Perioperative Management of Postoperative Nausea and Vomiting: A Quality Improvement Project

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Abstract

Postoperative nausea and vomiting (PONV) is an adverse event affecting 30% of the general surgical population and up to 80% of high risk patients. In addition to being distressing to patients, PONV is also associated with longer stays in PACU and increased hospital admissions and health care costs. The purpose of this scholarly project was to assess the CRNAs' knowledge, preferences, and practices for managing PONV and whether or not they perceived a PONV quick reference guideline as a useful tool for their practice to aid in identifying high-risk patients, managing baseline PONV risks, and selecting strategies for prophylaxis and rescue treatment. A copy of the Quick Reference Guide, educational PPT, and pre and post intervention surveys were created and shared via email with participants. Results were analyzed and compared to assess the perceptions of the CRNAs regarding usefulness of the Quick Reference Guide. Overall, post-survey responses indicate participants read the information provided and perceived the Quick Reference Guide handout to be useful. Most participants perceived the Quick Reference Guide would be useful if implemented in the department. A major limitation of the project included the number of responses from the pre and post implementation surveys. The financial impact to the institution to implement this guide would be minimal, and decreasing PONV rates would save money long term. For future research, larger sample size of participants is recommended so results can more accurately reflect trends in pre versus post implementation knowledge on the subject.

Keywords: postoperative nausea and vomiting, anesthesia providers, general anesthesia

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Section I. Introduction

Background

Postoperative nausea and vomiting (PONV) is one of the most common side effects of surgical procedures requiring anesthesia. In fact, nearly 25%-30% of surgical patients may experience PONV, with symptoms including nausea, vomiting, or retching within 24 hours following anesthesia (Stoops & Kovac, 2020). While postoperative pain is also commonly reported, PONV is often rated as worse than postoperative pain (Feinleib et al., 2021). PONV is one of the main reasons patients are unable to be discharged after outpatient surgery (Aubrun et al., 2018). Complications from PONV can include extended stays in the post anesthesia care unit (PACU), electrolyte imbalances, unexpected admission as an inpatient, and increased medical and institutional costs (Stoops & Kovac, 2020). Lee et al. (2017) also stated that PONV can lead to surgical site instability such as wound dehiscence and bleeding, potential aspiration, and dehydration. Due to significant potential complications related to PONV, it is important that patients undergo preoperative risk factor assessment and then initiation of prophylactic measures when appropriate.

The American Association of Nurse Anesthetists (AANA) Standard 2 requires that anesthesia providers "perform and document or verify documentation of a preanesthesia evaluation of the patient's general health, allergies, medication history, preexisting conditions, anesthesia history, and any relevant diagnostic test…" (2019, p.1). In 2020, Gan et al. published a consensus guideline for managing PONV that includes the Apfel preoperative risk scoring system for adult patients. This assessment consists of four risk factors, each assigned one point if applicable to the patient. The total score then correlates with a risk for PONV with zero points equaling a 10% risk, one point a 20% risk, two points a 40% risk, three points a 60% risk, and

four points an 80% risk. By using this simplified Apfel system from Gan et al., anesthesia providers can meet the AANA Standard 2 requirement and use their assessment result to plan and treat patients, on an individualized basis, to reduce the incidence of PONV. These guidelines published by Gan et al. were endorsed by the AANA.

In the perioperative period, a certified registered nurse anesthetist (CRNA) is usually the main provider of patient care. This includes a preoperative assessment, medication administration, delivery of anesthesia, and maintenance of hemodynamics both during and after surgery. Therefore, responsibility for PONV management falls directly to CRNAs and other anesthesia providers. Stoops and Kovac (2020) explain that PONV data needs to be accurately collected in the electronic medical record (EMR) so CRNAs can "adequately monitor the impact of antiemetic interventions and overall PONV incidence" (p. 675). They further explain that EMR reminders and mandatory preoperative PONV risk assessment help improve anesthesia provider PONV management.

Organizational Needs Statement

The local institution involved in implementation of this project is a large medical center in the southeast United States with a modern operating unit providing care for a wide variety of surgical cases. From minor non-invasive cosmetic procedures to invasive and timely neurosurgery, this facility carries out an average of 27,000 surgeries every year. Each of these carries the risk of PONV and its associated consequences. The partnering organization currently does not use a standardized guideline for the management of PONV. Due to the myriad of complications and costs associated with the occurrence of PONV, a national guideline has recently been published and endorsed by the AANA. The guideline recommends that a PONV risk assessment be conducted on all adult patients undergoing general anesthesia. While

anesthesia providers at this facility currently uphold Standard 2, as outlined by the AANA (2019), in their preoperative assessment, using the consensus guideline could prove to be beneficial. This facility, like many others, currently has a shortage of nurses in the peri-operative area, making it even more important for patients not to be in the PACU for extended periods of time. With PONV potentially causing a delay in discharge and an extension of time in the PACU, there could be significant back up in the operating rooms due to limited availability of staff members to provide additional patient care. This delay in progression of patients out of the PACU increases the costs associated with operating room time as well as anesthesia time for patients caught waiting in the operating room for a PACU space.

Problem Statement

PONV is an adverse event affecting 30% of the general surgical population and up to 80% of high risk patients. In addition to being distressing to patients, PONV is also associated with longer stays in PACU and increased hospital admissions and health care costs.

Purpose Statement

The purpose of this scholarly project was to assess the CRNAs' knowledge, preferences, and practices for managing PONV and whether or not they perceived a PONV quick reference guideline as a useful tool for their practice to aid in identifying high-risk patients, managing baseline PONV risks, and selecting strategies for prophylaxis and rescue treatment.

Section II. Evidence

Description of Search Strategies

The purpose of this literature review was to examine current evidence and recommendations addressing the management of PONV. The PICOT question used to guide the search strategy was: In postoperative nausea and vomiting, how does a preoperative risk assessment done by anesthesia providers affect the management of postoperative nausea and vomiting in adults undergoing general anesthesia in the operating room?

A search of current literature was conducted using the databases PubMed and Cumulative Index to Nursing and Allied Health Literature (CINAHL) as well as the search engine Google Scholar. Boolean operators were used to combine keywords and concepts. The search strategy used to query PubMed was (general anesthesia OR volatile agent OR anesthesia drug) AND (vomiting OR nausea) AND (anesthetists). This search strategy pulled in the MeSH terms *anesthesia, general*; *volatilization*; *anesthesia*; *vomiting;* and *nausea*. CINAHL was searched using a combination of keywords and subject headings identified using the keywords. Google Scholar was searched using the same search strategy as PubMed. Limits applied, when available, included publication in the most recent five years (2017-2022), peer-reviewed, English language, and adults. See Appendix A for a list of keywords, MeSH terms, and subject terms utilized in searches. See Appendix B for search strategies and numbers of articles found and kept using structured searching. Additional evidence and information were identified by reviewing related and referenced articles as well as the websites and resources of anesthesia organizations. No additional searches were expanded beyond the previously described searches. Eight articles were identified for a full-text review.

Based on Melnyk and Fineout-Overholt's (2019) levels of evidence hierarchy, evidence identified as pertinent to this project included one systematic review and meta-analysis (Level I), one randomized controlled study (Level II), two non-randomized controlled studies (Level III), two controlled cohort studies (Level IV), one quality improvement project (Level VI), and one expert opinion paper (Level VII). See Appendix C for a further breakdown of information from each article examined.

Selected Literature Synthesis

Each of the eight articles included in this review addressed the issue of PONV, but in different terms of risk or causation factors. For example, Johannson et al. (2021) and Zheng et al. (2021) examined patient specific characteristics, such as gender or body-mass index (BMI), Kandavar and Padmanabha (2021) and Lee et al. (2017) analyzed anesthesia drugs, and Aubrun et al. (2018) and Johannson et al. compared types of surgical procedures. While some of the articles focused on a specific theme, such as day-case surgeries and the incidence of PONV, others looked at more generalized themes like patient characteristics associated with higher rates of PONV. Additionally, Stoops and Kovac (2020) explained the pathophysiology mechanisms and how anesthesia drugs, surgical procedures, and patient characteristics affect the body and develop into symptoms of PONV while Gan et al. (2020) conducted a meta-analysis to develop consensus guidelines for the most efficient PONV management techniques. Dewinter et al. (2018) further examined the use of a simplified PONV algorithm in reducing incidence of PONV as well as improving compliance among anesthesia providers.

Patient Characteristics

Nearly all authors discussed specific patient characteristics and how they relate to PONV. Johannson et al. (2021) conducted a retrospective observational study of 2030 patients in the

PACU of a single Swedish county hospital over a six-month timeframe, finding patients with a BMI over 35, female gender, under 50 years old, or with a history of smoking had higher rates of PONV. Similarly, Stoops and Kovac (2020) explained that female gender and those under 50 years old usually have higher rates of PONV due to physiological dispositions. Contrary to the findings of Johannson et al., however, Stoops and Kovac found smokers had significantly lower rates of PONV, possibly due to their acclimation to toxic components from smoke creating anti-emetogenic effects. Zheng et al. (2021) also found patients under the age of 50 reported PONV more often than those over the age of 50 in a study designed to compare PONV rates between two different surgical procedures in female patients with BMI greater than 30. Despite the differences in study design and sample populations, these investigators each found increased incidence of PONV in female patients and those under the age of 50 years. Additionally, Gan et al. (2020) identified female gender, non-smokers, and an age less than 50 as three out of five main risk factors to consider when assessing PONV risk.

Anesthesia Drugs

The type of anesthesia drugs used were noted to influence the PONV rates in several studies. Kandavar and Padmanabha (2021) compared PONV rates for patients who received intravenous propofol or inhalational sevoflurane for maintenance of general anesthesia. In their prospective observational study of 64 patients undergoing elective otorhinolaryngology surgery, significantly more patients experienced PONV after receiving sevoflurane than after receiving propofol. The authors concluded that the type of anesthetic drug used to maintain general anesthesia has an effect on PONV. Similarly, Lee et al. (2017) compared PONV rates with anesthesia reversal agents sugammadex versus pyridostigmine-glycopyrrolate in 7179 adult patients over a five year period. They found significantly less PONV reported in patients

reversed with sugammadex than those reversed with pyridostigmine-glycopyrrolate. Explanations of the pathophysiology of volatile agents such as sevoflurane and reversal agents such as neostigmine in increasing PONV, by Stoops and Kovac (2020), support these findings by Kandavar and Padmanabha, as well as those of Lee et al. These findings are further supported by Gan et al. (2020) through their inclusion of volatile agent avoidance as a major risk mitigation strategy. While these studies examined the effects of different drugs on PONV, they concluded similarly that the type of anesthetic drug used during surgery is a contributing factor to PONV.

Type of Surgery

In addition to the anesthetic drug used during surgery, the type of surgical procedure itself is another cause of and risk factor for PONV. Johannson et al. (2021) found that patients who underwent major surgery, laparoscopic surgery, or a surgery lasting over an hour all reported PONV more than others. While Johannson et al. examined PONV in more generalized surgical procedures, Zheng et al. (2021) specifically compared PONV in two types of surgery, laparoscopic sleeve gastrectomy and laparoscopic gynecologic surgery, in a retrospective study of 278 female patients with BMI over 30. In comparing the finding of Johannson et al. and Zheng et al., the PONV rates were highest among patients undergoing abdominal and gynecologic surgical procedures. In work similar to that of Johannson et al., Aubrun et al. (2018) compared PONV rates from ten different surgical procedures among 2144 adult patients with varying demographics and found that patients undergoing abdominal surgery had higher incidence of PONV than other surgical patients .

In their synthesis of available evidence, Stoops and Kovac (2020) explained how surgical time is directly correlated with increased PONV. They also explained how certain procedures, like those on the upper airway, nose, throat, mouth, esophagus, or stomach also have higher

association with PONV. This is again consistent with the findings of Aubrun et al. (2018). Although the papers looked at different surgery types, both broadly and specifically, they concluded that the type of surgical procedure had a direct effect on the incidence of PONV. Therefore, it is important to take into consideration the type of surgery a patient is having in order to better manage PONV.

