# Postoperative Nausea and Vomiting: A Quality Improvement Project

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**Abstract**

Postoperative nausea and vomiting (PONV) management and prophylaxis is an important consideration for CRNAs. PONV is an adverse event affecting 30% of the general surgical population and up to 80% of high-risk patients. PONV is associated with longer stays in PACU and increased hospital admissions and health care costs. The purpose of this scholarly quality improvement project was to assess the CRNAs' knowledge, preferences, and practices for managing PONV and whether or not they perceived a PONV quick refence guideline as a useful tool for their practice to aid in identifying high-risk patients, managing baseline PONV risks, and selecting strategies for prophylaxis and treatment. This project was completed at an ambulatory surgical center associated with a large academic medical center. A synthesis of the literature was performed and a short educational presentation along with a quick reference guide summarizing the synthesis was presented to CRNAs participants (n=7). Participants were asked to use the quick reference guide in their planning and management of PONV for a two-week period. Pre- and post-surveys were administered. Survey results indicated the CRNAs perceived the educational material and quick reference guide to be useful in the prevention and management of PONV. Post-survey results indicated increased familiarity with risk-based PONV prophylaxis, a key element of current consensus guidelines. Constraints on participants' time was a key limitation. Future studies should focus on specific aspects of the current consensus guidelines for PONV management, such as the Apfel risk score or specific interventions for PONV, such as aromatherapy or acupuncture.

*Keywords*: PONV, CRNA, prevention, prophylaxis, guidelines

## Table of Contents

## Section I: Introduction

### Background

Among the many issues in contemporary healthcare, postoperative nausea and vomiting (PONV) stands out as a topic of interest for nurse anesthetists. PONV has a wide range of consequences, from mild annoyance to serious adverse events (Collins-Yoder & Owings, 2019). The depth of literature on this subject is vast (Öbrink et al., 2015), and yet investigators cede an incomplete understanding of this phenomenon (Denholm & Gallagher, 2021). Up to 30% of patients undergoing surgery experience PONV even in the light of modern anesthetic and surgical techniques (Hegarty et al., 2016) and many high risk patients have a greater than 75% risk of PONV (Apfel et al, 2012).

PONV has been described as “the little big problem” (Öbrink et al., 2015, p. 100). Surgery and the anesthetic strategies which make surgery possible are insulting to the body’s emetogenic system in several ways. Opioids, sedating agents, anesthesia gases, and reversal agents all contribute to nausea and vomiting (N/V) pathways via multiple neurotransmitter pathways. Length of surgery (greater than 1 hour), type of surgery (eye, ear/nose/throat, abdominal, major orthopedic, and gynecologic), and any procedure which requires opioid administration are associated with increased risk of PONV (Öbrink et al., 2015).

PONV afflicts patients in the post anesthesia care unit (PACU) immediately after surgery and after discharge. Hegarty et al. (2016) note that 10%-30% of patients will experience some degree of PONV depending on the modalities of prophylaxis utilized. They also noted that patients sometimes experience PONV up to one week after their surgery, when they are at home and without access to treatment modalities. PONV is the most common complaint among

postoperative patients second only to pain (Shaikh et al., 2016). Yet many patients prioritize nausea and vomiting higher than pain (Apfel et al., 2012., Shaikh, et al, 2016).

Some have suggested this issue persists in contemporary healthcare because of patient acuity seen in procedural areas, despite substantial advances in anesthetic technique (Collins-Yoder & Owings, 2019). As patient acuity increased, the range of consequences for PONV also increased. Nausea can be a mere distraction and essentially self-limiting. Vomiting, to which nausea is often associated, may lead to wound dehiscence, gastric content aspiration, dehydration, life-threatening pneumothorax, or esophageal rupture (Shaikh et al., 2016). PONV extends PACU time and delays hospital discharge (Apfel et al., 2012). The pertinent and complicated nature of this issue gives rise to the question: How can anesthesia providers reduce PONV incidence?

The seminal work of Apfel and colleagues (Apfel et al., 1999; Apfel et al., 2012) provides the risk-scoring system upon which current prophylaxis and treatment guidelines are often based. The most recent PONV prophylaxis and treatment guidelines were issued by The International Anesthesia Research Society in 2020 (Gan et al., 2020). This document has endorsement of more than 20 associations, including the American Society of Anesthesiologists (ASA) and the American Association of Nurse Anesthesiologists (AANA). These authors recommend a sliding scale of intervention based on risk stratification in which patients in a low-risk class receive at least two drug classes for prophylaxis and those in a high-risk class receive three or four. The guideline encourages providers to consider as many risk-reduction strategies as possible for the higher-class strata, including  neuraxial blockade, total intravenous anesthesia (TIVA), and use of multiple prevention modalities (Gan et al., 2020).

Certified registered nurse anesthetists (CRNAs) have the capability and responsibility of minimizing PONV as an element of the patient's perioperative experience. The nurse anesthesia scope of practice, last updated by the AANA in 2020, makes this clear. Comprehensive evaluation of patient history and health status, followed by the selection and administration of medications, begins in the preoperative area, where PONV risk assessments are likely to occur. Throughout the intraoperative period, CRNAs are tailoring anesthetic techniques and administration of adjuvants in accordance with their patient-specific plan of care. The anesthetist's responsibility for the patient does not end when the surgical procedure is complete—it extends through the recovery period when patients are at highest risk of PONV (AANA, 2020). While improving patient outcomes has been, and will always be, an interdisciplinary team effort, it is clear that nurse anesthetists are uniquely positioned to take a leading role in reducing the incidence of PONV.

**Organizational Needs Statement**

The partnering organization for this quality improvement (QI) project stands to benefit from inquiry into its anesthesia providers' current PONV prophylaxis and treatment practices. As the primary health institution for a large, rural region with a population of over one million, this multi-hospital system has the opportunity to realize cost savings and improvements with even small reductions of PONV. Each episode of N/V may represent extra time spent in the perioperative environment or PACU, extra attention by nursing, and decreased patient satisfaction. Additionally, emesis itself puts patients at risk of sequalae such as wound dehiscence and aspiration which have their own implications for healthcare cost. The partner organization, anesthetists, and patients may all gain by efforts to increase understanding of current national guidelines which may help decrease these deleterious outcomes.

**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 associated with longer stays in PACU, and increased hospital admissions and health care costs.

**Purpose Statement**

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

## Section II. Evidence

### Description of Search Strategies

The body of evidence available regarding PONV is immense, and so a "Problem, Intervention, Comparison, Outcome, Time, and Setting" (PICOTS) question was utilized to render the most relevant articles. The PICOTS question is as follows: In PONV, how does the use of an education guide/tip sheet based on up-to-date guidelines affect the practices of CRNAs caring for patients in the perioperative period? Several key concepts were identified to use as search strategies. Terms such as "postoperative nausea and vomiting," "CRNA/anesthetist," "education," "guidelines," and "prevention" provided relevant evidence. Appendix A contains the concept chart used for this search strategy.

Applying these concepts in PubMed, CINAHL, and Google Scholar returned several hundred articles of relevance. Limitations were set such that articles specifically pertaining to *postoperative* nausea and vomiting were kept, along with publication date within ten years. Focus was placed on articles dealing with PONV in adult patients and priority was given to evidence pertaining to prophylaxis or treatment. Of the total, approximately 90 articles were reviewed. Additionally, the AANA and ASA have numerous resources which proved useful in finding scholarly work and evidence. See Appendix B for a detailed literature search log including the numbers of articles identified and precise search terms used for each database or search engine.

A literature matrix consisting of the sixteen articles deemed most relevant to the purpose of this project is included in Appendix C. In reviewing the selected literature, two seminal articles (Apfel et al., 1999; Apfel, et al. 2012) fell outside the time limits imposed on the search strategies but were referenced in multiple pertinent articles and so were included within this

review. The Melnyk and Fineout-Overholt levels of evidence framework was used to codify the relative strength of each item of literature (Melnyk & Fineout-Overholt, 2019). The matrix contains six Level VII (expert consensus) articles selected for their usefulness in providing a background for the pathophysiology of PONV as well as the historical and current guidelines for prophylaxis and treatment. Two Level VI studies (descriptive studies) included in the matrix describe QI projects to enhance evidence-based practice regarding PONV. Two Level V studies (uncontrolled cohort trials) were included for their pertinence to this QI project. There are two Level IV studies (controlled cohort) which are the seminal articles referenced even by contemporary studies. These articles each have sample sizes over 2,000 and have become the basis for the current understanding of PONV risk factors. Additionally, there are four Level I (systematic review/meta-analysis) studies included for their analysis of treatment and prophylaxis methods. Collectively, over 600 randomized control trials (RCTs) are represented in these reviews.

## Selected Literature Synthesis

### *Pathophysiology of PONV*

A brief discussion of the pathophysiology of N/V will provide context for the prophylaxis and treatment strategies for PONV. The “vomiting center” in the brainstem receives impulses from many neurological pathways and involves a host of neurotransmitters (Shaikh et al., 2016). There are five principal neurotransmitters of N/V which represent pharmacological targets: acetylcholine (M1/muscarinic), dopamine (D2), histamine (H1), serotonin (5-HT3), and neurokinin (NK1 or substance P; Denholm & Gallagher, 2019).

Any of the five senses (sight, hearing, smell, taste, touch) can independently trigger a N/V response (Collins-Yoder & Owings, 2019). The chemoreceptor trigger zone (CTZ) contacts

blood and CNS contents and is sensitive to toxins, medications, neurotransmitters, and other emetogenic substances found in the blood (Hegarty et al., 2016). Cranial Nerves IX and X jointly mediate the gag reflex (Collins-Yoder & Ownings, 2019) and communicate to the nucleus tractus solitarius (NTS; Denholm & Gallagher, 2019). The NTS also receives inputs from the CTZ, and both forward signals to the vomiting center independently (Shaikh et al., 2016). The GI tract is sensitive to irritants through chemoreceptors and responds to physical stress through mechanoreceptors (Hegarty et al., 2016). The limbic and vestibular (CN VIII) systems communicate to the vomiting center as well, resulting in the phenomena of motion sickness and anxiety-induced nausea (Hegarty et al., 2016). Anesthesia gases such as nitrous oxide and other drugs commonly used for sedation interact at multiple points of this etiologic maze to exacerbate the body's nausea system (Shaikh et al., 2016). Transient hypotension related to anesthetic effects on the sympathetic nervous system (SNS) also predispose to PONV (Hegarty et al., 2016). To summarize, nausea and vomiting are caused by all of the following phenomena experienced by patients perioperatively: noxious inputs to any of the five senses, anxiety, pain, chemical or mechanical irritation of the GI tract, endogenous or exogenous blood and CNS contents, positional changes, hemodynamic changes, and drugs used to accomplish sedation and anesthesia.

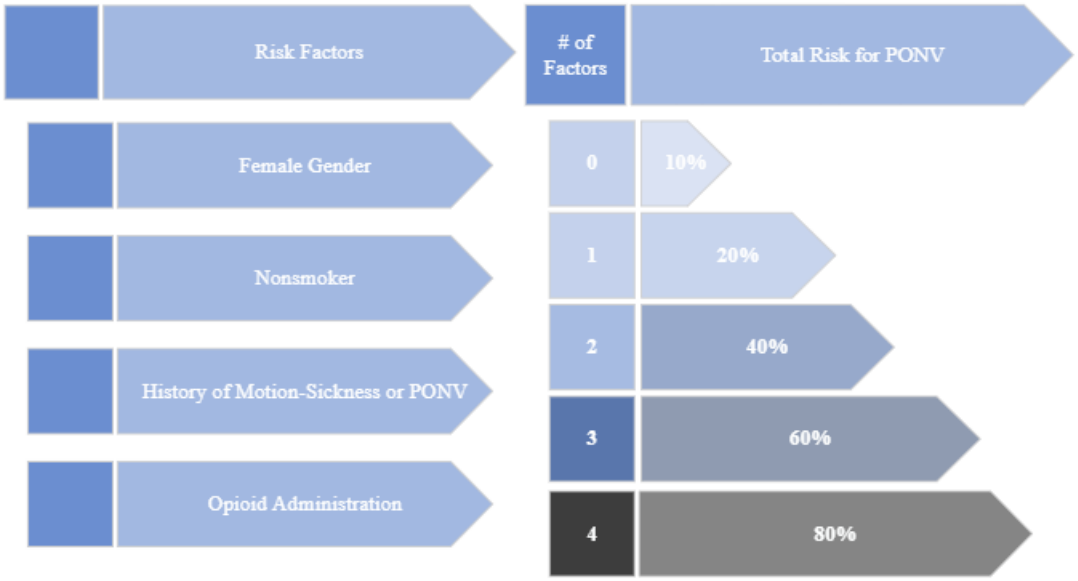
### *PONV Risk Factors*

Numerous risk factors for PONV have been identified in the literature and scoring methods have been adopted which are used in practice. Apfel et al. (2012) studied PONV in a sample of more than 2000 ambulatory surgical patients and identified five primary risk factors for vomiting: nausea in the PACU, use of opioids, history of PONV, age less than 50, and female gender. They found the risk of PONV increased from 7% with only one risk factor to 89%

depending on the number of risk factors a patient reported (Apfel et al., 2012). The scoring system used most commonly is based on the Apfel et al. (1999) study which identified four significant factors for PONV: female gender, history of motion sickness or PONV, nonsmoker, and use of post operative opioids. This study found that the baseline risk for an individual with no risk factors is 10-21% but may be as high as 78% for a high-risk individual (Apfel et al., 1999). See Figure 1 for the Apfel risk stratification.

**Figure 1**

*Risk Factor Stratification*




*Note.* % of total risk for PONV based on findings in Apfel et al. (1999).

***Pharmacological Modalities for PONV Management***

There are pharmacologic and non-pharmacologic modalities for PONV treatment and prevention. In their current consensus guidelines, Gan et al. (2020) emphasize pharmacologic modalities while acknowledging evidence exists for the efficacy of some non-pharmacologic modalities such as acupuncture. Attention is also given by these authors to tailoring anesthetic strategy in general, such as considering TIVA for high-risk or other appropriate patients. Evidence for both pharmacologic and non-pharmacologic modalities are presented in the literature matrix.

