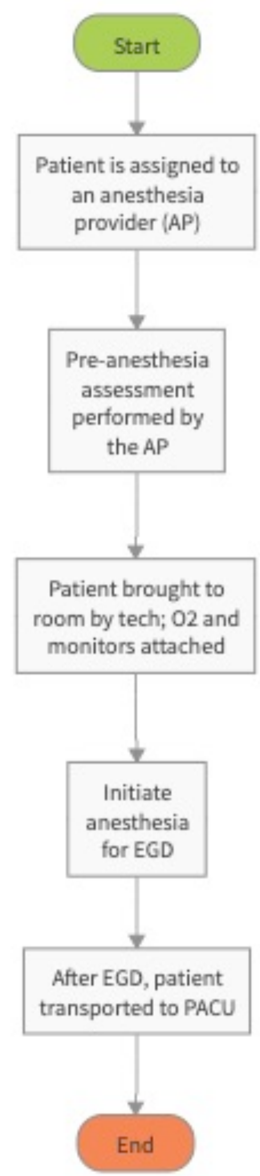
Run Chart of Incidence of Hypoxia During Esophagogastroduodenoscopy



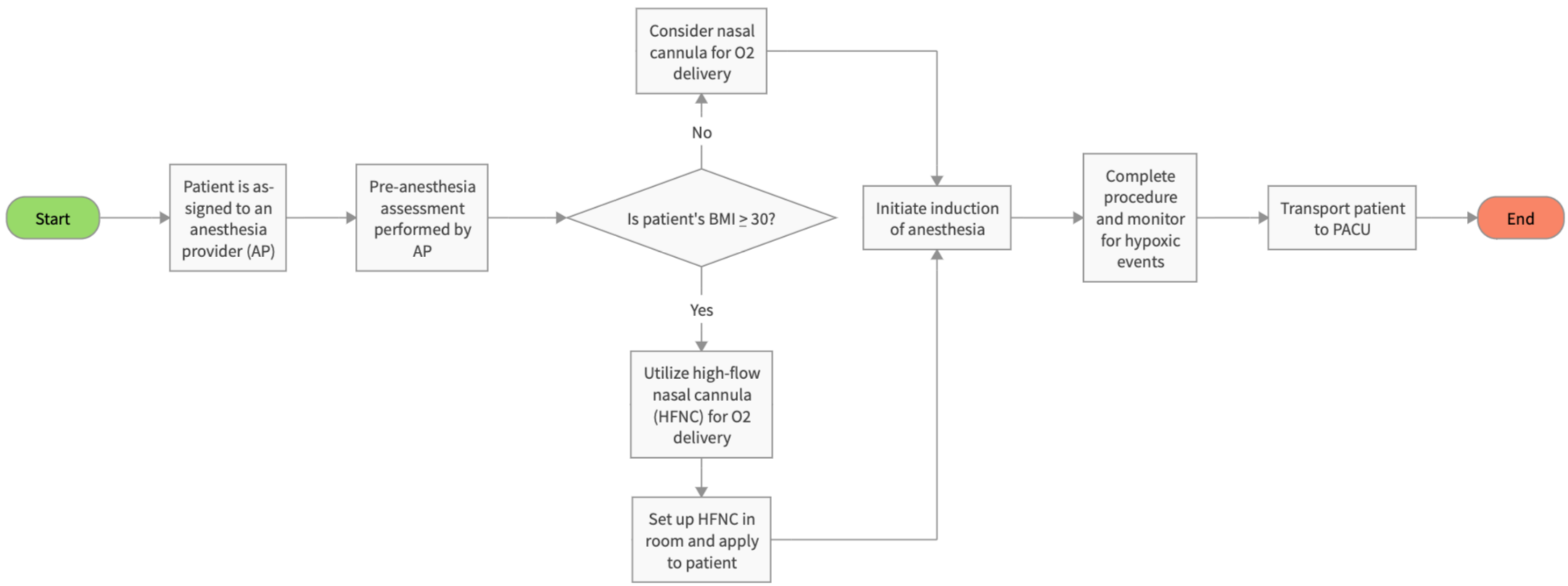
Appendix A
Fishbone Diagram



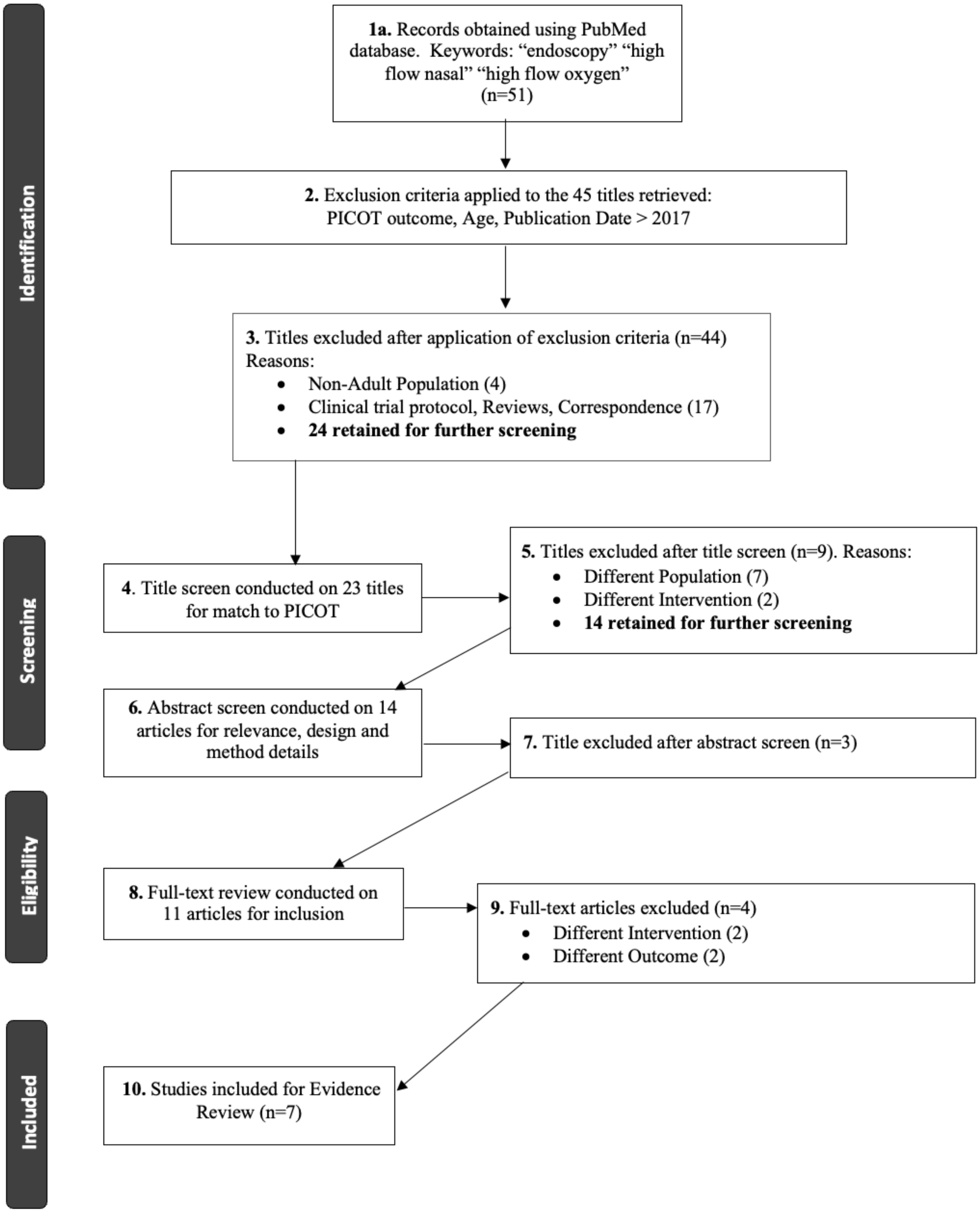
Appendix B
Current Process Map



Appendix C
Desired Process Map



Appendix D
PRISMA Diagram



Appendix E
Evidence Review Table

Carron, M., Tamburini, E., Safaee Fakhr, B., De Cassai, A., Linassi, F., & Navalesi, P. (2022). High-flow nasal oxygenation during gastrointestinal endoscopy: Systematic review and meta-analysis. *British Journal of Anaesthesia*, *4*(C), 100098. https://doi.org/10.1016/j.bjao.2022.100098					Level: I-B
Purpose/ Hypothesis	**Type of Evidence and Research Design**	**Sample – Population, Size, Setting**	**Intervention/ Procedures**	**Primary Outcome Measures**	**Results/Conclusions**
The purpose of this study was to assess the benefit of using high-flow nasal oxygen (HFNO) during upper gastrointestinal endoscopy procedures (GEPs).	Systematic review and meta-analysis of randomized controlled trials (RCTs)	**Inclusion criteria**: RCTs of patients undergoing upper and/or lower endoscopy under deep sedation. Use of HFNO, nasal cannula, or face mask. English language. Adult patients > 18 years old. Studies published between 2000 and 2021 were included. **Exclusion criteria**: Observational, non-clinical, or pediatric studies. Lack of data or a full-text version of the article. Non-peer-reviewed articles. **Excluded**: A total of 5997 studies were excluded. **Accepted**: A total of 6 studies encompassing 2867 patients were included in the meta-analysis. **Control**: Patients receiving conventional oxygen therapy (COT), such as nasal cannula and face mask. **Intervention**: Patients receiving HFNO	A PRISMA diagram was used to display the studies included. The authors searched major electronic databases for articles published between 2000 and 2021. Bias was assessed using the Risk of Bias (RoB) 2 Tool and the certainty of evidence was assessed using the Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) approach.	The primary outcome was the incidence of hypoxic events (defined as SpO2 < 90%).	**Statistical Results**: In patients receiving HFNO, 5.2% experienced desaturations compared to 27.2% receiving COT. These results were statistically significant in five out of the six studies. The authors determined that the overall risk of bias is unclear due to the inconsistent randomization and heterogeneity of the studies. The overall quality of evidence was considered high when assessing for the primary outcome. **Conclusions**: The use of HFNO during endoscopic procedures has the potential to significantly reduce the risk of hypoxic events, especially in patients with BMI ≥ 30. However, the authors determined a high level of heterogeneity among the studies, which limits the results of the meta-analysis. The authors admit that additional research is needed on the use of HFNO during endoscopy, especially in morbidly obese patients.