The literature discussed supports that females, adults under 50 years old, and those who do not smoke are at higher risk for having PONV (Gan et al., 2020; Johannson et al., 2021; Stoops & Kovac, 2020; Zheng et al., 2021). These factors should be taken into consideration when preparing a patient for surgery. The type of anesthesia drugs used during surgery should also be considered and chosen wisely to help reduce the risk of PONV, especially in patients with other risk factors (Gan et al., 2020; Kandavar & Padmanabha, 2021; Stoops & Kovac, 2020). It was found that using propofol for maintenance of anesthesia and sugammadex for reversal are better alternatives for reducing PONV compared to sevoflurane and pyridostigmine-glycopyrrolate, respectively (Gan et al., 2020; Lee et al., 2017; Stoops & Kovac, 2020). Different surgical procedures have varying associated rates of PONV (Gan et al., 2020; Johannson et al., 2021; Stoops & Kovac, 2020) with head and gastric related surgeries having higher incidence than other types of procedures (Aubrun et al., 2018; Stoops & Kovac, 2020). Each of these risk factors for PONV should be examined on a case by case basis to ensure patients are at the lowest risk possible for developing PONV. The guidelines by Gan et al. (2020) incorporate the evidence discussed, as well as other sources, into widely accepted consensus guidelines for the management of PONV.

Anesthesia Provider Implications

Patient outcomes, perceptions, and satisfaction of quality anesthesia care is greatly influenced by PONV (Pym, A., & Ben-Menachem, E., 2018; Stoops & Kovac, 2020). Multiple researchers have found that anesthesia provider implementation of a standardized PONV management guideline and protocol helps to not only reduce the incidence of PONV, but also improve patient satisfaction score (Gan et al., 2020; Pym, A., & Ben-Menachem, E., 2018; Stoops & Kovac, 2020). As was mentioned by Stoops and Kovac (2020), in a large and busy surgical setting, not having a standardized PONV management guideline for anesthesia providers to follow makes it difficult to maintain regulatory compliance. The authors also mention that a simple preoperative PONV risk assessment is more successful in reducing PONV than a complex and detailed risk assessment and treatment plan. This is supported by Gan et al. (2020) who simplified the Apfel assessment into four patient characteristics in their consensus guideline: female gender, non-smoker, history of PONV and/or motion sickness, and postoperative opioids. Implementing a simple and quick PONV risk assessment guideline has been shown to increase compliance among anesthesia providers as well as improve PONV management and ultimately patient outcomes and satisfaction. Dewinter et al. (2018) found that use of a PONV prophylaxis algorithm significantly reduced incidence of PONV and increased compliance of use of the algorithm among anesthesia providers.

Project Framework

The model used to implement this project was the model for improvement utilized by the Institute for Healthcare Improvement (IHI, 2022) with a single plan-do-study-act (PDSA) cycle implemented. The PDSA cycle is used for testing change, and includes planning to test the change (Plan), carrying out the test (Do), observing and learning from the consequences (Study),

and determining modifications to be made to the test (Act). For this project the plan was to test for change using a Quick Reference Guide for the management of PONV. The project occurred over a two week period during which CRNAs at the partnering organization were asked to utilize the information on the Quick Reference Guide to influence their care of adult patients undergoing general anesthesia. The study portion was implemented by examining participant responses to pre-intervention and post-intervention survey questions to determine the consequences and outcomes of the implementation. Suggested modifications were then determined and shared with future researchers to use in an additional PDSA cycle, constituting the act portion.

Ethical Considerations and Protection of Human Subjects

The intervention implemented in this project has equal benefit and risk to all anesthesia providers at the local institution. There was no potential for harm for anyone participating in the project. Prior to project initiation, the primary investigator completed CITI modules *All Biomedical Investigators* and *Key Personnel and Responsible Conduct of Research*. These modules can be found at https://about.citiprogram.org/. Permission of the participants was implied through participation, and no signed consent was required. Approval for this project included two processes (see Appendix D). The initial approval process was through the East Carolina University College of Nursing in collaboration with the University and Medical Center Institutional Review Board (UMCIRB) to evaluate the need for full review. The project met the criteria as a quality improvement project and a full review was not required. Once the project was ready for implementation, approval was obtained through the research office of the partnering organization in conjunction with the UMCIRB. The clinical contact CRNA in the

project setting provided a signed letter of acknowledgement regarding project implementation and data collection as part of the organizational review process.

Section III. Project Design

Project Setting

This project was implemented at a major medical center serving a large rural population. This facility has a main operating room unit with 23 rooms, a separate cardiothoracic unit with six rooms, and a robotics unit with two rooms. There is a preoperative and postoperative combined unit as well as a separate preoperative holding area for patients already admitted to the institution. All of the operating rooms are set up with the same anesthesia machine, drug cart, and anesthesia supply cart.

Several potential barriers to implementation of this project were initially identified. The facility has three separate preoperative units, and the patients may not all be coming to the operating room from the same preoperative space. Another potential barrier was lack of time between cases. The CRNAs are busy, and there was potential that they would feel too pressured to complete the preprocedural assessment in addition to their usual care requirements for each case. Finally, this local institution often floats CRNAs to their nearby outpatient surgery center. This was a potential barrier to the project as a CRNA may have been floated to the surgery center for part of the implementation time frame.

This institution does have one main combined preoperative and postoperative care unit. This facilitated the project because it allowed participants quick access to patients both before and after surgery to determine their PONV management and outcomes. Also, the fact that all of the CRNAs had the same equipment and drugs available to use in each operating room decreased variability of intraoperative PONV treatment in each case.

Project Population

The target population of this quality improvement project was CRNAs performing general anesthesia on adult patients undergoing general, obstetrical, or robotic surgery in the main operating rooms at the partnering organization. These CRNAs have a variety of educational backgrounds, with some holding master's degrees and others with doctorate degrees. There is also variability in experience, as some have over 20 years of experience while others recently graduated in the past year or two. A facilitator to this project is that all of the CRNAs undergo continuing education to stay up-to-date on current guidelines, including PONV management. A potential barrier specific to this population was that the CRNAs may not be willing to participate in this project or fully commit to implementing the project for two full weeks. Additionally, information about the project was provided via email, limiting the opportunity to address any questions or concerns.

One advantage with this target population was that several of the practicing CRNAs at the partnering organization are graduates of this program. This may have made them more willing to help as well as better understand the necessity and requirements of this project. Another potential advantage with this target population is that PONV management falls mainly under the responsibility of the CRNA, therefore they may have high interest in this topic and current guidelines.

Project Team

The team implementing this project consisted of the primary student as the team lead, three additional students working with the team lead, the project chair with experience as a CRNA, a site contact CRNA with the partnering organization, a contact CRNA in the clinical setting, the CRNA program director, and the course director. The team lead was responsible for

implementing the project and analyzing the data collected. The team lead and the three additional students collectively worked on the quick reference guide, the PowerPoint presentation and video, and the survey questions to be provided to the CRNAs at the partnering organization. The project chair was responsible for guiding development of the project and approving items prior to distribution and implementation. The site contact CRNA signed the letter of acknowledgement that data would be collected in the surgical unit at the partnering organization. The clinical CRNA and CRNA program director helped with recruitment and implementation in the clinical setting. The course director and project chair helped navigate the correct order and methods of designing, planning, implementing, and analyzing data throughout the project.

Methods and Measurement

Postoperative nausea and vomiting is an adverse event affecting 30% of the general surgical population and up to 80% of high risk patients. In addition to being distressing to patients, PONV is also associated with longer stays in the PACU, and increased hospital admissions and health care costs. The purpose of this scholarly project was to assess the CRNAs' knowledge, preferences, and practices for managing PONV and whether or not they perceived a PONV Quick Reference Guideline to be a useful tool for their practice to aid in identifying high-risk patients, managing baseline PONV risks, and selecting strategies for prophylaxis and rescue treatment. Education was provided through implementation of a Quick Reference Guide for anesthesia providers. This guide included the most current consensus guidelines for managing PONV as well as the four factor Apfel risk assessment scoring chart. This Quick Reference Guide was developed with the goal of evaluating its effectiveness in PONV management at the partnering organization. A copy of this guide can be found in Appendix E.

Qualtrics surveys were created with separate questions for prior to and after implementation of the project. Survey questions were designed utilizing primarily Likert scale responses as well as some open-ended responses. These questions were then entered into Qualtrics and transformed into a survey that was easily delivered to the target population. These survey questions and their associated responses can be found in appendix F. To implement the project, an initial, secure email containing the Quick Reference Guide, a link to the pre-intervention survey, and a video presentation explaining the intervention was sent to the target population. A copy of this email along with the presentation slides is in Appendix G. Additional emails were later sent that included a reminder to participate in the project, a link to the post-intervention survey, and appreciation for participation. These emails are also included in Appendix G. Finally, results from these survey questions were analyzed and compared in order to assess the perceptions of the CRNAs in regard to the usefulness of the PONV Quick Reference Guide.

During the planning process, it was decided what type of intervention was to be implemented, what information would be included in the intervention, and how the information and intervention would be delivered to the target population. Once the intervention and plan were finalized, two separate review board processes were completed to gain approval for implementation of the project. This included verifying that the project was a quality improvement project for the university, as well as approval from the partnering organization and the unit director of the target population.

In the *Do* phase of the project, participants were recruited by the clinical contact CRNA to maintain objectivity and confidentiality. The target population was provided the pre-intervention survey, the PowerPoint presentation with voiceover describing PONV management

and the intervention, and the Quick Reference Guide they were to use during the two week time frame. Implementation consisted of the target population using the Quick Reference Guide for a two week time frame at the partnering organization. After this two weeks, the post-intervention survey was distributed to the target population and response data was collected and collated.

Analyzing the data collected prior to and after implementation of the intervention was the next project phase, *Study*. Responses were examined and analyzed using Excel. Finally, recommended modifications were noted for possible future implementations of this intervention in the *Act phase*.

Implementation of this intervention went as planned with minimal adjustment necessary throughout the process.

Section IV. Results and Findings

Results

The purpose of this scholarly project was to assess CRNAs' knowledge, preferences, and practices for managing PONV and whether or not they perceived a PONV quick reference guideline is a useful tool for their practice to aid in identifying high-risk patients, managing baseline PONV risks, and selection of strategies for prophylaxis and rescue treatment. Qualtrics survey questions were sent prior to implementation of the Quick Reference Guide for a baseline understanding of current PONV practices and knowledge. Then, after two weeks of using the Quick Reference Guide, another set of survey questions was sent to gauge how helpful the CRNA participants found it to be in their practice of PONV management. There were ten total CRNAs invited to participate in the project, with six responding to the pre-survey and only three responding post implementation. Data that was collected with Qualtrics was then analyzed using Excel.

