Spring 2021

Use of a Simplified Protocol for the Prevention of Postoperative Nausea and Vomiting in Adult Ambulatory Surgical Patients

Roger Horne
University of New Hampshire

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Faculty Mentor: Susan J. Fetzer, PhD, RN, CNL

Practice Mentor: John McNemar, DNAP, CRNA

Date of Submission: April 22, 2021

Abstract

Postoperative nausea and vomiting (PONV) remains a common complication affecting surgical patients after receiving anesthesia. Prevention of PONV is important in an ambulatory surgical setting where patient access to rescue treatment is limited after discharge. A quality improvement (QI) project introduced a simplified PONV prevention strategy to decrease the incidence of PONV at a Veterans Health Administration ambulatory surgery center. A retrospective chart audit of all facility surgical patients receiving anesthesia care (n = 94), excluding ophthalmology patients, was conducted prior to COVID-19 restrictions to establish baseline PONV incidence. An evidence-based, simplified PONV prevention protocol was developed and implemented. After a 2-week protocol familiarization period an 8-week chart audit of all surgical patients receiving anesthesia care (n = 81) was performed determining post-protocol PONV incidence. The incidence of PONV post-protocol implementation was significantly lower (8.6% vs 19.1%, $p < .001$). The type of anesthesia administered, monitored anesthesia versus general anesthesia ($p = .827$), did not influence the incidence of PONV. An unanticipated finding was a significant increase in PACU length of stay between post-protocol and baseline samples (86 minutes vs 71.5 minutes, $p = .001$). Implementation of a simplified protocol for the prevention of PONV resulted in a significant reduction in PONV incidence.

Keywords: postoperative nausea and vomiting, PONV risk, quality improvement, ambulatory surgery

Table of Contents

Use of a Simplified Protocol for the Prevention of Postoperative Nausea and Vomiting in Adult Ambulatory Surgical Patients

Introduction

Problem Description

Postoperative nausea and vomiting (PONV) are common complications affecting nearly 30% of all surgical patients (Rull & Tidy, 2019; Sizemore & Grose, 2020) and up to 80% of high-risk patients (Tabrizi et al., 2019). PONV prevention is important in an ambulatory setting where patient access to effective treatments is limited or nonexistent after discharge from a surgical facility. Patients who develop PONV have higher rates of postoperative complications and medical costs as well as decreased levels of patient satisfaction and quality of care (Cao et al., 2017). The literature contains a surfeit of PONV etiologies (Cao et al., 2017; Dewinter et al., 2018; Gan et al., 2020; Macario et al., 1999; Nagarekha et al., 2016, Pierre & Whelan, 2012; Shaikh et al., 2016; Tabrizi et al., 2019; Wesmiller et al., 2017). Numerous recommendations and guidelines exist to enable practitioners to better identify at-risk patients and deploy effective PONV prevention strategies. Sadly, PONV remains a common experience in surgical populations (Gan et al., 2020; Sizemore & Grose, 2020).

Identification of at-risk PONV patients and implementing countermeasures to decrease the incidence of PONV should be a part of any anesthetic care plan. However, anesthesia providers often view the PONV prevention strategies described in the literature as being overly complex and may not utilize best practices (Dewinter et al., 2018). In 2019, the anesthesia department of a Veterans Health Administration ambulatory surgical center (VA ASC) in the northeastern United States provided anesthesia services for 1,592 outpatient surgical procedures.

Four hundred seventy-eight Veterans, 30% of the 2019 workload at the VA ASC, may have experienced PONV. This quality improvement project centered on developing and implementing a simplified, evidence-based PONV prevention strategy within the VA ASC anesthesia service with the possibility to benefit patients by improving patient recovery times and decreasing the incidence of PONV.

Available Knowledge

In 2010, over 48.3 million ambulatory surgery procedures were performed in the United States (Hall, Schwartzman, Zhang, & Liu, 2017). To ensure patient tolerance of a surgical procedure the provision of anesthesia to patients is necessary to induce a loss of sensation and to minimize pain. PONV is a common complication that results from anesthesia administration, the surgical procedure, or other patient factors (Rull & Tidy, 2019). PONV occurs in almost 30% of all surgical patients and up to 80% of patients with a prior history of PONV (Sizemore & Grose, 2020; Tabrizi et al., 2019). PONV is described by patients as highly distressing and is often viewed more negatively than surgical pain (Cao et al., 2017). A study by Wesmiller and colleagues (2017) affirmed PONV as a tangible concern of patients and the authors described that patients would favor enduring surgical pain instead of taking pain reducing medications, such as opioids, to avoid the pain reliever side effects of nausea and or vomiting.

Approximately 60% of surgeries in the US are now performed in ambulatory surgical settings (Apfel et al., 2012). Determining the incidence of PONV and utilizing an effective prevention strategy is warranted to potentially improve care for the ambulatory surgical population. Wesmiller and colleagues (2017) reported benefits of reducing PONV to include improved patient outcomes and satisfaction, a rapid return to baseline activities of daily living, and a reduction in overall hospital costs. The development of a PONV prevention strategy, personalized to each patient, helps anesthesia providers deliver world-class anesthesia care.

A study by Shaikh and colleagues (2016) described the emetic control center originating within the medulla oblongata. The five primary afferent pathways involved in stimulating vomiting include the chemoreceptor trigger zone, the vagal mucosal pathway in the gastrointestinal system, the midbrain afferents, the neuronal pathways from the vestibular system, and the reflex afferent pathways from the cerebral cortex (Shaikh et al., 2016; Tabrizi et al., 2019). If one of the afferent pathways is stimulated it can result in activation of the vomiting center by way of serotonergic, neurokinin-1 (NK-1), histaminergic, dopaminergic, or muscarinic receptors (Shaikh et al., 2016; Tabrizi et al., 2019). Hypotension, hypoxemia, pain, movement, and disturbances of the gut or oropharynx can also result in stimulation of the brain's vomiting center (Shaikh et al., 2016). Since multiple pathways and receptor activation are responsible for stimulating the vomiting center, it is prudent to take a multimodal approach to decrease the incidence of PONV (Shaikh et al., 2016; Tabrizi et al., 2019).