Gu, W. J., Wang, H. T., Huang, J., Pei, J. P., Nishiyama, K., Abe, M., Zhao, Z. M., & Zhang, C. D. (2022). High flow nasal oxygen versus conventional oxygen therapy in gastrointestinal endoscopy with conscious sedation: Systematic review and meta-analysis with trial sequential analysis. *Digestive Endoscopy*, *34*(6), 1136–1146. https://doi.org/10.1111/den.14315					Level: I-B
Purpose/ Hypothesis	**Type of Evidence and Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome Measures**	**Results/Conclusions**
The purpose of the study was to determine the efficacy of using HFNO during GEPs compared to COT.	Systematic review and meta-analysis of RCTs	**Inclusion Criteria**: RCTs that involved adults undergoing GEPs under conscious sedation. Use of HFNO as the intervention and COT as the control. **Exclusion Criteria**: Studies that included patients with hypoxemia before the procedure were excluded. **Excluded**: A total of 50 studies were excluded. **Accepted**: A total of 8 studies including 3212 patients were accepted. **Control**: Patients receiving COT (such as nasal cannula and face mask). **Intervention**: Patients receiving HFNO	Cochrane's Collaboration tool was used to assess risk of bias. A PRISMA diagram was used to display the included studies. The authors searched major electronic databases through the year 2022.	The primary outcome of the studies was hypoxemia, which was defined as $SpO_2 < 90\%$ in all studies except one, which defined it as $SpO_2 < 92\%$.	**Statistical Results**: HFNO was found to significantly reduce the risk of hypoxia during GEPs (p=.005). The risk of bias was considered high in terms of blinding, as the RCTs were difficult to blind due to the obvious difference in appearance of the various oxygen devices. Otherwise, the studies had either a low or unclear risk of bias. **Conclusions**: While the results indicated that HFNO may reduce the risk of hypoxia during endoscopy as compared to COT, more studies are needed to increase confidence and reach adequate power, according to the authors' trial sequential analysis.

Hung, K. C., Chang, Y. J., Chen, I. W., Soong, T. C., Ho, C. N., Hsing, C. H., Chu, C. C., Chen, J. Y., & Sun, C. K. (2022). Efficacy of high flow nasal oxygenation against hypoxemia in sedated patients receiving gastrointestinal endoscopic procedures: A systematic review and meta-analysis. *Journal of Clinical Anesthesia*, 77, 110651. https://doi.org/10.1016/j.jclinane.2022.110651					Level: I-B
Purpose/ Hypothesis	**Type of Evidence and Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome Measures**	**Results/Conclusions**
The purpose of this study was to determine the efficacy of using HFNO during gastrointestinal endoscopic procedures (GEPs).	Systematic review and meta-analysis of RCTs	**Inclusion Criteria**: RCTs that included adult patients receiving GEPs under sedation. Use of HFNO as the intervention and COT as the control. **Exclusion Criteria**: The authors excluded observational studies, case reports, case series, and studies where sedation was not provided for GEPs. **Excluded**: A total of 37 reports and 151 articles were excluded. **Accepted**: A total of 7 RCTs including 2998 patients were accepted. **Control**: Patients receiving COT (nasal cannula or face mask at 6 LPM). **Intervention**: Patients receiving HFNO (flow ranged from 20 to 70 LPM)	PRISMA was used to report the studies included in this meta-analysis. The authors searched major electronic databases to identify eligible trials. Cochrane Collaboration's tool was used to assess risk of bias.	The primary outcome studied was hypoxia, defined as an $SpO_2 < 90\%$ in five studies and $SpO_2 < 92\%$ in two studies.	**Statistical Results**: In patients while undergoing GEPs, hypoxia occurred in 4.2% of patients receiving HFNO, compared to 15.2% on COT (p=0.009). The risk of bias of the studies was determined to be unclear due to the difficulty in blinding these studies. **Conclusions**: The research indicates that HFNO is associated with a significantly lower risk of hypoxia in patients undergoing GEPs under sedation. However, the authors admit there was a high level of heterogeneity between the studies, which limits the results of the meta-analysis.