Data Presentation

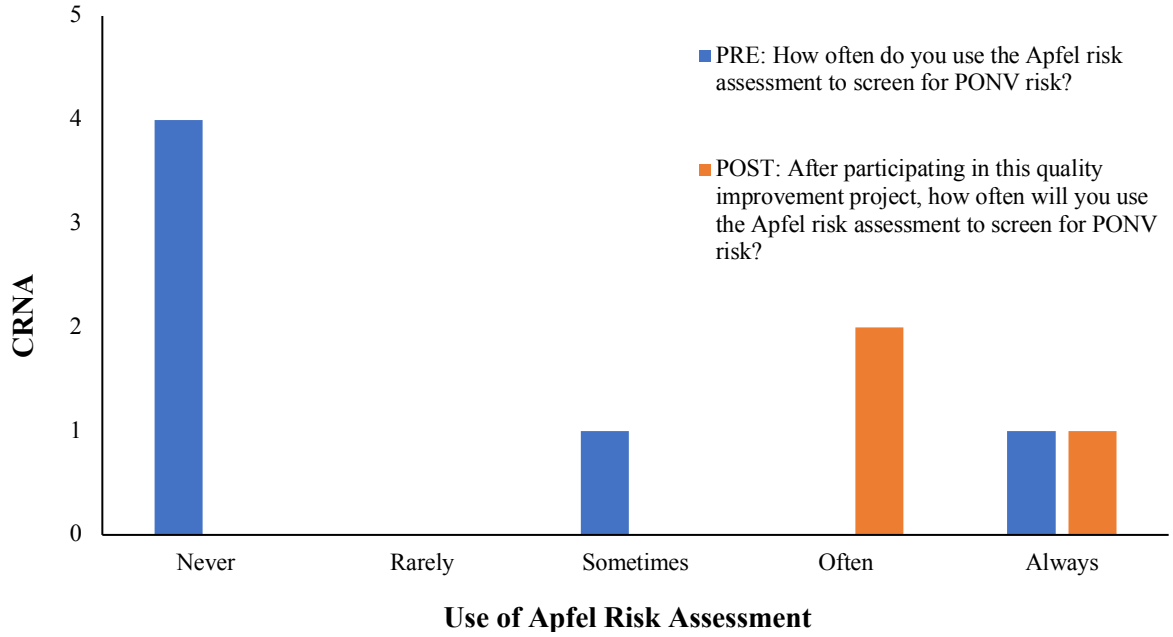
Before implementation of the Quick Reference Guide and the informational PowerPoint, participants were asked their opinion of what percentage, on average, of adult general anesthesia patients experience PONV. Responses from five participants ranged between 50 and 25 percent, with 30 percent being the most frequent response. A sixth participant selected "no clue." After implementation, all three participants responded with 30 percent. Participants were also asked what percentage, on average, of high risk adult general anesthesia patients experience PONV, in which they responded 99, 80, 60, 30, 5, and "no clue". When asked this same question after implementation, all three responded 80. Prior to implementation, six participants stated that they always consider prophylaxis and treatment of PONV when planning for a case. However, after

implementation, with only two responses, one participant said they would often consider prophylaxis and treatment of PONV when planning for a case and one said they would always consider it.

Prior to implementation of the Quick Reference Guide, four out of six participants responded they were not familiar with the Apfel risk assessment for PONV, one stated they were somewhat familiar, and one stated they were very familiar. After implementation, all three participants responded they were very familiar with the Apfel risk assessment. Before implementation, four out of six participants never used the Apfel risk assessment for screening for PONV risk, one sometimes used it, and one always used it. However, when asked after implementation how often they will use the Apfel risk assessment in future practice, two out of three participants said often and the third said always. As can be observed in Figure 1, before implementation, three of six participants responded they never, one responded rarely, one responded often, and one responded always in regard to how often they tailor PONV prophylaxis based on Apfel risk factors. In comparison, after implementation, one of three responded they will often tailor PONV prophylaxis based on Apfel risk factors while the remaining two responded they will always do so.

Figure 1.

CRNA Use of Apfel Risk Assessment for PONV



Note. Pre-intervention n=6, post-intervention n=3.

Prior to implementation, participants were asked how often they use ondansetron, droperidol, dexamethasone, and scopolamine for preventing PONV during routine general anesthesia cases. Four of six responded with always and two responded with often for ondansetron; droperidol three responded never, two responded rarely, and one responded sometimes in regard to; four responded often, one always, and one rarely for dexamethasone; three responded often for scopolamine, two sometimes, and one rarely. After implementation of the Quick Reference Guide, when asked how often the participants plan on using these medications for PONV management, three responded always to ondansetron usage; one responded often, one responded sometimes, and one responded rarely in regard to use of

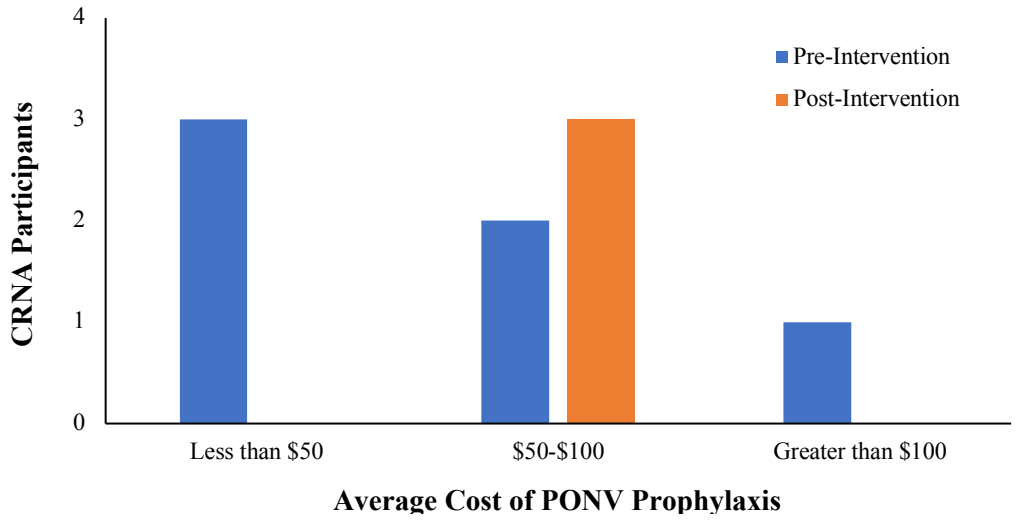
droperidol; two responded often and one always for dexamethasone; two responded often and one sometimes for scopolamine administration.

When participants were asked, prior to implementation, how many pharmacologic agents they usually used for patients at low risk for PONV, three responded one agent, two responded two agents, and one responded three agents. When asked after project implementation how many pharmacologic agents they planned to employ for patients at low risk for PONV, two responded with two agents and one with three agents. Prior to the intervention, when participants were asked how many pharmacologic agents they usually used for patients at high risk for PONV, four responded more than three agents and two responded three agents. When asked how many pharmacologic agents participants planned to employ for patients at high risk for PONV after project implementation, one responded with two agents and two with greater than three agents. Figure 2 displays pre and post intervention results when participants were asked to estimate the average cost of PONV prophylaxis for each case.

Half of the six participants were unsure if there was an implemented PONV management protocol in their department prior to implementation, two said there was a protocol, and one said there was not a protocol. After implementation, two of the three participants responded that recommending an implemented PONV management protocol would be very useful, and one responded it would be somewhat useful. Five out of six participants perceived a quick reference guide as somewhat useful in managing PONV and one perceived- it to be very useful prior to implementation. After implementation, one of the three perceived the PONV Quick Reference Guide as somewhat useful and the other two perceived it as very useful in managing PONV. The last question in the post-implementation survey was open ended regarding participant

suggestions on how they would improve the PONV Quick Reference Guide. One participant suggested making it electronic in EPIC and one suggested making it pocket sized.

Figure 2.
Estimate of the Average Cost of PONV Prophylaxis for Each Case



Note. Pre-intervention n= 6, post-intervention n=3.

Analysis

When comparing results from the pre intervention and post intervention survey questions, it is reasonable to conclude that CRNAs participating in this project were educated about PONV and some even might change their current practice of PONV management.

In regard to education about PONV, several questions were objective data questions pertaining to factual information regarding PONV. This information was provided in the PowerPoint slides delivered during the implementation phase of the project. Prior to implementation, these questions were not answered 100% correctly. However, after the

information was dispersed, all of the participants chose the correct answer for all three questions on the post intervention survey. For example, when asked prior to project implementation the average percentage of adult general anesthesia patients that experience PONV, just two of the six respondents selected the appropriate response of 30. After implementation, all three of the respondents answered 30, which was the number provided in the informational handout.

What was more interesting about the results of the survey questions were the post implementation survey questions that asked participants if they plan on changing their current PONV management practices. For example, one pre implementation survey asked how often participants used the Apfel risk assessment to screen for PONV risk. Surprisingly, four responded never, one responded sometimes, and one responded always. However, after implementation, two of the participants responded they would often use the Apfel risk assessment to screen for PONV risk in their future practice and one responded they would always use it. This indicated that the Apfel risk assessment must have been liked by those participants enough for them to respond that they plan on using it in their future practice. Another question on the pre implementation survey asked participants if there was an implemented PONV management protocol in their department. Three of the respondents were not sure if there was one in place or not. After implementation, participants were asked if they would recommend the department having an implemented PONV management protocol and two of them responded they would find one very useful and one responded they would find it somewhat useful.

Overall, it seems that the results from the post implementation survey questions indicate that participants did read the information that was provided and seemed to like the Quick Reference Guide handout. With survey answers being 100% correct for the objective data post

implementation questions, the participants did pick up objective information about PONV management from the provided information. It also can be assumed from the subjective survey responses that the participants think an implemented PONV management protocol and a Quick Reference Guide would be useful in the department. Participants even suggested making the Quick Reference Guide pocket sized or converting it to electronic format and adding it to the current medical recording system to increase accessibility.

Section V. Implications

Financial and Nonfinancial Analysis

The financial implications of effective PONV management are great incentive to ensure anesthesia providers follow current guidelines in their everyday practice. As Gan et al. (2020) examined in their consensus guidelines for PONV, the average patient cost for three antiemetic drugs is less than $11. Relative to this, Gan et al. found that it costs the institution approximately $74 for each episode of PONV. This additional cost includes an average of one extra hour spent in the PACU requiring nursing care. Assuming an average daily case load of 50, with an average of 30% of patients having PONV, the financial burden of PONV would be roughly $1,110 per day. Compare this to approximately $550 if three antiemetic drugs were used for every patient each day. This cost analysis does not even take into consideration the more serious potential complications associated with PONV. If a patient were to aspirate and compromise their airway, it is likely that they would need to stay intubated and in the Intensive Care Unit (ICU) overnight. According the Dasta et al., the average cost of a day in the ICU requiring mechanical ventilation in the United States is $10,794 (2005).

With awareness of these financial incentives, it is likely that the local institution would be willing to implement some form of PONV management protocol. As was recommended by some of the participants in this project, having a guideline or management protocol incorporated into the current electronic health record system would be beneficial. This would likely cost the institution little as they already have in house programmers familiar with the electronic system. Though there is no structured protocol, the local institution has all of the antiemetic drugs and other PONV management tools already available.

In addition to the financial benefit of a PONV management protocol, patient satisfaction scores would also likely increase. Gan et al. (2020) found that patients were willing to pay nearly $30 to prevent PONV for themselves and nearly $80 to prevent PONV for their children. Since patient satisfaction is a large motivation for quality improvement, it is only logical that the local institution would be willing to implement a cost-effective protocol that should also improve patient ratings. However, implementing this protocol does not necessarily mean that it will immediately result in change. Anesthesia providers are often set on their own practices and reluctant to change. Further education and incentives may need to be provided to ensure the anesthesia department is following an implemented protocol accurately. This could be another source of financial burden on the institution, depending on the type of education they choose to provide.

Implications of Project

As is stated by the AANA, Standard 2 requires all anesthesia providers to "perform and document or verify documentation of a preanesthesia evaluation of the patient's general health, allergies, medication history, preexisting conditions, anesthesia history, and any relevant diagnostic test…" (2019, p.1). This includes a risk assessment for PONV based on anesthesia history, medications, and preexisting conditions such as acid reflux. Assessment of these risk factors should be done on every patient as part of the responsibility encompassed in anesthesia care. The AANA fully endorsed the use of Gan et al.'s (2020) consensus guidelines on the management of PONV in the perioperative period. Included in these guidelines was the simplified Apfel scoring system, which was also used in implementation of this project. Given the responses collected both before and after implementation, anesthesia providers that

participated in this project felt that a standardized protocol for PONV management would be useful in their everyday practice.

With an average of 27,000 surgeries each year, and the risk of PONV nearly 30%, there are likely nearly 8,000 patients every year that experience PONV at this local institution. That's 8,000 additional hours that PACU nurses must spend taking care of patients with PONV, and 8,000 patients who are likely to be less satisfied with their experience due to their episode of PONV. For the local institution, if a standardized PONV management protocol could reduce this number by even 10%, that would be a drastic decrease in nursing resources, financial burden associated with PONV, and patients that are unsatisfied due to PONV.

