Management of Postoperative Nausea and Vomiting:

A Quality Improvement Project

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Abstract

Postoperative nausea and vomiting (PONV) is a complex side effect of general anesthesia affecting 30% of the general surgical population and up to 80% of high-risk patients. Prevention and management of PONV are crucial roles of the CRNA, beginning in the preoperative setting and continuing through the postoperative setting. Currently, there is a lack of standardized guidelines for PONV management among departments. The purpose of this scholarly project was to assess the CRNAs' knowledge, preferences, and practices for managing PONV, and whether they perceived the PONV Quick Reference Guide as a useful tool for their practice to aid in identifying high-risk patients, managing baseline PONV risks, and selecting strategies for prophylaxis/rescue treatment. An educational PowerPoint, summative PONV Quick Reference Guide, and endorsed guidelines as well as pre- and post-project implementation surveys were shared with CRNAs participating in the quality improvement project. Upon completion of the two-week implementation period, during which CRNAs utilized the educational PowerPoint and PONV Quick Reference Guide, participants completed the post-project implementation surveys allowing for analysis when compared to pre-project implementation surveys. Participants perceived increased familiarity and competency with the ASRS, recommended having an implemented PONV management protocol, and perceived a quick reference guide for the management of PONV as useful. Suggestions for future applications include in-person education or interactive learning modules, increased availability of physical materials, and limiting education to practice-relevant information.

Keywords: postoperative nausea and vomiting, PONV, prevention, nurse anesthetist, CRNA

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Section I. Introduction

Background

Postoperative nausea and vomiting (PONV) is generally defined as nausea and/or vomiting (N&V) in the 24-hour period following general anesthesia. However, this vague criterion does little to portray the complexity of the underlying issue. Typically presenting as uncontrollable nausea, reflexive retching, and frequent emesis, the pathophysiology of PONV is a complicated series of involuntary responses incorporating multiple autonomic pathways and bodily systems. Both modifiable and genetic factors play a large role in PONV, making the condition arduous to fully predict despite current knowledge of the issue. Affecting approximately 27.7% of surgical patients worldwide and 22.4% in the United States, the prevalence of PONV is far from rare in the postoperative setting (Amirshahi et al., 2020).

Posing the potential for a wide range of physical and monetary consequences, PONV bears more than a risk for discomfort and should be understood by those likely to precipitate the condition in practice (Aubrun et al., 2019; Sizemore et al., 2021). PONV can cause a wide range of complications from vital sign changes, primarily tachycardia and hypertension, to increased cavity pressures, including intracranial, intrabdominal, and intrathoracic (Sizemore et al., 2021). Also posing financial implications, PONV remains a top reason for failure to discharge in outpatient surgeries and potentially causes delays in physical recovery (Aubrun et al., 2019; Elsaid, et al., 2021; Shaikh et al., 2016; Sizemore et al., 2021). With additional risks for aspiration, bleeding, electrolyte/acid-base imbalances, suture dehiscence, and evisceration, PONV is a result of general anesthesia that should be strategically addressed using a structured protocol (Elsaid, et al., 2021; Shaikh et al., 2016; Sizemore et al., 2021).

PONV is an undesirable side effect of general anesthesia initiated by the central nervous system (CNS) and five afferent pathways (Shaikh et al., 2016). Understanding the relationship between these neuronal pathways and the CNS starts with defining the word afferent, which means conducting inward, as opposed to efferent, meaning conducting outward (Merriam-Webster, n.d.-a; Merriam-Webster, n.d.-b). Therefore, these afferent pathways are conducting impulses inward, towards the brain and spinal cord, which constitute the CNS (The University of Queensland [TUQ], n.d.). The five afferent pathways leading to PONV are the chemoreceptor trigger zone (CTZ) found in the area postrema at the floor of the fourth ventricle, the vagal mucosal pathway originating in the gastrointestinal (GI) tract, the vestibular pathway in the inner ear, cranial nerve pathways originating in the pharynx, and midbrain pathways residing at the top of the brainstem where the brain and brainstem conjoin (Mirza & Das, 2021; Shaikh et al., 2016; Sizemore et al., 2021; TUQ, n.d.). These afferent pathways create emetogenic triggers that are received by the reticular formation in the medulla, leading to N&V in the postoperative patient (Shaikh et al., 2016).

The reticular formation is constructed of a poorly defined series of neuronal pathways that run along the brainstem and is considered the area responsible for N&V, among many other functions (Mangold & Das, 2021; Shaikh et al., 2016). Additionally, the reticular formation has been shown to work in conjunction with the nucleus tractus solitarius which controls autonomic responses in the upper GI tract producing N&V. A closer look at these afferent pathways helps define their individual roles in PONV. It is important to note that these afferent pathways influence PONV independently, meaning prevention and management must be multimodal to antagonize a wide range of emetogenic pathways and receptors. The five receptors directly

connected to PONV are serotonergic, histaminergic, muscarinic/cholinergic, neurokinin 1, and dopaminergic (Denholm & Gallagher, 2018; Shaikh et al., 2016, Zhong et al., 2021).

The CTZ, seen as a dominant contributor to PONV, is part of the area postrema and has a unique anatomical position between the cerebral spinal fluid (CSF) and brain parenchyma (Miller & Leslie, 1994). This location, its lack of a blood-brain barrier, and extended microvillous clusters allow this specialized tissue to detect toxins and drugs circulating in the blood and CSF (Miller & Leslie, 1994; Shaikh et al., 2016). With medications like inhalational anesthetics and opioid analgesics stimulating the CTZ pathway, N&V is triggered through neurotransmitter signaling received by the reticular formation (Denholm & Gallagher, 2018; Shaikh et al., 2016). These neurotransmitters can also account for stimulation of the nucleus tractus solitarius which is linked to salivation, coughing, gagging, and vomiting (AbuAlrob & Tadi, 2021; Shaikh et al., 2016).

The vagal mucosal afferent pathway, part of the vagal nerve and located in the GI tract, contains three types of receptors: mechanoreceptors which are sensitive to physical changes, chemoreceptors which are sensitive to drugs and toxins, and thermoreceptors which monitor changes in temperature (Shaikh et al., 2016; Wang et al., 2020). Of these, the mechanoreceptors can be broken down further into tension, stretch, mucosal, and tension-mucosal receptors, which are often stimulated during GI surgeries and with toxin/medication administration (Wang et al., 2020). Physical manipulation of the GI tract, the formation of a pneumoperitoneum by inflating the abdomen with carbon dioxide for laparoscopic surgeries, pressure on the vagal nerve, and physical damage from incisions/resections can stimulate mechanoreceptors during surgery, leading to an increased risk for PONV (Denholm & Gallagher, 2018; Matthews, 2017; Zhong et al., 2021). Additionally, the chemoreceptors of the vagal afferent pathway are similar to the CTZ

where drugs such as anesthetics and opioids can trigger N&V (Denholm & Gallagher, 2018; Shaikh et al., 2016; Wang et al., 2020).

The vestibular afferent pathway, also associated with motion sickness, is part of the inner ear system and can explain the close relationship between PONV risk and a history of motion sickness, a commonly screened-for risk factor. It should be noted, however, that this pathway is considered less responsible for producing PONV independently (Handler et al., 2017). Along with complex functions such as hearing, the inner ear system contributes to the perception of horizontal and lateral head movements by way of semicircular ducts, cephalic orientation via the otolithic organs, and involuntary eye movements through the vestibulo-ocular reflex. Affected by inhalational anesthetics, ear surgeries, sudden position changes, and analgesics, the vestibulocochlear nerve, also known as cranial nerve VIII, can lead to sensations of dizziness, disorientation, and nausea through signaling transmitted to the cerebellum and brainstem which is further relayed to induce vomiting (Denholm & Gallagher, 2018; Shaikh et al., 2016).

Also playing a smaller role in PONV, the cortical afferent pathway, sometimes called the somatosensory pathway, includes the cerebral cortex and limbic system (Zhong et al., 2021). This pathway has functions that include processing external stimuli such as physical sensation, smell, taste, and sight. This area is also responsible for internal processes like emotions and memory (Shaikh et al., 2016; Zhong et al., 2021). The cortical afferent pathway has been shown to have a correlational relationship with N&V when individuals experience stress and/or pain, but information on this is limited (Zhong et al., 2021). The cortical afferent pathway is believed to affect PONV due to its regulatory effects on parasympathetic and sympathetic responses; examples of which are the changes in breathing and heart rate seen in individuals suffering from

N&V (Zhong et al., 2021). However, the exact role of this pathway in PONV is not clear, and it remains difficult to gather information due to diagnostic obstacles.

Finally, the midbrain afferent pathway, responsible for the pharyngeal reflex or 'gag reflex,' plays a paramount role in the manifestation of PONV (Shaikh et al., 2016). Through stimulation in the pharynx, which is frequently encountered in intubated patients as they awaken from surgery, the gag reflex is mediated by the glossopharyngeal and vagus nerves, processed in the midbrain, and further relayed to the nucleus tractus solitarius and reticular formation. Through this pathway, coughing and gagging can be triggered and potentially provoke PONV in those already at risk.

PONV occurs in approximately 80% of high-risk patients, making evidence-based management and prevention an important topic among anesthesia providers (Apfel, et al., 1999). The lack of standardized PONV management/prevention remains a problem despite evidence-based guidelines presented in the *Fourth Consensus Guidelines for the Management of Postoperative Nausea and Vomiting* by Gan et al. (2020). The presented guidelines have been endorsed by the American Society of Anesthesiologists (ASA) and the American Association of Nurse Anesthesiology (AANA), the largest organizations representing both medical and nursing anesthesiology (Gan et al., 2020). Along with the ASA and AANA, 25 other organizations representing pharmacists and healthcare professionals from Australia, Brazil, China, Europe, India, Japan, Korea, Malaysia, Thailand, Singapore, South Africa, and Taiwan have endorsed the proposed guidelines (Gan et al., 2020).

The need for evidence-based management of PONV increases as agencies like the Centers for Medicare & Medicaid Services (CMS) add PONV prevention to their agenda. The CMS has introduced this through the merit-based incentive payment system measure #430

(MIPS #430; CMS, 2019). The purpose of MIPS #430 is to increase the prevention of PONV while monitoring provider interventions during the case. This measure allows the CMS to identify high-risk patients who are undergoing general anesthesia via a volatile anesthetic, assess the PONV management used during the case, and categorize the data into three categories. The three categories include high-risk patients who received at least two antiemetic medications for PONV management, high-risk patients who did not receive at least two antiemetic medications for PONV management, and high-risk patients who did not receive at least two antiemetic medications for PONV management because of exemption reasons. Along with evidence-based prevention and management of PONV, MIPS #430 necessitates that anesthesia providers accurately screen for PONV to categorize high-risk patients as remuneration levels are tied to this measure.

Due to CRNAs' advantageous position to both cause and prevent PONV, educating anesthesia providers about PONV and the endorsed guidelines is important to ensure prevention and management. However, CRNAs' perceptions of management options are an important factor to consider when choosing management strategies. There is no universal strategy for the prevention and management of PONV, and anesthesia providers are responsible for choosing and individualizing their approach on a case-to-case basis, making education a key element in PONV prevention.

Organizational Needs Statement

The participating organization has 37 operating rooms (ORs) including 23 main ORs, 6 cardiovascular rooms, and 8 outpatient rooms. The facility performs approximately 27,000 surgeries per year across a wide spectrum of specialties. With many CRNAs and anesthesiologists, this facility is the main hub of the organization's nine-hospital system and

provides care for the roughly 1.4 million people in the surrounding region. To meet these needs, a large staff is necessary, which may increase the risk of PONV as provider preferences vary and management is not standardized in the department. This facility does track department and provider-specific PONV occurrence rates which could be used to improve provider-specific outcomes. For these reasons, education and organizational guidelines that provide an evidence-based approach to PONV management may be useful.

Typically, at the participating organization, intravenous famotidine is administered to all patients in the preoperative setting. Patients with a prevalent history of gastroesophageal reflux may also receive sodium citrate orally. Dexamethasone may be given preoperatively depending on patient risk factors and their medical history; diabetes commonly excludes administration. Dexamethasone is sometimes given after induction if it was not administered preoperatively. A transdermal scopolamine patch is unpredictably administered preoperatively to high-risk PONV patients. Intraoperatively, ondansetron is the primary intervention for PONV prevention. Intravenous diphenhydramine can be administered intraoperatively for those with a high PONV risk although it is not as common. However, these are not department standards, and management of PONV varies depending on patient allergies, comorbidities, and the anesthesia provider's preferences.

Problem Statement

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 the postoperative anesthesia care unit (PACU), increased hospital admissions, and higher healthcare costs.

Purpose Statement

The purpose of this scholarly project was to assess the CRNAs' knowledge, preferences, and practices for managing PONV, and whether they perceived the PONV Quick Reference Guide as a useful tool for their practice to aid in identifying high-risk patients, managing baseline PONV risks, and selecting strategies for prophylaxis/rescue treatment.