Weibel et al. (2020) conducted a network meta-analysis of evidence for drug-based PONV interventions that included nearly 600 RCTs involving almost 100,000 participants. The sample included examinations of over 40 stand-alone administrations and over 50 drug combinations. The authors found that combinations of drugs were better than single drugs for preventing PONV. High-quality evidence supported single drug effectiveness for ondansetron (a serotonin/5-HT3 antagonist), dexamethasone (a corticosteroid), and aprepitant (an NK1 antagonist), among a few others. Side effects were generally dose-dependent and rarely occurred at dosages relevant to PONV prophylaxis and treatment (Weibel et al., 2020). Consistent with these findings, Gan et al. (2020) endorse a combination prophylaxis strategy in which drugs of differing classes are added depending on the risk for PONV. These authors also recommend that treatment of PONV, if required, utilize a third (or fourth) pharmacologic class not already used in the administrations for prevention (Gan et al., 2020). Furthermore, in the risk studies conducted by Apfel and associates, the participants primarily received multi-class (combination) prophylaxis (Apfel et al., 1999; Apfel et al,. 2012).

### *Non-Pharmacologic Modalities for PONV Management*

Evidence exists to support the effectiveness of non-pharmacologic modalities for PONV prevention. For this review, the selected literature includes studies involving three non-pharmacologic modalities: aromatherapy, acupressure therapy, and intravenous fluid bolus or rehydration (Asay et al., 2019; Collins-Yoder & Owings, 2019; Lee et al., 2015; Öbrink et al., 2015).

Asay et al. (2019) conducted a systematic review of five randomized control trials involving aromatherapy use for PONV. The studies cumulatively included nearly 1,000 participants. The findings of this review are unequivocal: aromatherapy may reduce PONV and should be considered as a part of a multimodal strategy. However, an important caveat is the studies reviewed all have serious limitations, including small sample sizes and weak randomization practices (Asay et al., 2019). Gan et al. (2020) mention the utility of isopropyl alcohol in decreasing the duration and intensity of nausea. Collins-Yoder and Owings (2019) point out that the cost and the risks of adverse outcomes are so low with aromatherapy that its use should not be discouraged, especially since there is some evidence to support its efficacy.

In the same line of thinking, Öbrink et al. (2015) state, regarding PC6 acupressure therapy, “It is surprising that simple non-pharmacological techniques such as the acupressure wrist band are not more commonly used” (p. 103). Indeed, Lee et al. (2015) published the most comprehensive systematic review of acupressure use for PONV involving approximately 60 RCTs representing nearly 8,000 participants. These authors found PC6 stimulation to be as effective as antiemetic use for PONV. Gan et al. (2020) make note of the evidence for the effectiveness of specific acupuncture point stimulation in preventing PONV and suggest it may

be used adjunctively with antiemetic drugs. Lee et al. (2015) recommend PC6/antiemetic drug combinations as a subject for further study.

Intravenous fluid administration has been included in guidelines for PONV for some time and is endorsed by the major anesthesia provider associations (Gan et al., 2020). Jewer et al. (2019) published a systematic review involving 38 RCTs and 4,034 participants. Though many of the studies lacked an adequate description of randomization and blinding practices, the findings are unequivocally favorable regarding the benefits of intravenous crystalloid administration for preventing PONV. The use of intraoperative crystalloids is associated with less PONV and reduced antiemetic use (Jewer et al., 2019).

***Risk-Reduction Strategies***

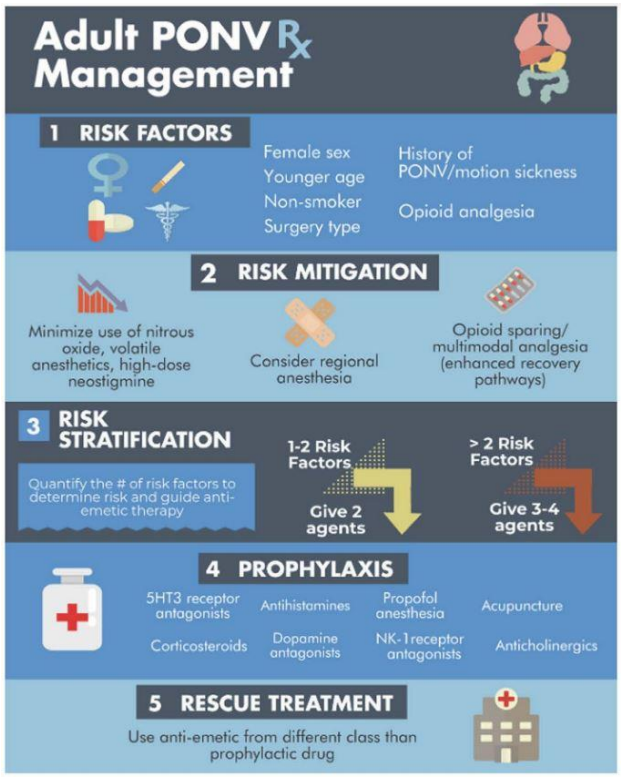
Both Gan et al. (2020) and Öbrink et al. (2015) discuss PONV incidence-reduction strategies. The use of multiple drug classes for prevention and separate class usage for treatment of "break-through" PONV is endorsed, as is IV fluid administration. An additional way anesthesia providers can reduce PONV incidence is through sedation selection and neuraxial blockade, reducing opioid requirements which are a major risk factor (Gan et al. 2020; Öbrink et al., 2015). Use of alpha 2 agonists such as dexmedetomidine may reduce PONV, possibly because opioid requirements are less. Some patients may be appropriate candidates for TIVA using propofol, which is less emetogenic than volatile gases and may be protective for PONV (Gan et al., 2020). These strategies are a way to ameliorate baseline risk.

Gan et al. (2020) recommend a risk-based PONV prophylaxis and treatment approach that considers patient characteristics as well as operative strategies. The basis for this assessment of risk arises from the seminal studies by Apfel and colleagues (1999; 2012) which identified four patient characteristics of significance for PONV: female sex, age less than 50 years,

nonsmoking status, and history of PONV or motion sickness. These investigators found that the risk for PONV increases from 10% to nearly 80% depending on the number of risk factors identified. Using the Apfel scoring system, anesthetists can quickly generate an evidence-based strategy for decreasing the incidence and severity of PONV. Figure 2 summarizes the concept of risk-based treatment and prophylaxis.

**Figure 2**

*Risk-Based PONV Management*




*Note:* Taken from Gan et al., (2020). Used with permission from the American Society for Enhanced Recovery.

### *CRNA Practices*

It is the goal of this project to assess if CRNAs perceive a Quick Reference Guide (QRG) preceded by a short educational presentation to be useful for risk-based PONV prophylaxis and treatment. Several studies have demonstrated improved outcomes when a risk scoring system is used. Pym and Ben-Menachem (2018) demonstrated (n=600) that incidence of PONV and time to discharge decrease when anesthesia providers use a risk-based, individualized management strategy for PONV. The study findings suggest that time to discharge from the PACU may be prolonged by 30 minutes if a patient has N/V in the PACU and their anesthesia provider did not assess a risk score. Similarly, Dewinter et al. (2018) observed that use of an even simpler risk algorithm than Apfel resulted in reduction of relative risk by 33%. These authors found that the Apfel score was incorrectly assessed or not performed at all more than 50% of the time in an audit of 422 records. This led the researchers to develop a simpler risk algorithm based on gender alone. Males were given at least two anti-emetic agents while females were given at least three, and the incidence of PONV was 11% less.

Multiple QI projects have targeted CRNA adherence to evidence-based guidelines for PONV prophylaxis. Hargrove-Loper (2019) sought to establish the efficacy of use of the Apfel score by CRNAs in an ambulatory surgery center. The author audited patient records prior to introducing an Apfel risk-assessment tool to anesthesia providers for their use in planning the anesthetic. After introducing the tool, outcomes such as time to discharge from the PACU and N/V incidence were tracked. Though the sample size was not large, the study findings are in line with those of larger investigations: namely, promotion of a risk-based strategy is associated with more rapid discharge and lower incidence of PONV. Bernal (2020) assessed CRNA perceptions of the efficacy of a reference tool for clinical decision-making based on up-to-date PONV

management guidelines. This investigation was made even more relevant considering medication shortages experienced by anesthetists (ondansetron) were associated with increased provider willingness to contemplate a broader range of interventions. Survey respondents unanimously agreed their participation in the project education and use of the clinical decision tool enhanced PONV prevention. Each of these studies (Bernal, 2020., Dewinter et al., 2018., Hargrove-Loper, 2019., Pym & Ben-Menachem, 2018) involved the promotion of the Apfel risk assessment and found it to be associated with practice differences resulting in enhanced care delivery.

**Project Framework**

This project was guided by the plan-do-study-act (PDSA) change method. The PDSA method is a continuous process amenable for adoption by QI projects (Institute for Healthcare Improvement [IHI], 2022). Beginning with a clinically relevant question or goal, such as *reduce the incidence of PONV by 15% within six months*, one proceeds to the development of a project goal or purpose. This is the beginning of the Plan stage. After this, appropriate measurement methods are developed and then the intervention to be measured takes place, corresponding with the *Do* and *Study* stages. In the *Act* stage, an assessment occurs, after which adjustments can be made and the process continued in a circular and ever-refining fashion.

**Ethical Considerations and Protection of Human Subjects**

The potential benefits involved in this project's intervention apply to anesthetists and patients under their care. There was no risk of inequitable application of this benefit, namely, the assessment of CRNA perception of the usefulness of a PONV QRG. There was no known potential harm to our target population (anesthetists). Ethics modules by the Collaborative Institutional Training Initiative (https://about.citiprogram.org/) were completed by the primary investigator prior to project implementation. Additionally, this project underwent approval via

the educational institution's process as QI so that full institutional review board (IRB) level of assessment was deemed unnecessary. Subsequently, the research office of the partner organization approved this project in conjunction with the educational institution's University Medical Center and Institutional Review Board (UMCIRB). Local site partner permission was obtained prior to data collection. Appendix D contains the documents from the project approval process in full.

## Section III. Project Design

### Project Setting

The project was implemented in a day surgery center with a daily core staff of 7 CRNAs. The participants planned for and administered anesthetics many times per day, so there was ample opportunity to use the QRG to plan for PONV prophylaxis. The historical association between the healthcare institution and the academic institution was a facilitating factor for this project. A consequence of this relationship is staff familiarity with DNP projects and QI projects. A significant barrier to completing this project was the time burden on participants in viewing the educational materials prior to the project and then using the QRG during the two-week project timeframe. Additionally, participants had to complete a pre- and post-intervention survey, which also took time.

### Project Population

The anesthetists at the day surgery center are a mix of staff members who work solely at that site and others who float between the center and the main hospital operating areas. This QI project asked these participants to willingly modify the usual flow of their day to use the QRG when planning for PONV prophylaxis. It is possible that some of the anesthetists found this to be cumbersome and this may have been a barrier to the project. However, many of these providers graduated from the academic institution and so are aware of the process of DNP requirements for QI projects, which facilitated the implementation and data collection processes.

### Project Team

Four students collaborated in the development of the project, but each member conducted independent implementation, data collection, and analysis. A project chair oversaw the planning, implementation, and assessment of the project. A CRNA administrator from the healthcare institution signed a letter of acknowledgement that data would be collected on their unit. The

CRNA faculty member liaised between the healthcare and academic institutions. Additionally, the CRNA program director and DNP course director oversaw instruction and implementation of the project.

**Methods and Measurement**

The goal of this pre-test, post-test implementation project was to assess the knowledge, preferences, and practices of CRNAs at the partnering healthcare institution for managing PONV and whether they perceived a QRG for PONV prevention to be useful. Evidence from up-to-date guidelines was synthesized and presented to the anesthetists in a PowerPoint video presentation developed during this project. The PowerPoint slides can be found in Appendix E. A PONV QRG summarizing this presentation was also provided. The project sought to assess the CRNAs' perceptions of the usefulness of this guide. This QRG is included in Appendix F. Appendix G contains the emails which delivered this material to the participants, and Appendix H contains copies of the pre- and post-implementation surveys delivered using Qualtrics software. The project's measurement objectives primarily pertained to current anesthetist perceptions and practices before and after the project protocol implementation, in view of current published guidelines.

The PDSA methodology guided the planning and implementation of this project. In the *plan* phase, a comprehensive literature review revealed the evidentiary basis for the currently endorsed guidelines for PONV management by anesthesia providers. This body of evidence was synthesized and a short educational presentation using PowerPoint was developed, along with a QRG summarizing this information. Permission to use select tables/figures from Gan et al. (2020) was obtained from the publisher and is included in Appendix I. Pre- and post-presentation surveys were also developed. The project's clinical CRNA, in concert with the institutional

CRNA, identified and assigned the setting for project implementation (the day surgery center associated with the healthcare institution).

In the *do* phase, participant willingness was assessed with the help of the clinical contact person. Willing participants received an email with a link to a pre-project survey to assess their current practices and perceptions of evidence-based QRG. Attached in this email were the PowerPoint educational presentation, the QRG, and a copy of the consensus guidelines found in Gan et al. (2020). Participants were asked to use the QRG to support their practice for a two week period. After two weeks, another email containing a link for a post-project survey was sent. One week later, a final thank-you email was sent to participants. This email also served as a reminder for any who had not yet completed the post-protocol implementation that the data collection period was soon ending (Appendix F). Participants also received polite queries in person during the implementation period as a reminder of the project. Data collection was halted the next week. Of note, 100% of participants responded to both the pre- and the post-protocol implementation survey!

In the s*tudy* and *act* phases, the data and responses from the participants' surveys were codified. Results included Likert-scale responses as well as open-ended responses with suggestions by participants. The project was disseminated in this DNP paper and a formal presentation was given to faculty and students. This presentation was uploaded to The Scholarship (the institution's online scholarly publication), making the content electronically available. The survey results were kept as confidential as possible.

## Section IV. Results and Findings

### Results

The purpose of this scholarly project was to assess the CRNAs' knowledge, preferences, and practices for managing PONV and whether they perceived a PONV QRG as a useful tool for their practice. Pre-survey and post-survey results were both collected using Qualtrics data collection software.