Khanna, P., Haritha, D., Das, A., Sarkar, S., & Roy, A. (2023). Utility of high-flow nasal oxygen in comparison to conventional oxygen therapy during upper gastrointestinal endoscopic procedures under sedation: A systematic review and meta-analyses. *Indian Journal of Gastroenterology*, *42*(1), 53–63. https://doi.org/10.1007/s12664-022-01308-6					Level: II-B
Purpose/ Hypothesis	**Type of Evidence and Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome Measures**	**Results/Conclusions**
The purpose of this study was to determine whether HFNO leads to more effective oxygenation during upper endoscopic procedures compared to COT (such as nasal cannula and face mask).	Systematic review and meta-analysis	**Inclusion Criteria**: Studies were included that met the following criteria: RCTs, comparative cohort studies, case series, cross-sectional studies, case-control studies. Adult patients undergoing upper GEPs receiving HFNO or COT. **Exclusion Criteria**: Any articles where the full text was unable to be retrieved. **Excluded**: A total of 145 studies were excluded. **Accepted**: A total of 8 RCTs and 1 longitudinal study including 2394 patients were accepted. **Control**: Patients receiving COT during upper GEPs **Intervention**: Patients receiving HFNO during upper GEPs	The authors searched major electronic databases for the studies. Bias was assessed using the ROBINS-I assessment tool for non-randomized studies and the RoB 2.0 for RCTs. The quality of evidence was evaluated using the GRADE tool.	The primary outcome was the incidence of hypoxia, which was defined as SpO2 < 92%.	**Statistical Results**: Patients using HFNO had a reduced risk of hypoxia as compared to COT (p<0.0001). **Conclusions**: The use of HFNO during upper GEPs may reduce the risk of desaturations for patients. The authors determined there was an overall low risk of bias, however the quality of evidence was determined to be low due to the heterogeneity of the populations and RCT settings. This limits the interpretation of the meta-analysis results.

Mazzeffi, M. A., Petrick, K. M., Magder, L., Greenwald, B. D., Darwin, P., Goldberg, E. M., Bigeleisen, P., Chow, J. H., Anders, M., Boyd, C. M., Kaplowitz, J. S., Sun, K., Terrin, M., & Rock, P. (2021). High-flow nasal cannula oxygen in patients having anesthesia for advanced esophagogastroduodenoscopy: HIFLOW-ENDO, a randomized clinical trial. *Anesthesia and Analgesia*, *132*(3), 743–751. https://doi.org/10.1213/ANE.0000000000004837	Level: I-A

Purpose/ Hypothesis	**Type of Evidence and Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome Measures**	**Results/Conclusions**
The purpose of this study was to determine whether the use of HFNO reduced the risk of hypoxia during esophagogastroduodenoscopy (EGD).	Single-center, unblinded randomized controlled trial	**Sampling Technique**: Convenience **Eligible Participants**: Adults > 17 years old having anesthesia for EGD (duration > 15 minutes). **Setting**: Single tertiary care academic medical center **Excluded**: Patients having EGDs < 15 minutes or procedures including argon plasma coagulation were excluded. Pregnant patients and those having planned endotracheal intubation were also excluded. **Accepted**: A total of 262 patients were accepted. **Control**: Standard nasal cannula (SNC) at 6 LPM **Intervention**: HFNO at 20 LPM	Patients were randomized to receive either SNC or HFNO during the EGD. The physicians and nurses were not blinded to the intervention. Patients were assessed for hypoxic events of SpO2 < 92% lasting for at least 15 seconds.	The primary outcome was the incidence of hypoxia during the EGD, which was defined as SpO2 < 92% for at least 15 seconds.	**Statistical Results**: A total of 262 patients were included in the study. There was a significantly lower incidence of hypoxic events in the HFNO group (21.2%) as compared to the SNC group (33.1%) (p=0.03). The authors determined that 262 patients were required for 80% power, assuming alpha=0.05. **Conclusions**: The use of HFNC during anesthesia for EGDs is associated with a significantly lower risk of hypoxic events as compared to SNC. In their post-hoc analysis, the authors determined that obesity (BMI ≥ 30) did not affect the relationship between HFNO and hypoxia.