Section II. Evidence

Description of Search Strategies

The purpose of this literature review was to examine current evidence and recommendations addressing PONV. The PICOT (problem, intervention, comparison, outcome, and time) question used to guide the search strategy was: Does focused PONV education for CRNAs affect the occurrence of postoperative nausea and vomiting in adults undergoing general anesthesia within the 24-hour postoperative period? A search of the 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: (postoperative nausea and vomiting) AND (prevention) AND (education). This search strategy pulled in the MeSH terms: postoperative nausea and vomiting, and education. Limits applied included a publication date in the most recent 5 years (2016-2022). The English language was also applied to the search limits. CINAHL was searched using a combination of keywords and subject headings, and the subject headings were identified using the keywords. Google Scholar was searched using the same search strategy as PubMed. See Appendix A for a list of keywords, MeSH terms, and subject terms utilized in the searches. See Appendix B for search strategies and the number of articles found and kept using the structured searches. Additional information was identified by reviewing related and referenced articles as well as professional websites.

Evidence was identified and appraised based on the relevance to the PICOT question, the problem statement, the purpose statement, and the prevention of PONV in practice. After examining the preventative methods proposed in the guidelines by Gan et al. (2020), additional articles were selected to focus on the interventions outlined in the research. Medication articles

and studies were selected based on their relevance to preventing PONV in clinical practice, and lastly, articles related to management guidelines used in PONV prevention were selected to analyze the effectiveness of education in PONV prevention. Upon full-text review and based on Melnyk and Fineout Overholt's (2019) levels of evidence, seven systematic reviews/meta-analyses of randomized controlled trials (Level I) articles, two random-control trial (Level II) articles, one nonrandomized controlled trial/diagnostic case-control study (Level III), two controlled cohort studies/cross-sectional studies (Level IV), three descriptive or qualitative study/case study/EBP implementation/QI articles (Level VI), and four expert opinion/literature review (Level VII) articles were identified as pertinent to this project. No uncontrolled cohort study (Level V) articles were chosen. The full list of articles, levels of evidence, and additional details about the individual articles can be viewed in Appendix C: Literature Matrix.

Selected Literature Synthesis

The ideal management of PONV remains a multimodal approach using pharmacological prevention in conjunction with alternatives to inhalational agents during general anesthesia (Gan et al., 2020). Furthermore, advancements in regional and neuraxial anesthesia provide more alternatives to general anesthesia, making PONV management versatile and adaptable to a wider range of cases. To individualize treatment plans, proper screening via PONV risk assessments must be completed to tailor interventions to the patient’s needs. After risk assessments have determined an appropriate level of prevention, a standardized approach guided by evidence-based practice should be utilized. To utilize endorsed guidelines and evidence-based practice in the prevention of PONV, education remains an important component in ensuring compliance with current standards.

Risk Assessment

Over the years, numerous risk assessment guides have been created based on the risk factors associated with PONV. Examples of PONV risk factors include age, length of surgery, use of nitrous oxide, use of volatile anesthetics, middle ear pressure, sudden position changes, anxiety, body weight, type of surgery, length of surgery, and more (Darvall et al., 2021; Shaikh et al., 2016; Sizemore et al., 2021; Zhong et al., 2021; Ziemann-Gimmel et al., 2020). In 1999, Apfel et al. selected four primary variables deemed most pertinent: gender, smoking status, a history of motion sickness/PONV, and postoperative opioid administration (Shaikh et al., 2016; Sizemore et al., 2021). Using these risk factors, Dr. Apfel and his team created a succinct risk assessment guide to predict the likelihood of PONV occurrence. The risk assessment guide was named the Apfel Simplified Risk Score (ASRS), and it remains the most widely used risk assessment guide in the medical system (Apfel et al.,1999; Darvall et al., 2021). By screening for four equally weighted variables, the following probabilities of PONV occurrence are determined: 10% for no risk factors, 20% for one risk factor, 40% for two risk factors, 60% for three risk factors, and 80% for four risk factors. (Apfel et al., 1999). Based on the current guidelines set forth by Gan et al. (2020), the presence of 0-1 risk factor is classified as low risk, the presence of 2 risk factors is classified as medium risk, and the presence of 3 or more risk factors is classified as high risk.

Nevertheless, the ASRS is not perfect, and problems with its application have been noted in research. Darvall et al. (2021) observed that risk scores can vary among providers as one variable in specific, postoperative opioid administration, can only be predicted. This has led some researchers to become skeptical of the ASRS's reliability. The ASRS also fails to address smaller details like opioid dosage, which carries a dose-dependent relationship to the risk of

PONV occurrence. Other weaknesses of the ASRS have been seen as risk scores increased provider knowledge of patients' PONV risk but did not affect the prevention and management provided (Kappen et al., 2016). Additionally, Ziemann-Gimmel et al. (2020) analyzed the direct relationship between obesity and PONV, which the ASRS fails to screen for. This potentially limits the ASRS's use to general surgery patients because it renders an inaccurately low probability of PONV occurrence in bariatric patients. This is increasingly concerning as Hales et al. (2020), from the National Center for Health Statistics, estimated that approximately 42.4% of the United States adult population was classified as obese in 2017-2018.

Despite shortcomings, it is difficult to have a simplified and condensed risk assessment guide that covers every variable of such a complex issue. Through revisions to the ASRS, areas of concern such as obesity could be addressed, but doing so could lengthen and complicate the short and simplified assessment guide. Since 1999, recurrent research has studied the effectiveness of the aging ASRS and compared it to alternative risk assessment guides. Throughout, the ASRS continues to show promising results when correctly used on appropriate patient populations (Gunawan et al., 2020). The ASRS is not perfect, but it is satisfactory for offering an approximate probability of PONV and aiding in the identification of high-risk patients.

Alternative Methods

As outlined in the *Fourth Consensus Guidelines for the Management of Postoperative Nausea and Vomiting* by Gan et al. (2020), the avoidance of select common anesthesia practices can substantially reduce the incidence of PONV in those at risk. With volatile anesthetics and nitrous oxide considered high-risk for PONV, total intravenous anesthesia is promoted as an alternative to inhalational anesthetics for reducing PONV occurrence. Propofol is specifically

highlighted, as some intravenous medications like etomidate increase the risk for PONV. Providers can further reduce PONV occurrence by choosing alternatives to general anesthesia including regional and neuraxial anesthesia when applicable. Alternatives to opioid analgesics such as gabapentin, ketamine, dexmedetomidine, acetaminophen, and non-steroidal anti-inflammatory drugs have also shown promising reductions in PONV. For many providers, these alternatives are not always an option due to surgical and patient variables, leaving pharmacological prevention a primary form of PONV management.

Serotonin Antagonists

Serotonin antagonists for the prevention of PONV have shifted towards highly selective medications like ondansetron which have a high affinity for 5-HT receptors. Despite the use of ondansetron being commonplace for the treatment and prevention of PONV, correlational studies suggest other selective serotonin antagonists, like palonosetron, may be more effective at preventing PONV while also posing little to no effect on patient QT corrected intervals (Bandewar et al., 2019; Denholm & Gallagher, 2018). Serotonin antagonists have also been found to be particularly effective when used in conjunction with neurokinin receptor antagonists.

Corticosteroids

Steroids such as dexamethasone offer reductions in the occurrence of PONV. Even endorsed by Gan et al. (2020), an exact understanding of why this medication produces antiemetic effects is still unclear (Denholm & Gallagher, 2018). Despite widespread use among patients, the potential for hyperglycemia presents drawbacks in the use of steroids for PONV prevention. This side effect leaves the use of corticosteroids often limited to non-diabetic patients.

Antidopaminergics

Dopamine antagonists include medications like droperidol, haloperidol, and amisulpride to combat the occurrence of PONV (Denholm & Gallagher, 2018; Wolfe & Bequette, 2021). Dopamine antagonists were shown to be effective in a systematic review by Wolfe and Bequette (2021), which identified notable decreases in PONV with administration. However, it is important to note that the potential side effects of these medications leave this category somewhat undesirable due to their sedation-like and controversial cardiovascular complications (Denholm & Gallagher, 2018; Wolfe & Bequette, 2021). Of note, droperidol has become a highly utilized dopamine antagonist recently adopted in the *Fourth Consensus Guidelines for the Management of Postoperative Nausea and Vomiting* by Gan et al. (2020).

Neurokinin Receptor Antagonists

Neurokinin receptor antagonists, including the drug aprepitant, are among newer the medications now being used in the prevention of PONV (Denholm & Gallagher, 2018). Aprepitant has been the focus of a systematic review and meta-analysis by Liu et al. (2015) showing its successful prevention of PONV in numerous controlled studies. A later systematic review and meta-analysis by Murakami et al. (2020) concluded that the use of aprepitant could reduce PONV, presenting a dosage-dependent odds ratio of 0.4 and 0.32, with 40 mg and 80 mg respectively. Aprepitant has also proven to be more effective in decreasing N&V than selective serotonin antagonists in the immediate hours following surgery. Unfortunately, no differences in the complete prevention of PONV were seen between the two medications, despite the advantages that neurokinin receptor antagonists offer (Liu et al., 2015).

Antimuscarinics

Antimuscarinics such as scopolamine, which antagonize cholinergic/muscarinic receptors, play a frequent role in the prevention of PONV (Shaikh et al., 2016). Options such as

transdermal scopolamine patches have long been used for the prevention of motion sickness and PONV. Regarding PONV specifically, many studies show promising reductions in PONV occurrence, as outlined in a meta-analysis by Apfel et al. (2010). However, applying the patch the night before surgery was shown to be more efficacious for preventing PONV than applying the patch the day of surgery. The two groups, application the night before surgery and application the day of surgery, had a relative risk of 0.56 compared to 0.61, respectively.

Antihistamines

Antihistamines work by antagonizing histaminergic 1 receptors with some medications having additional effects on muscarinic receptors. Medications such as diphenhydramine and cyclizine are included in this class of drugs (Denholm & Gallagher, 2018; Shaikh et al., 2016). These medications are effective against PONV, and in a study by Pourfakhr et al. (2019), patients who received 30mg of diphenhydramine two minutes before fentanyl administration experienced PONV at a rate of only 16% as compared to 40% in the non-control group. However, drowsiness from diphenhydramine can be undesirable in some settings.

Structured Management

An important step in preventing and managing PONV is a standardized and structured approach based on evidence-based practice. With hospitals varying in their institutional standards, the implementation of a simple, PONV management protocol has been shown to increase the consistency and effectiveness of department PONV prevention. Pym and Ben-Menachem (2018) found the implementation of a standardized PONV management guideline increased compliance from 9% to approximately 20%. Additionally, the hospital was able to reduce high-risk patients' stay times in the PACU from 83 minutes to 63 minutes, on average. An additional study found that implementing a simplified form of their existing PONV

management guidelines was able to increase provider compliance from 18% to 46% (Dewinter et al., 2018). The overall occurrence of PONV in the 24-hour postoperative period reduced from 33% to 22% respectively.

However, the implementation of PONV education, standardized management guidelines, and simplified management guidelines still left compliance below 50% in both studies (Pym & Ben-Menachem, 2018; Dewinter et al., 2018). Gan et al. (2020) suggest low compliance and deviation from guidelines are unlikely to result from a lack of education. This could suggest that provider preferences and opinions should be analyzed closely in future studies, but more research is needed at this time.

Project Framework

A single plan-do-study-act (PDSA) cycle, as described by the Institute for Healthcare Improvement (IHI, 2022) was used to structure this quality improvement (QI) project. To start the *plan* phase, research from existing literature was gathered and synthesized. Utilizing the synthesized information, the problem and purpose statements were fabricated. The synthesized information was then used to create an educational PowerPoint and PONV Quick Reference Guide. These would be later used as educational materials in the QI project. Next, the pre-project implementation survey was created to evaluate the CRNAs' perceptions of PONV and their current PONV management. The post-project implementation survey was created to evaluate their perceptions of PONV, their current PONV management, and the provided educational materials including the PONV Quick Reference Guide. Approval was obtained from the institutional review board (IRB) to proceed as a QI project. Approval through the research office of the partnering organization in conjunction with the East Carolina University and Medical Center Institutional Review Board (UMCIRB) was requested and obtained. Local facility

approval to collect data was obtained from a site contact person whose signature was required on the partnering organization's approval form. Finally, the team CRNA clinical contact provided CRNA volunteers to participate in the QI, and an implementation timeframe was chosen. Every step was reviewed, revised, and approved by the project team before moving to the next task.

The *do* phase began with sending pre-project implementation surveys and educational material to the participating CRNAs one week prior to the QI project start. The educational material was sent with the pre-project implementation survey, and CRNAs were instructed to view the material after completion of the pre-project implementation survey. The QI project was then implemented for two weeks during which physical copies of the educational materials were made available in the facility. When the implementation timeframe concluded, the post-project implementation survey was sent and made available to participants for two weeks. When the survey closed, final data was collected ending the *do* phase.