#### *Data Presentation*

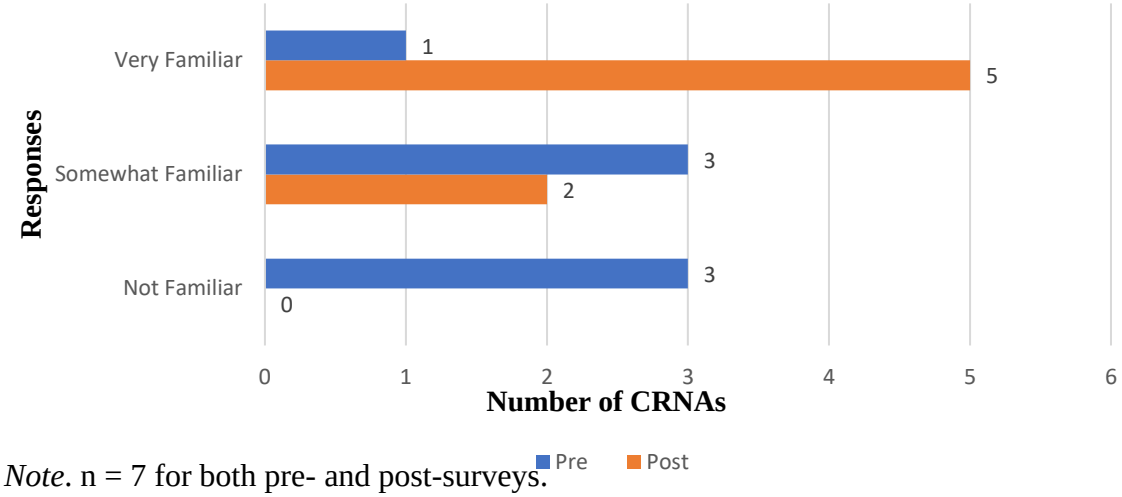
The initial questions on both the pre- and post-surveys pertained to the incidence of PONV among general and high-risk populations. When asked what percentage of adult general anesthesia patients they believed experienced PONV, participants responses ranged between 10% and 85%. Regarding those considered high-risk for PONV, the anesthetists perceived between a 50% to 85% incidence. When asked how often they considered prophylaxis and treatment of PONV when planning for a case all anesthetists indicated they "always" or "often" considered it. There were seven respondents to each of these questions.

Several questions on both the pre- and post-surveys addressed participants' familiarity and use of the Apfel risk assessment, with similar wording used to align the questions for pre- and post-intervention comparison. Participants were asked how familiar they were with using the Apfel risk assessment for PONV risk screening (see Figure 3), how often they used the Apfel risk assessment to screen for PONV risk (see Figure 4), and how often they tailored PONV prophylaxis based on Apfel risk factors (see Figure 5).

When participants were asked to indicate the frequency with which they used certain antiemetic medicines there were multiple differences between pre- and post-survey responses. See Table 1.

**Figure 3**

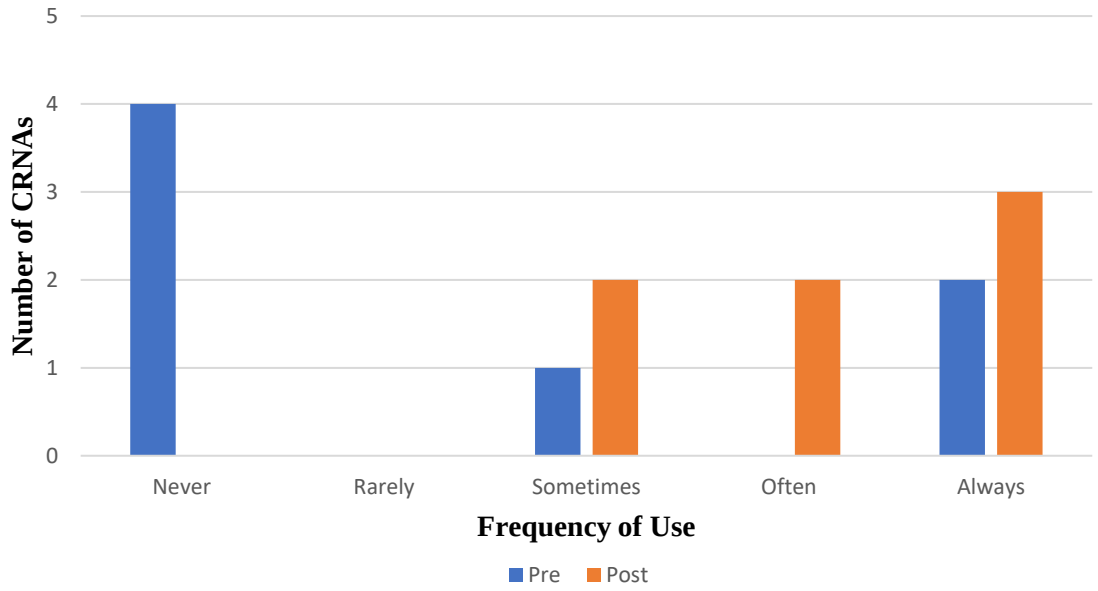
*CRNA Familiarity with Apfel Risk Assessment*




*Note*. n = 7 for both pre- and post-surveys.

**Figure 4**

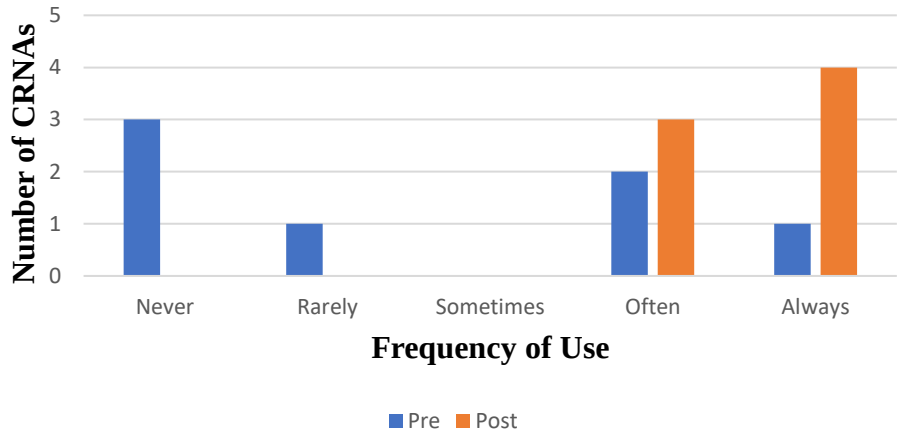
*Frequency of Apfel Assesment Use*




*Note*. n = 7 for both pre- and post-surveys.

**Figure 5**

*Predicted Frequency of Use of Apfel Risk Assessment*




*Note*. n = 7 for both pre-and post-surveys.

**Table 1**

*Frequency of Use of Selected Agents*

Scopolamine

| | Pre | Post |
|---|---|---|
| Never | 0 | 1 |
| Rarely | 0 | 0 |
| Sometimes | 5 | 2 |
| Often | 2 | 4 |
| Always | 0 | 0 |

Dexamethasone

| | Pre | Post |
|---|---|---|
| Never | 0 | 0 |
| Rarely | 0 | 0 |
| Sometimes | 0 | 1 |
| Often | 5 | 4 |
| Always | 2 | 2 |

Droperidol

| | Pre | Post |
|---|---|---|
| Never | 0 | 0 |
| Rarely | 6 | 2 |
| Sometimes | 1 | 5 |
| Often | 0 | 0 |
| Always | 0 | 0 |

Ondansetron*

| | Pre | Post |
|---|---|---|
| Never | 0 | 0 |
| Rarely | 0 | 0 |
| Sometimes | 0 | 1 |
| Often | 2 | 1 |
| Always | 4 | 5 |

*Note*. For each drug, n = 7 for both pre- and post-surveys except ondansetron. *The pre-test n = 6 for ondansetron. Red indicates low quantity. Shades of green indicate higher quantity.

Subsequent questions regarded the number of pharmacologic agents employed for patients identified as low risk or high risk for PONV. Nearly all participants (n=7) stated they used or would plan to use two agents for low-risk scoring patients on both pre- and post-surveys. However, on the pre-survey two participants stated they would use two agents and the rest stated they would use three, or more than three, agents for high-risk patients, while on the post-survey all participants indicated they would use three, or more than three, agents for high-risk patients.

Other questions were asked about what the CRNAs perceived the cost of PONV prophylaxis to be, whether or not the department had a PONV protocol, and whether or not the CRNAs found this QI project's QRG to be useful. On the pre-protocol implementation survey, four of the seven participants responded that the cost was less than $50, one that the cost was between $50 and $100, and two that it was greater than $150. On the post-protocol implementation survey, three participants responded less than $50 and the others $50 to $100. On the pre-survey, five of seven participants stated "no" or "not sure" when asked if there was a PONV protocol for their department, while on the post-survey all selected that such a protocol would be "somewhat" or "very" useful. When asked if they felt a QRG for managing PONV would be useful, five participants on the pre-survey and six participants on the post-survey responded "useful" or "very useful."

A final question, only presented on the post-survey, was: "How would you improve the PONV quick reference guide?". Respondents offered constructive feedback including "Although it is packed full of useful information, maybe convert it into a double-sided reference with data on one side and drug/dosages on the other?"; "Looks great as is"; and "Condense the info. Not user friendly."

**Analysis**

The purpose of this scholarly project was to assess the CRNAs' knowledge, preferences, and practices for managing PONV and whether or not they perceived a PONV Quick Refence Guideline as a useful tool. When comparing the pre- and post-implementation survey questions side by side, the results were interesting. When asked about the incidence of PONV, the range of responses was essentially similar from pre- to post- implementation survey. Though there were slight variations, due to the confidential nature of the surveys it was not possible to track each set of responses to a specific participant and so it is difficult to draw inferences.

The participants were asked about their familiarity with the Apfel risk assessment, how often they perform it, and if they use it to plan PONV treatment and prophylaxis. In the pre-implementation survey, only one participant selected "very familiar" and three selected "not familiar." On the post- implementation survey, however, five selected "very familiar" and none selected "not familiar" responses. This suggests that education regarding the Apfel assessment specifically was effective. Four participants selected they "never" use the Apfel score on the pre-test, but none did so on the post- implementation survey. On the pre- implementation survey, only two CRNAs indicated they used the risk score more than "sometimes." On the post-implementation survey, all participants indicated they planned to perform the risk score either "sometimes," "often," or "always." There was a similar shift between pre- and post-implementation survey from "never" or "rarely" towards "always" when the participants were asked how often they use (pre) or planned to use (post) the Apfel score to plan their PONV prophylaxis and treatment. These are encouraging results given the fact that a risk-based approach to PONV prophylaxis using the Apfel score is a key component of the 2020 consensus

guidelines. Though the participants' perceptions of the effectiveness of the QRG is not at issue in these questions, their responses seem to reflect favorably upon the QRG as far as adoption of Apfel risk score/assessment is concerned.

The CRNAs were asked about the frequency with which they plan to administer various antiemetics. The results for ondansetron, dexamethasone, and scopolamine were similar from pre- to post- implementation survey. Participants indicated a shift in the willingness to administer droperidol, however, with four more participants in the "sometimes" category than in the "rarely" category from pre- to post- implementation survey. Of note, droperidol is the only drug of the four listed that is not stocked in the Pyxis by the anesthesia workstation. Dexamethasone, ondansetron, and scopolamine are more readily available which may explain why participants did not indicate much change in their frequency of use. It seems likely that droperidol is used rarely to begin with, at least in part because it is not at the workstation while multiple other antiemetic alternatives are stocked there.

The participants were asked how many agents they would give to low and high risk individuals, respectively. Participants selected similarly for low-risk patients. For high-risk individuals, all participants indicated "three", or "more than three", agents on the post-implementation survey, which is consistent with the consensus guidelines and represents a small change from the pre- implementation survey, in which two participants selected "two Agents" for a high-risk patient.

Interestingly, the participants' perceptions overestimated the expected expense of PONV prophylaxis on both the pre- and post- implementation survey. In the pre- implementation survey most participants selected "no" or "unsure" when asked if the department had an existing PONV management protocol. However, all participants indicated in the post- implementation survey

that such a protocol would be “somewhat useful” (three) or “very useful” (four). Though the QRG has elements of a protocol, it is more of an educational tool. Nevertheless, it is interesting that participants perceived that a protocol would be useful to some degree. Regarding the QRG, six participants indicated on the post- implementation survey that it would be “somewhat useful” or “very useful” compared to three and two, respectively, on the pre- implementation survey.

The final question on the post-test was open-ended and sought suggestions from participants. Two individuals commented that the QRG could have been presented more clearly by making it more concise or dividing it into two pages. One indicated that no changes were necessary. The participants’ perceptions of the QRG did not change dramatically. However, their views on the usefulness of the Apfel score shifted favorably. Additionally, reported willingness to use droperidol increased and all participants indicated their perception that a formal PONV protocol would be of use. These results are in line with the consensus guidelines and suggest that the project was effective, at least in part, in drawing attention to evidence-based guidelines.

## Section V. Implications

### Financial and Nonfinancial Analysis

A discussion of the evidence about the costs associated with PONV demonstrates the cost saving potential of this quality improvement project for the partnering organization. Parra-Sanchez et al. (2012) studied the incidence of PONV retrospectively in 100 ambulatory surgical patients. The authors considered the time required by staff members to address PONV, supplies used in the treatment of PONV, and the effect of PONV on the duration of the recovery period. Individuals who experienced PONV spent an average of one hour longer in the recovery area than those who did not have PONV. Recovery nurses were required to spend, on average, 14 minutes longer in direct patient care if patients had PONV. The authors found that the costs for the recovery period was increased by $75 to $90 for patients who experienced PONV.

Krzyzanowski et al. (2018) studied the effects of implementing a PONV prophylaxis protocol (specifically dexamethasone-based) on post-surgical outcomes for bariatric patients. The authors noted a decreased length of stay for protocolized patients of 0.73 days. Additionally, the proportion of patients who experienced severe PONV declined from 33% to 10%, and the proportion of patients who had no PONV whatsoever increased from 27% to 62%. These authors estimated an average savings of $428 per person. The decreased length of stay accounted for the largest proportion of this.

Other investigators have sought to determine the net profit or loss of implementing a PONV prophylaxis protocol for a surgical institution. Dzwonczyk et al. (2012) performed a retrospective study in which all surgical charts within a two-year period were reviewed with respect to PONV factors and their associated costs. In factoring the costs of PONV, the authors considered the charges for care related to PONV, hospital expenses related to PONV, and the

total reimbursements for care. Expenses included considerations such as supplies, medication, and facilities costs. Additionally, some patients had to return to the emergency room for N/V they experienced after discharge and these readmission costs and charges were also considered. The authors conclude that if PONV prophylaxis had been given to just the high-risk patients within the group, the estimated profit for the institution would have been $105,000 over the two-year period. If PONV prophylaxis had been given to all patients, the estimated profit would have been $141,000. Their findings are unequivocal: "The care providers as well as the institution should not be concerned about the economic burden of PONV prophylaxis, because the hospital will not experience any loss and will even be able to gain by providing the adequate prophylaxis to patients undergoing surgical procedures" (Dzwonczyk et al., 2012, p.15).