Dewinter et al. (2018) and Tabrizi et al. (2019) described the simplification of a PONV algorithm as an effective strategy to decrease the incidence of PONV in their surgical populations. Identifying patients at-risk for PONV was central to the success of their simplified protocols (Dewinter et al., 2018 & Tabrizi et al., 2019). Pierre and Whelan (2012) suggested the use of the Apfel Simplified Risk Assessment of PONV tool to assess patient risk. The tool identifies four primary risk factors patients may have to be considered at higher risk of developing PONV. The risk factors include female sex, smoking history, a history of PONV or motion sickness, and the use of opioids in the postoperative period (Pierre & Whelan, 2012).

Pierre and Whelan (2012) described the risk of PONV as 10%, 20%, 40%, 60%, or 80% if a patient's risk score is 0, 1, 2, 3, or 4, respectively.

Gan and colleagues (2020) conducted a systematic review of PONV and released updated consensus guidelines for managing PONV in the surgical population. Gan et al. (2020) provided a simplified PONV prevention algorithm in their recommendations based on an algorithm developed by the American Society for Enhanced Recovery. Their recommendations include the four primary risk factors in the Apfel Simplified PONV Risk Assessment Tool, but also include two additional risk factors: age less than 50 and surgery type (Gan et al., 2020). In the ambulatory setting, a prospective study by Apfel and colleagues (2012), cited by Gan and colleagues (2020), stated an age less than 50 years and surgery type were statistically significant independent predictors for PONV in the post anesthesia care unit (PACU) and after discharge.

Surgeries identified as having a higher risk for PONV development in adults include laparoscopic, gynecological, bariatric, and cholecystectomy procedures (Gan et al., 2020). Gan and colleagues (2020) supported limiting intraoperative opioids. The researchers described the use of postoperative opioids as a significant risk factor resulting in an increased incidence of PONV. Addressing PONV risk is essential in the ambulatory setting since after discharge, surgical patients no longer have immediate access to quick-acting, intravenous (IV) antiemetic therapy.

The algorithm described in the Gan et al. (2020) guidelines include five steps. The first step is for the provider to determine how many risk factors for PONV are present for a patient. The tabulated PONV risk score ranges from 0 to 6. The second step of the algorithm is the application of risk mitigation countermeasures to decrease the risk of PONV. Such countermeasures, when feasible, include minimizing the use of volatile anesthetics, nitrous oxide, and high-dose neostigmine; performing regional anesthesia if suitable; and employing a multimodal analgesia or opioid-sparing technique (Gan et al., 2020).

The third step of the algorithm is risk stratification for treatment recommendations. The patient's PONV risk score, 0 to 6, determines the treatment recommendations. If a patient presents with zero risk factors, no prophylaxis is recommended. If one or two risk factors are scored, the patient receives two different classes of antiemetic agents to prevent PONV. The provision of three or four antiemetic agents are recommended if a patient's PONV risk score is 3 or greater (Gan et al., 2020).

The fourth step of the algorithm described by Gan and colleagues (2020) includes prophylaxis options. The algorithm does not dictate what antiemetic to administer, but instead uses broad recommendations by drug class, using acupuncture, or propofol anesthesia techniques. The algorithm includes serotonin receptor antagonists, corticosteroids, antihistamines, dopamine antagonists, neurokinin-1 antagonists, and anticholinergics (2020). Gan and colleagues (2020) provided evidence of other pharmacological antiemetics such as the use of midazolam or intramuscular ephedrine as antiemetics. In addition, Gan et al (2020) described non-pharmacological prophylaxis options such as acupuncture and ensuring adequate fluid resuscitation of patients.

The fifth step of the algorithm involves rescue treatment if patients experience PONV during the postoperative period. The algorithm recommendation for rescue treatment is to administer a different class of antiemetic medication to a patient than was already provided prophylactically (Gan et al., 2020).

The use of a simplified algorithm for PONV prevention has been shown to be effective. A study by Dewinter and colleagues (2018) demonstrated statistically significant improvement in the incidence of PONV after implementation of a simplified PONV prevention algorithm. The study was conducted in a 20-room operating room where they performed 19,000 surgeries annually. They included all patients 18 years and older who underwent general anesthesia for elective, non-cardiac surgery. Dewinter and colleagues (2018) utilized an uncontrolled, before-and-after study design for their project. A five-day chart audit was conducted to determine a baseline PONV incidence of 33%. A departmental, evidence-based PONV prevention protocol was developed and implemented. After 8 months a second 5-day chart audit was performed and the PONV incidence rate decreased to 22%, a significant difference ($p = .02$).

A quality improvement project by Tabrizi and colleagues (2019) also demonstrated a statistically significant decrease in the incidence of PONV after the introduction of a simplified PONV prevention algorithm. The study included female patients between 18 and 75 years of age undergoing ambulatory surgery for gynecologic and breast surgery with either monitored anesthesia care (MAC) or general anesthesia. The authors determined a baseline incidence of PONV of 21.1%, then developed and implemented a simplified algorithm. The post-protocol PONV incidence was 9.5%. The quality improvement project achieved a significant difference in PONV ($p = .009$). The use of a simplified algorithm to reduce the incidence of PONV is evident in the literature and has the potential to decrease PONV at the project facility ASC.

According to Dewinter et al. (2018) and Tabrizi et al. (2019), the identification of at-risk PONV patients and the application of a simplified PONV prevention algorithm were effective in decreasing PONV incidence. A weakness of these studies was in their sampling methods. Dewinter et al. (2018) stated their findings may not be reflective of their population's PONV incidence since an arbitrarily chosen week of data was collected both pre and post intervention. The Tabrizi et al. (2019) study indicated manual chart reviews may have limited their sample size and the results may not be reflective of the actual population's PONV incidence. Furthermore, both of their projects could have been influenced by the Hawthorne effect.

Currently, the project facility does not have a standard method for evaluating PONV risk nor delivering proper PONV prophylaxis to patients. The Dewinter et al. (2018) and Tabrizi et al. (2019) studies are forthrightly applicable to the project facility since their approaches were relatively simple, low-risk, cost-effective, and conducted within the ambulatory surgery setting. While the Dewinter et al. (2018) and Tabrizi et al. (2019) studies indicated limited sample sizes the project facility had the resources to review 100% of eligible charts over a greater period. Therefore, the project facility can further expound upon the work by Dewinter et al. (2018) and Tabrizi et al. (2019). As a part of continuous quality improvement, the VA ASC may benefit from utilizing the strategies developed by Dewinter et al. (2018) and Tabrizi et al. (2019) to decrease the incidence of PONV.