The *study* phase started as pre- and post-project implementation survey results were finalized. The results were analyzed using Excel, any significance in the data was noted, visual depictions of the findings were created, and results were organized to prepare for dissemination. Approval from the project chair was granted before continuing to the *act* phase. This concluded the *study* phase

In the *act* phase, data and outcomes were presented through a formal poster presentation with faculty, peers, and participants to explain the project methods and results and to answer questions regarding the specifics of the QI project. The data and outcomes were also uploaded to the ECU digital repository, The Scholarship, to disseminate the results, marking the completion of one PDSA cycle. The PDSA cycle was an appropriate model for the QI project as it allows for quick turnaround times and expansion upon the results in future projects.

Ethical Considerations and Protection of Human Subjects

During this QI project, CRNAs' knowledge, preferences, and practices for managing PONV were assessed, along with their perception of the PONV Quick Reference Guide as a tool to aid in identifying high-risk patients, managing baseline PONV risks, and selecting strategies for prophylaxis/rescue treatments. Participant equality and equity were ensured throughout. The educational materials presented to participating CRNAs were evidence-based recommendations falling within the usual standard of care practiced in the organization. No vulnerable populations participated in the QI project, and no patient information was recorded or maintained.

For this project, an approval process through the College of Nursing to evaluate the need for full IRB approval was completed. With the project deemed a QI project, full IRB approval was not needed, and consent forms were not required from participating CRNAs (Appendix D). Once project planning was finalized, but before initiation, facility approval through the research office of the partnering organization, in conjunction with the East Carolina University and Medical Center Institutional Review Board (UMCIRB), was obtained (Appendix E). Local facility approval to collect data was obtained from a site contact person whose signature was required on the partnering organization's approval form. The primary investigator completed the Collaborative Institutional Training Initiative (CITI; https://about.citiprogram.org/) modules *All Biomedical Investigators and Key Personnel* as well as *Responsible Conduct of Research*.

Section III. Project Design

Project Setting

The setting of this QI project was preoperative, intraoperative, and postoperative locations at the participating organization and included the CRNA, the patient, and surrounding staff such as surgeons, anesthesiologists, nurse practitioners, physician assistants, nurses, and technicians. The ORs served as the primary setting where CRNAs worked and formed opinions about the educational PowerPoint and PONV Quick Reference Guide. Additional settings for this QI project included the preoperative holding area where CRNAs used the PONV Quick Reference Guide for patient screening and the PACU where PONV would be identified and treated. Additional elements of the QI setting included the Pyxis, pharmacy, and equipment used in the day-to-day practice of an anesthesia provider. Barriers in this setting included occupational time constraints, patient allergies, patient comorbidities, CRNAs' personal preferences, and CRNAs' openness to change. These barriers could have influenced the CRNAs' perceptions of the educational PowerPoint and PONV Quick Reference Guide.

Project Population

The project population for this QI project consisted of CRNAs working in the participating organization's main ORs. All participating CRNAs were actively licensed through the state, certified as CRNAs, and credentialed by the hospital. These medical professionals facilitated the project by choosing to participate, as participation was optional.

Project Team

The project team was led by Jared Galbreath and consisted of the faculty project chair, a CRNA clinical contact, the course director, and three student colleagues. These members collaborated to ensure the direction and purpose of the QI project while assisting in the development of the educational materials, PONV Quick Reference Guide, and pre- and post-

project implementation surveys. The team lead independently delivered the educational materials, gathered pre- and post-project implementation survey data, analyzed the data, and presented the findings publicly. A site contact at the participating facility signed the acknowledgment of data collection for project approval. The CRNA clinical contact and the director of the CRNA/DNP program were also accessible contacts for support with clinical and professional guidance, respectively. The course director guided the execution of the QI project in conjunction with the project chair while aiding the team lead throughout the process.

Methods and Measurement

As previously stated, a single PDSA cycle, as published by the IHI (2022) was used to structure this QI project. The *plan* phase was initiated by gathering relevant research from existing literature and studies. This information was then synthesized and utilized to fabricate the problem and purpose statements. Next, the synthesized information was used to create the PONV Quick Reference Guide (Appendix F) and educational PowerPoint (Appendix G) which served as the primary educational materials in the QI project. After the educational materials were constructed, the pre- and post-project implementation surveys (Appendix H) were created, using Qualtrics, to evaluate CRNAs' perceptions of the incidence of PONV, current PONV management, educational materials provided, and the usefulness of the PONV Quick Reference Guide. Before moving further, approval was obtained from the institutional review board (IRB) to proceed as a QI project (Appendix D). The next step was approval through the research office of the partnering organization in conjunction with East Carolina University and the UMCIRB (Appendix E). Local facility approval to collect data was obtained from a site contact person whose signature was required on the partnering organization's approval form. Lastly, the team CRNA clinical contact obtained CRNA volunteers to participate in the QI, and an

implementation timeframe was chosen. All steps in the *plan* phase were scrutinized and refined by the project chair and team before moving to the next phase of the QI project.

The *do* phase began by sending pre-project implementation surveys and educational materials to the participating CRNAs via email one week before the QI implementation window. The email included the pre-project implementation survey, educational PowerPoint, and PONV Quick Reference Guide. Participants were instructed to complete the pre-project implementation survey first and then view educational materials. The email was sent one week before the QI implementation timeframe, allowing participants to complete the survey and familiarize themselves with the material. After viewing the educational PowerPoint and PONV Quick Reference Guide, CRNAs were asked to use the information provided for two weeks, during which physical copies of the educational materials were made available in the facility. Upon completion of the two-week implementation period, CRNAs were emailed the post-project implementation survey which mirrored the pre-project implementation survey, with the addition of one question about the PONV Quick Reference Guide and provided education. The post-project implementation survey was available to complete for an additional two weeks after the QI implementation had ended. The survey links to the pre- and post-project implementation surveys were closed after this time, and the final data was collected. All data was kept confidential throughout the QI project. All emails to participants can be found in Appendix I.

In the *study* phase, data was analyzed and interpreted using Excel. Any significance in the data was noted, visual depictions of the findings were created, and results were organized to prepare for dissemination. Approval from the project chair was granted before continuing to the *act* phase. At this point, the *study* phase was concluded.

The *act* phase included presenting and electronically publishing the results allowing opportunity for future revisions to the QI project. A formal poster presentation was held with faculty, peers, and participants to explain the project methods and results and answer questions regarding the specifics of the project. Lastly, this paper and the presentation poster were uploaded to the ECU digital repository, The Scholarship, making it available to the public as the final step of the *act* phase.

Section IV. Results and Findings

Results

The purpose of this project was to assess CRNAs' knowledge, preferences, and practices for managing PONV, and whether they perceived the PONV Quick Reference Guide 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 treatments. To collect this data, pre-project implementation surveys were delivered to participants one week prior to the start of the QI project. This was done to give the participants adequate time to complete the survey and view the provided educational PowerPoint and PONV Quick Reference Guide. At the end of the two-week implementation period, the post-project implementation survey was delivered, and participants were given two weeks to complete the survey. Following this period, all surveys were closed, and the results were finalized.

The results, gathered through Qualtrics from a total of 12 pre-project implementation questions and 13 post-project implementation questions, were a combination of open-ended and Likert scale responses. An additional question in the post-project implementation survey was used for participant feedback only. All other questions were mirrored in both the pre- and post-project implementation surveys to aid in analysis, which was completed through Excel. In pre-project implementation surveys, five of nine participants completed the entire survey, and one participant partially completed the survey, answering only the first question. Post-project implementation participation was lower, with three participants completing the entire survey.

Data Presentation

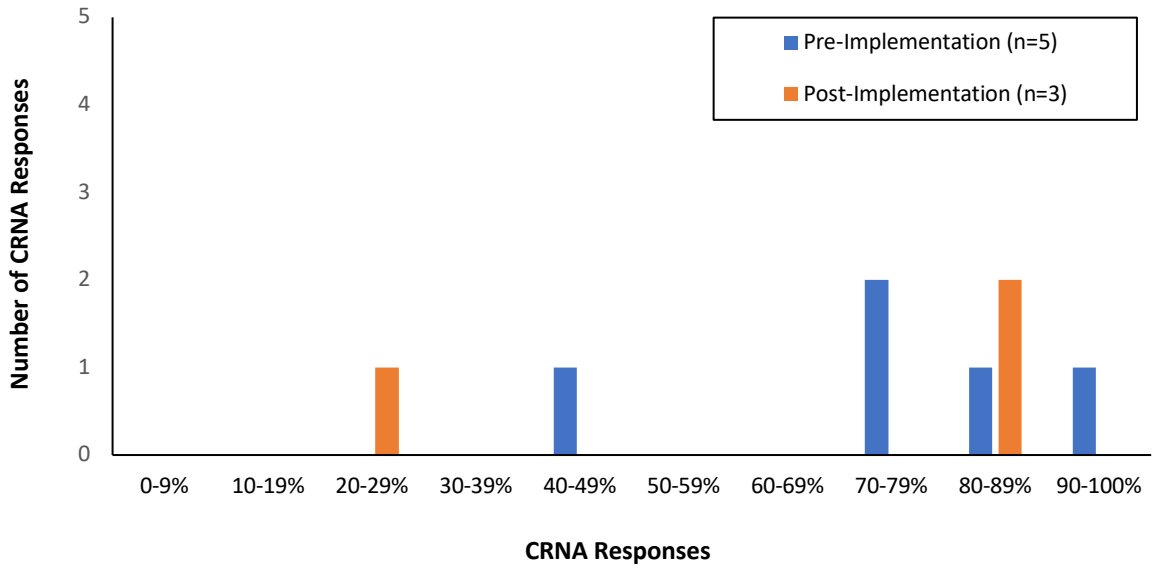
To assess participants' estimations of the incidence of PONV in adult general anesthesia patients, an open-ended question was presented asking the participants to state the average

incidence of PONV in adult general anesthesia patients. Pre-project implementation, before educational materials were provided, responses from six participants included three participants estimating 20%, two estimating 30%, and one estimating 50%. The same question was mirrored in the post-project implementation survey. In post-project implementation results, two of the three participants estimated that 30% of adult general anesthesia patients incur PONV and one participant estimated 17%.

Similarly, a question asking participants to estimate the incidence of PONV in high-risk adult general anesthesia patients was asked as an open-ended question. Participants were instructed to state their answer as the percentage of high-risk adult general anesthesia patients they believed suffered from PONV, on average. Figure 1 presents the pre- and post-project implementation data.

Figure 1

Perceptions of Percentage of HIGH-RISK Adult General Anesthesia Patients Experiencing PONV



Next, the surveys assessed participants' perceptions of how frequently they considered prophylaxis and treatment of PONV when planning for a case. This was assessed via a Likert scale question. Prior to providing educational materials, two participants *often* considered prophylaxis and treatment of PONV when planning for a case, and three *always* considered it. In post-project implementation surveys, one participant reported they would *often* consider prophylaxis and treatment of PONV when planning for a case, and two participants reported they would *always* consider it.

Figure 2 presents pre- and post-project implementation data obtained when participants were asked about their familiarity with using the ASRS for PONV risk screening. This was presented to participants as a Likert scale question.