Without knowing the precise incidence of PONV and the costs associated with it for the partnering organization, it is difficult to be quantitative about the potential benefits implementing this type of quality improvement project might pose to the organization. Using the available evidence, however, there is a basis for suggesting that the surgery center stands to save $75, one hour of PACU time, and about 15 minutes of direct RN care per incidence of PONV. For procedures which routinely see longer lengths of stay at locations like a main hospital OR, the cost savings may be even greater at nearly a full day saved for patients who would have otherwise had PONV if a prophylaxis protocol was not used. The average dollar savings may be about $400 per patient. Depending on the surgical volume, PONV prophylaxis may represent cost savings or net profit increases exceeding $100,000 within as little as two years.

For the ambulatory surgery center at the partnering organization to implement this type of QI project with their own staff and on their own initiatives, certain costs would need to be factored. It might take 40 hours to conduct a literature search and review pertinent evidence. The

synthesis of evidence may require 40 more hours. Producing the educational material (write and edit a presentation, survey questions, and QRG) and implementing the project (select participants, produce emails, distribute educational materials) could also take 40 hours. This amounts to three weeks work. A DNP-prepared APRN would be well suited to this role and so the cost of removing this individual from their normal, revenue-generating clinical duties for the duration of this project would also need to be considered. If not already available, the institution would need to provide access to databases, programs such as PowerPoint, computer hardware, and office space for these activities to be completed.

A detracting factor for the success of a potential future QI project includes the lack of an institution wide PONV prophylaxis protocol. Based on the survey responses to this small QI project, it seems likely that anesthetists are considering PONV to some extent with regularity. However, the prophylaxis and treatment regimen is nonuniform across the group of anesthesia providers. Further QI projects may provide clarity as to the proportion of provided anesthetics which adhere to the current consensus guidelines. Once the amount, if any, of deviations from these is known, the potential benefit to the organization of a larger-scale using this project as a pilot will be made evident.

To some extent, the potential benefits of implementing QI projects with the aim of increasing practice-wide adherence to the current consensus guidelines are intangible yet significant. If just one episode of PONV delays a patient's PACU stay by one hour, increases facility costs by $75, and results in 14 extra minutes of direct RN care time, it is apparent that even modest reductions in the incidence of PONV would pay increasing dividends over time.

If the organization sponsored a similar project, there would likely be a good return on investment. Prior to this QI project implementation, four of seven participants indicated that

would never or rarely use the Apfel risk assessment to plan prophylaxis and treatment for PONV. After the implementation of the protocol, all seven anesthetists indicated willingness to use risk assessment in the course of planning their anesthetics. On the post-implementation survey, all anesthetists indicated that an institutional PONV protocol would be "somewhat useful" or "very useful." Given the evidence suggesting that implementation of a PONV protocol can decrease the incidence of PONV by 11% (Dewinter et al., 2018), it seems clear that the surgery center and healthcare institution as a whole stand to see a satisfactory return on any investment should a similar QI project be conducted.

**Implications of Project**

The AANA has endorsed the guidelines put forth by Gan et al. (2020), which posit that a risk based strategy is the best approach to PONV prophylaxis and management. The work of Apfel and colleagues has a strong evidentiary base and is the recommended risk assessment tool for use in anesthesia planning. CRNAs are well positioned to perform this assessment of risk and not only plan but prescribe, administer, and manage PONV prophylaxis and treatment. Their ability to seamlessly incorporate PONV considerations into their anesthetic plans is consistent with their training, education, skills, and scope of practice as described by their professional practice standards. The CRNA scope of practice is clear that the anesthetist's responsibility spans the entire perioperative period and that the onus for PONV prevention and treatment is on the CRNA (AANA, 2020).

The results of this QI project indicate that awareness of the Apfel risk assessment was not universal at the ambulatory center where the project was implemented. Indeed, on the pretest, only one participant indicated they were "very familiar" with Apfel. This is significant given that the Apfel risk assessment is a cornerstone of the current consensus guidelines for PONV

prophylaxis and treatment. Some of the findings of the literature search strongly suggest that incorporating Apfel or another risk-based approach can improve PONV outcomes significantly. Incorporating a risk score alone was found to decrease the incidence of PONV and decrease time to discharge (Pym & Ben-Menachem, 2018). Other findings indicate that even when the Apfel score is performed regularly, it may be done incorrectly 50% of the time (Dewinter et al., 2018). The same study found that implementation of a simple risk-based algorithm decreased PONV incidence by 11% in the study population. The implication for the partnering organization in this QI project is that significant benefits can be achieved with a closer look at local PONV practices and encouragement towards use of the consensus guidelines. Should the organization wish to use this pilot project as a springboard for other PONV initiatives, it may find that this is at trend towards acceptance for adopting a facility PONV protocol. All participants predicted they would use the Apfel risk assessment “often” or “always” and that a department protocol would be “somewhat” or “very” useful.

Patients, the partnering organization, and nurse anesthesia practice as a whole may benefit from the potential outcomes of this project if it were repeated on a larger scale. Some of the potential positive outcomes for patients include decreased experience of PONV, decreased exposure to the potential sequelae of PONV, decreased healthcare costs, decreased time in the healthcare facility, and increased satisfaction both before and after discharge. The partnering organization in general and the ambulatory center in particular may reap substantial financial benefits in the form of decreased cost, decreased length of stay, and increased throughput efficiency. The upshot of these benefits is increased reinvestment of resources into the organization’s mission. Quality improvement has a natural place in nursing practice. Perhaps it could be said that every nurse anesthetist inherits a legacy of improvement upon graduation. One

reason participants were so willing to give their time and energy to this project may be that the ethos of nursing lends itself to constant improvement. It is likely that CRNAs will remain at the vanguard of improvement in care delivery.

**Sustainability**

The affordability of implementing prophylactic antiemetics is an important question, for an organization positioned to sponsor a similar project. Dzwonczyk et al. (2012) found that a moderate-risk patient requiring three doses of prophylactic antiemetic had an associated cost of $11. If the institution were to treat every single patient as moderate- to high-risk and pay $11 to provide three prophylactic agents, approximately seven patients could receive prophylaxis before the PACU cost of one episode of PONV ($75) was equaled. This practice would pay for itself if just one of every six patients receives the theoretical benefit of successful PONV prophylaxis. This QI project sought to determine CRNA perceptions of the adequacy of a QRG which succinctly presented the 2020 consensus guidelines, of which there are several components. A QI project zeroing in on individual components may lead to positive outcomes also. For example, a project focusing on the Apfel risk assessment specifically, evaluating perceptions of its ease of use and effectiveness, may reveal ways to improve the use of this evidence-based tool. Also, while this QI project emphasized drug choice preferences, another QI project may emphasize these strategies such as TIVA or regional anesthesia to decrease the incidence of PONV.

**Dissemination Plan**

To share the findings of this project, CRNA department members and project participants were invited to a formal presentation. A poster summarizing the literature findings, educational materials, QRG, survey questions, and project results was created and referenced during the presentation. The final version of this paper and the poster were shared with project participants

and CRNA department faculty. They were additionally submitted to The Scholarship, the university's publicly available digital repository.

## Section VI. Conclusion

### Limitations

There are several limitations associated with this project. The short implementation time (two weeks) presented some challenges. For planning purposes, the beginning of the implementation was somewhat hampered by being unable to access the surgery center until the day implementation began. This made it so that email was the most viable mode of delivery for the project. Had implementation begun as little as a week prior, there would have been opportunity to establish face-to-face communication regarding the QRG, the goals of the project, and the role the participants were being asked to play. As things were, it was not possible to know if participants were able to take full advantage of the QRG for two weeks or if the time between pre- and post-implementation surveys was more abbreviated.

Additionally, the small sample size of 7 participants is a limitation. However, a much larger sample would certainly have required a longer implementation time and possibly more resources. Another limitation is that the surveys inherently relied on participants to self-report. There is no way to determine if participants provided responses they perceived as desirable or conducive to the project as opposed to responses that accurately reflected their practices and perceptions.

The project relied upon the willingness and availability of CRNAs to go above and beyond their routine duties. Working with a student clinical learner who was also implementing a QI project meant that the CRNA preceptors had to assume a double burden if they were to be participants. It is possible that this introduced bias into the responses, which may not reflect true perceptions and practices.

**Recommendations for Additional Study**

This project could serve as the basis for a similar one at another institution. It would be advisable for the anesthesia learner to spend time in the clinical setting with the individuals who will be asked to be participants ahead of the implementation time. This would allow the investigator to determine the best ways to disseminate information about the project, whether that be by email, hard copies posted in a common area, or face-to-face interactions. If possible, it may be beneficial to approach anesthesia management to see if there may be mutual interest in the potential benefits of the project. If the QI project has a dual student and management face, participants may be more likely to engage with the educational content and complete the surveys.

Other avenues for study or future implementation can be found within the consensus guidelines. Determining CRNA perceptions of nonpharmacological strategies and interventions such as aromatherapy or acupressure may yield interesting results. Determining CRNA preferences around TIVA and what method may be most effective in preventing PONV would also be of interest. Perhaps the key next step indicated by this project is to investigate the best way to enact a risk-based PONV treatment and prophylaxis protocol for an anesthesia department. The concept of a risk-based strategy is the core of the consensus guidelines and has a strong evidence base to suggest efficacy in reducing incidence and cost of PONV.

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## Appendix A

## PICOT Question and Search Concept Chart

**Problem or Population**: CRNAs and PONV Prophylaxis and Treatment
**Intervention:** Education guide/tip sheet to encourage conformity to practice guidelines
**Comparison**: Before and after intervention
**Outcome**: Practitioner adoption to up-to-date practice guidelines
**Time**: The perioperative period
**Setting**: ECU health OR

### PICOT Question

In PONV, how does use of an education guide/tip sheet based on up-to-date guidelines affect the practices of CRNAs caring for patients in the perioperative period.

### Concept Chart

| | **Concept 1** Postoperative Nausea and Vomiting | **Concept 2** CRNA or Anesthetist | **Concept 3** Education or Guidelines | **Concept 4** Prevention |
|---|---|---|---|---|
| Keywords | Postoperative nausea and vomiting | CRNA | Education Guidelines | Prevention |
| Pubmed MeSH | "Postoperative Nausea and Vomiting" | "anesthetist" | "Guidelines" OR "Education" | "Prevention" |
| CINAHL | "Nausea and Vomiting" | "nurse anesthetist" | "Practice Guidelines" | "Prevention" |
| Google Scholar | "Postoperative nausea and vomiting" | "CRNA" | "Guidelines" AND "Education" | "Prevention" |

## Appendix B

## Literature Search Log

| Search date | Database or search engine | Search strategy | Limits applied | Number of citations found/kept | Rationale for inclusion/exclusion of items |
|---|---|---|---|---|---|
| 9/14/2022 | PubMed | String: (postoperative nausea and vomiting) AND prevention AND (education OR guidelines)<br><br>Advanced: ("postoperative period"[MeSH Terms] OR ("postoperative"[All Fields] AND "period"[All Fields]) OR "postoperative period"[All Fields] OR ("post"[All Fields] AND "operative"[All Fields]) OR "post operative"[All Fields]) AND ("nausea"[MeSH Terms] OR "nausea"[All Fields] OR "nauseas"[All Fields]) AND ("vomiter"[All Fields] OR "vomiters"[All Fields] OR "vomiting"[MeSH Terms] OR "vomiting"[All Fields] OR "vomit"[All Fields] OR "vomited"[All Fields] OR "vomits"[All Fields] OR "vomitings"[All Fields] OR "vomition"[All Fields] OR "vomitting"[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 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 | none | 157 found / 21 kept | Pertaining to postoperative nausea and vomiting, generally published within the last 10 years (seminal articles not excluded), intervention or prophylactic emphasis, educational/practices emphasis, adult population |

| | | | | | |
|---|---|---|---|---|---|
| | | "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] OR ("guideline"[Publication Type] OR "guidelines as topic"[MeSH Terms] OR "guidelines"[All Fields])) | | | |
| 9/14/2022 | CINAHL | ((MH "Nausea and Vomiting")) AND ("prevention" OR (MH "Practice Guidelines") OR (MH "Guideline Adherence") OR "prophylaxis" ) AND ((MH "Anesthesia") OR (MH "Nurse Anesthetists") OR (MH "Postoperative Complications") OR (MH "Postoperative Period") ) | (2018-2022) | 166 found / 44 kept | Focus on prevention and treatment of postoperative nausea and vomiting, adult population only, English language article/translation available |
| 9/14/2022 | Google Scholar | (postoperative nausea and vomiting) AND prevention AND (education OR guidelines) | (2018-2022) | Reviewed 8 pages/ kept 33 | Relevance to postoperative nausea and vomiting/ interventions and prophylaxis focus, adult population |