Framework

The Lean 8-Step Practical Problem-Solving (8-Step PPS) approach has been used for decades by the manufacturing industry to reduce waste, decrease costs, and eliminate wasteful steps (Nicosia, Park, Gray, Yakir, & Hung, 2018). This quality improvement tool is widely utilized by the healthcare industry and is an effective tool to improve healthcare quality, reduce non-value-added processes, and decrease costs (Simon & Canacari, 2012). The eight steps include: clarify the problem; breakdown the problem; set the target; analyze the root causes; develop countermeasures; implement countermeasures; monitor results and processes; and standardize and share successes. The 8-Step PPS approach is a refinement of the Plan-Do-Check-

Act (PDCA) cycle (Holland, 2019). The use of 8-Step PPS provides a structured, team and patient-centered approach to determining root causes, addressing process problems, and evaluating process results.

Specific Aims

The aims of this quality improvement project were to assess the baseline incidence of PONV, to develop an evidence-based, simplified protocol for PONV prophylaxis, and to evaluate the post-protocol implementation incidence of PONV in a VA ASC.

Methods

Context

The quality improvement initiative was conducted at a VA ambulatory surgery center in the northeastern United States. Annually, the surgery department provides surgical care for approximately 1,600 non-cardiac surgical procedures in 3 operating rooms. Surgical services provided include general surgery, podiatry, gastrointestinal (GI) endoscopy, ophthalmology, gynecology, orthopedics, urology, and vascular surgery. The anesthesia service personnel include one anesthesiologist, who is designated as the director of the anesthesia service and three certified registered nurse anesthetists. The perianesthesia nursing service consists of seven registered nurses providing care pre and post procedure. The intraoperative nursing staff include six registered nurses, three surgical technologists, and one GI technician.

Cost Benefit Analysis

In 2019, the project facility performed 1,592 surgical procedures. Sizemore and Gross (2020) stated up to 30% of surgical patients may experience PONV, which potentially results in

478 patients experiencing PONV. Gress and colleagues (2020) reported 98% of PACU charges stem from staffing costs whereas the use of supplies and medications are minimal to overall PACU costs. In 2020 dollars, Gress and colleagues (2020) reported PACU costs for patients with PONV of $830 and without PONV of $728. Gress et al. (2020) noted longer PACU stays, which included both phases I and II recovery periods, for PONV patients of 234 minutes when compared to patients without PONV of 171 minutes.

A study conducted by Parra-Sanchez and colleagues (2012) reported significant costs of treating PONV to an organization whereas administering prophylactic PONV antiemetics was far less expensive. Additionally, Parra-Sanchez et al. (2012) reported patients who experienced PONV in the PACU, consisting of both phase I and phase II recovery periods, had higher costs than patients who did not experience PONV. Parra-Sanchez et al. (2012) reported patients who experienced PONV in the PACU typically stayed one hour longer than patients who did not experience PONV. Longer stays in the PACU due to PONV resulted in higher adjusted incremental costs of $75, within a 95% confidence interval (CI) of $67 to $86 (2012). They also reported an average cost of PACU care of $730 for treating a patient with PONV and $640 for a patient without PONV (Parra-Sanchez et al., 2012).

Gress and colleagues (2020) described costs of antiemetics averaging $0.35 each (2020), slightly higher than amounts reported in the studies by Parra-Sanchez et al. (2012) and Dzwonczyk et al. (2012) with an average cost of $0.304 per agent. If the approximated 478 PONV patients were treated with either one, two, or three antiemetics, the overall cost of care may have been reduced. Using the Gress and colleagues (2020) reported antiemetic costs of $0.35 per agent, the 478 patients treated with one antiemetic agent would cost $167.30. If two antiemetic agents were given the cost would be $334.60. If three antiemetic agents were administered the cost would have been $501.90. If providers utilized three antiemetics to prevent PONV, it would cost an organization less than $1 according to Dzwonczyk et al. (2012) and Parra-Sanchez et al. (2012) and $1.05 according to the Gress et al. (2020) study.

Parra-Sanchez et al. (2012) stated an average additional cost of $75 when treating a PONV patient. Using the estimate of an additional cost of $75 to treat a PONV patient, the VA ASC may have spent $35,850 combatting PONV in 2019. Gress and colleagues (2020) reported the difference in cost between treating a PONV patient and a non-PONV patient as $102. There was a potential of the VA ASC spending an additional $48,756 treating the estimated 478 PONV patients in 2019. Using the Gress et al. (2020) reported costs, giving 3 antiemetics at a cost of $1.05, the organization potentially reduces PONV costs of care by $100.95 per patient or $48,254.10 for the estimated 478 PONV patients in 2019. Given the minimal cost of antiemetic therapy it behooves organizations to provide PONV prevention antiemetic therapy to all surgical patients. Budgeted monies are finite resources in governmental healthcare organizations and the cost difference in preventing PONV and treating PONV is substantial. By reducing the incidence of PONV, the overall cost of caring for surgical patients will decrease, allowing the savings to be used elsewhere in the facility.

The personnel costs associated with this project such as conducting chart reviews, developing a simplified protocol, and implementing the protocol were absorbed within existing surgical department staffing expenditures. The staff members participating in this project are salaried employees and all activities were conducted within their tours of duty without reductions in current case load. In addition, any overhead costs such as utility expenditures, administrative costs, insurance, or any other direct or indirect costs were not recorded nor stratified in this study since those costs are already accounted for in the standard operating budget of the VA ASC.