Sustainability

The local organization currently supplies and uses almost all of the medications and suggestions outlined by Gan et al. (2020) in their consensus guidelines for PONV management. However, if the organization was to implement a standardized protocol, it would have to provide education on the protocol as well as a method of charting the included compliance with the protocol for each patient. Education could be in the form of handouts or email communication along with a short informational presentation at a monthly department meeting. For the charting in the electronic health record (EHR), a quick-click form could be created similar to those used for airway and arterial line placement. Along with this education and adaptation to charting, the only other change would need to be the risk assessment for each patient undergoing general anesthesia. The anesthesia providers would be the one to do this and then have to treat with drugs already currently available in the OR. The costs to the institution would be minimal to implement this protocol, but it could potentially save money in the long run if the rates of PONV were

decreased. A short trial of this protocol could be conducted for six months to a year to determine the financial benefits or burden associated with implementation.

Dissemination Plan

Project information and collected data were transformed into poster format to be presented to the CRNA department members at the participating local organization. Members of the target population used in the project was also invited to attend. The final version of this paper along with the poster will be posted in The Scholarship, the East Carolina University digital repository.

Section VI. Conclusion

Limitations

A few limitations were noted during planning, implementing and collecting data. First was that all communication was done electronically, not in person, so real-time questions about the project or information could not be addressed. This limited knowing if participants fully understood what was being implemented and what they needed to do while participating in the project. Another limitation was the number of responses from pre and post implementation was quite different. Six participants responded in the pre implementation survey and just three participated in the post implementation survey. Since it was an anonymous project, it is impossible to know who completed or did not complete which survey. Therefore, individuals could not be selectively sent reminders to complete the survey. Some possible explanations for this are that some of the participants did not feel they had time to complete both surveys, or some could have been on vacation the weeks of the post survey implementation. Since all the participants did not respond to both survey questions, it limits the analysis of the data collected. It is impossible to know if any of the participants that completed the pre survey also completed the post survey and vice versa. It is quite possible that some participants only completed one of the surveys, which would skew any data showing education on PONV management after project implementation.

Recommendations for Future Implementation and/or Additional Study

If this project were to be continued or revisited by another organization, a few recommendations should be considered. A larger sample size of participants would be ideal, so that results can more accurately reflect trends in pre- versus post-implementation knowledge on the subject. Also, a method of tracking which participants have completed the pre- and post-

surveys would be helpful, as long as confidentiality is maintained for their actual responses. Another recommendation is extending the data collection and time frame that the surveys are available to the participants. Additional reminder emails might encourage participation of those that might not have been in the operating room the entire duration of the project implementation.

Given the results of this quality improvement project, it seems that the participants supported instituting a PONV management protocol at the local organization. Further research into details the actual guideline for the protocol would need to be completed. Also, the incidence of PONV at the organization should be tracked both before and after implementation of a PONV management protocol to ensure the positive outcomes of such guideline. Ideally, projects or studies should be launched for a more extended period of time to identify trends in the incidence of PONV after implementing a standardized protocol. More extensive cost analysis would also be beneficial for determining the financial impact of drugs and other techniques to prevent PONV used in the operating room on the cost of PONV occurrence in the PACU and beyond.

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Appendix A

Literature Concept Table & Search Strategy Templates

	Concept 1: General anesthesia	Concept 2: Nausea and vomiting	Concept 3: Anesthesia provider
Keywords (these are the "normal" words you would use anywhere)	volatile agents OR anesthesia OR anesthesia drugs OR general anesthesia	Nausea OR vomiting OR post-operative vomiting	CRNA OR Certified Registered Nurse Anesthetist OR anesthesia provider
PubMed MeSH (subject headings specific to PubMed)	Anesthesia, general [MeSH] OR volatilization [MeSH] OR anesthesia [MeSH]	Vomiting [MeSH] OR nausea [MeSH]	anesthetists
CINAHL Subject Terms (Subject headings specific to CINAHL)	Anesthesia, General	Nausea and Vomiting	Nurse Anesthetist
Other – Google Scholar	volatile agents OR anesthesia OR anesthesia drugs OR general anesthesia	Nausea OR vomiting OR post-operative vomiting	Nurse anesthetists or CRNA

Appendix B

Literature Search Log

Search date	Database or search engine	Search strategy	Limits applied	Number of citations found/kept	Rationale for inclusion/exclusion of items
9/7/22	PubMed	(general anesthesia OR volatile agent OR anesthesia drug) AND (vomiting OR nausea) AND (anesthetists) ("general anaesthesia"[All Fields] OR "anesthesia, general"[MeSH Terms] OR ("anesthesia"[All Fields] AND "general"[All Fields]) OR "general anesthesia"[All Fields] OR ("general"[All Fields] AND "anesthesia"[All Fields]) OR (("volatile"[All Fields] OR "volatiles"[All Fields] OR "volatilities"[All Fields] OR "volatilization"[MeSH Terms] OR "volatilization"[All Fields] OR "volatility"[All Fields] OR "volatilizations"[All Fields] OR "volatilize"[All Fields] OR "volatilized"[All Fields] OR "volatilizes"[All Fields] OR "volatilizing"[All Fields]) AND ("agent"[All Fields] OR "agents"[All Fields])) OR (("anaesthesia"[All Fields] OR "anesthesia"[MeSH Terms] OR "anesthesia"[All Fields] OR "anaesthesias"[All Fields] OR "anesthesias"[All Fields]) AND "drug"[All Fields])) AND ("vomiter"[All Fields] OR "vomiters"[All Fields] OR "vomiting"[MeSH Terms] OR "vomiting"[All Fields] OR "vomit"[All	adults 2018-2022	32 articles found; 7 kept	Included cases with a meta-analysis and regarding pre-operative risk scores and assessments; excluded pediatric studies and studies not directly involving PONV

		Fields] OR "vomited"[All Fields] OR "vomits"[All Fields] OR "vomitings"[All Fields] OR "vomition"[All Fields] OR "vomitting"[All Fields] OR ("nausea"[MeSH Terms] OR "nausea"[All Fields] OR "nauseas"[All Fields])) AND ("anaesthetists"[All Fields] OR "anesthetists"[All Fields] OR "anesthetists"[MeSH Terms] OR "anesthetists"[All Fields] OR "anaesthetist"[All Fields] OR "anaesthetists"[All Fields] OR "anesthetist"[All Fields])			
9/7/22	CINAHL	((MH "Nausea and Vomiting") OR (MH "Vomiting") OR (MH "Nausea")) AND (((MH "Anesthesia, General") OR (MH "Anesthesia")) OR ("anesthesia provider" OR (MH "Anesthetists") OR (MH "Nurse Anesthetists") OR (MH "Anesthesia Nursing") OR (MH "Anesthesiologists")))	adults 2017-2022	7 results with all 3 MH's used; 137 results with only only "Anesthesia, General" and "Nausea and Vomiting"; 10 kept	Some articles were related to pediatric surgery, others were not relevant specifically to post-operative nausea and vomiting
9/7/22	Google Scholar	(general anesthesia OR volatile agent OR anesthesia drug) AND (vomiting OR nausea) AND (anesthetists)	2017-2022	5 pages searched; numerous citations were relevant and kept	Kept the meta-analysis of PONV studies; excluded pediatric cases and ones not directly related to PONV

Appendix C

Literature Matrix

Authors/Year/ Title/ Journal	Purpose and Conceptual Framework or Model	Design/ Level of Evidence (Melnyk)	IV DV or Themes concepts and categories	Instrument Used	Sample method	Sample Size/ Characteristics	Results/Limits/ Relevance to Project
Aubrun, F., Ecoffey, C., Benhamou, D., Jouffroy, L., Diemunsch, P., Skaare, K., Bosson, J. L., & Albaladejo, P. (2019). Perioperative pain and post-operative nausea and vomiting (PONV) management after day-case surgery: The SFAR-OPERA national study. *Anaesthesia, Critical Care & Pain Medicine*, *38*(3), 223–229.	To describe the perioperative pain and PONV management within selected day-case surgical procedures in France. No framework or model noted.	Level II- Randomized controlled study	IV: Type of surgical procedure (ten different procedures) DV: incidence of postoperative pain or nausea and vomiting	OPERA- Observational, prospective survey STATA version 13 VAS- Visual Analogue Scale NRS- Numerical Rating Scale Apfel Score	Patients from 206 randomly selected healthcare institutions in France between December 2013 and December 2014	2144/ All patients were over the age of 12 and were undergoing one of ten different surgical procedures	The survey found that the practice patterns for pain treatment and PONV prophylaxis after ambulatory surgery vary among French institutions and are not always in line with national guidelines. They also found that a written protocol for PONV management was available in 75% of the institutions but was dedicated to day-case surgery in only 10% of them. Limitation: Only 23.1% of all French health facilities were represented in this study Usefulness: Provides breakdown of surgery type and the comparison of

							PONV related to each procedure. This is similar to other articles and will help in determining how the type of surgery relates to incidence of PONV.
Dewinter, G., Staelens, W., Veef, E., Teunkens, A., Van de Velde, M., & Rex, S. (2018). Simplified algorithm for the prevention of postoperative nausea and vomiting: A before-and-after study. *British Journal of Anaesthesia : BJA, 120*(1), 156-163.	To test the effectiveness of a simplified algorithm for PONV prophylaxis on the incidence of PONV. No framework or model noted.	Level VI-Quality Improvement Project	Before-and-after study of implementation of the simplified PONV algorithm	Simplified PONV algorithm, GraphPad Prism – version 6, SAS System for Windows-version 9.4	Patients from the University Hospitals Leuven in Belgium from January 12, 2016 – January 18, 2016 and November 28, 2016 – December 2, 2016	N/A/ Adult patients over age 18 in the PACU undergoing elective non-cardiac non-day case surgery under general anesthesia.	Use of the simplified PONV algorithm resulted in a significant reduction in the incidence of PONV. Also, using the simplified PONV algorithm increased compliance of the anesthesia department PONV guidelines.
Gan, T. J., Diemunsch, P., Habib, A. S., Kovac, A., Kranke, P., Meyer, T. A., Watcha, M., Chung, F., Angus, S., Apfel, C. C., Bergese, S.	To provide perioperative practitioners with a comprehensive and up-to-date, evidence-based guidance on the risk stratification,	Level I-Systematic Review/ Meta-analysis	Guidelines formulated based on risk factors, administration of prophylactic drugs, and generalized multimodal PONV	MECIR-Methodological Expectations of Cochrane Intervention Review PRISMA-Preferred Reporting Items for Systematic	Articles published from January 2011 to February 2019 with continued literature surveillance	N/A/ Adults over age 18	Meta-analysis and systematic review used to formulate seven consensus guidelines for the prevention and treatment of PONV. They analyzed the most important risk factors, used a

D., Candiotti, K. A., Chan, M. T., Davis, P. J., Hooper, V. D., Lagoo-Deenadayalan, S., Myles, P., Nezat, G., Philip, B. K., Tramèr, M. R., … Society for Ambulatory Anesthesia (2020). Consensus guidelines for the management of postoperative nausea and vomiting. *Anesthesia and Analgesia*, *118*(1), 85–113.	prevention, and treatment of PONV in both adults and children. No framework or model noted.		prevention and treatment.	Reviews and Meta-analyses PRESS- Peer Review of Electronic Search Strategies	through September 2019		simple risk scoring system adapted from Apfel's original system, and explained how to incorporate these factors into anesthesia practice.
Johansson, E., Hultin, M., Myrberg, T., & Walldén, J. (2021). Early post-operative nausea and vomiting: A retrospective observational study of 2030 patients. *Acta Anaesthesiologica Scandinavica*,	To determine and explain risk of early PONV in the postoperative care unit in one Swedish county hospital No framework or model noted.	Level III-Quantitative nonrandomized controlled study	IV: Patient demographics (age, sex, BMI, smoker); type of surgery (major, intermediate, minor); duration of anesthesia DV: PONV reported Retrospective Observational Study	SPSS to run statistical analyses Apfel score	Medical records and charts reviewed indicating nausea, vomiting, or any related treatment	2030/All surgical patients of different ages, sexes, and personal characteristics	The authors found 194 patients (9.6%) of their 2030 studied had PONV. Every tenth patient that had general anesthesia experienced PONV. Limitations: data based on documentation which could have been missed or not correct documentation so the true occurrence

65(9), 1229–1239.							of PONV could be higher. Usefulness: helps identify patient risk factors associated with increased rate of PONV; examines the type of surgical procedure and the associated rate PONV
Kandavar, S., & Padmanabha, S. (2021). Comparison of Effects of Propofol and Sevoflurane used in maintenance of general anaesthesia on post-operative nausea and vomiting - A prospective observational study. *Journal of Evolution of Medical and Dental Sciences, 10,* 1515-1518.	To evaluate if sevoflurane and propofol used in maintenance of anesthesia have any influence on PONV in patients undergoing general anesthesia at a hospital in India. No framework or model noted.	Level IV-Quantitative controlled cohort study	IV: Drug (propofol or sevoflurane) given to patient DV: PONV during first 24 hours after surgery Prospective Observational Study	SPSS software version 2.0 Fischer's exact test Mann-Whitney test	Patients assessed for any occurrence of PONV at hour zero, four, six, and 24 after extubation. 32 patients in Group P received propofol; 32 patients in Group S received sevoflurane during surgery	64/Patients undergoing elective otorhinolaryngology surgery; mean age of 29.69 years in group P and 29.20 years in group S; all other demographics were comparable between groups	The authors found that PONV in Group P was 6.25% but was 37.5% in Group S. At hour four after extubation, five patients in Group S still had nausea while none reported nausea in Group P. Limitation: This only examined patients undergoing a specific surgery type where the rate of PONV in higher in general compared to other types of surgery. Usefulness: helps identify differences in PONV rates from different volatile agents used for general anesthesia.