# Appendix C

## Literature Matrix

| Authors | Year Pub | Article Title | Journal | Purpose | Level of Evidence | IV DV or Themes concepts and categories | Sample Size | Comments/critique of the article/methods GAPS |
|---|---|---|---|---|---|---|---|---|
| Apfel et al. | 1999 | A simplified risk score for predicting post operative nausea and vomiting: Conclusoins from cross-validations between two centers. | *Anesthesiology* | The study analyzed two other studies done by two independent medical centers from which two separate risk scoring systems were developed, the Apfel and Koivuranta score. This study tested the cross-validity of the scoring systems in the opposite patient populations. Ultimately 4 patient factors (common to both systems) were found to be valid accross both populations as predictors of PONV. | Level IV | DV = PONV. IV = Gender, Age, Smoking status, history of PONV | 2,722 | There were some important similarities in these studies. The patients received no prophylasix uniformly and had the same induction and sedation strategies. However, the centers were in different countries, different surgical procedures were represented, and one study contained children as well as adults (though the groups were stratified and analyzed separately). This is a landmark study and is still referenced in the literature two+ decades later. |
| Apfel et al. | 2012 | Who is at risk for postdischarge nausea and vomiting after ambulator surgery? | *Anesthesiology* | To determine which patients have the highest risk for PONV and PDNV (Post Discharge Nausea and Vomiting). PONV: Gender F, age < 50, hx PONV, periop opiod dosage, duration of sx, type of sx (lap). PDNV: The 5 significant risk factors are female gender, age < 50, history of PONV, opiod administration in the PACU, and N/V in the PACU. Risk ranges depending on number of risk factors a patient has. 10% (1) up to 80% (all 5). | Level IV | DV = PONV. IV = Gender, Age, Smoking status, history of PONV | 2,170 | Despite use of a clearly-defined severity scale, nausea and vomiting (and retching) is still highly subjective and therefore difficult to study with exactitude. Additionally, antiemitic use was recorded and included in the study but not controlled by the study, so this represents a potentially confounding variable. Nevertheless, this is a seminal study which is often quoted in current literature reviews. |
| Asay, K., Olson, C., Donnelly, J., & Perlman, E. | 2019 | The use of aromatherapy in postoperative nausea and vomiting: A systematic review. | *Journal of Perianesthesia* | To evaluate whether or not aromatherapy affects the incidence of PONV - Authors found aromatherapy to have a diminishing effect on PONV and suggest it be utilized as one among multiple modalities used to address or prevent PONV. Relatively low cost nursing intervention. | Level I | DV = PONV. IV = Aromatherapy Use, type of aromatherapy used vs control (none) | 5 RCTs Total. 1,023 participants | All of the studies have serious flaws and are low quality evidence at best. Aromatherapy is a very low cost intervention which requires no provider proscription and can therefore be implemented with fewer barriers. The risk of side effects or adverse events are virtually nil. Furthur studies are needed to determine precise aromas or aroma/oil mix which are most efficacious. |
| Bernal, D. | 2020 | A clinical decision tool to guide prevention of adult postoperative nausea and vomiting during ondansetron shortages. | | To design and destribute a reference tool for clinical decision-making for PONV prevention based on up-to-date guidelines and then evaluate the perceived usefulness of that tool. | Level VI | CRNA perceptions as to the efficacy of a clinical reference tool for decision-making regarding PONV prophylaxis. | 7 CRNAs | The small sample size, due to a low survey response rate, represents a limiation to the applicability of the data. However, the results are unambiguous in that 100% of survey respondents indicated the study intervention to be helpful in preventing PONV during an ondansetron shortage. Most participants had a better view of using alternatives to ondansetron after participating in the educational program. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Collins-Yoder & Owings | 2019 | Periprocedural Considerations for the Prevention and Treatment of Nausea and Vomiting | *Journal of Radiology Nursing* | An outline of current recommendations aimed at decreasing complications associated with procedural N/V. | Level VII | NA | NA | Provides a very compact review of pathophysiology as well as pharmacalogic and nonpharmacalogic modalities. |
| Denholm & Gallagher | 2021 | Physiology and pharmacology of nausea and vomiting | *Anaesthesia and Intensive Care Medicine* | A review of the etiology of nausea and vomiting. | Level VII | NA | NA | References Gan et al., Apfel et al. Outlines 5 stimuli and 5 receptors involved with N/V . Discusses pharmacalogic agents. Discusses compliations/sequelae of PONV. |
| Dewinter et al. | 2018 | Simplified algorithm for the prevention of postoperative nausea and vomiting: a before and after study | *British Journal of Anaesthesea* | The authors developed a simple algorithm to guide PONV prophylaxis. The study tests the efficacy of this algorithm with respect to PONV before and after implementation. | Level V | IV = anesthesia provider use of simplified PONV prophylaxis algorithm. DV = PONV incidence | 422 participants. 211 in the regular Apfel risk score group, 211 in the simplified algorithm group. | The study findings suggest that, as simple as the Apfel risk score is, it is still complicated enough that it is incorrectly performed most of the time. The simplified algorithm gave recommended two antiemetics for males and three for females. The simple algorithm group saw a 11% reduciton in PONV incidence indicating a 33% reduction in relative risk for PONV. |
| Gan et al. | 2020 | Fourth Consensus Guidelines for the Management of Postoperative Nausea and Vomiting | *International Anesthesia Research Society* | To make available to anesthesia providers a comprehensive, up-to-date set of guidelines for PONV prevention and treatment based on the available evidence. | Level VII | 8 guideline categories. 1: Assess for PONV risk. + recommended assessment tools. 2: Ameliorate risk + strategies. 3: Use multimodal PONV prophylaxis + recommendations. 4: Prophylactic schemes for pediatrics. 5: Rescue/treatment guidelines for N/V occurrence. 6: Establish prophylaxis and treatment protocols. 7: Multimodal ERP. 8: Research priorities. | NA | Over 20 professional societies have endorsed these guidelines, including the AANA. The authors emphasize pharmacalogic modalities and mention, but are not explicit about, non pharmacalogic modalities. The authors note that the evidence base for aromatherapy and acutherapy are not strong. |

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| Hargrove-Loper, K. | 2019 | Development and evaluation of a nurse anesthetist-directed postoperative nausea and vomiting risk stratification tool for patients undergoing laparoscopic surgery in an ambulatory surgery center | | To determine if the use of a risk stratification tool for PONV (based on Apfel) by nurse anesthetists can reduce incidence of PONV and reduce discharge times following laparoscopic surgery. | Level VI | IV = anesthesia provider use of Apfel risk score for PONV. DV = PONV incidence | 59 participants. 31 Non-Apfel, 28 Apfel | The Apfel group (anesthetists used the Apfel score for anesthesia planning) saw a 15 minute average shorter time to discharge. There was a lower incidence of PONV in the Apfel group. Limitations: small sample size (1 patient vomited in the Apfel group and 2 in the Non-Apfel group). Every patient in the non-intervention group still recieved at least one antiemetic, possibly confounding the comparison. |
| Hegarty et al. | 2016 | Ambulatory anesthesia and postoperative nausea and vomiting: predicing the probability | *Ambulatory Anesthesia* | A review of the contemporary PONV risk scoring systems and corresponding PONV prophylactic strategies and the general efficacy of a risk-based prophylactic approach to PONV. | Level VII | NA | NA | The authors reference the Apfel studies as well as other PONV risk assessments not emphasized in this DNP project. More broadly, the article lends agreement to the concensus of other groups. Namely, the efficacy of a prophylactic approach based on a risk assessment for PONV is supported by contemporary evidence. |
| Jewer et al. | 2019 | Supplemental peri-operative intravenous crystalloids for postoperative nausea and vomiting: an abridged Cochrane systematic review | *Anaesthesia* | Does the literature support the use of IV fluid hydration to prevent PONV? Yes, IV crystalloid administration pre and perioperatively does reduce risk of PONV. | Level I | IV = IV crystalliod administration, DP = PONV | 38 RCTs. 4034 participants | The quality of evidence assessed using GRADE. Moderately strong evidence supporting that IV crystalloid administration reduces risk for PONV. Moderate evidene that IV crystalloid administration reduces need for antiemitic administration. PONV was not uniformly defined amont the sample. Timing and volume of dose was also not uniform. Many studies insufficiently described randomization and blinding procedures. |
| Lee et al. | 2015 | Stimulation of the wrist acupuncture point PC6 for preventing postoperative nausea and vomiting (Review) | *Cochrane Database of Systematic Reviews* | Is Accupoint PC6 stimulation safe and effective in the prevention and treatment of PONV? Low quality evidence unanimously suggests it is. | Level I | IV = PC6 stimulation, DP = PONV | 59 RCTs. 7667 participants | Roughly half the trials were rated to have high risk of bias in one or more domains. The total quality of evidence is low due to study limitations and significant methedological differences across the sample. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Obrink et al. | 2015 | Post-operative nausea and vomiting: Update on predicting the probability and ways to minimize its occurrence, with focus on ambulatory surgery | *International Journal of Surgery* | This narrative review synthesizes a broad range of studies to provide a summary of guideliens for most effective PONV prophylasix and treatment | Level VII | Risk factors, prevention and treatment modalities and strategies | NA | While Gan et al. (2020) mention non pharmacalogic methods, Obrink et al., go a little farther and actually recommend their use. Obrink et al. emphasizes modifiable factors while Gan et al. discuss pharmacalogic interventions specifically and at length. Both seem to agree in a risk-based strategy in which the risk stratification correspond to the number of modalities utilized. |
| Pym, A. and Ben-Menachem, E. | 2018 | The effect of a multifaceted postoperative nausea and vomiting reduction strategy on prophylaxis administration amongst higher-risk adult surgical patients | *Anaesthesia and Intensive Care* | Does the promotion of an evidence-based PONV management guideline result in greater adherence to established guidelines and reduce the incidence of PONV? Yes. | Level V | IV = promotion of PONV management guidelines. DV = adherence to established guidelines, PONV, PACU time | 628 participants. 333 pre-intervention and 295 post-intervention | Institutional adherence to the established guidelines for PONV management increased roughly 10% in the post-intervention group. PACU time decreased in the post-intervention group (>30 minutes comparing pre-intervention patients with PONV and post-intervention patietns without PONV). PONV occurrence was 9 % less in the intervention group. |
| Shaikh et al. | 2016 | Postoperative nausea and vomiting: A simple yet complex problem | *Essays and Researches* | A review of the pathophysiology, prophylactic strategies, and rescue therapy for PONV. | Level VII | NA | NA | The article eferences the Apfel and Koivuranta scoring methods for PONV risk. The evidence base for antiemetic agents and doses is synthesized. The authors conclude that a multimodal appraoch with thought given to PONV risk is cost-effective. |
| Weibel et al. | 2020 | Drugs for preventing postoperative nausea and vomiting in adults a er general anaesthesia: a network meta-analysis (Review) | *Cochrane Database of Systematic Reviews* | The study objective is to compare and rank the effectiveness of the pharmacalogic measures used to prevent and treat PONV, and also to determine optimal dosages. | Level I | Pharmacalogic classes, combinations, dosages. PONV | 585 RCTs. 97,517 participants | 44 single drugs and 51 combinations are studied by the sample. Roughly half of the studies involved ondansetron. Bias risk was unable to be determined in roughly half of the studies. Study concludes that drug combinations tend to be more efficacious than single drugs. Effectiveness was generally dose dependent. 5 drugs are singled out as most certain to prevent PONV. Side effects or adverse events were rare but certainty is low and more study is suggested. |

*Note*: Key to abbreviations used in chart: DV (Dependent Variable); IV (Independent Variable); PONV (Postoperative Nausea and Vomiting); PDNV (Post Discharge Nausea and Vomiting); N/V (Nausea and Vomiting); AANA (American Association of Nurse Anesthesiologists); IV (Intravenous); RCTs (Randomized Control Trials). Key to Levels of Evidence: I: Systematic review or meta-analysis of RCTs; II: RCTs; III: Nonrandomized controlled trials; IV: Controlled cohort studies; V: Uncontrolled cohort studies; VI: Descriptive or qualitative study, case studies, EBP implementation; VII: Expert opinion from individuals or groups. Adapted from *Evidence-based practice in nursing and healthcare: A guide to best practice* (4th ed.), by B. M. Melnyk and E. Fineout-Overholt, 2019, p. 131. Copyright 2019 by Wolters Kluwer.

# Appendix D

## Approval Process Documents

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 proces[illegible] For projects being done at Vidant Health, site supp[illegible] will be required. Please emai[illegible] to obtain site support from [illegible].

Name of Project Leader:

John Gregory Cornish

Project Title:

Postoperative Nausea and Vomiting: A Quality Improvement Project

Brief description of Project/Goals:

The purpose of this quality improvement project is to assess anesthesia providers' perceptions of 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 [illegible] 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. 11/12/2022

Center for Research and Grants

## Quality Improvement Project vs. Human Research Study Determination Form

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

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

| | | |
|---|---|---|
| **Project Title: Post Operative Nausea and Vomiting: A Quality Improvement Project** | | |
| **Funding Source: None** | | |
| **Project Leader Name: John Cornish, SRNA. Maura McAuliffe, Ph.D.** ☐ **Ed.D.** ☐ **J.D.** ☐ **M.D.** ☐ **Ph.D.** ☐ **Pharm.D.** ☒ **R.N.** ☐ **Other(specify):** | | |
| **Job Title:** SRNA/ CRNA Faculty | **Phone:** [redacted] | **Email:** mcauliffem[redacted].edu |
| | **Primary Contact (If different from Project Leader):** | |
| | **Phone:** [redacted] | **Email:** cornishj21@student[redacted].edu |

## Key Personnel/ Project Team members:

| **Name and Degree:** | **Department:** (Affiliation if other than ECU Health) | **Email:** |
|---|---|---|
| John Cornish, SRNA | [redacted] Nurse Anesthesia Program | Cornishj21@students.[redacted].com |
| Maura McAuliffe, Ph.D. | [redacted] Nurse Anesthesia Program | [redacted] |
| | | |

Rev 2.2023



## QI/QA Assessment Checklist:

| Consideration | Question | Yes | No |
|---|---|---|---|
| **PURPOSE** | Is the PRIMARY purpose of the project/study to:<br>• IMPROVE care right now for the next patient? OR<br>• 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:<br>• literature<br>• 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?<br>• An outside organization with an interest in the results<br>• A manufacturer with an interest in the outcome of the project relevant to its products<br>• 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 Post Operative Nausea and Vomiting (PONV) management quick reference handout. Process: A quick-reference perioperative PONV ma[illegible]ndout, based upon accepted national guidelines, will be developed. Anesthesia providers a[illegible]h SurgiCenter 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 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 the participant perceptions prior to and post implementation of the project. No patient information will be recorded or maintained during this project.

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

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

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

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

f) Specify what data will be used and any dates associated with when that data was originally collected (i.e Patient Name, Diagnosis, Age, Sex), *If applicable, please attach your data collection sheet.*

-Aside from participant emails, no identifiable data will be gathered. Data of interest is participant opinions and perceptions of practice and the newly developed informational tool.

g) Where will the data (paper and electronic) for your project be stored? Please specify how it will be secured to protect privacy and maintain confidentiality. For paper data, please provide physical location such as building name and room number and that it will be kept behind double lock and key. For electronic data, please provide the file path and folder name network drive where data will be stored and specify that it is secure/encrypted/password protected. If using other storage location, please provide specific details.
-All data will be gathered using Qualtrics survey software then transferred to Excel for analysis. The only identifying information will be the email addresses. Qualtrics survey software is accessed through ECU and involves multifactorial password protection. Data in Excel will be on a password protected personal laptop. Email addresses will be deleted from Excel files after both surveys are complete 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 (de-identified) until student graduation, anticipated to be spring of 2024.

i) Please specify how the collected data will be used (internal/external reports, publishing, posters, etc.) and list name(s) of person responsible for de-identification of data before dissemination.
-The deidentified data will be analyzed with results shared via a poster presentation to the 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.