Figure 2

Familiarity with Using the Apfel Risk Assessment for PONV Risk Screening

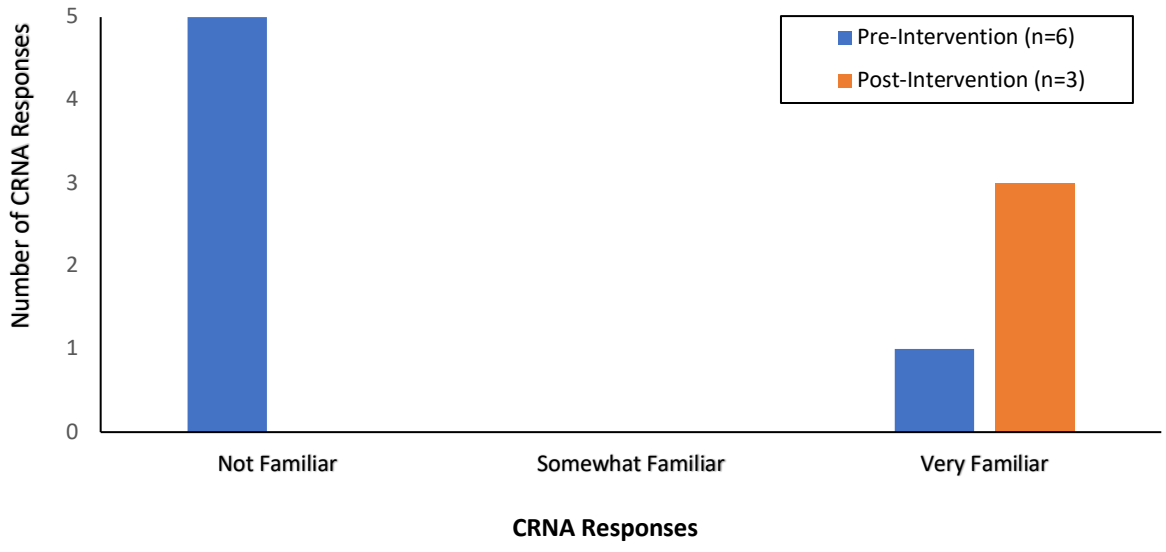
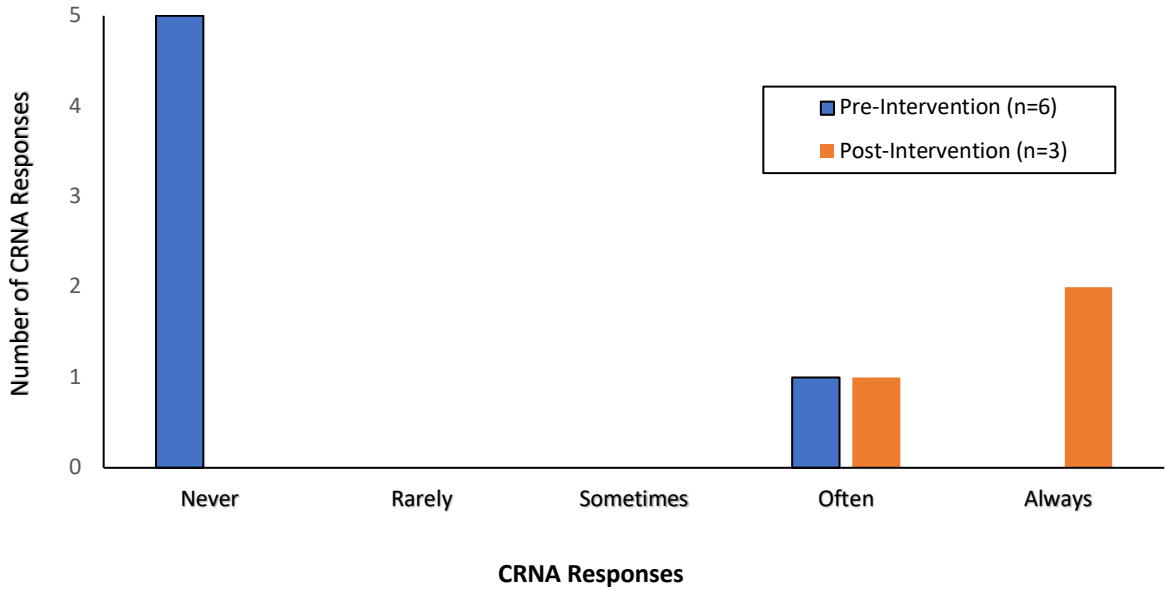


Figure 3 presents data from the pre- and post-project implementation survey where participants were asked how often they used the ASRS when screening for PONV risk.

Figure 3

Use of the Apfel Risk Assessment to Screen for PONV Risk



Additionally, participants were asked whether they use the ASRS to tailor their PONV management, as opposed to just using the tool for screening purposes alone. Prior to providing educational materials, five participants reported *never* using the ASRS to tailor PONV management and one participant reported they used it *often*. In comparison, post-project implementation responses showed that two participants reported they would *often* use the ASRS to tailor PONV management, and one participant reported they would *always* use it.

Multiple questions assessed participants' preferences for pharmacological prevention and an estimation of PONV prophylaxis cost. These questions included details like how many agents the participants would employ for low-risk versus high-risk patients, and what medications were

personally preferred when using multiple agents. Participants' preferences were assessed through Likert scale questions in hypothetical, routine, adult general anesthesia cases during which the patient would have no contraindications to any of the medications. Medications included were limited to ondansetron, droperidol, dexamethasone, and scopolamine.

Prior to providing educational materials, while three of five participants reported *rarely* using ondansetron, two participants reported using it *often*. Post-project implementation, one participant reported they would use ondansetron *all the time*, and two responded they would use it *often*. In pre-project implementation surveys, reported scopolamine and dexamethasone use were identical, as two of the five participants reported they used scopolamine/dexamethasone *often*, one participant reported they used scopolamine/dexamethasone *sometimes*, and two participants reported they *rarely* used scopolamine/dexamethasone. However, on post-project implementation surveys, reported usage of the medications was no longer identical. All three respondents reported they would use scopolamine *sometimes*. Reported usage of dexamethasone was *often* by two participants and *rarely* by one participant. Prior to the intervention, droperidol was *sometimes* used by one of the five participants, *rarely* used by two, and *never* used by two. In comparison, two of the three participants responded they would *sometimes* use droperidol and one participant responded they would *never* use the medication post-project implementation.

As mentioned previously, the number of agents employed for low-risk versus high-risk patients was also assessed. All five participating participants responded they would use *one* pharmacological agent for the prevention of PONV in low-risk patients on the pre-project implementation surveys. After project implementation, two of three participants responded they would use *two* pharmacological agents in low-risk patients, and a single participant selected to use *one* pharmacological agent. On the pre-project implementation surveys, high-risk patients

were reported to receive, on average, *two*, *three*, and *greater than three* pharmacological agents by one, two, and two participants, respectively. Post-project implementation results showed two participants reporting they would use *two* pharmacological agents and one participant reporting they would use *greater than three*. Lastly, three participants estimated PONV prophylaxis to cost *$50 to $100*, and two participants perceived it as costing *greater than $100* in pre-project implementation surveys. Post-project implementation results showed two participants estimated the cost of PONV prophylaxis to be *less than $50* and one participant perceived it to be *$50 to $100*.

Additional questions in the pre-project implementation survey pinpointed participant awareness of current, department-implemented protocols for PONV management and if they perceived a PONV Quick Reference Guide as useful in their practice. In post-project implementation surveys, the mirrored question inquired if participants would recommend a department-implemented protocol and whether they perceived a PONV Quick Reference Guide as useful. These questions were presented as Likert scale questions. The data showed four of five participants were *not sure* if there was a current, department-implemented protocol prior to project implementation. One participant replied that there *was* a protocol. Post-project implementation, three of three participants responded they would *recommend* having a department-implemented protocol for PONV management. Regarding the PONV Quick Reference Guide, the participants perceived a quick reference guide for PONV management to be *somewhat useful* (four), to *very useful* (one) before project implementation. Post-project implementation perceptions demonstrated one participant perceived the PONV Quick Reference Guide to be *somewhat useful*, and two perceived it would be *very useful*.

The last question of the post-project implementation survey was not mirrored by any pre-project implementation questions. This was an open-ended question to assess what participants would improve about the PONV Quick Reference Guide. Two participants responded to this question. One participant suggested having *greater availability of the resource*. The other participant said *the QI project did a great job*.

Analysis

Both prior to and after the implementation period, participants reported a wide range of responses when asked about their perception of average PONV occurrence in adult general anesthesia and in high-risk adult general anesthesia patients. Prior to project implementation, participants reported ranges from 40% to 98%. Post-project implementation, even with fewer participants, responses were still quite varied, ranging from 25% to 80%. Despite the wide range of participants' responses, the number of participants who answered with statistically accurate responses of 30% in adult general anesthesia cases and 80% in high-risk adult general anesthesia patients was the same or increased in post-project implementation surveys, showing participants' awareness regarding PONV prevalence among the stated populations was potentially improved. Additionally, the participants' perceptions of PONV prophylaxis cost became more accurate. The purpose of including this content in the surveys and education was to outline the relatively low average cost of prevention, less than $50, as compared to the $75 cost for every occurrence of PONV.

Despite this potential improvement, participants' considerations of PONV prophylaxis and treatment when planning for a case showed little change after QI project implementation. Prior to receiving educational materials, two participants stated they *often* considered PONV prophylaxis and treatment when planning for a case, and three participants stated they *always*

considered PONV prophylaxis and treatment when planning for a case. Post-project implementation, one participant reported they would *often* consider PONV prophylaxis and treatment when planning for a case, and two participants reported they would *always* consider PONV prophylaxis and treatment when planning for a case. The lack of change between pre- and post-project implementation was not surprising, as most participants were already considering PONV prophylaxis and treatment *often* or *always*. No participants reported *not* considering PONV during their cases, indicating their awareness and attention to the issue even prior to the QI project.

Participants reported a greater familiarity with the ASRS after the implementation period (all participants perceived they were *very familiar* in the post-project implementation survey) and had a greater likelihood of using it when tailoring PONV prevention and management for their patients. All three participants agreed an implemented PONV management protocol would be *useful* in the post-project implementation survey. However, the PONV Quick Reference Guide they were provided during the QI project was perceived as only *somewhat useful* by two participants and *very useful* by one participant.

Section V. Implications

Financial and Nonfinancial Analysis

PONV has the potential to cause a wide range of negative physical and monetary consequences, costing not only the patient but potentially the facility (Aubrun, et al., 2019; Sizemore et al., 2021). PONV can cause complications ranging from vital sign changes like tachycardia and hypertension to increased cavity pressures, including intracranial, intrabdominal, and intrathoracic (Sizemore et al., 2021). With further risks like aspiration, bleeding, electrolyte/acid-base imbalances, suture dehiscence, and evisceration, PONV is a complication of surgical anesthesia that can and should be strategically avoided using a structured protocol (Elsaid, et al., 2021; Shaikh et al., 2016; Sizemore et al., 2021). PONV has financial implications as it remains a top reason for failure to discharge in outpatient surgeries and potentially causes delays in physical recovery (Aubrun et al., 2019; Elsaid, et al., 2021; Shaikh et al., 2016; Sizemore et al., 2021). Additionally, the CMS has added PONV prevention to its agenda through MIPS #430 (CMS, 2019). PONV poses an approximate incremental cost of $75 per episode on top of incremental costs like delays in the PACU, decreased reimbursement from the CMS, potential adverse events such as the examples listed previously, and more (Gan et al., 2020). When compared to the less than $15 cost of PONV prophylaxis, it is clear that prophylactic treatment and management of PONV is a cost-effective solution (Gan et al., 2020).

With education taking less than 15 minutes to complete and the distribution of the PONV Quick Reference Guide being digital (and printed as needed), this approach would cost little time and money for the organization. Organizational educational modules are currently used for education offering an existing platform to deliver the education. Once a month, department meetings are held for the purpose of education and updates on current evidence-based practices. This, again, offers an existing platform to deliver the education and PONV Quick Reference

Guide. When compared with prolonged PACU times, the risk for planned outpatients to need an overnight stay, the low cost of prophylaxis, reduced CMS reimbursement, and potential returns to the OR due to physical consequences of PONV, it is clear the minor cost of education is cheaper than higher rates of PONV occurrence. Additionally, patient safety and satisfaction by preventing PONV occurrence offers ample reasoning for both financial and nonfinancial affordability.

Implications of Project

Management of patient care during the preoperative, intraoperative, and postoperative period is the role of the surgeons, anesthesia providers, and healthcare team. With the ASA, AANA, and 25 other organizations representing pharmacists and healthcare professionals from Australia, Brazil, China, Europe, India, Japan, Korea, Malaysia, Thailand, Singapore, South Africa, and Taiwan endorsing the *Fourth Consensus Guidelines for the Management of Postoperative Nausea and Vomiting* by Gan et al. (2020), integration of the guidelines into practice is a logical step for all departments. It is important to further outline how financial reimbursement is becoming tied to PONV screening and management through the CMS and the implementation of MIPS #430. With patient risks, both physical and monetary, closely associated with PONV occurrence, unit-implemented protocols for PONV management offer facilities and organizations a standardized approach to prevention. CRNAs benefit from education on current modalities of prevention and maintain autonomy while reinforcing their decision-making with evidence-based practices supported by the organizations that represent them. Ultimately, PONV management is a standard of care that should be addressed appropriately by all individuals in the anesthesia community. With little to no cost, the limited time and resources necessary make education an optimal option for protocol implementation.

Sustainability

The sustainability of the education and materials used in the QI project, a brief PowerPoint and PONV Quick Reference Guide, can easily be achieved by any organization. With primary costs related to the time needed for initial education and the creation of the PowerPoint, the organization could afford to take the QI project and expand it to all anesthesia staff. Effective designs for delivery include an educational module that could be made available on an individual basis or presented during a department meeting. Additional materials could be emailed to participants and printed as needed. A primary factor impacting sustainability would be ensuring staff participation through completion, which was the largest obstacle throughout the QI project. Again, this can be addressed by assigning learning modules that must be completed or by making education the focus of a department meeting where all staff can be present. Additionally, maintaining the PDSA format would be pivotal to keeping the education and protocols current.