Lee, O. H., Choi, G. J., Kang, H., Baek, C. W., Jung, Y. H., Woo, Y. C., Oh, J., & Park, Y. H. (2017). Effects of Sugammadex vs. Pyridostigmine-glycopyrrolate on post-operative nausea and vomiting: Propensity score matching. *Acta Anaesthesiologica Scandinavica*, *61*(1), 39–45.	To compare the effects of sugammadex on PONV with those of pyridostigmine-glycopyrrolate mixture in patients having general anesthesia at Chung-Ang University Hospital in South Korea No framework or model noted.	Level IV-Controlled cohort study	IV: Reversal drug (sugammadex or pyridostigmine-glycopyrrolate) given to patient DV: reports of PONV Retrospective study	SPPS Shapiro-Wilk test, paired t-test, Wilcoxon signed-rank test, and McNemar test	Chart review of adults who had undergone general anesthesia between January 1, 2010 and December 31, 2015.	7179/All patients were treated with fentanyl-based IV-PCA and underwent general anesthesia during various types of surgery. Two groups were formed; those that received sugammadex (Group S) and those that received pyridostigmine-glycopyrrolate (Group R)	The authors concluded that patients reversed with sugammadex had a lower rate of PONV than those that received pyridostigmine-glycopyrrolate Limitation: retrospective study so some data could be missing or incomplete; not a randomized controlled study Usefulness: helps identify differences in rate PONV from two different reversal drugs; also examines patient factors and other anesthetic drugs
Pym, A., & Ben-Menachem, E. (2018). The effect of a multifaceted postoperative nausea and vomiting reduction strategy on prophylaxis administration amongst higher-risk adult surgical	To compare the outcomes of PONV using an evidence-based PONV guideline in higher-risk adult surgical patients at St. Vincent's Hospital in Sydney, Australia	Level IV-Quantitative controlled cohort study	IV: Patient demographics (age, sex, smoker); type of surgery (low or high risk); previous PONV; prophylaxis agents DV: PONV reported	SPSS Log-rank test	Patients assessed for PONV after undergoing general anesthesia. Pre and post intervention data collection over a two-month block at St.	Pre-intervention over eight weeks included 333 moderate or high-risk cases and 295 included in the post-intervention cases.	The authors concluded that an intervention of a PONV prevention guideline increased prophylaxis rates for patients at higher risk of PONV. Limitations: data was collected on PONV rates during PACU admission and not after PACU;

patients. *Anaesthesia and Intensive Care*, *46*(2), 185–189.	No framework of model noted				Vincent's Hospital		study was conducted at a single institution. Usefulness: Findings indicated that PONV management is still a significant target for improved clinical practice
Stoops, S., & Kovac, A. (2020). New insights into the pathophysiology and risk factors for PONV. *Best Practice & Research Clinical Anaesthesiology, 34*(4), 667-679.	Explain complications related to PONV; understand the pathophysiology risk factors; examine how anesthesia medications, surgical time, different surgical procedures, and patient related characteristics impact PONV No framework or model noted.	Level VII: Expert Opinion	Categories examined included: CNS central and peripheral-related factors; medications and anesthesia-related factors; surgical procedures and techniques; genetics; and patient-related characteristics	Apfel Score	N/A	N/A	The authors explained that there are multiple complex and challenging factors involved in the pathophysiology and etiology of PONV. They also stated that based on PONV risk score and the use of antiemetic algorithms, a plan for antiemetic medications can be created for each patient. Limitations: this article was not a research based study, it was information based without any testing or patients involved Usefulness: the article helps support the understanding of how patient

							characteristics, different anesthesia drugs, and different surgical procedures effect PONV in patients. This article can be used in conjunction with study-based articles to explain the pathophysiology behind their results
Zheng, X. Z., Cheng, B., Luo, J., Xiong, Q. J., Min, S., & Wei, K. (2021). The characteristics and risk factors of the postoperative nausea and vomiting in female patients undergoing laparoscopic sleeve gastrectomy and laparoscopic gynecological surgeries: A propensity score matching analysis. *European Review for Medical and Pharmacological*	To compare the prevalence of PONV in matched patients undergoing laparoscopic sleeve gastrectomy and laparoscopic gynecological surgeries in at a hospital in Chongqing, China. No framework or model noted.	Level III-Nonrandomized controlled study	IV: Type of surgery (laparoscopic sleeve gastrectomy or laparoscopic gynecologic surgery) DV: rate of PONV Retrospective Study	Apfel Score; SPPS version 26; Mann-Whitney U test; Propensity Score Matching Method; Verbal Rating Score	Retrospective chart review at one institution from January 1, 2016 to September 1, 2020	278/All female patients with BMI greater than 30 . Two main groups: LSG and LGS	The authors concluded that the type of surgery influenced the rate of PONV in their sample. The results suggested that procedure-related alterations in gastric physiology play a major role in contributing to the susceptibility to PONV in patients that received the laparoscopic sleeve gastrectomy. There was a higher incidence rate of PONV in patients that had the LSG compared to those that received LGS. Limitations: possible missed diagnosis of

Sciences, 25 (1), 182-189							PONV due to it being a retrospective study; the study only examined up to 48 hours post-surgery Usefulness: This article specifically examined the difference in two types of surgery and the correlated prevalence of PONV only in female patients with a BMI over 30.

Note. Key to abbreviations used in chart: PONV: Postoperative Nausea and Vomiting; IV: Independent Variable; DV: Dependent Variable; LSG: laparoscopic sleeve gastrectomy; LGS: laparoscopic gynecologic surgery. Key to Levels of Evidence: I: Systematic review/meta-analysis of randomized controlled trials; II: Randomized controlled trials; III: Nonrandomized controlled trials; IV: Controlled cohort studies; V: Uncontrolled cohort studies; VI: Descriptive or qualitative study, case studies, evidenced-based practice implementation and quality improvement; VII: Expert opinion from individuals or groups. Adapted from *Evidence-based practice in nursing and healthcare: A guide to best practice* (4th ed.), by B.M. Melnyk and E. Fineout-Overholt, 2019, p.131.

Appendix D

Institutional Review Board Processes

Quality Improvement/Program Evaluation Self-Certification Tool

Purpose:
Projects that do not meet the federal definition of human research pursuant to 45 CFR 46 do not require IRB review. This tool was developed to assist in the determination of when a project falls outside of the IRB's purview.

Instructions:
Please complete the requested project information, as this document may be used for documentation that IRB review is not required. Select the appropriate answers to each question in the order they appear below. Additional questions may appear based on your answers. If you do not receive a STOP HERE message, the form may be printed as certification that the project is "not research", and does not require IRB review. The IRB will not review your responses as part of the self-certification process. For projects being done at [redacted] site support will be required. Please email [redacted] to obtain site support from [redacted]

Name of Project Leader:

Kristin Beute

Project Title:

Perioperative Management of Postoperative Nausea and Vomiting: A Quality Improvement Project

Brief description of Project/Goals:

Brief description of Project/Goals:

A quick-reference perioperative PONV management handout , based upon accepted national guidelines, will be developed. Anesthesia providers at a local institution will be asked several questions (through Qualtrics) about their perceptions of the adequacy of their currently used PONV management and their current practice. An educational video about the use of a newly developed PONV management quick reference handout will be made available to them, and they will be asked to use the handout for two weeks. Upon completion of the two-week utilization period, they will be asked to complete a questionnaire about their perceptions of the adequacy of the PONV management handout and their current practice. Qualtrics survey software will be used to deliver the intervention link and gather participant perceptions prior to and post implementation of the project. No patient information will be recorded or maintained during this project.

Will the project involve testing an experimental drug, device (including medical software or assays), or biologic?

- ○ Yes
- ● No

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

- ○ Yes
- ● No

Is this a multi-site project (e.g. there is a coordinating or lead center, more than one site participating, and/or a study-wide protocol)?

- ○ Yes
- ● No

Is this a systematic investigation designed with the intent to contribute to generalizable knowledge (e.g. testing a hypothesis; randomization of subjects; comparison of case vs. control; observational research; comparative effectiveness research; or comparable criteria in alternative research paradigms)?

- ○ Yes
- ● No

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

- ● Yes
- ○ No

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

- (●) Yes
- ( ) No

Does the project involve "no more than minimal risk" procedures (meaning the probability and magnitude of harm or discomfort anticipated are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests)?

- (●) Yes
- ( ) No

Is the project intended to improve or evaluate the practice or process within a particular institution or a specific program, and falls under well-accepted care practices/guidelines?

- (●) Yes
- ( ) No

Based on your responses, the project appears to constitute QI and/or Program Evaluation and IRB review is not required because, in accordance with federal regulations, your project does not constitute research as defined under 45 CFR 46.102(d). If the project results are disseminated, they should be characterized as QI and/or Program Evaluation findings. Finally, if the project changes in any way that might affect the intent or design, please complete this self-certification again to ensure that IRB review is still not required. Click the button below to view a printable version of this form to save with your files, as it serves as documentation that IRB review is not required for this project. 11/24/2022

Center for Research and Grants

[redacted]

Quality Improvement Project vs. Human Research Study Determination Form

This worksheet is a guide to help the submitter to determine if a project or study is a quality improvement (QI) project or research study, is involving human subjects or their individually identifiable information, and if IRB approval as defined by the Health and Human Services (HHS) or Food and Drug Administration (FDA) is required. (For more guidance about whether the activity meets the definition of Human Subjects Research see the IRB FAQs or the Human Subject Research Decision Chart)

Please use Microsoft Word to complete this form providing answers below. For signatures, please hand sign or convert into a PDF file and electronically sign. Once completed and signed please email the form to the [redacted] Center for Research and Grants [redacted] A CRG team member will contact you with the results of their review and may request additional information to assist with their determination. The determination will be made in conjunction with the UMCIRB office.