**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 Health 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]

**Operational Mgr/Leader Name:** _____

DocuSigned by: [redacted]
5AB2E7B0536740E0 3/2/2023 | 12:21 PM EST

**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 publication describing this project: "This project was reviewed and determined to qualify as quality improvement by the 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 IRB determines the activity is not human subject research, then any presentation, publication, etc. should not refer to the activity as "human subject research," "exempt research," or "expedited research."

## Attestation of Understanding

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

Under HIPAA's minimum necessary provisions, [illegible] 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 [illegible] can disclose PHI to another CE (i.e. [illegible], 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 [illegible] healthcare data utilized in this project should not be shared outside of the CE without a fully executed data use/sharing agreement. [illegible] leadership reserves the opportunity to review all articles for dissemination/ publication for which [illegible] healthcare data has been utilized and that the content is being disseminated in the appropriate manner as a quality initiative, not resembling research in any context.

John Gregory Cornish — **2-11-2023**

**Project Leader Signature** **Date**

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

----------for ECU Health CRG Use Only----------

## NHSR vs. HSR Determination:

☑ **Not Human Subject Research:** Th[redacted] has determined that based on the description of the project/study, app[redacted] IRB is not necessary. Any changes or modifications to this project may be discussed with the [redacted] 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.

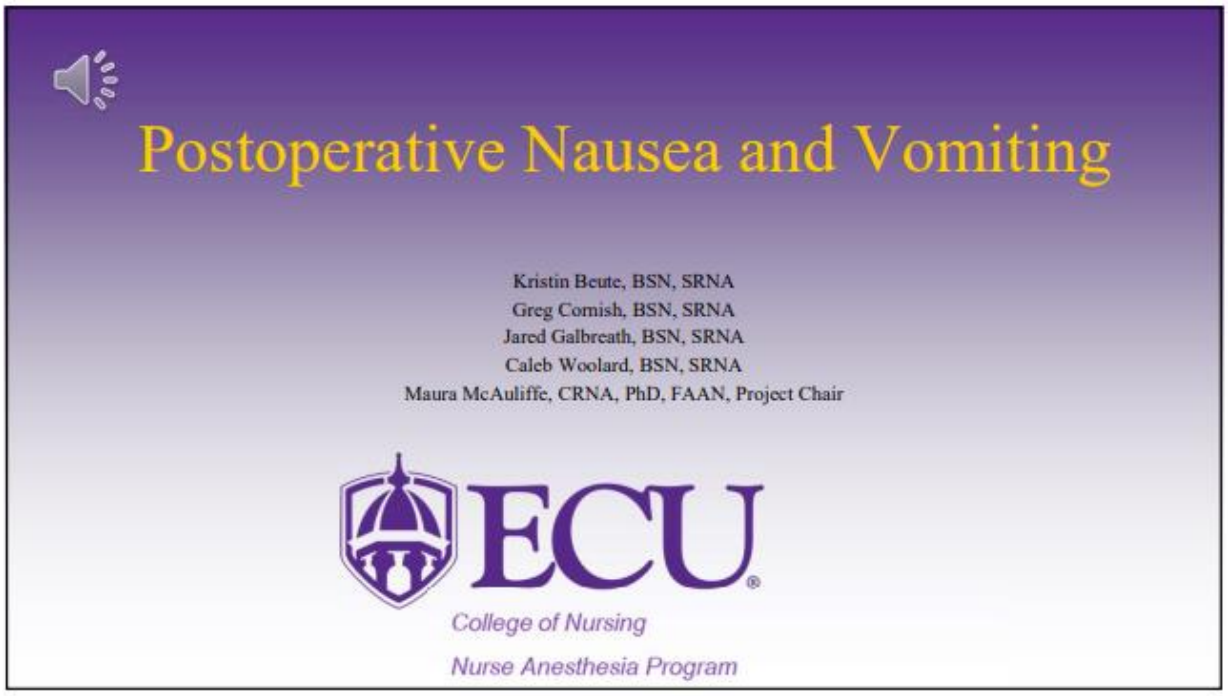
## Approval Signatures:

**CRG Reviewer:** [redacted] **Date:** 3/7/2023

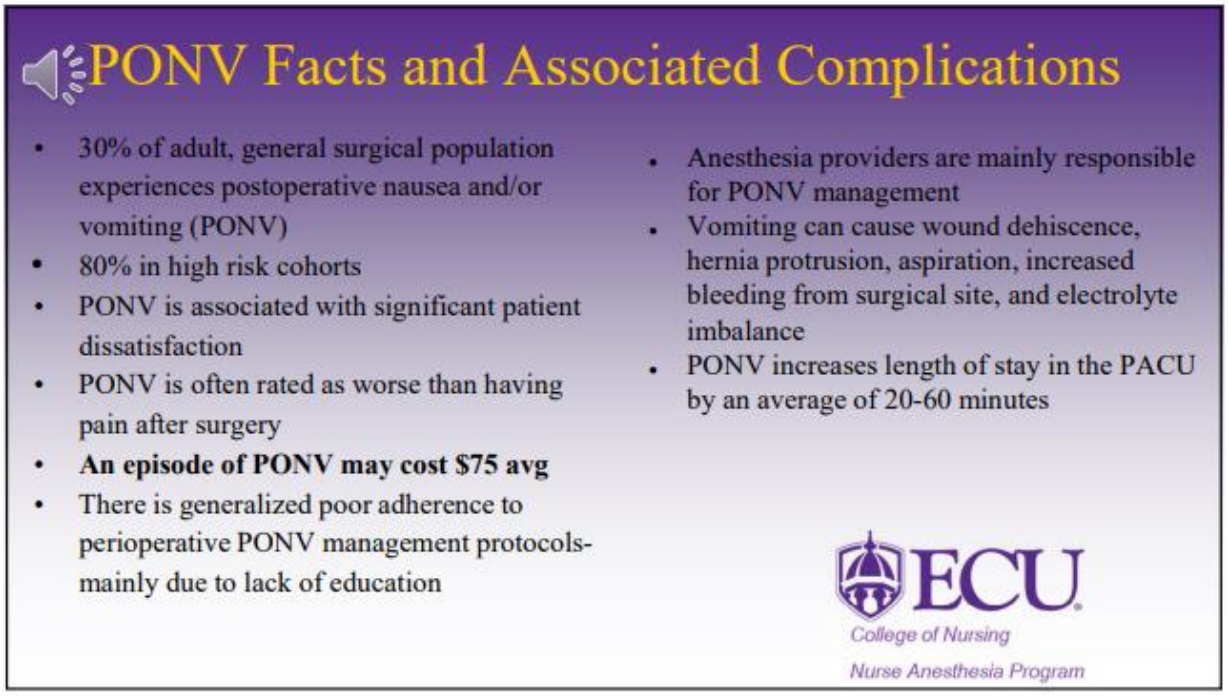
**UMCIRB Office Staff Reviewer:** [redacted] **Date:** 3/8/23

## Appendix E

## PowerPoint PONV Presentation




1




2

# Risk Factors

- 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**

ECU
College of Nursing
Nurse Anesthesia Program

3

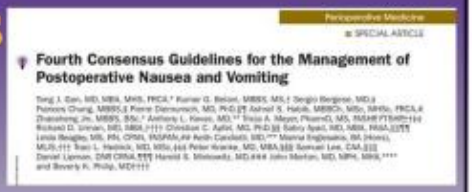
# Risk Assessment

- 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 |

4

# Guidelines


Perioperative Medicine

SPECIAL ARTICLE

**Fourth Consensus Guidelines for the Management of Postoperative Nausea and Vomiting**

Fourth Consensus Guidelines:

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

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

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5

# 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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6

# 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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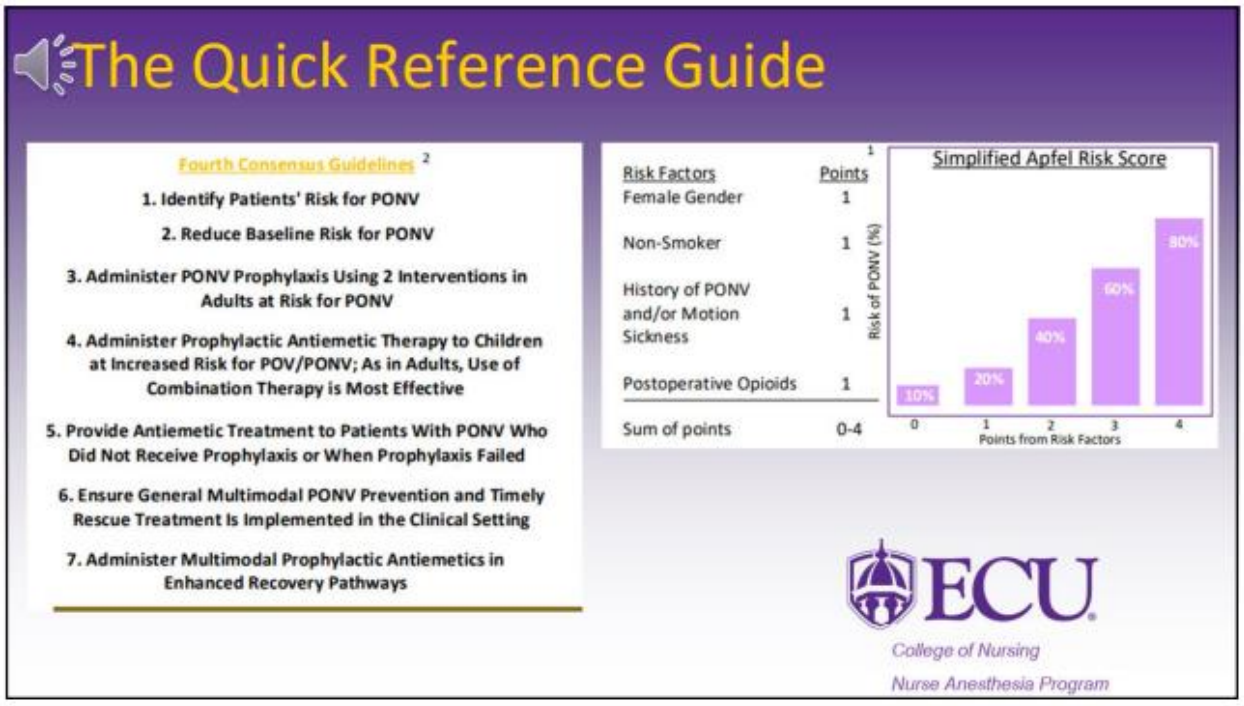
7

# The Quick Reference Guide


8

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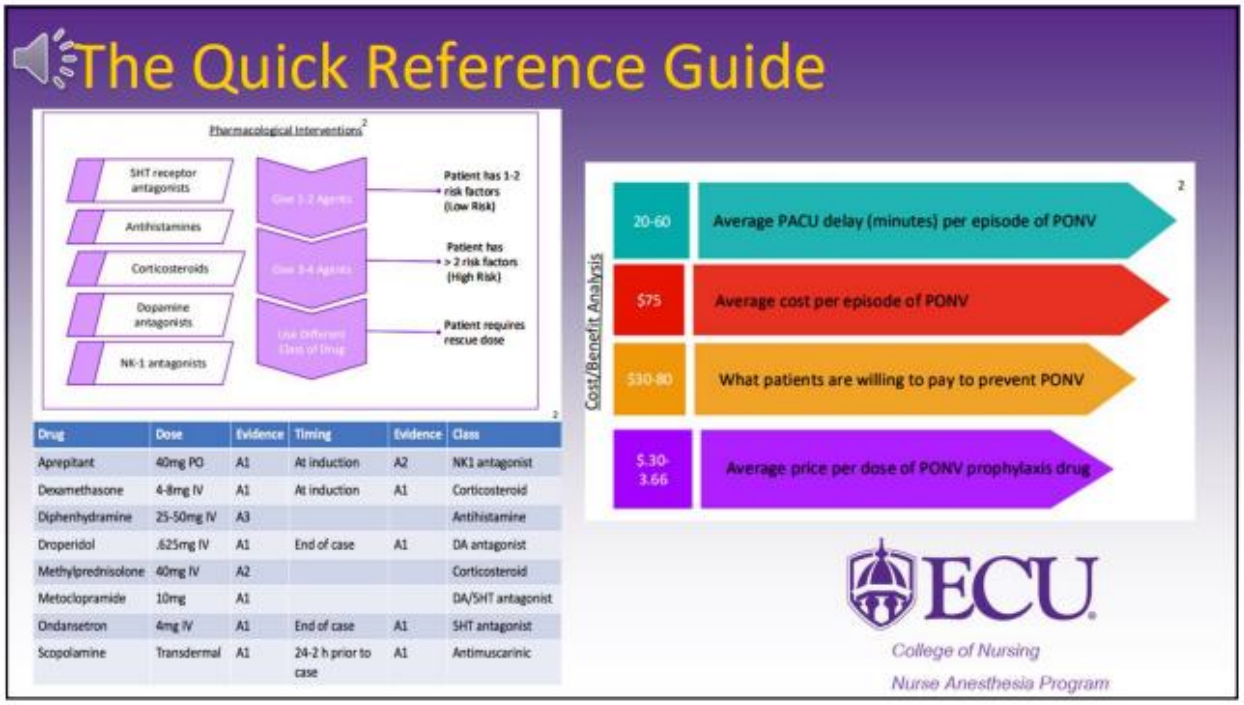


| Drug | Dose | Evidence | Timing | Evidence | Class |
|---|---|---|---|---|---|
| Aprepitant | 40mg PO | A1 | At induction | A2 | NK1 antagonist |
| Dexamethasone | 4-8mg IV | A1 | At induction | A1 | Corticosteroid |
| Diphenhydramine | 25-50mg IV | A3 | | | Antihistamine |
| Droperidol | .625mg IV | 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 | SHT antagonist |
| Scopolamine | Transdermal | A1 | 24-2 h prior to case | A1 | Antimuscarinic |

10

# 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 1 (p410)

| 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.