Dissemination Plan

Dissemination of the findings from this QI project was achieved through delivering a presentation and electronically publishing the results. A formal, in-person poster presentation with faculty, peers, and participants was delivered to explain the project methods and results as well as to answer questions regarding the specifics of the QI project. Lastly, this paper was uploaded to the ECU digital repository, The Scholarship, making it available to the public. Making the results available electronically allows for application of the findings beyond the project timeline and provides support for revisions and development of future QI projects.

Section VI. Conclusion

Limitations

Several limitations were faced during this QI project, with a primary limitation being the attrition of participants. The initial sample for the project was small, with only nine participants, and the number dwindled to the point that only three CRNAs completed the post-project implementation survey. With partial participation from the beginning of the project, attrition during the QI project posed a limitation that led to difficulty with data analysis. The survey responses were confidential, which made it impossible to pair up responses and know which ones reflected changed perceptions after the implementation phase. Another limitation was the constricted timeframe for the QI project, which may not have provided adequate time for all participants to respond. Further resistance was met as physical copies of the educational PowerPoint, PONV Quick Reference Guide, and QR codes to the pre- and post-project implementation surveys disappeared. They were placed in areas frequently visited by the CRNAs to immerse the participants in the material with the intention of making all materials easily accessible whenever needed. However, it was requested that the materials be moved during the first week of the implementation period, and they were no longer available in areas frequented by participants. For this reason, distribution of the material was predominantly restricted to email which one participant reported in their post-project implementation survey as a limitation.

Recommendations for Future Implementation and/or Additional Study

Though based on limited findings, the recommendations derived from this project are to present and distribute a succinct educational PowerPoint and PONV Quick Reference Guide to CRNAs with the goal of supporting consistent, evidence-based practice in PONV management. Increased familiarity and usage of the ASRS and positive CRNA perceptions resulting from the QI project's chosen methods further bolster consistent management throughout practice.

Improving implementation strategies by changing to an in-person department presentation of the education that ensures participation and limits distractions, which might otherwise occur if participants try to review the PowerPoint between cases, is suggested based on observed attrition and feedback from participants. Other alternatives to email include the possibility for interactive learning modules or guided discussion.

Materials should be made readily available in anesthesia lounges and common areas for staff to reference, immersing them in the material and decreasing the attrition rate seen in this initial QI project. The recommendation to condense the PONV Quick Reference Guide and educational PowerPoint to practice-based information is intended to directly address PONV management for participants. This would remove nonessential or distracting information allowing the participants to focus directly on PONV management and prevention. The removal of excess information would further streamline the education and, potentially, decrease attrition. If attrition rates were reduced, the impact of the education could be better analyzed and more focused improvements made, which would further increase sustainability. Continuous improvement as the QI project repeats the PDSA cycle will hone the effectiveness of the education and PONV Quick Reference Guide. With no major financial implications, participants' perceptions and acceptance of the education and PONV Quick Reference Guide are of particular importance to the long-term viability of this QI project and future iterations.

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The University of Queensland. (n.d.). *Central nervous system: Brain and spinal cord*. The University of Queensland Australia: Queensland Brain Institute. Retrieved November 9,

2021, from https://qbi.uq.edu.au/brain/brain-anatomy/central-nervous-system-brain-and-spinal-cord

Wang, Y., Lartigue, G., & Page, A. J. (2020). Dissecting the role of subtypes of gastrointestinal vagal afferents. *Frontiers in Physiology*, *11*, 643. https://doi.org/10.3389/fphys.2020.00643

Wolfe, R., & Bequette, J. (2021). Dopamine receptor antagonists for the prevention and treatment of postoperative nausea and vomiting. *Journal of Perianesthesia Nursing*, *36*(2), 199-202. https://doi.org/10.1016/j.jopan.2020.12.009

Zhong, W., Shahbaz, O., Teskey, G., Beever, A., Kachour, N., Venketaraman, V., & Darmani, N. (2021). Mechanisms of nausea and vomiting: Current knowledge and recent advances in intracellular emetic signaling systems. *International Journal of Molecular Sciences*, *22*(11), 5797. https://doi.org/10.3390/ijms22115797

Ziemann-Gimmel, P., Schumann, R., English, W., Morton, J., & Anupama, W. (2020). Preventing nausea and vomiting after bariatric surgery: Is the Apfel risk prediction score enough to guide prophylaxis? *Obesity Surgery, 30*(10), 4138-4140. http://dx.doi.org/10.1007/s11695-020-04682-2

Appendix A

Literature Concepts Table

	Concept 1: Postoperative nausea and vomiting	Concept 2: Prevention	Concept 3: Education	Concept 4: Intraoperative Postoperative
Keywords:	Postoperative nausea and vomiting PONV Nausea and vomiting	Screening Treatment Prevention	Training Education Outcomes	Intraoperative Perioperative Postoperative
PubMed:	Postoperative nausea and vomiting Written for PubMed as "postoperative nausea and vomiting" [MeSH Terms]	Prevention	Education Written for PubMed as "education" [MeSH Terms]	N/A
CINAHL:	Nausea and vomiting Written for CINAHL as (MH "nausea and vomiting")	Prevention		Postoperative Written for CINAHL as (MH "postoperative period")
Google Scholar:	Postoperative nausea and vomiting	Prevention	Education	CRNA

PubMed: (postoperative nausea and vomiting) AND (prevention) AND (education) Filters: from 2016 - 2022

CINAHL: (Postoperative nausea and vomiting) AND (prevention) AND (education) Filters: from 2016-2022, Peer Reviewed

Google Scholar: (postoperative nausea and vomiting) AND (prevention) AND (education) AND (CRNA) Filters: 2016-2022, Review Articles

Other: N/A

Strategies for Searching:

- Filter articles for those within the past 5 years (2016 since 2022 has not concluded)
- MeSH terms were used in PubMed except for the word ‘prevention’.
- *Suggest Subject Terms* option in CINAHL was used except for the word ‘prevention’.
- The reference section of useful resources was used to obtain related studies/articles.

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
09-08-22	PubMed	(Postoperative nausea and vomiting) AND (prevention) AND (education) Filters: English, from 2016 - 2022 (("postoperative nausea and vomiting"[MeSH Terms] OR ("postoperative"[All Fields] AND "nausea"[All Fields] AND "vomiting"[All Fields]) OR "postoperative nausea and vomiting"[All Fields]) AND ("prevent"[All Fields] OR "preventability"[All Fields] OR "preventable"[All Fields] OR "preventative"[All Fields] OR "preventatively"[All Fields] OR "preventatives"[All Fields] OR "prevented"[All Fields] OR "preventing"[All Fields] OR "prevention and control"[MeSH Subheading] OR ("prevention"[All Fields] AND "control"[All Fields]) OR "prevention and control"[All Fields] OR "prevention"[All Fields] OR "prevention s"[All Fields] OR "preventions"[All Fields] OR "preventive"[All Fields] OR "preventively"[All Fields] OR "preventives"[All Fields] OR "prevents"[All Fields]) AND ("educability"[All Fields] OR "educable"[All Fields] OR "educates"[All Fields] OR "education"[MeSH Subheading] OR "education"[All Fields] OR "educational	Filters: 2016-2022, English	132 Found/ 11 Kept	Prevention of PONV/Not applicable

		status"[MeSH Terms] OR ("educational"[All Fields] AND "status"[All Fields]) OR "educational status"[All Fields] OR "education"[MeSH Terms] OR "education s"[All Fields] OR "educational"[All Fields] OR "educative"[All Fields] OR "educator"[All Fields] OR "educator s"[All Fields] OR "educators"[All Fields] OR "teaching"[MeSH Terms] OR "teaching"[All Fields] OR "educate"[All Fields] OR "educated"[All Fields] OR "educating"[All Fields] OR "educations"[All Fields])) AND ((english[Filter]) AND (2016:2022[pdat]))			
09-08-22	CINAHL	(MH "Postoperative Period") AND ("Prevention") AND (MH "Nausea and Vomiting")	Filters: 2016-2022, Peer Reviewed, English	41 Results/ 9 Kept	Prevention of PONV/Not Applicable
09-08-22	Google Scholar	(Postoperative nausea and vomiting) AND (prevention) AND (education) AND (CRNA)	Filters: 2016-2022	690 Results/ 17 Kept	Prevention of PONV/Not Applicable

Appendix C

Literature Matrix

Year	Author, Title, Journal	Purpose & Conceptual Framework or Model	Design and Level of Evidence	Setting	Sample	Tools and/or Interventions	Results
1999	Apfel, C. C., Läärä, E., Koivuranta, M., Greim, C. A., & Roewer, N. (1999). A simplified risk score for predicting postoperative nausea and vomiting: Conclusions from cross-validations between two centers. *Anesthesiology*, *91*(3), 693–700.	PONV occurrence predictions based on risk factors.	III: Diagnostic Case-Control Study	PONV prediction in the healthcare setting	Data from 2,722 cases where patients greater than 18 years of age underwent surgery involving the use of a volatile anesthetic	Risk variables were reduced after logistic regression analyses to create a simplified PONV risk assessment. The original and simplified risk scores were cross-validated.	Simplifying the PONV risk assessment did not weaken the predicative abilities of the risk assessment.
2010	Apfel, C. C., Zhang, K., George, E., Shi, S., Jalota, L., Hornuss, C., Fero, K. E., Heidrich, F., Pergolizzi, J. V., Cakmakkaya, O. S., & Kranke, P. Transdermal scopolamine for the prevention of postoperative nausea and vomiting: A systematic review and meta-analysis. *Clinical*	PONV prevention. Efficacy of transdermal scopolamine patches in the prevention of PONV.	I: Meta-Analysis	PONV prevention in the preoperative, intraoperative, and postoperative setting	25 randomized controlled trials	Randomized controlled trials regarding transdermal scopolamine as prevention for PONV	Transdermal scopolamine is an effective tool for preventing PONV. The early versus late application of the patch plays a role in the efficacy of the drug.

	therapeutics, *32*(12), 1987–2002.						
2015	Liu, M., Zhang, H., Du, B., Xu, F., Zou, Z., Sui, B., & Shi, X. Neurokinin-1 receptor antagonists in preventing postoperative nausea and vomiting: A systematic review and meta-analysis. *Medicine*, *94*(19), 762.	Breakdown of Neurokinin-1 receptor antagonists and their role in the treatment of PONV. Compares Neurokinin-1 receptor antagonists with selective serotonin antagonists in treatment of PONV No conceptual framework or model noted.	I: Systematic Review and Meta-Analysis	PONV prevention in the preoperative, intraoperative, and postoperative setting	50 Articles	Analysis of articles related to neurokinin-1 receptor antagonists as prevention for PONV	Neurokinin-1 receptor antagonists have shown to be effective in the prevention of PONV.
2016	Kappen, T. H., van Loon, K., Kappen, M. A., van Wolfswinkel, L., Vergouwe, Y., van Klei, W. A., Moons, K. G., & Kalkman, C. J. (2016). Barriers and facilitators perceived by physicians when using prediction models in practice. *Journal of Clinical Epidemiology*, *70*, 136–145.	Qualitative information was gathered from physicians to examine how knowing patient specific PONV risk effected their preoperative, intraoperative, and postoperative care.	VI: Descriptive or qualitative study	PONV prevention in the preoperative, intraoperative, and postoperative setting	57 physicians	A qualitative survey was administered.	The tool used in the survey was able to increase physician knowledge of PONV risk but did not change their practice due to certain barriers.
2016	Shaikh, S., Nagarekha, D., Hegade, G., & Marutheesh, M. Postoperative nausea and	Review of PONV receptors and afferent pathways. Breakdown of basic medications and	I: Systematic Review	PONV physiology and prevention in	74 Articles	Articles regarding the physiology of PONV and the pharmacology	This article provided a foundation for afferent pathways

	vomiting: A simple yet complex problem. *Anesthesia, Essays and Researches*, *10*(3), 388–396.	their role in the treatment of PONV. No conceptual framework or model noted.		the preoperative, intraoperative, and postoperative setting		used as prevention	involved in PONV and preventative medications.
2018	Denholm, L., & Gallagher, G. Physiology and pharmacology of nausea and vomiting. *Anesthesia and Intensive Care Medicine*, *19*(9), 513-516.	Expert review of N/V receptors and afferent pathways. Breakdown of medications and their role in the treatment of PONV. No conceptual framework or model noted.	VII: Expert Opinion	Nausea and vomiting in all settings including the preoperative, intraoperative, and postoperative setting	4 Articles	Articles regarding the physiology of N/V and the pharmacology used as prevention	This article provided a foundation for afferent pathways involved in N/V and preventative medications.
2018	Dewinter, G., Staelens, W., Veef, E., Teunkens, A., Velde, M., & Rex, S. Simplified algorithm for the prevention of postoperative nausea and vomiting: a before-and-after study. *British Journal of Anaesthesia*, *120*(1), 156–163.	Quality improvement project to increase the adherence of anesthesia providers to PONV management guidelines No conceptual framework or model noted.	VI: Quality Improvement Project British Article	PONV prevention in the preoperative, intraoperative, and postoperative setting	Patient outcomes were analyzed along with provider adherence rates to the guidelines	A simplified form of the facilities current, evidence-based PONV management guidelines were introduced to the anesthesia providers	Introducing simplified, evidence-based PONV management guidelines improved PONV treatment and reduced PONV occurrence
2018	Pym, A., & Ben-Menachem, E. The effect of a multifaceted postoperative nausea and	Quality improvement project to increase the adherence of anesthesia	VI:	PONV prevention in the preoperative,	Patient outcomes were analyzed	Evidence-based PONV management guidelines were	Introducing evidence-based PONV management