Interventions

Baseline Chart Audit

The project auditors performed a 100% chart audit of all surgical patients during an eight-week period, pre-COVID-19 pandemic outbreak, in January and February 2020 to determine the baseline incidence of PONV in this population. Since the COVID-19 pandemic restrictions started in March 2020, the number of surgical procedures performed by the VA ASC decreased dramatically. Conducting an audit prior to the start of COVID-19 restrictions was more reflective of the true incidence of PONV. All surgical cases requiring the anesthesia department services were included, however, ophthalmology patients were excluded from the project since their anesthetics typically consist of local anesthetic eye drops only. The team reviewed factors that may have influenced PONV incidence and incorporated many of these elements into a Baseline Audit Tool (BAT). The BAT was designed to collect data to enable a better understanding of underlying PONV factors within the facility-specific patient population. The BAT included: the auditor performing the review; patient sex; patient age, the surgical service performing the procedure; American Society of Anesthesiologists Physical Status; the type of anesthesia administered; if any prophylactic antiemetics were given such as ondansetron, dexamethasone, metoclopramide, and transdermal scopolamine; the length of stay in the PACU recorded in minutes; if any PONV rescue antiemetics were administered; if the Veteran went home with postoperative opioids; if the Veteran experienced PONV in the PACU; and if the patient reported PONV during the postoperative telephone follow-up call.

General anesthesia was defined as a patient undergoing surgery with their airway secured with either an endotracheal tube or a laryngeal mask airway (LMA) device and where the patient does not respond to surgical stimulation. MAC was defined as a patient undergoing a surgical procedure receiving anesthesia who does not have their airway secured with an endotracheal tube or LMA and may respond to surgical stimulation. Regional anesthesia includes neuraxial anesthesia techniques such as spinal or epidural blocks and peripheral nerve blocks. Antiemetic use is the administration of antiemetics to surgical patients in the perioperative setting. An antiemetic is either given or it is not given. Antiemetics on formulary at the surgery center include ondansetron, scopolamine, dexamethasone, metoclopramide, haloperidol, midazolam, and diphenhydramine. The baseline audit reviewed data from hand-written PACU nurse documentation, which was scanned into the patient electronic health record. The documentation of a patient who experienced PONV was recorded in either one, two, or all three sections of the patient electronic chart: the anesthesia postoperative note; the PACU nursing note; and or the next-day, postoperative follow-up call note. No personal identifiable patient information was recorded during the baseline chart audit.

Protocol Development

The project leader (PL) developed a simplified PONV prevention protocol after reviewing current literature and recommended practices for PONV prevention (Dewinter et al., 2018; Gan et al., 2020; Tabrizi et al., 2019). The departmental PONV prevention protocol algorithm consisted of 4 steps (Appendix A). The first step provides an objective measurement of PONV prediction by identifying the number of risk factors a patient possesses, from 0 to 6 (Table 1). The baseline electronic anesthesia evaluation note did not have a PONV risk factor scoring option embedded in the note. A revision to the electronic anesthesia evaluation documentation was implemented with the assistance of the facility nursing informaticist to include PONV risk factor scoring. An anesthesia provider selects any risk factor present and then totals the number of selected risk factors to determine a PONV development risk score

(Appendix B). The electronic health record does not automatically total the number of risk factors and the anesthesia provider was responsible totaling the risk score.

Table 1

PONV Risk Factor Scoring

Risk Factors	Points
Female Gender	1
Non-Smoker	1
History of PONV/Motion Sickness	1
Age< 50	1
Surgery Type (cholecystectomy, laparoscopic, GYN, or bariatric)	1
Postoperative Opioids	1
Risk Score = Sum	**0 - 6**

The second step involves risk mitigation by the anesthesia provider. The use of volatile anesthetics, nitrous oxide, and high-dose neostigmine is shown to increase the likelihood of PONV (Gan et al., 2020). The anesthesia provider was asked to minimize the use of these agents while also considering the use of multimodal analgesia, opioid-sparing, and regional anesthesia techniques. The third step involves risk stratification. After an anesthesia provider performs risk scoring, the score, 0 to 6, determines the prophylactic treatment to be administered. A patient score of 0 did not warrant prophylaxis. If a patient’s score is 1 or 2, 2 prophylactic antiemetic agents are provided. If a patient’s score is 3 to 6, three or four prophylactic antiemetic agents are administered.

During the fourth step, the anesthesia provider selects formulary antiemetics personalized to each patient. Utilizing the Gan and colleagues (2020) recommendations for PONV prevention and considering the project facility formulary medications, the prophylactic agents available to administer include: ondansetron, transdermal scopolamine, dexamethasone, haloperidol, metoclopramide, diphenhydramine, midazolam, and propofol anesthesia. The use of ondansetron, a serotonin receptor antagonist, is considered a standard antiemetic against, which other antiemetics are compared (Gan et al., 2020). Transdermal scopolamine, an anticholinergic antagonist, can provide up to 24 hours of PONV prevention (Gan et al., 2020) and may be applied the night before surgery. The glucocorticoid, dexamethasone, in recommended doses of 4 to 10 milligrams, is utilized to decrease PONV incidence (Gan et al., 2020). Currently, the use of antidopaminergic agents to prevent PONV are not regularly utilized at the VA ASC. Droperidol was listed as one of the gold standard antiemetics for PONV prophylaxis, but its use declined after a Food and Drug Administration (FDA) black box warning of sudden cardiac death (Gan et al., 2020). After droperidol's black box warning, interest in haloperidol, another butyrophenone dopamine antagonist like droperidol, emerged and its role in PONV prevention has increased. Gan and colleagues (2020) stated that after induction of anesthesia, the effectiveness of haloperidol 1 milligram was no different than droperidol 0.625 milligrams. The Gan and colleagues (2020) study provides evidence supporting the use of haloperidol in doses less than 2 milligrams as being effective for PONV prevention but use as an antiemetic is not FDA approved. Another antidopaminergic, metoclopramide, is an option for use at the project facility. Metoclopramide 10 milligrams may be effective for the prevention of PONV, according to the Gan et al. (2020) guidelines, but the effectiveness is ambiguous. The authors stated the use of metoclopramide may be beneficial if no other dopamine antagonists are available at an institution (Gan et al., 2020). Antihistamines have been used to reduce PONV incidence and Gan and colleagues (2020) described the use of diphenhydramine 50 milligrams as an effective dosing to reduce the risk of PONV. Another option, the use of midazolam at induction or 30 minutes prior to surgery end is effective as ondansetron 4mg (Gan et., 2020). Gan and colleagues (2020) provided support of the use of intramuscular ephedrine for PONV prophylaxis, but the anesthesia team decided to exclude this option since many patients in the VA ASC population have underlying cardiac conditions, which could put them at risk for coronary ischemia (Gan et al., 2020). Lastly, propofol infusions, when used with other antiemetic agents, have been shown to decrease the risk of PONV development (Gan et al., 2020).