11

# 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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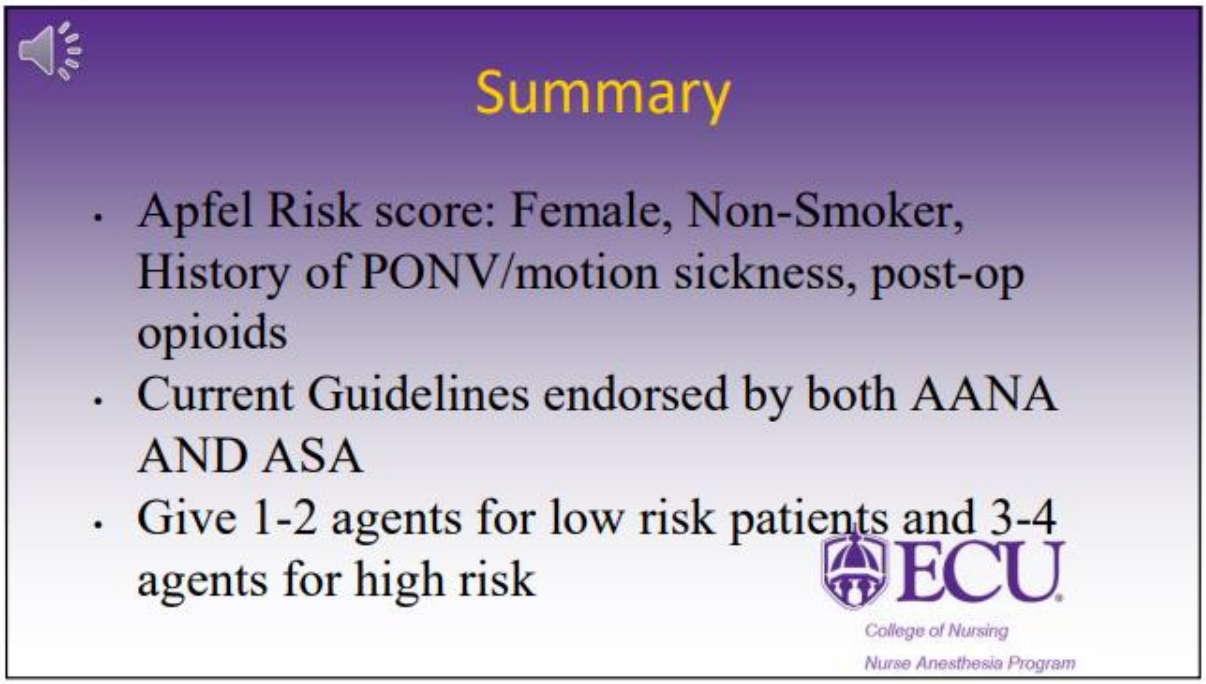
12


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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13


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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14

# Appendix F

## The Quick Reference Guide

ECU

# Postoperative Nausea and Vomiting Prevention

Kristin Beute, BSN, SRNA
Greg Comish, 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


Simplified Apfel Risk Score [2]

| 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 |


**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.

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

Avoidance of GA by the use of regional anesthesia[31,65] (A1)
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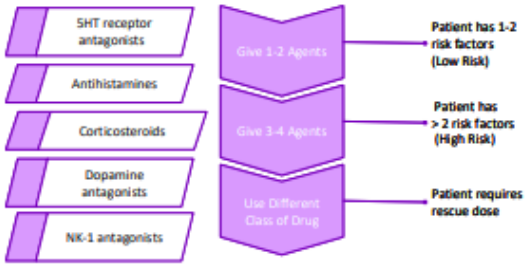
Adequate hydration[73,74] (A1)
Using sugammadex instead of neostigmine for the reversal of neuromuscular blockade[75] (A1)

Pharmacological Interventions [1]




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

| Drug | Dose | Evidence | Timing | Evidence | Class |
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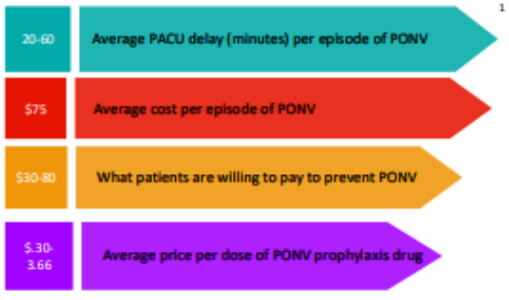
| Droperidol | .625mg IV | A1 | End of case | A1 | DA antagonist |
| Methylprednisolone | 40mg IV | A2 | | | Corticosteroid |
| Metoclopramide | 10mg | A1 | | | DA/5HT antagonist |
| Ondansetron | 4mg IV | A1 | End of case | A1 | 5HT antagonist |
| Scopolamine | Transdermal | A1 | 24-2 h prior to case | A1 | Antimuscarinic |

Cost/Benefit Analysis [1]




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

## Emails to Participants

**Email 1**

Dear SurgiCenter CRNAs,

Thank you for considering participating in a quality improvement project titled "Post Operative Nausea and Vomiting: A Quality Improvement Project." The purpose of this project is to assess the usefulness of a PONV Quick Reference Guideline to aid in identifying high-risk patients, managing baseline PONV risks, and selecting strategies for prophylaxis and rescue treatment at the SurgiCenter.

Participation is voluntary and will involve completing a short pre-intervention survey (12 questions), viewing a short presentation, utilizing a PONV Quick Reference Guide in your CRNA practice for two weeks (at your discretion), and completing a short post-intervention survey (13 questions) when the two-week implementation period is over.

Each survey should take less than 2-4 minutes to complete. The presentation can be viewed in 5-10 minutes. Audio recording of the presentation is available on the PowerPoint file if you wish to listen. The surveys were created and are completed using Qualtrics® survey software. Use of this PONV Quick Reference Guide falls within currently accepted practice in your work area. Your participation is voluntary and confidential. We will share the results of this QI study with you upon completion.

First, complete the pre-intervention survey provided here: link here.

Following completion of the survey, view the PONV Guidelines Presentation via this link or download the PowerPoint file attached in this email. PONV Quick Reference Guidelines are available digitally (attached to this email) and will be posted in the workroom.

An article with the current consensus guidelines for PONV prophylaxis and treatment is the basis of this QI project and is also attached as a pdf to this email if you would like to read it.

Again, thank you for your participation in our quality improvement project. I will be at the SurgiCenter from March 27th to April 6th if you have any questions. You may also reach out to me or Dr. Maura McAuliffe by email at any time.

Sincerely,

Greg Cornish, SRNA cornishj21@students.email.edu
Maura McAuliffe, CRNA, PhD, FAAN mcauliffem@ecu.edu

**Email 2**

Hello SurgiCenter CRNAs,

I just wanted to send a quick reminder about the ongoing DNP Project on PONV (original email below). If you've already filled out the pre-survey and viewed the presentation, thank you. If you haven't had a chance to do so yet, it's not too late and would be very helpful and much appreciated. There are still PONV Quick Reference Guides available digitally and in the workroom if you haven't already received one. You may use these at your discretion. After the end of next week, I will send out the post-surveys.

Links:
Pre-survey
PowerPoint

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

Sincerely,
Greg Cornish SRNA
Nurse Anesthesia Program
Class of 2024

**Email 3**

Dear SurgiCenter CRNAs,

Thank you to everyone who has already completed my pre-survey and viewed the video. 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 (the survey and presentation are quick and easy!). The link to the pre-survey is __link__, and you can follow it up by watching the introductory PowerPoint here. PONV Quick Reference Guides are available for your use 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 link to the post-survey. It should take 2-4 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 the SurgiCenter soon.

Sincerely,
Greg Cornish, SRNA
Nurse Anesthesia Program
Class of 2024

**Email 4**

Dear SurgiCenter CRNAs,

I just wanted to say thank you so much to everyone for helping me out with my DNP Project! I have collected all of the data I need to proceed with data analysis. Once my paper is complete you all will be able to read it if you'd like. And if you appreciated the PONV Quick Reference Guide and found it useful, you can feel free to use and distribute it at your discretion.

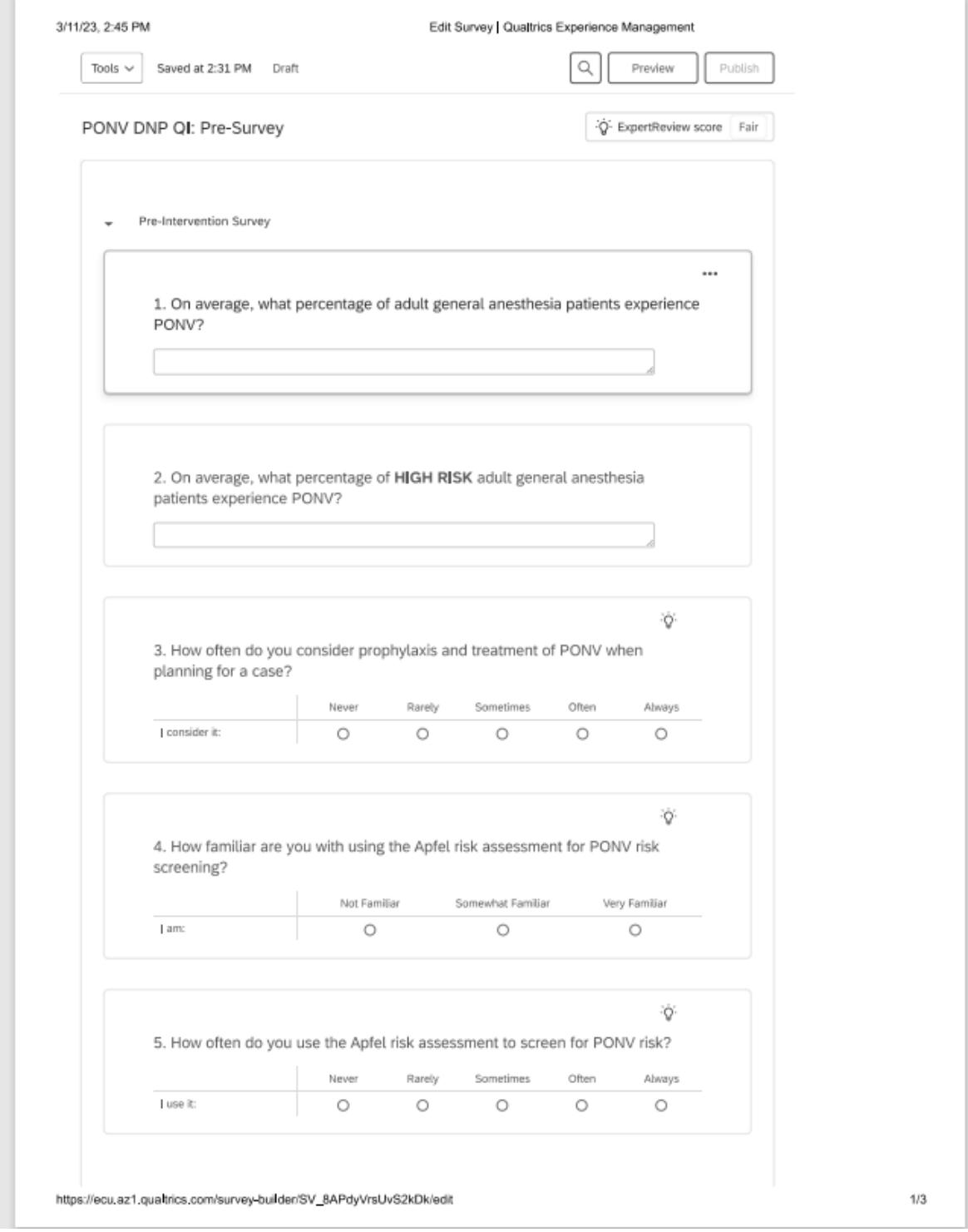
Thank you again! I hope to work with you more in the future.

Take care,
Greg Cornish, SRNA
Nurse Anesthesia Program
Class of 2024

# Appendix H

## Qualtrics Pre- and Post-Surveys

### Pre-Intervention Survey



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PONV DNP QI: Pre-Survey ExpertReview score Fair

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 | Rarely | Sometimes | Often | Always |
|---|---|---|---|---|---|
| I consider it: | ○ | ○ | ○ | ○ | ○ |

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

| | Not Familiar | Somewhat Familiar | Very Familiar |
|---|---|---|---|
| I am: | ○ | ○ | ○ |

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

| | Never | Rarely | Sometimes | Often | Always |
|---|---|---|---|---|---|
| I use it: | ○ | ○ | ○ | ○ | ○ |

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

| | Never | Rarely | Sometimes | Often | Always |
|---|---|---|---|---|---|
| I tailor it: | ○ | ○ | ○ | ○ | ○ |

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 | Rarely | Sometimes | Often | Always |
|---|---|---|---|---|---|
| ondansetron | ○ | ○ | ○ | ○ | ○ |
| droperidol | ○ | ○ | ○ | ○ | ○ |
| dexamethasone | ○ | ○ | ○ | ○ | ○ |
| scopolamine | ○ | ○ | ○ | ○ | ○ |

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?