Nay, M.-A., Fromont, L., Eugene, A., Marcueyz, J.-L., Mfam, W.-S., Baert, O., Remerand, F., Ravry, C., Auvet, A., & Boulain, T. (2021). High-flow nasal oxygenation or standard oxygenation for gastrointestinal endoscopy with sedation in patients at risk of hypoxaemia: A multicentre randomised controlled trial (ODEPHI trial). *British Journal of Anaesthesia*, *127*(1), 133–142. https://doi.org/10.1016/j.bja.2021.03.020					Level: I-A
Purpose/ Hypothesis	**Type of Evidence and Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome Measures**	**Results/Conclusions**
The purpose of this study was to determine whether the use of HFNO could decrease the occurrence of hypoxia during GEPs under deep sedation.	Multi-center, parallel-grouped, single-blinded randomized controlled trial	**Sampling Technique**: Convenience **Eligible Participants**: Adult patients 18 years and older undergoing upper and/or lower GEPs under deep sedation who were at risk for hypoxemia. **Setting**: Multicenter trial (one university hospital, one regional and teaching hospital, one private hospital, and one general district hospital) **Excluded**: Patients were excluded if the procedure was emergent or required planned endotracheal intubation. Any patient with a tracheostomy, on oxygen therapy at home, or current pregnant was also excluded. **Accepted**: A total of 379 patients were accepted. **Control**: Patients receiving COT during upper GEPs **Intervention**: Patients receiving HFNO during upper GEPs	Patients were randomized to receive either HFNO or COT. In the HFNO group, patients received 100% FiO2 at 40 L/min for at least 3 minutes before induction, when the settings were changed to 50% FiO2 and 70 L/min. In the COT group, patients were pre-oxygenated with 100% oxygen at 8 L/min with a face mask before induction. Then, a nasal cannula was applied at a flow rate of approximately 50% FiO2.	The primary outcome of the study was the incidence of hypoxia, which was defined as SpO2 $\leq$ 92%.	**Statistical Results**: A total of 379 patients took part in the study (this met the requirement of at least 352 patients to meet 80% power, assuming alpha=0.05). In the HFNO group, 9.4% of patients experienced hypoxia as compared to 33.5% in the COT group (p<0.0001). **Conclusions**: The use of HFNO is associated with a significantly reduced risk of hypoxia during GEPs. The authors discuss the cost of HFNO has a major barrier to broadening the use of HFNO, and suggest that is first be offered to obese patients and those with cardiac comorbidities.