	vomiting reduction strategy on prophylaxis administration amongst higher-risk adult surgical patients. *Anaesthesia and intensive care*, *46*(2), 185–189.	providers to PONV management guidelines No conceptual framework or model noted.	Quality Improvement Project	intraoperative, and postoperative setting	along with provider adherence rates to the guidelines	introduced to the anesthesia providers	guidelines improved PONV treatment and reduced PONV occurrence
2019	Bandewar, A., Naik, S., & Kokne, M. To compare the anti-emetic efficacy, duration of action, and side effects of palonosetron, ondansetron, and granisetron for anti-emetic prophylaxis of post-operative nausea and vomiting in patients undergoing laparoscopic abdominal surgeries. *Indian Journal of Anesthesia and Analgesia, 6*(5), 1497-1504.	Serotonin antagonists were examined and compared to determine their efficacy in PONV prevention No conceptual framework or model noted.	II: Randomized, Double Blind Study	PONV prevention in the intraoperative and postoperative setting Indian Article	120 patients were divided into three groups of 40 receiving a different serotonin antagonist.	Palonosetron, ondasetron, and granisetron were administered to individual groups to determine outomes and reductions in PONV occurrence	Palonosetron is more effective in the treatment of PONV, but all three showed reduced incidences of PONV in comparison to average occurrence rates
2019	Pourfakhr, P., Ziaei, S., Etezadi, F., Khajavi, M., & Sharifnia, M. (2019). Diphenhydramine definitely suppresses fentanyl-induced cough during general anesthesia induction: A double-blind, randomized, and	Diphenhydramine was investigated closer to prove efficacy in PONV prevention. No conceptual framework or model noted.	II: RCT	PONV prevention in the intraoperative and postoperative setting	100 patients ASA class I and II scheduled for laparoscopic surgery. Exclusion criteria noted in article.	Quantitative tools were used to assess vomiting while qualitative tools were used to assess nausea. A comparison of PONV in those who did and did	The histamine antagonist, diphenhydramine, reduced PONV when given before fentanyl administration. Reduction in Fentanyl induced

	placebo-controlled study. *Acta Medica Iranica*, 57(5), 316-319.			Iranian Article		not receive diphenhydramine prior to fentanyl administration.	cough noted as well.
2020	Gan, T., Belani, K., Bergese, S., Chung, F., Diemunsch, P., Habib, A., Jin, Z., Kovac, A., Meyer, T., Urman, R., Apfel, C., Ayad, S., Beagley, L., Candiotti, K., Englesakis, M., Hedrick, T., Kranke, P., Lee, S., Lipman, D., Minkowitz, H., … Philip, B. K. (2020). Fourth consensus guidelines for the management of postoperative nausea and vomiting. *Anesthesia and Analgesia*, *131*(2), 411–448.	Expert reviewed meta-analysis of PONV to construct preventative guidelines for practice. No conceptual framework or model noted.	I: Review with Meta-Analysis	PONV prevention in the preoperative, intraoperative, and postoperative setting. 4th iteration guidelines for management of PONV	430 Articles	Articles regarding the physiology of PONV and the pharmacology used as prevention	This article provided background information on PONV and an evidenced based approach to prevention that was backed by both the American Association of Nurse Anesthesiology and American Society of Anesthesiologists
2020	Gunawan, M. Y., Utariani, A., Maulydia, M., & Veterini, A. S. (2020). Sensitivity and specificity comparison between APFEL, KOIVURANTA, and SINCLAIR score as PONV predictor in post general anesthesia	Three PONV risk assessments were studied to find which model presented the most accurate prediction of PONV occurrence in patients.	IV: Cross-Sectional Study	PONV prediction in the healthcare setting Indonesian article	100 patients	Patient information and outcomes were analyzed assess the accuracy of each PONV assessment in predicting PONV occurrence	The Apfel risk assessment had the highest accuracy in predicting PONV occurrence.

	patient. *Qanun Medika, 4*(1), 69-76.	No conceptual framework or model noted.					
2020	Hales, C., Carroll, M., Fryar, C., & Ogden, C. (2020). *Prevalence of obesity and severe obesity among adults: United States, 2017–2018* (No. 360) [Data Brief]. Hyattsville, MD: National Center for Health Statistics.	Data from the National Health and Nutritional Examination Survey for 2017-2018 was analyzed to approximate the prevalence of obesity and trend obesity in the United States. No conceptual framework or model noted.	IV: Cross-Sectional Study	Prevalence of obesity in the United States	National Census	Patient information was analyzed to approximate the prevalence of obesity and trend obesity in the United States.	Among men, 40.3% aged 20–39 were obese, 46.4% aged 40–59 were obese, and 42.2% aged 60 and over were obese. Among women, 39.7% aged 20–39 were obese, 43.3% aged 40–59 were obese, and 43.3% aged 60 and over were obese.
2020	Murakami, C., Kakuta, N., Satomi, S., Nakamura, R., Miyoshi, H., Morio, A., Saeki, N., Kato, T., Ohshita, N., Tanaka, K., & Tsutsumi, Y. Neurokinin-1 receptor antagonists for postoperative nausea and vomiting: A systematic review and meta-analysis. *Brazilian Journal of Anesthesiology, 70*(5), 508-519.	Systematic review and meta-analysis examining the efficacy of Neurokinin-1 receptor antagonists in preventing PONV No conceptual framework or model noted.	I: Systematic Review and Meta-Analysis	PONV prevention in the intraoperative and postoperative setting Brazillian Article	31 Articles	Articles regarding neurokinin-1 receptor antagonists as prevention for PONV	Neurokinin-1 receptor antagonists are effective in preventing PONV. The author notes a lack of research hinders the article. More research is needed on the topic. A clear explanation and relationship is made between

							Neurokinin-1 receptor antagonists and PONV.
2020	Ziemann-Gimmel, P., Schumann, R., English, W., Morton, J., & Anupama, W. (2020). Preventing nausea and vomiting after bariatric surgery: Is the Apfel risk prediction score enough to guide prophylaxis? *Obesity Surgery, 30*(10), 4138-4140.	Literature review focused on the effects of obesity on PONV occurrence and the Apfel risk assessment No conceptual framework or model noted.	VII: Literature Review and Expert Opinion	PONV prediction in the healthcare setting	19 Articles	Articles regarding bariatric surgery, obesity, PONV, and the Apfel risk assessment	Obese patients are at a higher risk for PONV causing the Apfel risk assessment to be less accurate in the obese population. Additional interventions are suggested.
2021	Darvall, J., Handscombe, M., Maat, B., So, K., Suganthirakumar, A., & Leslie, K. (2021) Interpretation of the four risk factors for postoperative nausea and vomiting in the Apfel simplified risk score: An analysis of published studies. *Canadian Journal of Anesthesia, 68,* 1057–1063.	Literature review focused on the variability of Apfel risk assessment and how provider interpretation of the risk factors can lead to less accurate predictions No conceptual framework or model noted.	VII: Literature Review	PONV prediction in the healthcare setting Canadian Article	255 Studies	Studies using the Apfel risk assessment for PONV prediction were selected and analyzed to compare how the variables for the Apfel risk assessment were defined in the study	Differing interpretations of the Apfel risk assessment's variables are a cause for concern as they could lead to differing scores when using the Apfel risk assessment
2021	Sizemore, D. C., Singh, A., Dua, A., Singh, K., & Grose, B. W. (2021). Postoperative nausea. *StatPearls*.	Review of PONV receptors and afferent pathways. Breakdown of basic medications and	VII: Literature Review	PONV physiology and prevention in the	14 Articles	Articles regarding the physiology of PONV and the pharmacology	This article provided a foundation for afferent pathways involved in

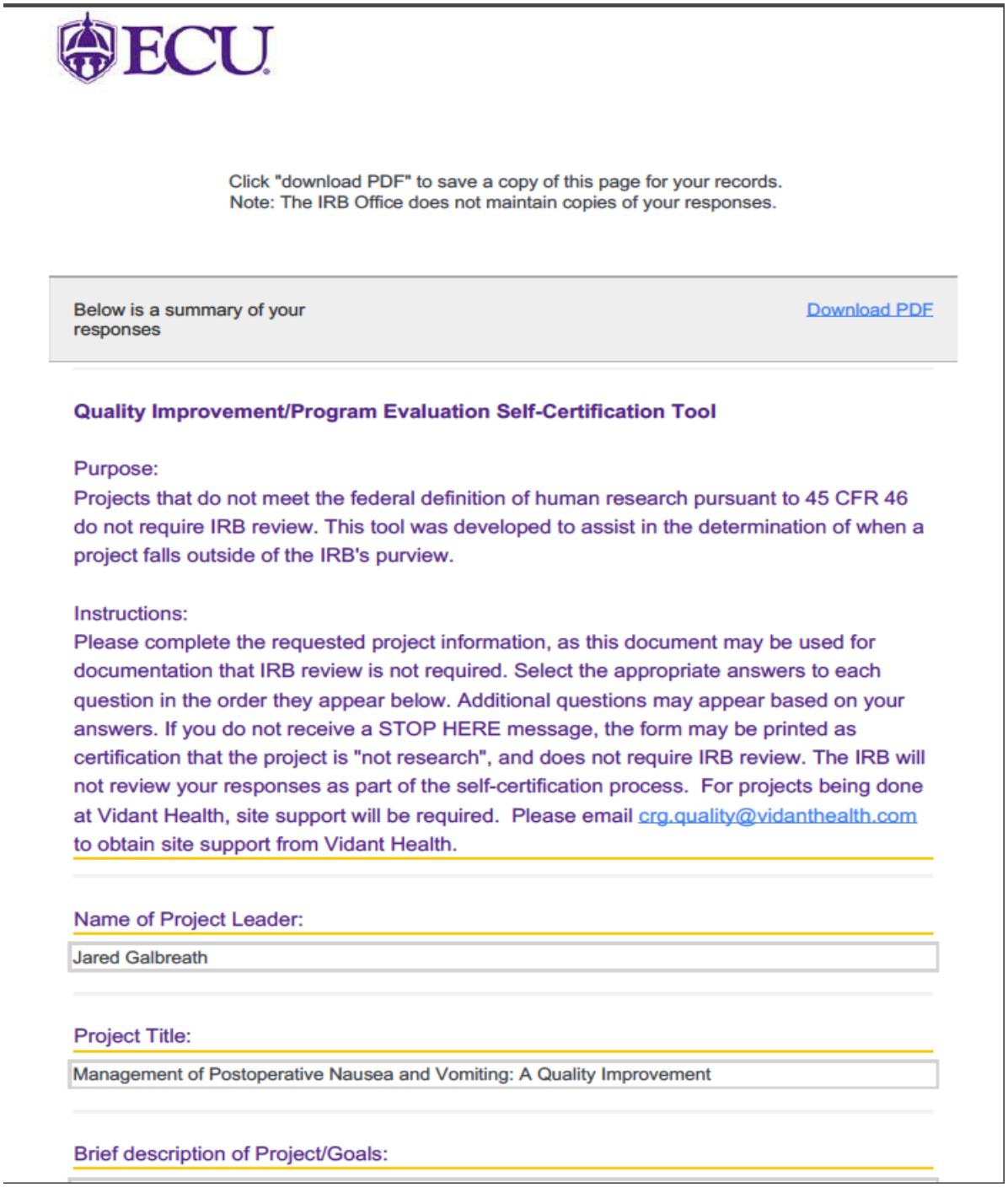
		their role in the treatment of PONV. No conceptual framework or model noted.		preoperative, intraoperative, and postoperative setting		used as prevention	PONV and preventative medications
2021	Wolfe, R., & Bequette, J. Dopamine receptor antagonists for the prevention and treatment of postoperative nausea and vomiting. *Journal of Perianesthesia Nursing*, *36*(2), 199-202.	Systematic review examining the effects of dopamine receptor antagonists on PONV. No conceptual framework or model noted.	I: Systematic Review	PONV prevention in the intraoperative and postoperative setting	31 Articles	Articles regarding dopamine receptor antagonists as prevention for PONV	Dopamine receptor antagonists have proven effective in preventing PONV.
2021	Zhong, W., Shahbaz, O., Teskey, G., Beever, A., Kachour, N., Venketaraman, V., & Darmani, N. (2021). Mechanisms of nausea and vomiting: Current knowledge and recent advances in intracellular emetic signaling systems. *International Journal of Molecular Sciences*, *22*(11), 5797.	Review of PONV receptors and afferent pathways. Breakdown of medications and their role in the treatment of PONV. No conceptual framework or model noted.	I Systematic Review	PONV physiology and prevention in the preoperative, intraoperative, and postoperative setting	300 Articles	Articles regarding the physiology of PONV and the pharmacology used as prevention	This article provided a foundation for afferent pathways involved in PONV and preventative medications.