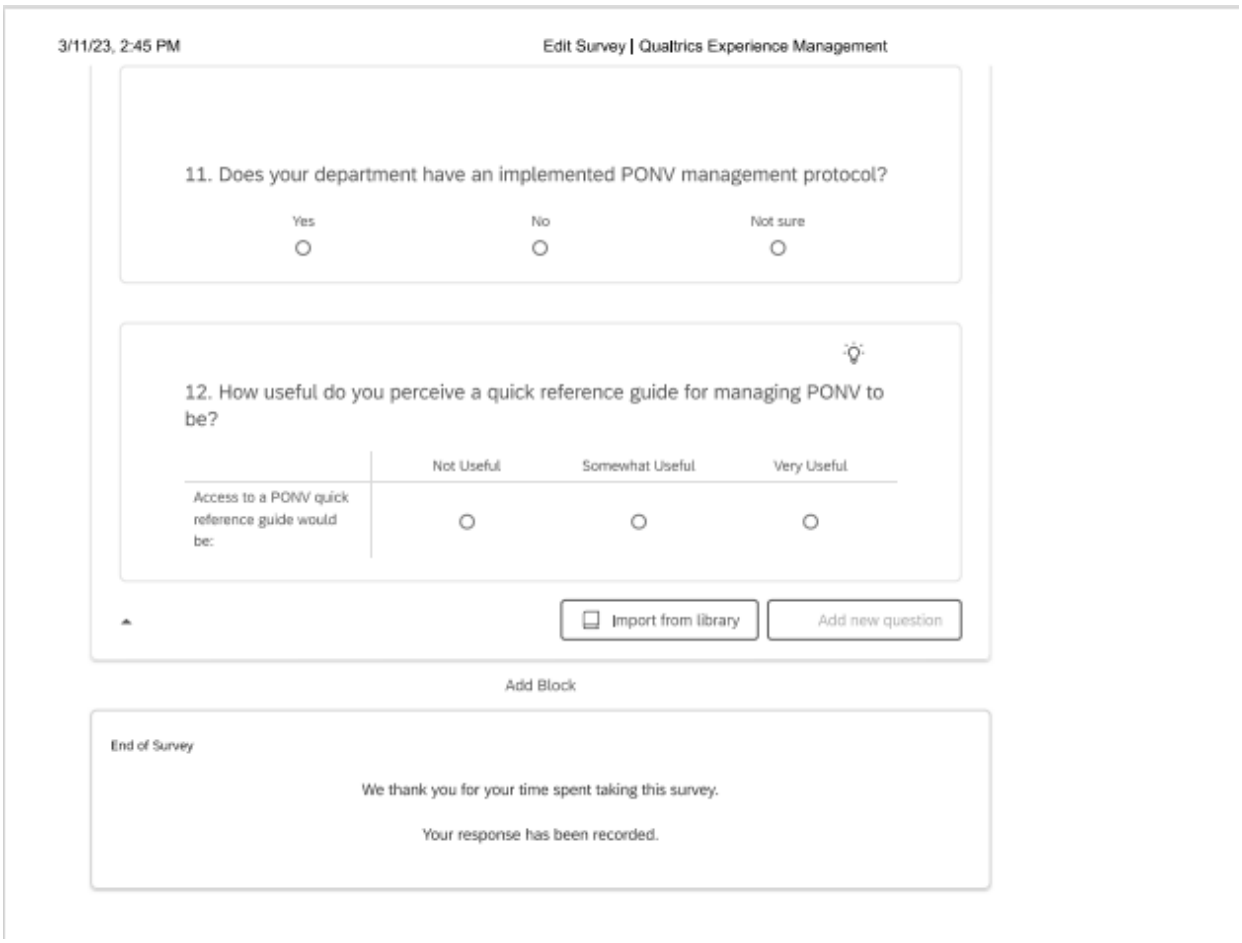
| | 0 Agents | 1 Agent | 2 Agents | 3 Agents | Greater than 3 Agents |
|---|---|---|---|---|---|
| I usually give: | ○ | ○ | ○ | ○ | ○ |

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?

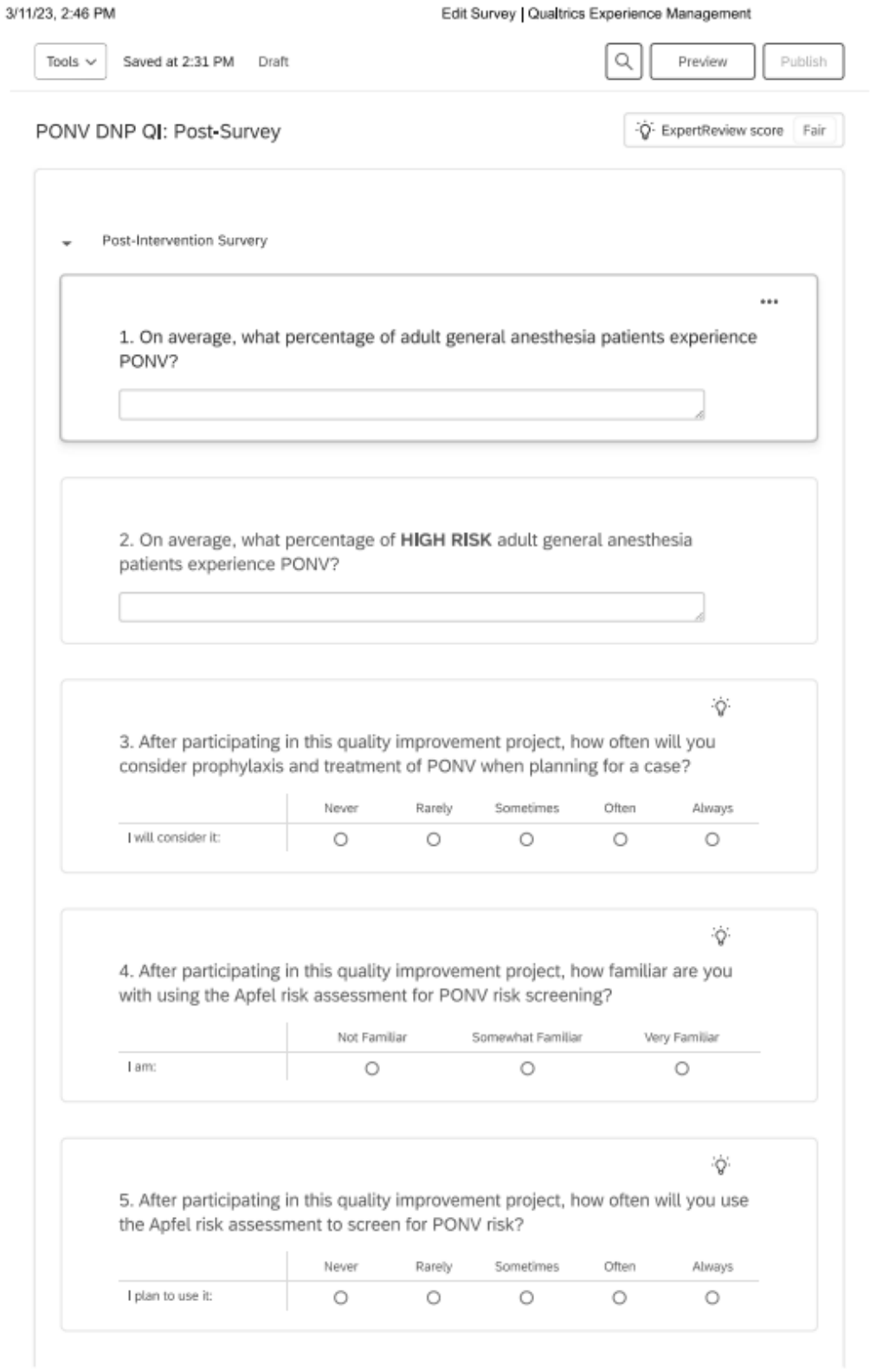
| | 0 Agents | 1 Agent | 2 Agents | 3 Agents | Greater than 3 Agents |
|---|---|---|---|---|---|
| I usually give: | ○ | ○ | ○ | ○ | ○ |

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

| | Less than $50 | $50-$100 | Greater than $100 |
|---|---|---|---|
| The average cost is: | ○ | ○ | ○ |


3/11/23, 2:45 PM
Edit Survey | Qualtrics Experience Management
11. Does your department have an implemented PONV management protocol?
Yes
No
Not sure
12. How useful do you perceive a quick reference guide for managing PONV to be?
Not Useful
Somewhat Useful
Very Useful
Access to a PONV quick reference guide would be:
Import from library
Add new question
Add Block
End of Survey
We thank you for your time spent taking this survey.
Your response has been recorded.

## Post-Intervention Survey



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

| | Never | Rarely | Sometimes | Often | Always |
|---|---|---|---|---|---|
| I plan to tailor it: | ○ | ○ | ○ | ○ | ○ |

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?

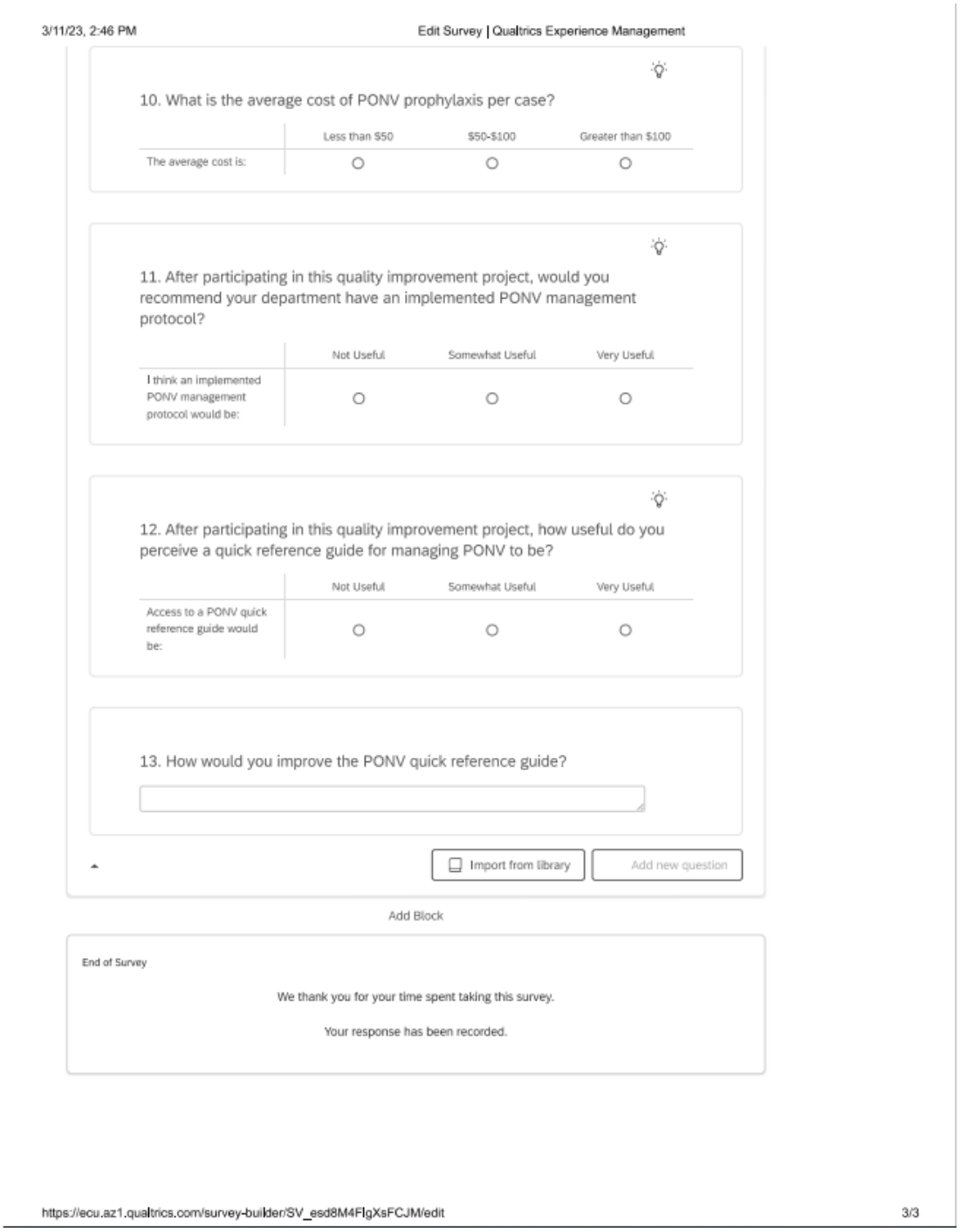
| | Never | Rarely | Sometimes | Often | Always |
|---|---|---|---|---|---|
| ondansetron | ○ | ○ | ○ | ○ | ○ |
| droperidol | ○ | ○ | ○ | ○ | ○ |
| dexamethasone | ○ | ○ | ○ | ○ | ○ |
| scopolamine | ○ | ○ | ○ | ○ | ○ |

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 Agent | 2 Agents | 3 Agents | Greater than 3 Agents |
|---|---|---|---|---|---|
| I plan to give: | ○ | ○ | ○ | ○ | ○ |

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 Agent | 2 Agents | 3 Agents | Greater than 3 Agents |
|---|---|---|---|---|---|
| I plan to give: | ○ | ○ | ○ | ○ | ○ |



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

| | Less than $50 | $50-$100 | Greater than $100 |
|---|---|---|---|
| The average cost is: | ○ | ○ | ○ |

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

| | Not Useful | Somewhat Useful | Very Useful |
|---|---|---|---|
| I think an implemented PONV management protocol would be: | ○ | ○ | ○ |

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

| | Not Useful | Somewhat Useful | Very Useful |
|---|---|---|---|
| Access to a PONV quick reference guide would be: | ○ | ○ | ○ |

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

Import from library Add new question

Add Block

End of Survey

We thank you for your time spent taking this survey.

Your response has been recorded.

https://ecu.az1.qualtrics.com/survey-builder/SV_esd8M4FlgXsFCJM/edit 3/3

# Appendix I

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| Intend to modify/change the content | No |
| Title | Post Operative Nausea and Vomiting: A Quality Improvement Project |
| Institution name | East Carolina University |
| Expected presentation date | Nov 2023 |
| Portions | Table 2, Table 3 |
| Requestor Location | John Cornish<br>[redacted]<br>[redacted]<br>United States<br>Attn: East Carolina University Nurse Anesthesia Program |
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Re: Permission Request

ASER <info@aserhq.org>
Mon 2/27/2023 10:57 AM
To: Cornish, Greg <cornishj21@students.ecu.edu>
This email originated from outside ECU.

Hi Greg,

Thank you for contacting ASER. As long as the source is properly referenced you may use the figure.

Best regards,

**Melissa Paa | Project Leader**
**American Society for Enhanced Recovery**
**and Perioperative Medicine**
2111 Chestnut Ave Suite 145-150
Glenview, IL 60025. USA
info@aserhq.org
Main: 847-495-9119
Direct: 847-440-3573

**SAVE THE DATE**
**2023 Annual Congress of Enhanced Recovery & Perioperative Medicine**
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**September 11-13, 2023**

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**From:** "Cornish, Greg" <cornishj21@students.ecu.edu>
**Date:** Sunday, February 26, 2023 at 3:25 PM
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**Subject:** Permission Request

Hi,

I am sending this email to request permission to use a figure as part of a quality improvement project in furtherance of a Doctorate of Nursing Practice.

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

This is the figure I am seeking permission to use (Figure 6):


**Figure 6.** Algorithm for PONV management in adults. Summary of recommendations for PONV management in adults, including risk identification, stratified prophylaxis, and treatment of established postoperative nausea and vomiting. Note that 2 antiemetics are now recommended for PONV prophylaxis in patients with 1–2 risk factors. 5-$HT_3$ indicates 5-hydroxytryptamine 3; PONV, postoperative nausea and vomiting. The Figure reused with permission from the American Society for Enhanced Recovery. For permission requests, contact info@aserhq.org.

Thank you,

John Gregory Cornish, SRNA
[illegible] College of Nursing
Nurse Anesthesia Program
[redacted]