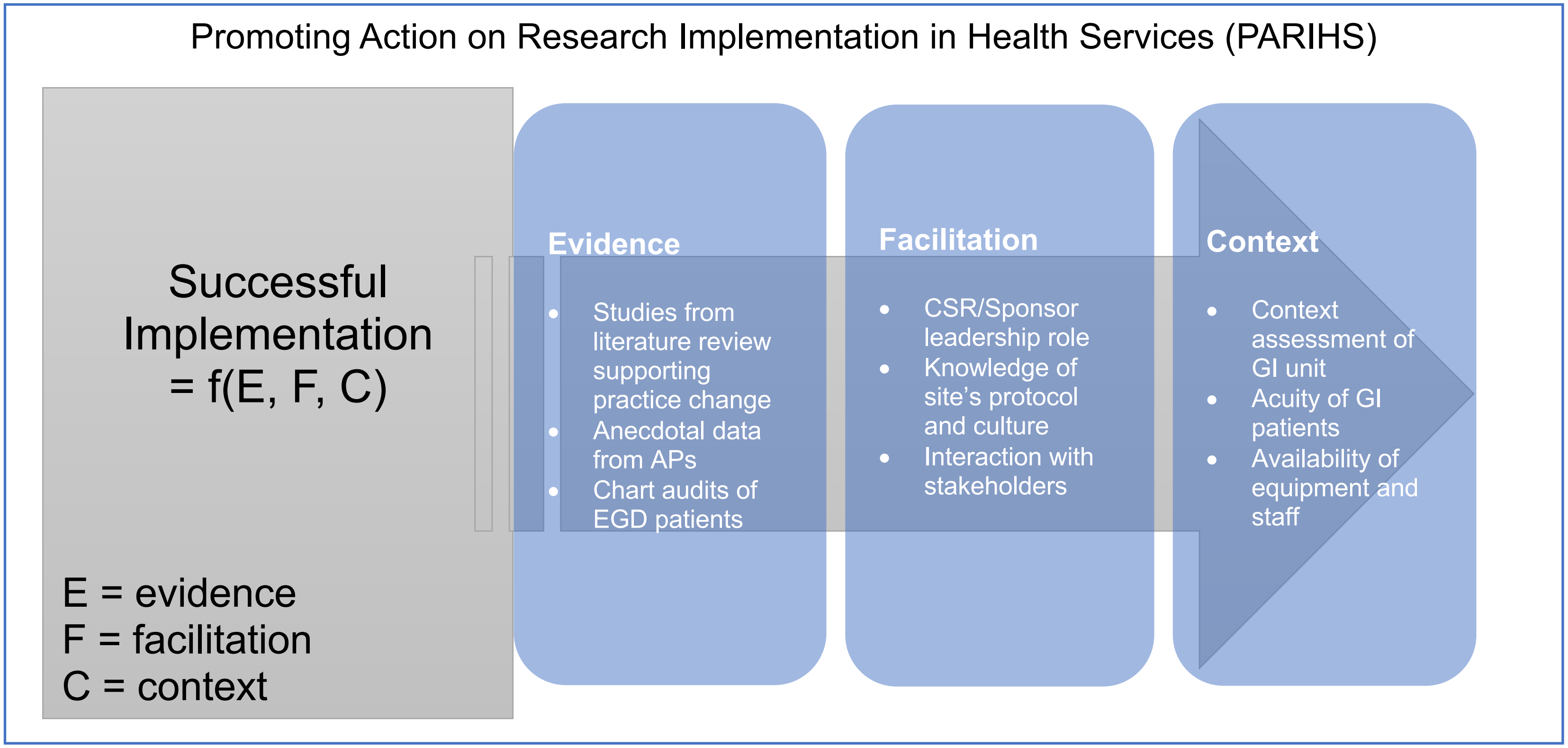
Shukla, K., Parikh, B., Kumar, A., & Nakra, M. (2021). Comparative evaluation of efficacy of oxygenation using high flow nasal cannula vs. conventional nasal cannula during procedural sedation for endoscopic ultrasound: A pilot study. *Journal of Anaesthesiology*, Clinical Pharmacology, *37*(4), 648–654. https://doi.org/10.4103/joacp.JOACP_371_20					Level: II-B
Purpose/ Hypothesis	**Type of Evidence and Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome Measures**	**Results/Conclusions**
The purpose of this study was to evaluate the effectiveness of HFNO compared to COT during endoscopic ultrasound (EUS).	Prospective, unblinded randomized comparative pilot study	**Sampling Technique**: Convenience **Eligible Participants**: Adult patients undergoing EUS. **Setting**: Gastroenterology center of a tertiary care hospital **Excluded**: Patients with pre-existing respiratory impairment or illness, history of obstructive sleep apnea, coronary artery disease, anticipated difficult airway, pregnancy, and allergy to any of the drugs used during sedation were excluded **Accepted**: A total of 60 patients were included in the study. **Control**: Conventional nasal cannula (NC) was used at 6-7 L/min **Intervention**: HFNO was used at 40% FiO2 (oxygen flow was not indicated)	Patients were randomized into two groups to receive either HFNO or NC therapy during their EUS.	The primary outcome was the incidence of desaturation, defined as SpO2 < 92% for greater than 10 seconds.	**Statistical Results**: Patients in the NC group had a greater decrease in SpO2 during the procedure as compared to the HFNO group, but the findings were not significant (p=0.51). A total of 56 patients were required to meet 90% power. **Conclusions**: The use of HFNO during EUS may not significantly impact the risk of desaturation. However, the authors admit that further research is needed on a broader patient population (OSA, obesity, limited pulmonary reserves) to determine efficacy of HFNO.

Appendix F
Evidence Synthesis Table

Project Title: Implementation of High-Flow Nasal Cannula in Obese Patients During Esophagogastroduodenoscopy			
PICOT: In adult obese patients undergoing esophagogastroduodenoscopy (EGD), why did 12% of patients experience hypoxic events?			
JHNEBP Model Level	**Total Number of Sources**	**Author and Quality Rating**	**Synthesis of Findings**
Level I Experimental study · Randomized Controlled Trial (RCT) · Systematic review of RCTs with or without meta-analysis	5	Carron et al. (B) Gu et al. (B) Hung et al. (B) Mazzeffi et al. (A) Nay et al. (A)	Carron et al. (2022), Gu et al. (2022), and Hung et al. (2022) found in their meta-analyses and systematic reviews that the risk of desaturation during GEPs was significantly less when using HFNO over COT. In these studies, GEPs included EGD, gastroscopy, colonoscopy, and endoscopic retrograde cholangiogram pancreatography. In the RCT carried out by Mazzeffi et al. (2021), there was a significantly lower incidence of desaturation in the group using HFNO as compared to COT during EGDs. In the RCT carried out by Nay et al. (2021), there was a significantly lower incidence of desaturation in the group using HFNO as compared to COT during upper and/or lower gastrointestinal endoscopy. While only one study looked specifically at EGDs (Mazzeffi et al., 2021), the GEPs included in the other four studies are fairly similar to EGDs in terms of risk of hypoxia and anesthetic plan, except for colonoscopy which does not require the proceduralist to share the airway with the anesthesia provider.
Level II Quasi-experimental studies · Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis	2	Khanna et al. (B) Shukla et al. (B)	Khanna et al. (2023) conducted a systematic review and meta-analysis that included RCTs and a longitudinal study. They found the use of HFNO during upper GEPs is associated with a significantly lower risk of desaturation as compared to COT. In their pilot study, Shukla et al. (2021) found that the use of HFNO during EUS may not significantly affect a patient's risk of desaturation. EUS is a procedure that is very similar to EGD in terms of a patient's risk of desaturation during anesthesia.
Level III Non-experimental study · Systematic review of a combination of RCTs, quasi-experimental, and non-experimental studies, or non-experimental studies only, with or without meta-analysis ·			