Note: Key to abbreviations: ASA=American Society of Anesthesiologists; PONV=postoperative nausea and vomiting; N/V=nausea and vomiting. Key to Levels of Evidence: I: Systematic review/meta-analysis of randomized controlled trials (RCTs); II: RCTs; III:

Nonrandomized controlled trials/diagnostic case-control study; IV: Controlled cohort studies/Cross-sectional studies; V: Uncontrolled cohort studies; VI: Descriptive or qualitative study/case studies/EBP implementation/QI; VII: Expert opinion from individuals or groups/Literature review. Levels of evidence 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. Copyright 2019 by Wolters Kluwer.

Appendix D

IRB/CON Approval



ECU

Click "download PDF" to save a copy of this page for your records.
Note: The IRB Office does not maintain copies of your responses.

Below is a summary of your responses

Download PDF

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 Vidant Health, site support will be required. Please email crg.quality@vidanthealth.com to obtain site support from Vidant Health.

Name of Project Leader:

Jared Galbreath

Project Title:

Management of Postoperative Nausea and Vomiting: A Quality Improvement

Brief description of Project/Goals:

The purpose of this quality improvement project is to assess anesthesia providers' perceptions of the adequacy of a newly developed PONV management quick reference handout. Process: A quick-reference perioperative PONV management handout, based upon accepted national guidelines, will be developed. Anesthesia providers at [redacted]site) 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. 11/17/2022

Appendix E

QI Project Approval

DocuSign Envelope ID: 33FD1264-DC8D-44E9-881D-ECD789FE979E

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)

Project Title: Management of Postoperative Nausea and Vomiting: A Quality Improvement Project		
Funding Source: None		
Project Leader Name: Jared Galbreath, BSN, SRNA/ Maura McAuliffe, PhD, CRNA ☐ Ed.D. ☐ J.D. ☐ M.D. ☐ Ph.D. ☐ Pharm.D. ☒ R.N. ☐ Other(specify):		
Job Title: ECU SRNA/ECU CRNA Faculty	**Phone:** [redacted]	**Email:** mcauliffem@ecu.edu
	Primary Contact (If different from Project Leader):	
	Phone: [redacted]	**Email:** galbreathj21@student.ecu.edu

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.

Key Personnel/ Project Team members:

Name and Degree:	Department: (Affiliation if other than [redacted]	Email:

Jared Galbreath, BSN, SRNA	ECU Nurse Anesthesia Program	galbreathj21@student.ecu.edu
Dr. Maura McAuliffe	ECU Nurse Anesthesia Program	mcauliffem@ecu.edu
Dr. Travis Chabo	ECU Nurse Anesthesia Program	chabot14@ecu.edu

Rev 2.2023 Page **1** of **7**

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 Quick Reference Guideline. A PONV Quick Reference Guideline, 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 PONV management guidelines and preparedness to deliver PONV preventive care. An educational PowerPoint about the use of the newly developed PONV

Quick Reference Guideline will be made available to them, and they will be asked to use the PONV Quick Reference Guideline 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 Quick Reference Guideline. Qualtrics survey software will be used to gather these 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 quality improvement project is to assess anesthesia providers' perceptions of adequacy of a newly developed PONV Quick Reference Guideline.

b) The project design:

-A quality improvement project with a single Plan, Do, Study, Act cycle using a pre- and postintervention survey design

c) Any interaction or intervention with humans:

-CRNA participants will be contacted via email and asked to complete a pre-survey and then utilize a PONV Quick Reference Guideline based on current evidence that aligns with practices currently accepted within the facility to support their practice regarding PONV. 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, Jared Galbreath, 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 PONV Quick Reference Guideline 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 postsurveys 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 email and IP addresses, no identifiable data will be gathered. Data of interest is participant opinions and perceptions of practice and of the newly developed PONV
Quick Reference Guideline.

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 email and IP addresses of participants. Qualtrics survey software is accessed through ECU and involves multifactorial password protection. Data in Excel will be on a password protected personal laptop. Email and IP addresses will be deleted from Excel files after both surveys are completed and analysis of results begins.

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 (deidentified) 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 ECU 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 ECU digital repository, The Scholarship. Jared Galbreath will be responsible for de-identification 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:**

DocuSigned by:
[redacted]
0704FC6E5DCA423...

3/1/2023 | 11:10 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] Center 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 <u>not</u> human subject research, then any presentation, publication, etc. should <u>not</u> 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's minimum necessary provisions, [redacted] must make reasonable efforts to limit PHI to the minimum necessary to accomplish the purpose of the use, disclosure or request.

Under HIPAA, a Covered Entity (i.e. [redacted] can disclose PHI to another CE (i.e. BSOM) 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] 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.

Jacqui Gallant 2-20-23

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:** 3/7/2023

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

Appendix F

PONV 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 [2]
Female Gender	1
Non-Smoker	1
History of PONV and/or Motion Sickness	1
Postoperative Opioids	1
Sum of points	0-4

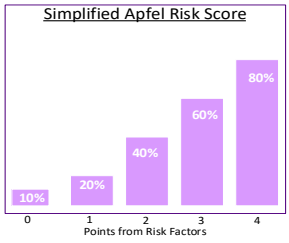


Table 3. Strategies to Reduce Baseline Risk 1 (p. 414)

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)

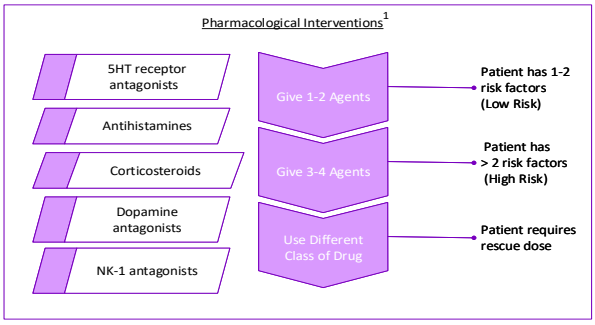


Table 2. Risk Factors for PONV in Adults 1 (p. 414)

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)

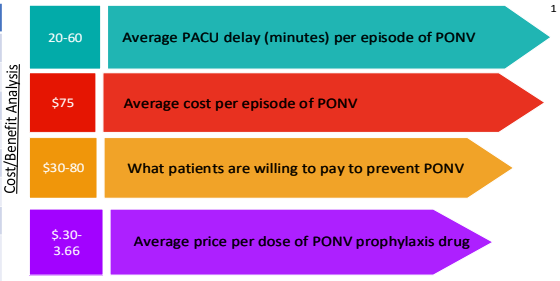
Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; PONV, postoperative nausea and vomiting.
[a]Use of nitrous oxide over 1 h duration.

Strength of Supporting Evidence

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

[1]

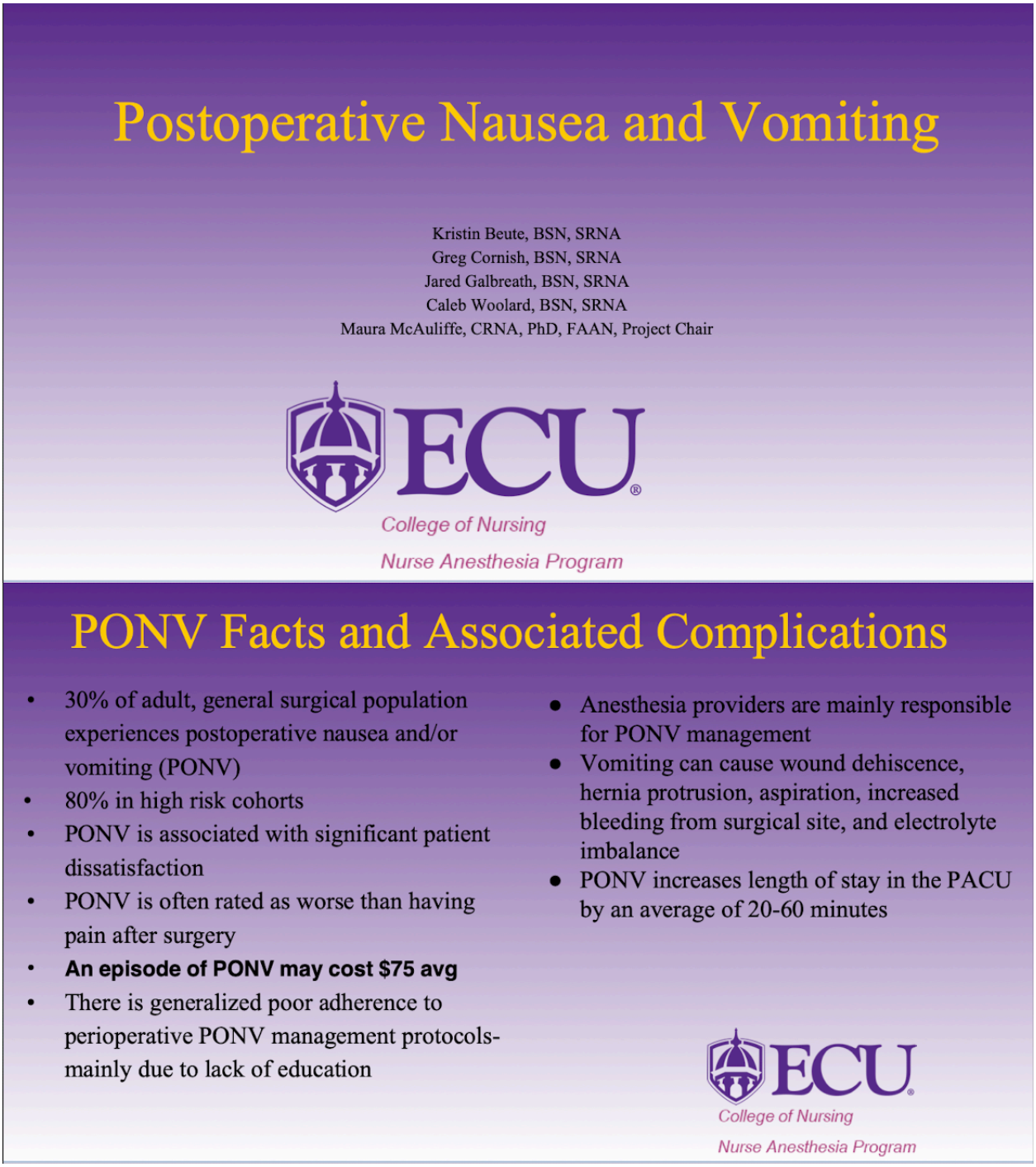
Drug	Dose	Evidence	Timing	Evidence	Class
Aprepitant	40mg PO	A1	At induction	A2	NK1 antagonist
Dexamethasone	4-8mg IV	A1	At induction	A1	Corticosteroid
Diphenhydramine	25-50mg IV	A3			Antihistamine
Droperidol	.625mg IV	A1	End of case	A1	DA antagonist
Methylprednisolone	40mg IV	A2			Corticosteroid
Metoclopramide	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



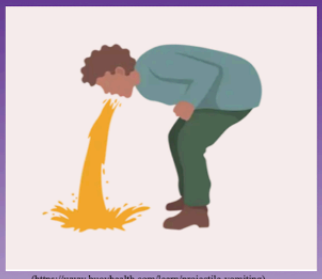
References
1. Gan, T. J., Belani, K. G., Bergese, S., Chung, F., Diemunsch, P., Habib, A. S., Jin, Z., Kovac, A. L., Meyer, T. A., Urman, R. D., Apfel, C. C., Ayad, S., Beagley, L., Candiotti, K., Englesakis, M., Hedrick, T. L., Kranke, P., Lee, S., Lipman, D., . . . Philip, B. K. (2020). Fourth consensus 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 G

Educational PowerPoint



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**

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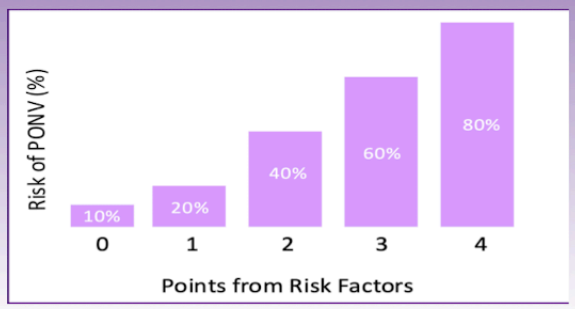
Risk Assessment

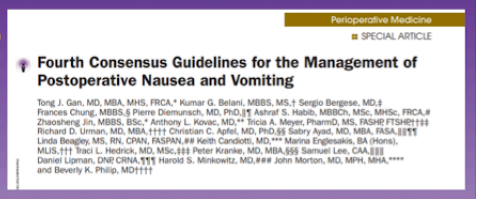
- Focused on four primary risk factors:
  - Gender
  - Smoking Status
  - History of PONV
  - Postoperative opioid administration
- Cumulative Score offers a relative risk based on the number of points the patient scores



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

Tong J. Gan, MD, MBA, MHS, FRCA,* Kumar G. Belani, MBBS, MS,† Sergio Bergese, MD,‡ Frances Chung, MBBS,§ Pierre Diemunsch, MD, PhD,‖¶ Ashraf S. Habib, MBBCh, MSc, MHSc, FRCA,# Zhaosheng Jin, MBBS, BSc,* Anthony L. Kovac, MD,** Tricia A. Meyer, PharmD, MS, FASHP, FTSHP,†† Richard D. Urman, MD, MBA,†††† Christian C. Apfel, MD, PhD,‡‡ Sabry Ayad, MD, MBA, FASA,‖‖¶¶ Linda Beagley, MS, RN, CPAN, FASPAN,## Keith Candiotti, MD,*** Marina Englesakis, BA (Hons), MLIS,††† Traci L. Hedrick, MD, MSc,‡‡‡ Peter Kranke, MD, MBA,§§§ Samuel Lee, CAA,‖‖‖ Daniel Lipman, DNP, CRNA,¶¶¶ Harold S. Minkowitz, MD,### John Morton, MD, MPH, MHA,**** and Beverly K. Philip, MD††††

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

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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.