Protocol Implementation

After protocol development, the PL provided a protocol training session to all anesthesia providers, perianesthesia nurses, and intraoperative nurses. The training session provided: the baseline incidence rate of PONV; addressed PONV causes, risks, and potential treatment options; discussed the importance of using current PONV guidelines; and guidance on how to employ the simplified protocol. Copies of the simplified protocol were sent to all anesthesia providers via e-mail and laminated copies were placed in the pre-op area, in each operating room, and in the PACU.

During the first two weeks of protocol implementation, to allow for familiarity, the team auditors and PL conducted daily chart audits to confirm compliance with the protocol, documentation of PONV risk scoring, and documentation of appropriate prophylaxis. A morning huddle was conducted to relay adherence to the protocol and answer any questions regarding the use of the simplified PONV prevention algorithm.

Post-Protocol Chart Audit

After the two-week implementation period, the auditors collected post-protocol implementation data via chart audits over eight weeks from February to April 2021. The auditors collected data according to the Post-Protocol Implementation Audit Tool (PAT). If an anesthesia provider did not adhere to the PONV prevention protocol, the chart was excluded from analysis. The PAT differed from the BAT with the addition of: PONV risk scoring; additional prophylactic agents administered to include diphenhydramine, haloperidol, midazolam, and propofol anesthesia; and whether the appropriate PONV prophylaxis regimen was provided to the patient based on the algorithm.

Data Collection Methods

The audit team consisted of two chart auditors, a nurse from the perianesthesia nursing section and a nurse from the intraoperative nursing section. The PL served as the subject matter expert for data collection in the chart audits. Intra-rater and inter-rater reliability testing were performed to validate baseline and post-protocol data collected as an accurate reflection of overall process performance. The identification of PONV was essential in determining the impact of this quality improvement project and PONV identification was the primary objective for the kappa analysis. Additionally, the type of anesthetic administered was included as an integral metric as PONV is more often experienced by patients undergoing a general anesthetic (Sizemore & Gross, 2020 & Tabrizi et al., 2019). Initial testing included five charts. Two charts were patients who experienced PONV, and three charts were patients who did not experience PONV. The charts were reviewed by the PL to determine the audit standards for each chart.

The two chart auditors were trained to conduct baseline chart audits by the PL. After training, each auditor and the PL performed a test audit together. The auditors performed five chart audits independently and recorded their findings on the data collection tool. The PL retrieved each chart in the facility electronic health record keeping system and then shared the screen with the auditors while concealing patient demographic information. The following day, the 5 charts were placed in a different sequence and each appraiser performed an independent, second chart audit of the same 5 records without viewing the patient demographic information.

After the data were collected, statistical analysis was performed using Minitab (Version 18, Minitab Inc., 2017), a commercially available statistical analysis software program.). The kappa for the 2 auditors versus standard was 0.88. While the overall scores indicated the measurement system was acceptable, the kappa score for determining PONV was the lowest at 0.77. The appraisers' difficulty identifying PONV stemmed from the documentation of PONV in different locations of a chart. Some charts indicated an episode of PONV in a free-text remarks portion of the chart instead of in the assessments and or medications sections where PONV is normally annotated in the chart. As detection of PONV was a critical element for this project, 3 additional charts, 1 chart with PONV and 2 charts without PONV, were added to ensure reliability of the auditors in the identification of PONV. The auditors were retrained to inspect all sections of the PACU nursing documentation to include the assessments, medications, and remarks sections in the identification of PONV. The auditors conducted another audit of the 3 new charts in the same manner of the first audit. After the data were collected, statistical analysis was performed again using Minitab (Version 18, Minitab Inc., 2017). The identification of PONV kappa score increased from 0.77 to 0.84 and the overall kappa score increased to 0.90, indicating acceptable agreement between the auditors.

Prior to data collection for the post-protocol sample, the same two auditors were trained by the PL on the changes to the audit tool. The training included the changes to the tool, where to locate the new information in the electronic chart, and how to record the data into the PAT. Since the main objectives of identifying PONV and recording type of anesthesia did not change an additional kappa analysis was not performed. Validating data collected is an accurate reflection of overall process performance and instills confidence that the auditors are collecting data reliably.

Study of the Interventions

The project used an attribute measurement system that classified each case as "experienced PONV" or "did not experience PONV" and then divided the total of "experienced PONV" cases by the total number of surgical cases reviewed within the data collection period to reach an incidence of PONV. Data analysis compared pre-intervention incidence with post-intervention incidence to determine if use of a simplified algorithm for PONV prevention resulted in improved incidence of PONV.

Outcome Measures

Postoperative nausea and vomiting (PONV) was defined as a patient who self-reports and or responds upon inquiry to experiencing either nausea and or vomiting at any time during their PACU stay and up to 24 hours after their surgery. Nausea was defined as a subjective feeling the patient possessed, which did not culminate in vomiting. Vomiting was defined as the use of coordinated muscular movements resulting in the forceful evacuation of gastric contents or without the evacuation of gastric contents such as in retching.

A patient experiencing PONV was a patient who after surgery, during their PACU stay and up to 24 hours after surgery, reported subjective complaints of nausea and or exhibited or reported vomiting or retching. A patient who did not experience PONV was defined as a patient without evidence or report of vomiting or retching and did not report any subjective complaints of nausea. A postoperative call was performed the day after a patient procedure by a perioperative nurse. The nurse ascertained patient status updates such as any experiences of

PONV, pain levels, or any other concerns and documented their findings in the patient electronic health record. If the procedure occurred on a Friday or the day before a holiday the postoperative call transpired on the next business day.

Analysis

Data collected from the baseline and post-protocol chart audits were analyzed using Minitab (Version 18, Minitab Inc., 2017). The sigma quality level and the percent yield of the incidence of PONV was calculated. The results were evaluated using a two-sample Poisson rate test to determine if any reductions occurred in the incidence of PONV after the implementation of a PONV prevention protocol.

Ethical Considerations

The study was conducted in an ethical manner. Chart auditors utilized patient identifiers to access selected charts, but patient identifiers were neither recorded in audit tools nor reported in project outcomes. The project facility's research department and the University of New Hampshire's Department of Nursing reviewed the project and confirmed no additional protections or approvals were warranted.