Qualitative study or systematic review of qualitative studies with or without meta-synthesis			
Level IV Opinion of respected authorities and/or reports of nationally recognized expert committees/consensus panels based on scientific evidence			
Level V Evidence obtained from literature reviews, quality improvement, program evaluation, financial evaluation, or case reports · Opinion of nationally recognized expert(s) based on experiential evidence			
Overall Quality Rating: **B** - The overall quality rating of the evidence above is good. The evidence across the seven studies consistently demonstrates that the use of HFNO is associated with a significant reduction in risk of desaturation during GEPs, minus a pilot study whose results were not statistically significant. However, the heterogeneity of the studies makes the results harder to generalize. Also, only one study specifically studied desaturations during EGDs and one RCT within a meta-analysis looked at obese patients. Many of the studies, however, noted that obese patients at more at risk for hypoxia due to their limited pulmonary reserves and that further research within this patient population is warranted. Therefore, the evidence supports a practice change of using HFNO rather than COT during EGDs for obese patients.			

Appendix G
PARIHS Framework



Appendix H
Gantt Chart

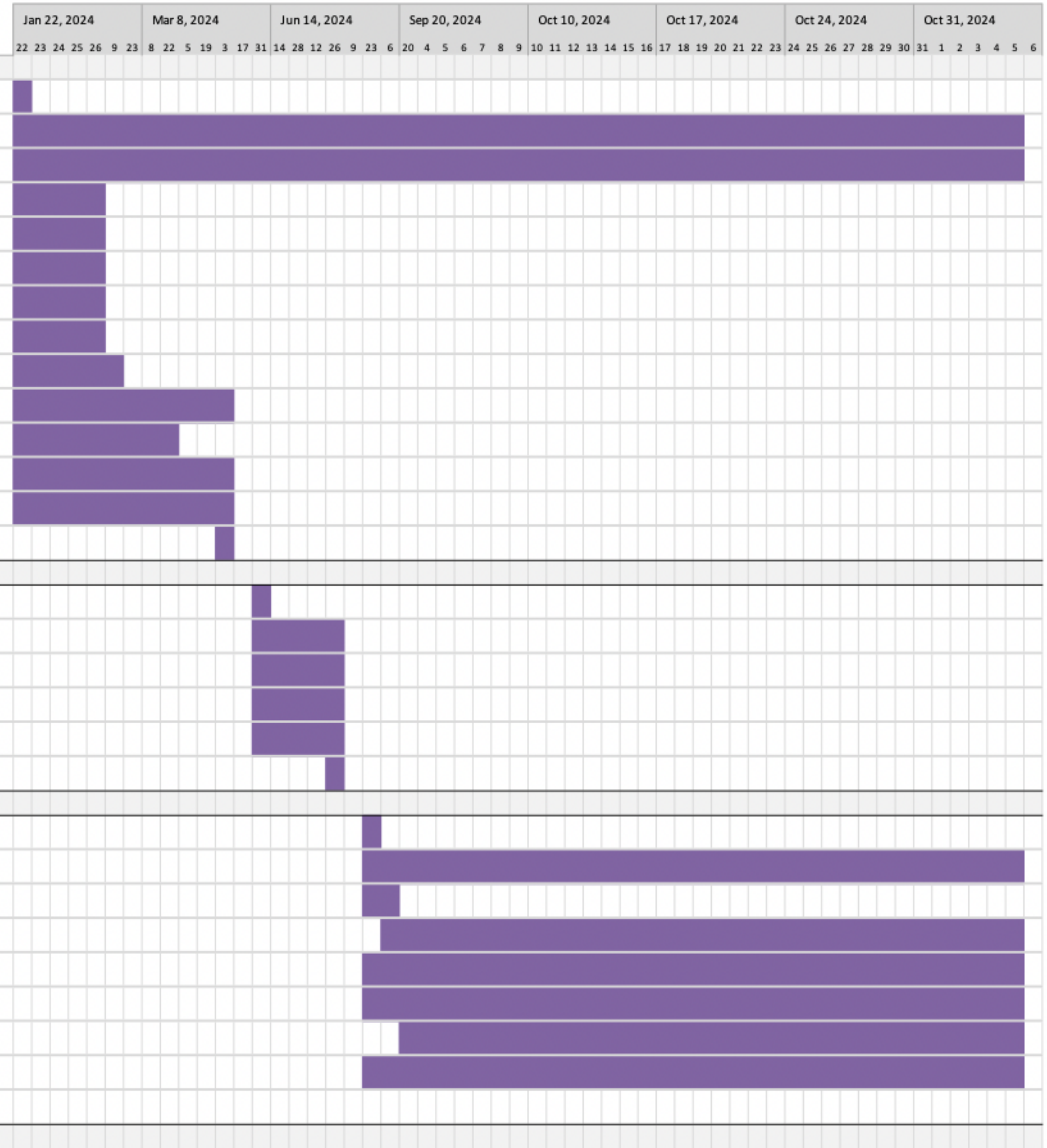
High-Flow Nasal Cannula in Obese Patients During Esophagogastroduodenoscopy