Project Title: Perioperative Management of Postoperative Nausea and Vomiting: A Quality Improvement Project		
Funding Source: None		
Project Leader Name: Kristin Beute, BSN, SRNA/ Maura McAuliffe PhD, CRNA ☐ **Ed.D.** ☐ **J.D.** ☐ **M.D.** ☐ **Ph.D.** ☐ **Pharm.D.** ☒ **R.N.** ☐ **Other(specify):**		
Job Title: Nurse Anesthesia Student/ Nurse Anesthesia Faculty	**Phone:** [redacted]	**Email:**mcauliffem@ecu.edu
	Primary Contact (If different from Project Leader):	
	Phone: [redacted]	**Email:** beutek17@students.ecu.edu

Key Personnel/ Project Team members:

Name and Degree:	**Department:** (Affiliation if other than [redacted])	**Email:**
Kristin Beute, SRNA	[redacted]	beutek17@students.ecu.edu
Maura McAuliffe, PhD, CRNA, FAAN, Project Chair	[redacted]	mcauliffem@ecu.edu
Travis Chabo, DNP, CRNA Program Director	[redacted]	chabot14@ecu.edu

QI/QA Assessment Checklist:

Consideration	Question	Yes	No
PURPOSE	Is the PRIMARY purpose of the project/study to: • IMPROVE care right now for the next patient? OR • IMPROVE operations outcomes, efficiency, cost, patient/staff satisfaction, etc.?	☒	☐
RATIONALE 1	The project/study falls under well-accepted care practices/guidelines or is there sufficient evidence for this mode or approach to support implementing this activity or to create practice change, based on: • literature • consensus statements, or consensus among clinician team	☒	☐
RATIONALE 2	The project/study would be carried out even if there was no possibility of publication in a journal or presentation at an academic meeting. (**Please note that answering "Yes" to this statement does not preclude publication of a quality activity.) **Of note, quality must not be published as if it is research!**	☒	☐
METHODS 1	Are the proposed methods flexible and customizable, and do they incorporate rapid evaluation, feedback and incremental changes?	☒	☐
METHODS 2	Are patients/subjects randomized into different intervention groups in order to enhance confidence in differences that might be obscured by nonrandom selection? (Control group, Randomization, Fixed protocol Methods)	☐	☒
METHODS 3	Will there be delayed or ineffective feedback of data from monitoring the implementation of changes? (For example to avoid biasing the interpretation of data)	☐	☒
METHODS 4	Is the Protocol fixed with fixed goal, methodology, population, and time period?	☐	☒
RISK	The project/study involves no more than minimal risk procedures meaning the probability and magnitude of harm or discomfort anticipated are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests.	☒	☐
PARTICIPANTS	Will the project/study only involve patients/subjects who are ordinarily seen, cared for, or work in the setting where the activity will take place?	☒	☐
FUNDING	Is the project/study funded by any of the following? • An outside organization with an interest in the results • A manufacturer with an interest in the outcome of the project relevant to its products • A non-profit foundation that typically funds research, or by internal research accounts	☐	☒

If all of the check marks are inside the shaded gray boxes, then the project/study is very likely QI and not human subject research. Projects that are not human subject research do not need review by the IRB.

In order to assess whether your project meets the definition of human subject research requiring IRB review or may qualify as a quality improvement/assurance activity, please provide the following information:

1. Project or Study Summary:

Please provide a **summary of the purpose and procedures** as well address all of the following:

The purpose of this quality improvement project is to assess anesthesia providers' perceptions of adequacy of a newly developed PONV management quick reference guide. A quick-reference PONV management guide, based upon accepted national guidelines, will be developed. Anesthesia providers at [redacted] will be asked several questions (through Qualtrics) about their perceptions of the adequacy of their currently used quick reference guidance and preparedness for PONV management. An educational video about the use of the newly developed quick reference guide will be made available to them, and they will be asked to use the guide for two weeks. Upon completion of the two-week utilization period, they will be asked to complete a questionnaire about their perceptions of the adequacy of the guide. Qualtrics survey software will be used to gather participant perceptions of acceptability and adequacy of the intervention prior to and post implementation of the project. No patient information will be recorded or maintained during this project.

a) **The project's primary purpose.** The purpose of this scholarly project is to assess the CRNAs' knowledge, preferences, and practices for managing PONV and whether or not they perceive a PONV quick reference guideline as a useful tool for their practice to aid in identifying high-risk patients, managing baseline PONV risks, and selecting strategies for prophylaxis and rescue treatment.

b) **The project design.** The project will consist of a single Plan, Do, Study, Act cycle using a pre- and post-intervention survey design.

c) **Any interaction or intervention with humans.** CRNA participants will be contacted via email and asked to complete a presurvey and then utilize an informational tool based on current evidence that aligns with practices currently accepted within the facility to support their practice regarding PONV management. After two weeks they will then be asked to complete a post-survey addressing their perceptions of the intervention and their own practice. The primary researcher will be available electronically, by phone, or in person to consult with participants as needed.

d) **A description of the methods that will be used and if they are standard or untested.** The intervention for this project will be a newly created informational tool focused on PONV management which is based on current evidence and falls within current accepted practice standards within the facility.

e) **Specify where the data will come from and your methods for obtaining this data -please specify who/where**
(i.e., CRG will provide you with the data, or someone from a specific department will provide you with the data, or you will pull it yourself). Data will be gathered directly from participants through completion of Qualtrics pre- and post-surveys delivered and completed electronically.

f) **Specify what data will be used and any dates associated with when that data was originally collected (i.e., Patient Name, Diagnosis, Age, Sex), *If applicable, please attach your data collection sheet*.** Aside from participant emails, no identifiable data will be gathered. Data of interest is participant opinions and perceptions of practice and the newly developed informational tool.

g) **Where will the data (paper and electronic) for your project be stored? Please specify how it will be secured to protect privacy and maintain confidentiality. For paper data, please**

provide physical location such as building name and room number and that it will be kept behind double lock and key. For electronic data, please provide the file path and folder name network drive where data will be stored and specify that it is secure/encrypted/password protected. If using other storage location, please provide specific details. All data will be gathered using Qualtrics survey software then transferred to Excel for analysis. The only identifying information will be the IP address of the computer used for completing each Qualtrics survey. No individually identifiable information will be collected or connected to responses. Qualtrics survey software is accessed through [redacted] and involves multifactorial password protection. Data in Excel will be on a password protected personal laptop.

h) **Please specify how long data will be stored after the study is complete?** (Keep in mind that data collected/generated during the course of the project that includes protected health information (PHI) should have identifiers removed at the earliest opportunity.)
No PHI will be collected for this project. Data will be stored in Qualtrics and in Excel files (de-identified) until student graduation, anticipated to be spring of 2024.

i) **Please specify how the collected data will be used (internal/external reports, publishing, posters, etc.) and list name(s) of person responsible for de-identification of data before dissemination.** The deidentified data will be analyzed with results shared via a poster presentation to the [redacted] Nurse Anesthesia Program students and faculty, with participants invited to view the presentation remotely. If requested, a presentation of results to the participating department will be provided. Additionally, analysis of results will be addressed in a DNP Project Paper, completion of which is required for program graduation. This paper will be posted in the [redacted] digital repository, The Scholarship. Kristin Beute will be responsible for deidentification of all data prior to dissemination.

Please use this space above or **attach a** separate **summary and/or any other additional documentation describing your project**.

2. **If the Primary purpose of your project is for QI, have you obtained approval from the [redacted] operational leader within your department or health system:**

☐ **No [STOP. Please contact the appropriate operational leader for approval before proceeding.]**

☒ **Yes** [Please specify here whom and obtain their signature in the signature section below]

[redacted] **Operational Mgr/Leader Name:** _____

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3/1/2023 | 11:12 PM EST

[redacted] **Operational Mgr/Leader Signature** **Date**

(Part 11 Compliant Electronic Signatures Acceptable-i.e. AdobeSign or DocuSign)

Please note:

- By submitting your proposed project/study for QI determination you are certifying that if the project/study is established to qualify as QI project, you and your Department would be comfortable with the following statement in any publications regarding this project: "This project was reviewed and determined to qualify as quality improvement by the [redacted] for Research and Grants."
- If you are submitting a Poster to Media Services, you will also need to submit this Quality Determination Form or IRB Approval to Media Services for printing.
- If the [redacted] CRG determines the activity is not human subject research, then any presentation, publication, etc. should not refer to the activity as "human subject research," "exempt research," or "expedited research."

Attestation of Understanding

My signature below indicates that I fully understand that HIPAA Privacy standards as they apply to Quality Projects involving Protected Health Information and patient medical records as outlined below.

Under HIPAA, a Covered Entity (i.e. [redacted] can disclose PHI to another CE (i.e. [redacted] for the following subset of health care operations activities of the recipient CE without needing patient consent:

- Conducting quality assessment and improvement activities
- Developing clinical guidelines
- Conducting patient safety activities as defined in applicable regulations
- Conducting population-based activities relating to improving health or reducing health care cost

Identified [redacted] healthcare data utilized in this project should not be shared outside of the CE without a fully executed data use/sharing agreement. [redacted] leadership reserves the opportunity to review all articles for dissemination/ publication for which [redacted] healthcare data has been utilized and that the content is being disseminated in the appropriate manner as a quality initiative, not resembling research in any context.

DocuSigned by:
3/6/2023 | 6:32 PM EST
[redacted]
361BE6482AD2480...

Kristin Beute, SRNA — **February 8, 2023**

Project Leader Signature — **Date**

(Part 11 Compliant Electronic Signatures Acceptable-i.e. AdobeSign or DocuSign)

----------for [redacted] CRG Use Only----------

NHSR vs. HSR Determination:

☑ **Not Human Subject Research:** The [redacted] CRG has determined that based on the description of the project/study, approval by the IRB is not necessary. Any changes or modifications to this project may be discussed with the [redacted] CRG at that time to ensure those changes do not elevate the project to human research that would need IRB approval.

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

Approval Signatures:

[redacted] **CRG Reviewer:** [redacted] **Date:** 3/7/23

UMCIRB Office Staff Reviewer: [redacted] **Date:** 3/8/23

Appendix E

PONV Management Quick Reference Guide

ECU

Postoperative Nausea and Vomiting Prevention

Kristin Beute, BSN, SRNA
Greg Cornish, BSN, SRNA
Jared Galbreath, BSN, SRNA
Caleb Woolard, BSN, SRNA
Maura McAuliffe, CRNA, PhD, FAAN, Project Chair

Fourth Consensus Guidelines [1]

1. Identify Patients' Risk for PONV
2. Reduce Baseline Risk for PONV
3. Administer PONV Prophylaxis Using 2 Interventions in Adults at Risk for PONV
4. Administer Prophylactic Antiemetic Therapy to Children at Increased Risk for POV/PONV; As in Adults, Use of Combination Therapy is Most Effective
5. Provide Antiemetic Treatment to Patients With PONV Who Did Not Receive Prophylaxis or When Prophylaxis Failed
6. Ensure General Multimodal PONV Prevention and Timely Rescue Treatment Is Implemented in the Clinical Setting
7. Administer Multimodal Prophylactic Antiemetics in Enhanced Recovery Pathways

Risk Factors	Points
Female Gender	1
Non-Smoker	1
History of PONV and/or Motion Sickness	1
Postoperative Opioids	1
Sum of points	0-4

[2]

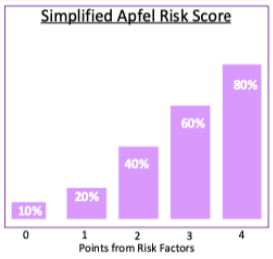


Table 3. Strategies to Reduce Baseline Risk [1 (p. 414)]

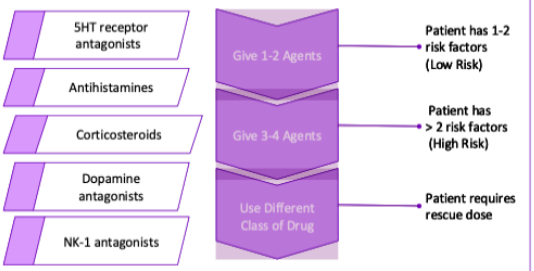
Avoidance of GA by the use of regional anesthesia[31,65] (A1)
Use of propofol for induction and maintenance of anesthesia[70] (A1)
Avoidance of nitrous oxide in surgeries lasting over 1 h (A1)
Avoidance of volatile anesthetics[26,61] (A2)
Minimization of intraoperative (A2) and postoperative opioids[26,47,49,72] (A1)
Adequate hydration[73,74] (A1)
Using sugammadex instead of neostigmine for the reversal of neuromuscular blockade[75] (A1)

Table 2. Risk Factors for PONV in Adults [1 (p. 414)]

Evidence	Risk Factors
Positive overall	Female sex (B1)
	History of PONV or motion sickness (B1)
	Nonsmoking (B1)
	Younger age (B1)
	General versus regional anesthesia (A1)
	Use of volatile anesthetics and nitrous oxide[a] (A1)
	Postoperative opioids (A1)
	Duration of anesthesia (B1)
	Type of surgery (cholecystectomy, laparoscopic, gynecological) (B1)
Conflicting	ASA physical status (B1)
	Menstrual cycle (B1)
	Level of anesthesiologist's experience (B1)
	Perioperative fasting (A2)
Disproven or of limited clinical relevance	BMI (B1)
	Anxiety (B1)
	Nasogastric tube (A1)
	Migraine (B1)
	Supplemental oxygen (A1)

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; PONV, postoperative nausea and vomiting.
[a]Use of nitrous oxide over 1 h duration.