Results

Baseline PONV Incidence

During the baseline chart audit, 94 charts met inclusion criteria. Ten patients experienced PONV in the PACU and eight patients experienced PONV within 24 hours after discharge for a total of 18 cases of PONV. Of the 94 charts audited, 10% (n = 9) were female and 90% (n = 85) were male patients. The resulting baseline PONV incidence rate was 19.1%.

Post-Protocol PONV Incidence

The second chart audit included 81 charts; however, 8 charts were excluded because the anesthesia provider did not provide PONV prophylaxis according to the protocol. The total number of charts in the post-protocol sample meeting inclusion criteria was 73 charts. There were two cases of PONV in the PACU and three cases of PONV reported in the post-op call for a total of five cases. Of the seventy-three charts audited, 6.8% (n = 5) were female patients and 93.2% (n = 58) were male patients. The post-protocol PONV incidence rate was 6.8%.

PONV Incidence Comparison

The incidence of PONV was significantly higher in baseline, 19.1% (18/94) than after protocol implementation, 6.8% (5/73) ($p < .001$). These data translate to a relative risk reduction of 64%. During the baseline period, 1 out of every 5.22 patients had PONV. After the protocol was implemented, 1 of every 14.6 patients experienced PONV. The null hypothesis in the two-sample Poisson rates test was there was no difference in the number of PONV cases between baseline and post-protocol samples. With a $p < .001$, the null hypothesis was rejected. The incidence of PONV decreased after implementation of the protocol.

PONV and Type of Anesthesia

Two general anesthesia cases and three MAC cases experienced PONV in the post-protocol sample. The expected numbers of PONV were 1.3 amongst general anesthetics and 3.7 for MAC's. When comparing expected versus observed cases of PONV, there was no significant difference. The type of anesthesia did not influence the incidence of PONV.

PACU Length of Stay

The PACU length of stay increased significantly in the post-protocol sample when compared to baseline (Figure 1). The distributions of the baseline and post-protocol are non-symmetric, skewed to the right with outliers, with an Anderson-Darling Normality Test value of $p < .005$. The baseline PACU length of stay has a median of 71.5 minutes and an interquartile range (IQR) of 25.25 minutes. In the post-protocol period, the PACU length of stay's median was 86 minutes an IQR of 38 minutes (Table 2). An outlier in the post-protocol sample was excluded from analysis for special cause variation, a PACU stay of 564 minutes, due to a procedural complication.

Figure 1

Boxplot PACU Length of Stay: Baseline versus Post-Protocol

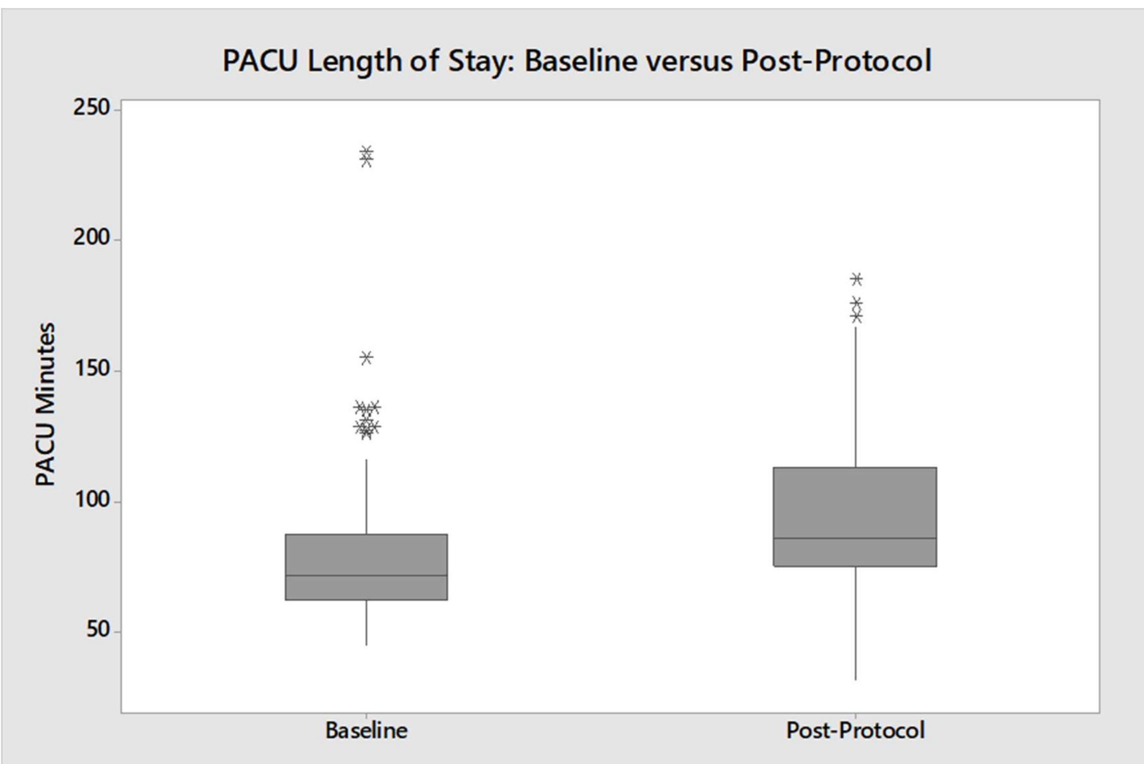

Table 2

PACU Length of Stay in Minutes: Baseline vs Post-Protocol

Variable	*n*	Mean Minutes	St. Dev.	Minimum	Median	Maximum	IQR
Baseline	94	80.9	32.33	44.00	71.50	234.00	25.25
Post-Protocol	72	94.2	34.38	31.00	86.00	185.00	38.00

The Mann-Whitney hypothesis test is indicated to determine differences in non-normal distributions with equal shape and variances. The difference in PACU lengths of stay between baseline, median 71.5 minutes, and post-protocol, median 86 minutes, increased significantly ($p = .001$) while the incidence of PONV decreased.