Virginia Basil

Project Start: Mon, 1/22/2024

Display Week: 1

Project Identification (NDNP810)	Responsible	START	END
Start of Spring Term		1/22/24	1/22/24
CITI (enter renewal date as end)	Self	1/22/24	8/31/25
HIPAA (enter renewal date as end)	Self	1/22/24	8/31/25
Identify stakeholders/team	Self	1/22/24	1/29/24
Identify roles/responsibilities	Self	1/22/24	1/29/24
Identify practice problem/root cause	Self/CSR	1/22/24	1/29/24
Context Assessment	Self	1/22/24	1/29/24
Identify scope/goals	Self/CSR	1/22/24	1/29/24
Synthesize Evidence	Self	1/22/24	2/12/24
Development project plans	Self/CSR	1/22/24	5/15/24
MILESTONE: Submit project proposal	Self	1/22/24	4/1/24
Site IRB Inquiry	Self/CSR	1/22/24	5/15/24
REDcap	Self	1/22/24	5/15/24
End of Spring Term		5/15/24	5/15/24
Project Development (NDNP811)			
Start of Summer Term		6/3/24	6/3/24
Develop implemenation plans	Self/CSR	6/3/24	7/26/24
Develop teaching plan	Self/CSR	6/3/24	7/26/24
MILESTONE: Site Presentation and Approval	Self	6/3/24	7/26/24
MILESTONE: IRB Determination	Self	6/3/24	7/26/24
End of Summer Term		7/26/24	7/26/24
Project Implementation (NDNP812)			
Start of Fall Term		8/26/24	8/26/24
MILESTONE: Project go-live (implement)		8/26/24	12/20/24
Educaton/Training		8/26/24	9/13/24
Monitor tactics and progress		9/13/24	12/20/24
Communicate with stakeholders		8/26/24	12/20/24
Data Collection		8/26/24	12/20/24
Dissemination Plan		10/1/24	12/20/24
MILESTONE: Manuscript		8/26/24	12/20/24
End of Fall Term		12/20/24	12/20/24
Project Evaluation and Dissemination (NDNP813)			



Display Week: 1

Jan 22, 2024							Mar 8, 2024							Jun 14, 2024							Sep 20, 2024							Oct 10, 2024							Oct 17, 2024							Oct 24, 2024							Oct 31, 2024						
22	23	24	25	26	9	23	8	22	5	19	3	17	31	14	28	12	26	9	23	6	20	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6

Start of Spring Term		1/27/25	5/21/25
Analyze, synthesize & evaluate results		1/27/25	5/21/25
Sustainability Plan		1/27/25	5/21/25
MILESTONE: Develop Poster		1/27/25	5/21/25
MILESTONE: Site Presentation		1/27/25	5/21/25
MILESTONE: Extremal Dissemination		1/27/25	5/21/25
MILESTONE: Final Manuscript		1/27/25	5/21/25
MILESTONE: UMSON Poster Day		1/27/25	5/21/25
Project Closure w/site		1/27/25	5/21/25
End of Spring Term		1/27/25	5/21/25
Insert new rows ABOVE this one			

Appendix I
Chart Audit Tool

Last 4 digits of the Patient ID:	
Date of procedure: * must provide value	Today D-M-Y
Procedure done: * must provide value	☐ EGD ☐ EGD with biopsy ☐ EGD with balloon dilation
Age (years): * must provide value	
Gender: * must provide value	○ Male ○ Female ○ Other reset
BMI: * must provide value	
Was the patient's SpO2 < 90% at any point during the procedure? * must provide value	○ No ○ Yes reset
What was the lowest recorded SpO2?	
What methods of O2 delivery were used during the procedure? * must provide value	☐ Nasal cannula ☐ Face mask ☐ High-flow nasal cannula ☐ Laryngeal mask airway (LMA) ☐ Endotracheal tube (ETT) ☐ Other