Pharmacological Interventions [1]



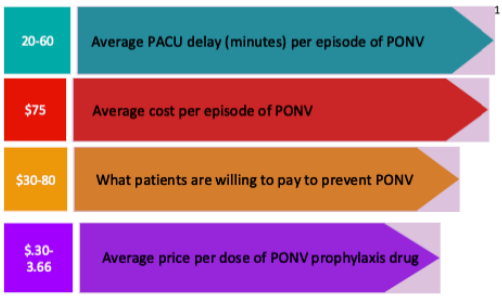
Strength of Supporting Evidence

- A1 — Multiple RCTs + meta analyses
- A2 — Multiple RCTs. No meta analyses.
- A3 — Single RCT.
- B1 — Cohort, Case control designs

[1]

Drug	Dose	Evidence	Timing	Evidence	Class
Aprepitant	40mg PO	A1	At induction	A2	NK1 antagonist
Dexamethasone	4-8mg IV	A1	At induction	A1	Corticosteroid
Diphenhydramine	25-50mg IV	A3			Antihistamine
Droperidol	.625mg IV	A1	End of case	A1	DA antagonist
Methylprednisolone	40mg IV	A2			Corticosteroid
Metoclopramide	10mg	A1			DA/5HT antagonist
Ondansetron	4mg IV	A1	End of case	A1	5HT antagonist
Scopolamine	Transdermal	A1	24-2 h prior to case	A1	Antimuscarinic

Cost/Benefit Analysis [1]



References
1. Gan, T. J., Belani, K. G., Bergese, S., Chung, F., Diemunsch, P., Habib, A. S., Jin, Z., Kovac, A. L., Meyer, T. A., Urman, R. D., Apfel, C. C., Ayad, S., Beagley, L., Candiotti, K., Englesakis, M., Hedrick, T. L., Kranke, P., Lee, S., Lipman, D., . . . Philip, B. K. (2020). Fourth consensus guidelines for the management of postoperative nausea and vomiting. *Anesthesia and Analgesia, 131*(2), 411-448. https://doi.org/10.1213/ANE.0000000000004833
2. Apfel, C. C., Läärä, E., Koivuranta, M., Greim, C., & Roewer, N. (1999). A simplified risk score for predicting postoperative nausea and vomiting: Conclusions from cross-validations between two centers. *Anesthesiology (Philadelphia), 91*(3), 693-700. https://doi.org/10.1097/00000542-199909000-00022

Appendix F

Qualtrics Pre and Post Intervention Survey Questions and Responses

Pre-Intervention Questions and Responses:

1. On average, what percentage of adult general anesthesia patients experience PONV?

15
25
30
30
50
No clue

2. On average, what percentage of HIGH RISK adult general anesthesia patients experience PONV?

99
80
No clue
60
30
5

3. How often do you consider prophylaxis and treatment of PONV when planning for a case?

#	Answer	%	Count
1	Never	0.00%	0
2	Rarely	0.00%	0
3	Sometimes	0.00%	0
4	Often	0.00%	0

5	Always	100.00%	6
	Total	100%	6

4. How familiar are you with using the Apfel risk assessment for PONV risk screening?

#	Answer	%	Count
1	Not Familiar	66.67%	4
2	Somewhat Familiar	16.67%	1
3	Very Familiar	16.67%	1
	Total	100%	6

5. How often do you use the Apfel risk assessment to screen for PONV risk?

#	Answer	%	Count
1	Never	66.67%	4
2	Rarely	0.00%	0
3	Sometimes	16.67%	1
4	Often	0.00%	0
5	Always	16.67%	1
	Total	100%	6

6. How often do you tailor PONV prophylaxis based on Apfel risk factors?

#	Answer	%	Count
1	Never	50.00%	3
2	Rarely	16.67%	1
3	Sometimes	0.00%	0
4	Often	16.67%	1
5	Always	16.67%	1
	Total	100%	6

7. How often do you typically use the following agents for preventing PONV (in patients with no contraindications to use of these medications) during routine general anesthesia cases?

#	Question	Never		Rarely		Sometimes		Often		Always		Total
1	ondansetron	0.00%	0	0.00%	0	0.00%	0	33.33%	2	66.67%	4	6
2	droperidol	50.00%	3	33.33%	2	16.67%	1	0.00%	0	0.00%	0	6
3	dexamethasone	0.00%	0	16.67%	1	0.00%	0	66.67%	4	16.67%	1	6
4	scopolamine	0.00%	0	16.67%	1	33.33%	2	50.00%	3	0.00%	0	6

8. How many pharmacologic agents do you usually employ for patients at LOW RISK (0-1 of the following risk factors: Female, Non-smoker, History of Motion Sickness, or Postoperative Opioid Administration) for PONV and with no contraindications to use of these medications?

#	Answer	%	Count
1	0 Agents	0.00%	0
2	1 Agent	50.00%	3
3	2 Agents	33.33%	2
4	3 Agents	16.67%	1
5	Greater than 3 Agents	0.00%	0
	Total	100%	6

9. How many pharmacologic agents do you usually employ for patients at HIGH RISK (3 or more of the following risk factors: Female, Non-smoker, History of Motion Sickness, or Postoperative Opioid Administration) for PONV and with no contraindications to use of these medications?

#	Answer	%	Count
1	0 Agents	0.00%	0
2	1 Agent	0.00%	0
3	2 Agents	0.00%	0
4	3 Agents	33.33%	2
5	Greater than 3 Agents	66.67%	4
	Total	100%	6

10. What is the average cost of PONV prophylaxis per case?

#	Answer	%	Count
1	Less than $50	50.00%	3
2	$50-$100	33.33%	2
3	Greater than $100	16.67%	1
	Total	100%	6

11. Does your department have an implemented PONV management protocol?

#	Answer	%	Count
1	Yes	33.33%	2
2	No	16.67%	1
3	Not sure	50.00%	3
	Total	100%	6

12. How useful do you perceive a quick reference guide for managing PONV to be?

#	Answer	%	Count
1	Not Useful	0.00%	0
2	Somewhat Useful	83.33%	5

3	Very Useful	16.67%	1
	Total	100%	6

Post- Intervention Questions and Responses:

1. On average, what percentage of adult general anesthesia patients experience PONV?

15
25
30
30
50
No clue

2. On average, what percentage of HIGH RISK adult general anesthesia patients experience PONV?

80
80
80

3. After participating in this quality improvement project, how often will you consider prophylaxis and treatment of PONV when planning for a case?

#	Answer	%	Count
1	Never	0.00%	0
2	Rarely	0.00%	0
3	Sometimes	0.00%	0
4	Often	50.00%	1
5	Always	50.00%	1
	Total	100%	2

4. After participating in this quality improvement project, how familiar are you with using the Apfel risk assessment for PONV risk screening?

#	Answer	%	Count
1	Not Familiar	0.00%	0
2	Somewhat Familiar	0.00%	0
3	Very Familiar	100.00%	3
	Total	100%	3

5. After participating in this quality improvement project, how often will you use the Apfel risk assessment to screen for PONV risk?

#	Answer	%	Count
1	Never	0.00%	0
2	Rarely	0.00%	0
3	Sometimes	0.00%	0
4	Often	66.67%	2
5	Always	33.33%	1
	Total	100%	3

6. After participating in this quality improvement project, how often will you tailor PONV prophylaxis based on Apfel risk factors?

#	Answer	%	Count
1	Never	0.00%	0
2	Rarely	0.00%	0
3	Sometimes	0.00%	0
4	Often	33.33%	1
5	Always	66.67%	2
	Total	100%	3

7. After participating in this quality improvement project, how often will you typically use the following agents for preventing PONV in patients with no contraindications to use of these medications during routine general anesthesia cases?

#	Question	Never		Rarely		Sometimes		Often		Always		Total
1	ondansetron	0.00%	0	0.00%	0	0.00%	0	0.00%	0	100.00%	3	3
2	droperidol	0.00%	0	33.33%	1	33.33%	1	33.33%	1	0.00%	0	3
3	dexamethasone	0.00%	0	0.00%	0	0.00%	0	66.67%	2	33.33%	1	3
4	scopolamine	0.00%	0	0.00%	0	33.33%	1	66.67%	2	0.00%	0	3

8. After participating in this quality improvement project, how many pharmacologic agents will you likely employ for patients at LOW RISK (0-1 of the following risk factors: Female, Non-smoker, History of Motion Sickness, or Postoperative Opioid Administration) for PONV and with no contraindications to use of the medications?

#	Answer	%	Count
1	0 Agents	0.00%	0
2	1 Agent	0.00%	0
3	2 Agents	66.67%	2
4	3 Agents	33.33%	1
5	Greater than 3 Agents	0.00%	0
	Total	100%	3

9. After participating in this quality improvement project, how many pharmacologic agents will you likely employ for patients at HIGH RISK (3 or more of the following risk factors: Female, Non-smoker, History of Motion Sickness, or Postoperative Opioid Administration) for PONV and with no contraindications to use of the medications?

#	Answer	%	Count
1	0 Agents	0.00%	0
2	1 Agent	0.00%	0
3	2 Agents	33.33%	1
4	3 Agents	0.00%	0
5	Greater than 3 Agents	66.67%	2
	Total	100%	3

10. What is the average cost of PONV prophylaxis per case?

#	Answer	%	Count
1	Less than $50	0.00%	0
2	$50-$100	100.00%	3
3	Greater than $100	0.00%	0
	Total	100%	3

11. After participating in this quality improvement project, would you recommend your department have an implemented PONV management protocol?

#	Answer	%	Count
1	Not Useful	0.00%	0
2	Somewhat Useful	33.33%	1
3	Very Useful	66.67%	2
	Total	100%	3

12. After participating in this quality improvement project, how useful do you perceive a quick reference guide for managing PONV to be?

#	Answer	%	Count
1	Not Useful	0.00%	0
2	Somewhat Useful	33.33%	1
3	Very Useful	66.67%	2

	Total	100%	3

13. How would you improve the PONV quick reference guide?

Make it electronic in EPIC
make it pocket size

Appendix G

Emails and Presentation Slides Sent to Target Population

Dear [redacted] CRNAs,

Thank you for considering participating in a quality improvement project titled "Perioperative Management of Postoperative Nausea and Vomiting: A Quality Improvement Project." The purpose of this project is to assess PONV management at [redacted]

Participation is voluntary and will involve completing a short pre-intervention survey, viewing a brief PowerPoint, utilizing a PONV Quick Reference Guide in your CRNA practice for two weeks from March 20-30th (at your discretion), and completing a short post-intervention survey when the two-week implementation period is over.

Each survey and the PowerPoint should take less than five minutes to complete. Significant information pertaining to the survey will be **bolded** in the PowerPoint. The surveys were created and are completed using Qualtrics® survey software. The use of the PONV Quick Reference Guide falls within currently accepted practice in your work area. Your participation is voluntary and confidential. We will share the results of this QI study with you upon completion.

First, complete the pre-intervention survey here.

Following completion of the survey, view the PowerPoint presentation regarding PONV management and the PONV Quick Reference Guide that is available in the attachment to this email.

Again, thank you for your participation in our quality improvement project. I will be at the main OR from March 20-March 30 if you have any questions. You may also reach out to me or Dr. McAuliffe by email at any time.

Sincerely,

Kristin Beute, SRNA, beutek17@students.ecu.edu
Dr. McAuliffe, CRNA, mcauliffem@ecu.edu

Hello [redacted] CRNAs,

I just wanted to send a quick reminder about the ongoing DNP Project on PONV management (original email below). If you've already filled out the pre-survey and viewed the PowerPoint, thank you. If you haven't had a chance to do so yet, it's not too late and would be very helpful and much appreciated. After the end of next week, I will begin sending out the post-surveys.