Discussion

The purpose of this project was to determine if use of a simplified PONV prevention protocol decreased the incidence of PONV in VA ambulatory surgery patients. While other authors reported higher baseline PONV incidence rates, 33% and 21.1% (Dewinter et al., 2018; Tabrizi et al., 2019), the current project reported a baseline rate of 19.1%. The difference in baseline rates may be attributed to differences in patient populations. The female sex is an independent risk factor for the development of PONV (Gan et al., 2020) and an overwhelming number of patients in this project sample, 90%, were male. In comparison, the Tabrizi et al. (2019) study had 100% female patients and the Dewinter et al. (2018) study had 49.5% female patients. The higher proportions of female patients in the samples may explain the higher rates of

PONV. The reported lower baseline PONV incidence rate may be due to the sample's lower proportion of females to males.

The VA ASC did not possess a formalized method of assessing and documenting a patient's risk of developing PONV. Several authors have endorsed the use of the Apfel PONV risk scoring tool that uses 4 risk factors, and documentation of PONV risk in a patient's electronic chart. The facility developed a PONV risk tool and placed it in the patient's electronic health record based on other authors' methodologies (Dewinter et al., 2018 & Tabrizi et al., 2019). The project facility tool differed from other projects' tools with the use of 6 risk factors and the goal of better predicting PONV risk based on the most recent PONV management guidelines (Gan et., 2020).

The project facility did not employ any PONV prevention protocol to prophylactically treat at-risk PONV patients prior to project start. Other authors reported significant PONV incidence rate improvements with the use of a standardized protocol. An evidence-based, simplified protocol to decrease the incidence of PONV was developed at the project facility similarly to other effective protocols described in the literature. The treatment options in this protocol differed from other studies since many of the newer antiemetic agents are not on formulary. The simplified protocol assisted anesthesia providers in selecting proper antiemetic therapy for patients by the inclusion of all available antiemetic agents at the project facility.

The PONV incidence rate in the post-protocol sample was significantly lower after the introduction of a simplified PONV prevention protocol. The reported result of 6.8% was lower than other authors' reported rates after protocol implementation, but it could be attributed to the population's predominantly male proportion. The Tabrizi et al. (2019) study patients were all female and the Dewinter et al. (2018) study patients were 49.5% female. Since the female sex is an independent risk factor for developing PONV, if a population has a higher number of female patients the likelihood of more patients having PONV should be expected.

The current study reported a relative risk reduction of 64% that was comparable to Tabrizi et al. (2019) study result of 57.6%. A different result was found in the Dewinter et al. (2018) study, which reported a lower relative risk reduction of 33%. Once again, variations in relative risk could be attributed to sample characteristics, male to female proportions, and the size of samples tested.

All charts reviewed in the post-protocol sample, $n = 81$, possessed a PONV risk score determined by an anesthesia provider. Anesthesia providers adherence to the prophylactic regimen was excellent at 90% (73/81). Eight charts were excluded from the project post-protocol sample since their anesthesia providers did not adhere the PONV prevention protocol. This was meaningful considering other authors reported lower protocol adherence statistics of 63.3% (Tabrizi et al., 2019) and 46% (Dewinter et al., 2018), though these studies were conducted in teaching institutions with a higher annual case load, 19,000 (Dewinter et al., 2018) and 30,000 (Tabrizi et al., 2019). The project facility is not a teaching center. The project leader provided education, training, and feedback to each anesthesia provider daily during the familiarization period, which possibly improved the rate of protocol adherence. The Dewinter and colleagues' (2018) study did not inform their staff of their performance in protocol adherence and relied solely on staff attending a protocol educational briefing and or reading an e-mail of the protocol process to ensure their staff understood the expectations. This lack of a personalized approach may be reflected in their lower rates of protocol adherence. No studies have stratified performance based on the type of anesthesia provider administering PONV prophylaxis.

The type of anesthesia administered did not impact PONV rates in this project. In the post-protocol sample, there were 5 cases of PONV and 2 were general anesthesia cases and 3 were MAC cases. Similarly, the baseline group reported 6 cases of PONV listed as general anesthesia cases and 12 cases of PONV as MAC. The use of general anesthesia and volatile anesthesia gases are cited as causing a higher incidence of PONV when compared to MAC anesthesia. The study by Dewinter et al. (2018) included only general anesthesia cases and Tabrizi et al. (2018) reported 71.4% of their patients received general anesthesia. As only 26% of the patients in this study received general anesthesia, this lower proportion may have impacted study findings.

An unanticipated finding in this project was a significant increase in PACU length of stay between the baseline and post-protocol samples as the expectation was to see a corresponding reduction in PACU length of stay with a reduction in PONV incidence. Many studies have endorsed decreased PACU lengths of stay (Dewinter et al., 2018, Gan et al., 2020, & Tabrizi et al., 2019) if PONV rates are reduced. There are several inferences as to why the PACU length of stay increased in this project. First, the way PACU nurses conducted charting between the 2 audit periods changed. In the baseline sample, PACU nurses charting involved hand-written documentation, which was then scanned into the patient's electronic health record. Two months prior to post-protocol sample data collection, a computerized PACU nurse charting system was introduced. The PACU nurses faced a substantial hurdle in completing the computerized chart documentation in a timely manner. Anecdotally, the PACU nurses stated the new system was taking them longer to document patient care than with the old, hand-written charts, resulting in the patient staying longer than needed. The nurses stated as they become better familiar with the charting system, the time it takes to input information should decrease and potentially decrease the PACU length of stay in the future. A second contribution to the increase in PACU length of stay could be due to COVID-19 restrictions in place at the project facility. During the project, the people providing ride homes to patients after surgery were not permitted in the facility and they were instructed to wait in the parking lot or elsewhere until the PACU nurse called them to come and pick up the patient at the main exit. The data collected in the post-protocol period occurred during the winter season and many drivers would leave the project facility grounds and go home instead of waiting in the parking lot. Once patients met discharge criteria the nurses called ride-home drivers to pick-up the patient and if they were far away from the ASC the patient stayed in the PACU longer than needed. Lastly, the ASC operated in a 50% capacity because of COVID-19 restrictions. As a result, staff experienced less production pressure to discharge patients quickly to free up bed spaces for follow-on surgical patients. Additionally, this project did not record other patient factors that may lead to longer PACU stays such as pain intensity, additional procedures performed in the PACU, and procedural complications.