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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

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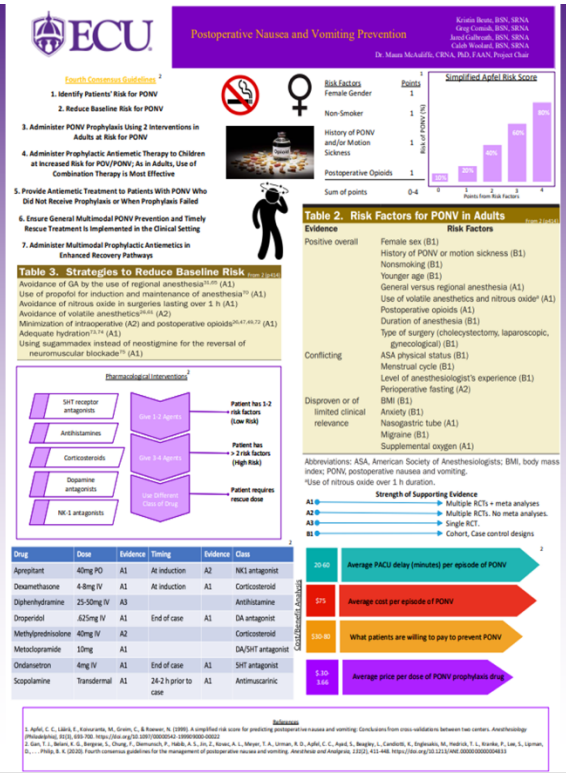
The Quick Reference Guide



The Quick Reference Guide

Fourth Consensus Guidelines [2]

1. **Identify Patients' Risk for PONV**
2. **Reduce Baseline Risk for PONV**
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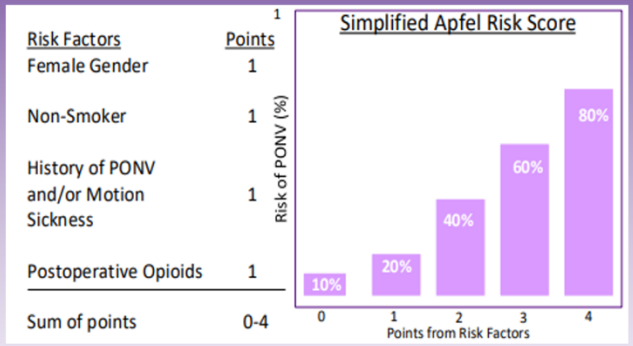
5. **Provide Antiemetic Treatment to Patients With PONV Who Did Not Receive Prophylaxis or When Prophylaxis Failed**
6. **Ensure General Multimodal PONV Prevention and Timely Rescue Treatment Is Implemented in the Clinical Setting**
7. **Administer Multimodal Prophylactic Antiemetics in Enhanced Recovery 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



[1]

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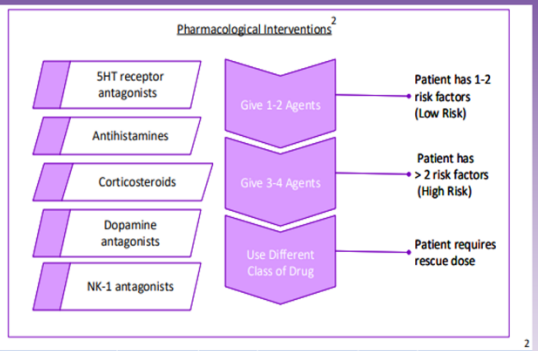
The Quick Reference Guide



[2]

Drug	Dose	Evidence	Timing	Evidence	Class
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Dexamethasone	4-8mg IV	A1	At induction	A1	Corticosteroid
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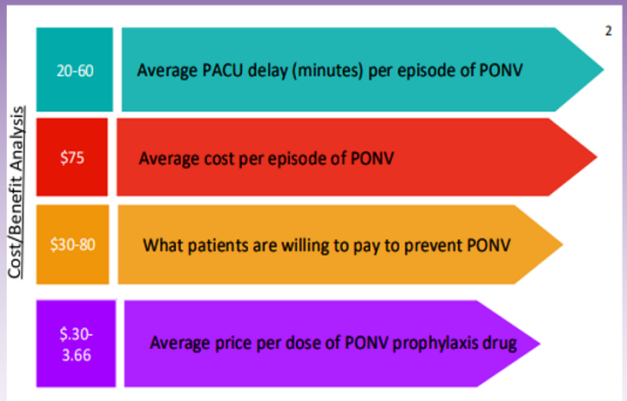

[2]

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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

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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

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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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Appendix H

Pre- and Post-Project Implementation Survey

Start of Block: Pre-Intervention Survey

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

_____

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

_____

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

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)
I consider it: (1)	○	○	○	○	○

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

	Not Familiar (1)	Somewhat Familiar (2)	Very Familiar (3)
I am: (1)	○	○	○

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

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)
I use it: (1)	○	○	○	○	○

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

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)
I tailor it: (1)	○	○	○	○	○

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?

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)
ondansetron (1)	○	○	○	○	○
droperidol (4)	○	○	○	○	○
dexamethasone (5)	○	○	○	○	○
scopolamine (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?

	0 Agents (1)	1 Agent (2)	2 Agents (3)	3 Agents (4)	Greater than 3 Agents (5)
I usually give: (1)	○	○	○	○	○

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?

	0 Agents (1)	1 Agent (2)	2 Agents (3)	3 Agents (4)	Greater than 3 Agents (5)
I usually give: (1)	○	○	○	○	○

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

	Less than $50 (1)	$50-$100 (2)	Greater than $100 (3)
The average cost is: (1)	○	○	○

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

○ Yes (1)

○ No (2)

○ Not sure (3)

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

	Not Useful (1)	Somewhat Useful (2)	Very Useful (3)
Access to a PONV quick reference guide would be: (4)	○	○	○

End of Block: Pre-Intervention Survey

Start of Block: Post-Intervention Survey

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

_____

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

_____

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

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)
I will consider it: (1)	○	○	○	○	○

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

	Not Familiar (1)	Somewhat Familiar (2)	Very Familiar (3)
I am: (1)	○	○	○

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

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)
I plan to use it: (1)	○	○	○	○	○

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

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)
I plan to tailor it: (1)	○	○	○	○	○

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?

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)
ondansetron (1)	○	○	○	○	○
droperidol (4)	○	○	○	○	○
dexamethasone (5)	○	○	○	○	○
scopolamine (6)	○	○	○	○	○

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?

	0 Agents (1)	1 Agent (2)	2 Agents (3)	3 Agents (4)	Greater than 3 Agents (5)
I plan to give: (1)	○	○	○	○	○

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?

	0 Agents (1)	1 Agent (2)	2 Agents (3)	3 Agents (4)	Greater than 3 Agents (5)
I plan to give: (1)	○	○	○	○	○

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

	Less than $50 (1)	$50-$100 (2)	Greater than $100 (3)
The average cost is: (1)	○	○	○

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

	Not Useful (1)	Somewhat Useful (2)	Very Useful (3)
I think an implemented PONV management protocol would be: (1)	○	○	○

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

	Not Useful (1)	Somewhat Useful (2)	Very Useful (3)
Access to a PONV quick reference guide would be: (1)	○	○	○

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

_____

End of Block: Post-Intervention Survery

Appendix I

Email with Links to Educational Materials and Qualtrics Surveys

Dear [redacted] CRNAs,

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

Participation is voluntary and will involve:

- Completing a short pre-intervention survey (12 questions)
- Viewing a brief educational PowerPoint (takes less than 10 minutes)
- Utilizing a PONV Quick Reference Guideline in your CRNA practice for two weeks (at your discretion)
- Completing a short post-intervention survey (13 questions) when the two-week implementation period is over.

Each survey and the educational PowerPoint should take less than 10 minutes to complete. The surveys were created and will be completed using Qualtrics® survey software. The use of the PONV Quick Reference Guideline falls within currently accepted practice in your work area. Your participation is voluntary and will be kept confidential. We will share the results of this QI study with you upon completion.

First, complete the pre-intervention survey via the link provided:
https://ecu.az1.qualtrics.com/jfe/form/SV_a46iKeSljdja4nA

Following completion of the survey, view the brief educational PowerPoint and PONV Quick Reference Guideline. The PONV Quick Reference Guideline is available via email and physical copies will also be available in the anesthesia work room.

Again, thank you for your participation in our quality improvement project. I will be at the [redacted] Main OR from June 5th until June 15th if you have any questions. You may also reach out to me or Dr. McAuliffe by email at any time.

Sincerely,

Jared Galbreath, SRNA
ECU Nurse Anesthesia Program
Class of 2024
galbreathj21@students.ecu.edu

Dr. McAuliffe, CRNA, FAAN
MCAULIFFEM@ecu.edu

Dear [redacted] CRNAs,

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

Participation is voluntary and will involve:

- Completing a short pre-intervention survey (12 questions)
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Each survey and the educational PowerPoint should take less than 10 minutes to complete. The surveys were created and will be completed using Qualtrics® survey software. The use of the PONV Quick Reference Guideline falls within currently accepted practice in your work area. Your participation is voluntary and will be kept confidential. We will share the results of this QI study with you upon completion.

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Again, thank you for your participation in our quality improvement project. I will be at the [redacted] Main OR from June 5th until June 15th if you have any questions. You may also reach out to me or Dr. McAuliffe by email at any time.

Sincerely,

Jared Galbreath, SRNA
ECU Nurse Anesthesia Program
Class of 2024
galbreathj21@students.ecu.edu

Dr. McAuliffe, CRNA, FAAN
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 video!). The link to the pre-survey/initial email is https://ecu.az1.qualtrics.com/jfe/form/SV_a46iKeSljdja4nA and you can follow it up by viewing the brief educational PowerPoint and viewing the PONV Quick Reference Guideline. The PONV Quick Reference Guideline is available via the first email and physical copies in the anesthesia work room if you would like them, but their use is not mandatory for participation in this project.

If you've already completed the first survey, please complete the post-survey at https://ecu.az1.qualtrics.com/jfe/form/SV_25d5a3p2noGJgFw. It should take less than 2 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. I look forward to coming back to [redacted] soon.

Sincerely,

Jared Galbreath, SRNA
ECU Nurse Anesthesia Program
Class of 2024
galbreathj21@students.ecu.edu

Dr. McAuliffe, CRNA, FAAN
MCAULIFFEM@ecu.edu

Dear [redacted] CRNAs,

I wanted to say thank you to everyone for helping me out with my DNP Project! I have collected all the data I need to proceed with data analysis and will be finishing my paper. Once it's complete, you all will be able to read it if you'd like. If you liked the PONV Quick Reference Guideline and found it useful, you can continue to use it, share the tool via email, and find additional physical copies in the anesthesia work room.

Thank you again! I hope to work with you more in the future.

Sincerely,

Jared Galbreath, SRNA
ECU Nurse Anesthesia Program
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galbreathj21@students.ecu.edu

Dr. McAuliffe, CRNA, FAAN
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