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

Sincerely,

Kristin Beute, SRNA, beutek17@students.ecu.edu
Dr. McAuliffe, CRNA, mcauliffem@ecu.edu

Dear [redacted] CRNAs,

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

If you have not filled out a pre-survey, I would really and truly appreciate your participation (it's just surveys and a PowerPoint!). The link to the pre-survey is here, and you can follow it up by watching the introductory PowerPoint attached in the original email.

If you've already completed the first survey, please complete the post-survey here. It should take less than 5 minutes.

If anyone has questions or issues with any of these links please let me know. Again, thank you to everyone for your help and for being excellent preceptors!

Sincerely,

Kristin Peed Beute, BSN, RN
[redacted]

Postoperative Nausea and Vomiting

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Jared Galbreath, BSN, SRNA
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Maura McAuliffe, CRNA, PhD, FAAN, Project Chair

[redacted]

PONV Facts and Associated Complications

- 30% of adult, general surgical population experiences postoperative nausea and/or vomiting (PONV)
- 80% in high risk cohorts
- PONV is associated with significant patient dissatisfaction
- PONV is often rated as worse than having pain after surgery
- **An episode of PONV may cost $75 avg**
- There is generalized poor adherence to perioperative PONV management protocols- mainly due to lack of education
- Anesthesia providers are mainly responsible for PONV management
- Vomiting can cause wound dehiscence, hernia protrusion, aspiration, increased bleeding from surgical site, and electrolyte imbalance
- PONV increases length of stay in the PACU by an average of 20-60 minutes

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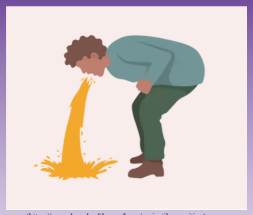
Risk Factors



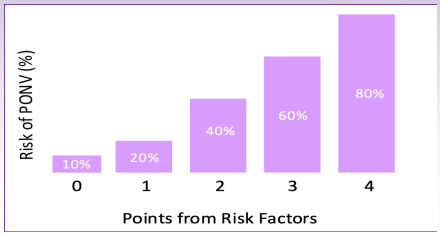
(https://www.buoyhealth.com/learn/projectile-vomiting)

- All increase the risk for PONV:
  - **Female Gender**
  - **Non-Smoking Status**
  - Younger Age
  - Normal BMI
  - **History of PONV or Motion Sickness**
  - General Anesthesia
    - Use of Volatile Anesthetics and/or Nitrous increase risk further
  - Long Duration of Anesthesia
  - Abdominal, Laparoscopic, Middle Ear, and Gynecological Surgeries
  - **Postoperative Opioid Administration**

[redacted]

Risk Assessment

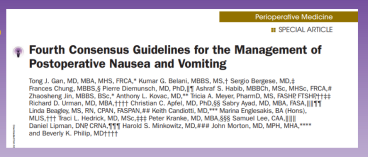
- Focused on four primary risk factors:
  - Gender
  - Smoking Status
  - History of PONV
  - Postoperative opioid administration
- Cumulative Score offers a relative risk based on the number of points the patient scores



Simplified Apfel Risk Score

Risk Factors	Points
Female Gender	1
Non-Smoker	1
History of PONV and/or Motion Sickness	1
Postoperative Opiods	1
Sum of points	0-4

Guidelines


Perioperative Medicine
SPECIAL ARTICLE
Fourth Consensus Guidelines for the Management of Postoperative Nausea and Vomiting

Fourth Consensus Guidelines:

- Identify Patients' Risk
- Reduce Baseline Risk
- Administer PONV Prophylaxis Using Combination Therapy in Adults at Risk
- Administer PONV Prophylaxis Using Combination Therapy in Children at Risk
- Provide Antiemetic Treatment to Patients with PONV
- Ensure General Multimodal PONV Prevention and Timely Rescue Treatment
- Administer Multimodal Prophylactic Antiemetics in Enhanced Recovery Pathways

These guidelines have been endorsed by the American Society of Anesthesiologists (ASA) and the American Association of Nurse Anesthesiology (AANA) along with twenty-five other organizations from across the world

[redacted]

Pharmacology

Serotonin 5HT3 Receptor Antagonist

- **Ondansetron (Zofran) -** 4 mg IV commonly given 30 minutes before extubation
  - **MOA:** Blocks serotonin peripherally on vagal nerve terminals and centrally in the chemoreceptor trigger zone (PONV prevention part).

Dopamine D2 Receptor Antagonist

- **Metoclopramide (Reglan) -** 10 mg IV given 30-60 minutes prior to surgery
  - **MOA:** Blocks dopamine receptors and serotonin receptors in the chemoreceptor trigger zone. Also increases gastric emptying.
- **Droperidol -** 0.625-1.25 mg given at the end of surgery
  - **MOA:** Causes a blockade of dopamine stimulation in the chemoreceptor trigger zone.

Histamine Receptor Antagonist

- **Diphenhydramine (Benadryl)** - 25-50 mg IV
  - **MOA:** Competes with histamine for H1 receptors in GI, Respiratory tract, and blood vessels.

[redacted]

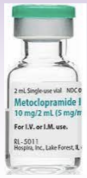
Pharmacology

Anticholinergic

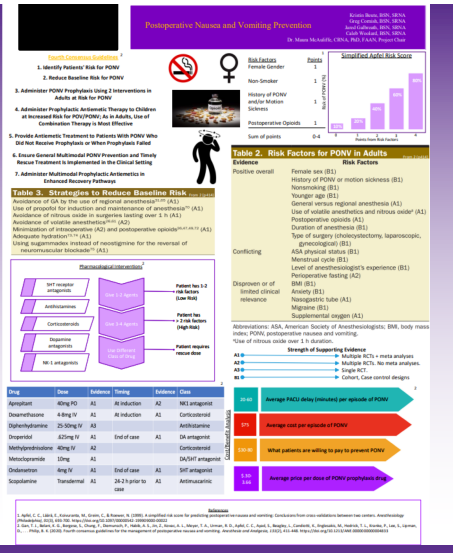
- **Scopolamine -** 1 patch applied behind the ear usually the night before surgery
  - **MOA:** Blocks the action of acetylcholine at parasympathetic sites and antagonizes histamine and serotonin.

Corticosteroid

- **Dexamethasone (Decadron) -** 4-8 mg given right after intubation or before the start of surgery
  - **MOA:** Antiemetic activity is unknown



The Quick Reference Guide



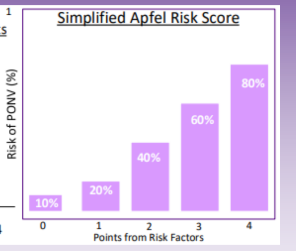
The Quick Reference Guide

Fourth Consensus Guidelines [2]

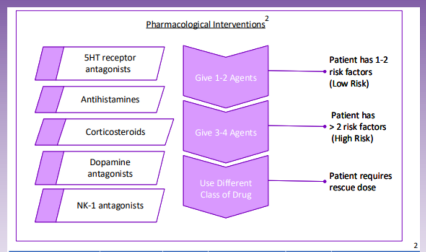
1. **Identify Patients' Risk for PONV**
2. **Reduce Baseline Risk for PONV**
3. **Administer PONV Prophylaxis Using 2 Interventions in Adults at Risk for PONV**
4. **Administer Prophylactic Antiemetic Therapy to Children at Increased Risk for POV/PONV; As in Adults, Use of Combination Therapy is Most Effective**
5. **Provide Antiemetic Treatment to Patients With PONV Who Did Not Receive Prophylaxis or When Prophylaxis Failed**
6. **Ensure General Multimodal PONV Prevention and Timely Rescue Treatment Is Implemented in the Clinical Setting**
7. **Administer Multimodal Prophylactic Antiemetics in Enhanced Recovery Pathways**

Simplified Apfel Risk Score

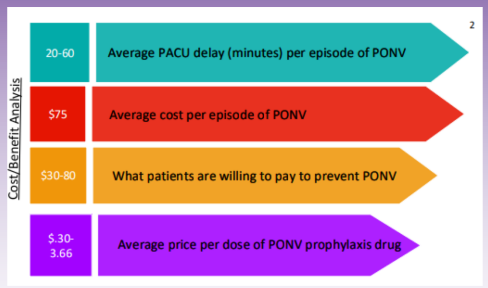
Risk Factors	Points
Female Gender	1
Non-Smoker	1
History of PONV and/or Motion Sickness	1
Postoperative Opioids	1
Sum of points	0-4



The Quick Reference Guide



Drug	Dose	Evidence	Timing	Evidence	Class
Aprepitant	40mg PO	A1	At induction	A2	NK1 antagonist
Dexamethasone	4-8mg IV	A1	At induction	A1	Corticosteroid
Diphenhydramine	25-50mg IV	A3			Antihistamine
Droperidol	.625mg IV	A1	End of case	A1	DA antagonist
Methylprednisolone	40mg IV	A2			Corticosteroid
Metoclopramide	10mg	A1			DA/5HT antagonist
Ondansetron	4mg IV	A1	End of case	A1	5HT antagonist
Scopolamine	Transdermal	A1	24-2 h prior to case	A1	Antimuscarinic



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The Quick Reference Guide

Table 3. Strategies to Reduce Baseline Risk From 2 (p414)

Avoidance of GA by the use of regional anesthesia[31,65] (A1)
Use of propofol for induction and maintenance of anesthesia[70] (A1)
Avoidance of nitrous oxide in surgeries lasting over 1 h (A1)
Avoidance of volatile anesthetics[26,61] (A2)
Minimization of intraoperative (A2) and postoperative opioids[26,47,49,72] (A1)
Adequate hydration[73,74] (A1)
Using sugammadex instead of neostigmine for the reversal of neuromuscular blockade[75] (A1)

Strength of Supporting Evidence

A1 → Multiple RCTs + meta analyses
A2 → Multiple RCTs. No meta analyses.
A3 → Single RCT.
B1 → Cohort, Case control designs

Table 2. Risk Factors for PONV in Adults From 2 (p414)

Evidence	Risk Factors
Positive overall	Female sex (B1)
	History of PONV or motion sickness (B1)
	Nonsmoking (B1)
	Younger age (B1)
	General versus regional anesthesia (A1)
	Use of volatile anesthetics and nitrous oxide[a] (A1)
	Postoperative opioids (A1)
	Duration of anesthesia (B1)
	Type of surgery (cholecystectomy, laparoscopic, gynecological) (B1)
Conflicting	ASA physical status (B1)
	Menstrual cycle (B1)
	Level of anesthesiologist's experience (B1)
	Perioperative fasting (A2)
Disproven or of limited clinical relevance	BMI (B1)
	Anxiety (B1)
	Nasogastric tube (A1)
	Migraine (B1)
	Supplemental oxygen (A1)

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; PONV, postoperative nausea and vomiting.
[a]Use of nitrous oxide over 1 h duration.

Summary

- 80% of high risk patients experience PONV
- Up to 30% of all patients may experience PONV
- Each PONV episode costs the facility an average $75
- PONV may cost <$5 to prevent

[redacted]

Summary

- Apfel Risk score: Female, Non-Smoker, History of PONV/motion sickness, post-op opioids
- Current Guidelines endorsed by both AANA AND ASA
- Give 1-2 agents for low risk patients and 3-4 agents for high risk

[redacted]

References

1. Apfel, C. C., Läärä, E., Koivuranta, M., Greim, C., & Roewer, N. (1999). A simplified risk score for predicting postoperative nausea and vomiting: Conclusions from cross-validations between two centers. *Anesthesiology (Philadelphia), 91*(3), 693-700. https://doi.org/10.1097/00000542-199909000-00022

2. Gan, T. J., Belani, K. G., Bergese, S., Chung, F., Diemunsch, P., Habib, A. S., Jin, Z., Kovac, A. L., Meyer, T. A., Urman, R. D., Apfel, C. C., Ayad, S., Beagley, L., Candiotti, K., Englesakis, M., Hedrick, T. L., Kranke, P., Lee, S., Lipman, D., . . . Philip, B. K. (2020). Fourth consensus guidelines for the management of postoperative nausea and vomiting. *Anesthesia and Analgesia, 131*(2), 411-448. https://doi.org/10.1213/ANE.0000000000004833

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