Limitations

This project has several limitations. First, the pandemic outbreak of COVID-19 and its impact on hospital systems played a role in measured project outcomes. The project baseline incidence of PONV was determined with data collected prior to the start of the pandemic and a comparison was made with data collected under COVID-19 restrictions. It was anticipated the restrictions would dissipate prior to the post-protocol data collection period, but that did not happen. The project facility never went above 50% operational capacity. Therefore, the PONV incidence rate calculated after protocol implementation may not reflect the actual PONV incidence rate. Second, in the first week of data collection post-protocol there were four cases of PONV. Upon review of the data, two of the patients did not receive appropriate PONV prophylaxis according to the simplified protocol. An additional week of protocol familiarization may have decreased the incidence of PONV during the initial stages of post-protocol data collection. Third, the antiemetics on formulary at the project facility are limited and evidence suggests newer antiemetics, such as NK-1 antiemetics, may further improve patient outcomes. Lastly, the protocol developed for this project was specifically designed to meet the needs of the project facility. Applying it to other institutions with different conditions may not yield similar results.

Recommendations

Recommendations for future study include sample collection after COVID-19 precautions are eliminated. Examining root causes as to why the median PACU length of stay increased in this project would be prudent. The anesthesia service must keep abreast of novel medications and review updated PONV prevention strategies to sustain the decreased incidence of PONV. Lastly, investigating the feasibility of acquiring newer antiemetics with the pharmacy department may improve the quality of care and patient outcomes in a VA ASC with limited financial resources.

Conclusions

The simplified protocol for the prevention of PONV in adult ambulatory surgical patients demonstrated a significant reduction in PONV incidence. Moreover, documentation of PONV risk scoring for each patient achieved 100% success during the study period. The delivery of appropriate antiemetic prophylaxis according to the protocol attained 90% success in this quality improvement project. The sustainability of reduced PONV incidence rates relies upon departmental support and continued education in newer PONV prevention strategies. The anesthesia service must continue to review changes, make updates to, and reinforce utilization of the protocol by their providers.

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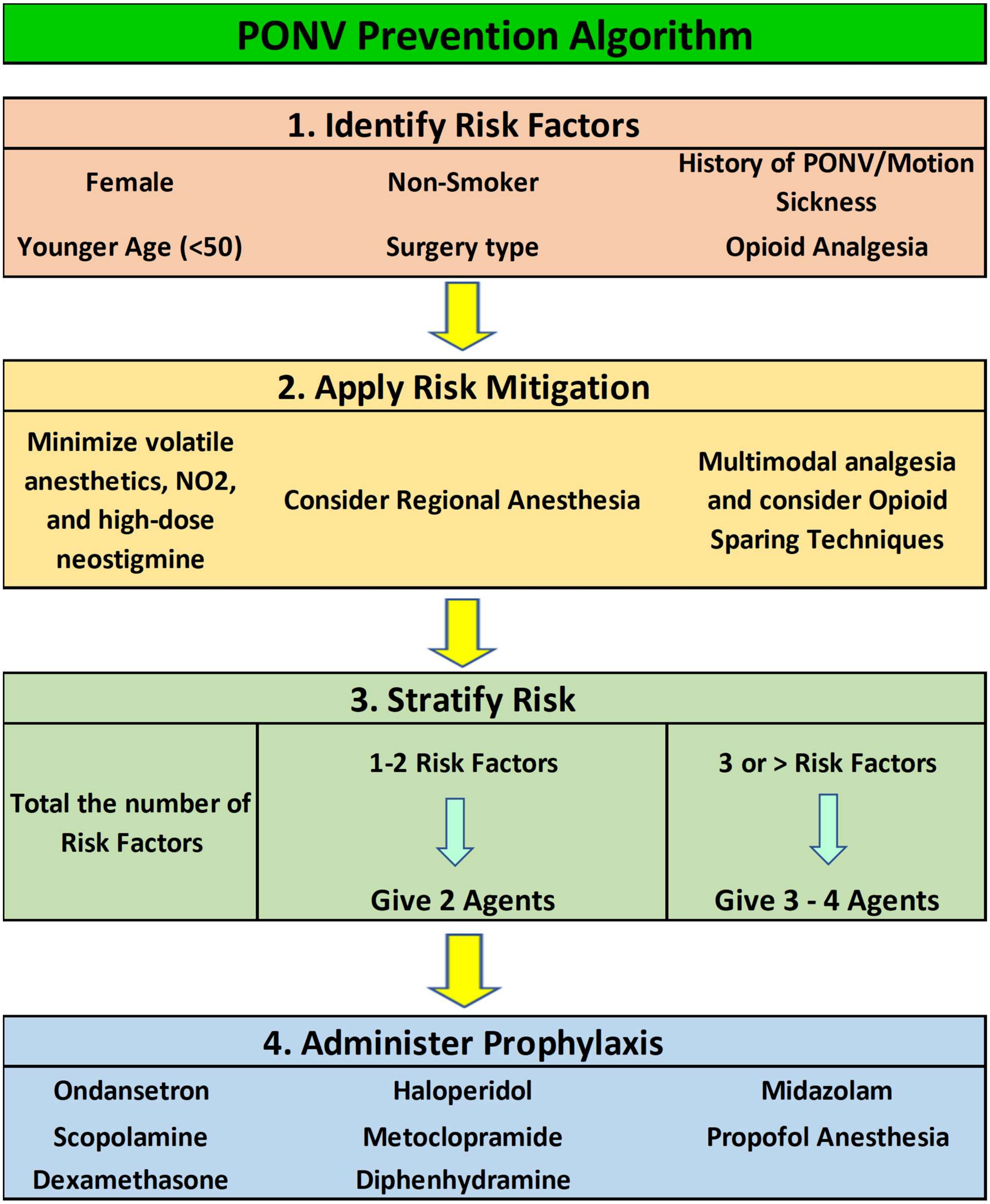
Appendix A

PONV Prevention Algorithm



Appendix B

PONV Risk Scoring in Electronic Anesthesia Evaluation Note

- [x] PREVIOUS ANESTHETICS AND COMPLICATIONS:
  - [ ] No previous complications
  - [ ] No previous anesthetics
  - [ ] None
  - [x] Risk of PONV
    - [ ] Female
    - [ ] Younger age (<50)
    - [ ] Non-smoker
    - [ ] Surgery type
    - [ ] H/O PONV/motion sickness
    - [ ] Opioid analgesia
    - [ ] Total Risk score