

Postoperative Nausea and Vomiting Screening and Prevention in Laparoscopic Surgical

Patients

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A DNP Project Manuscript
Submitted in Partial Fulfillment of the Requirements for the
Doctor of Nursing Practice Degree

School of Nursing, University of Maryland Baltimore
May 2024

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I have no conflict of interests to disclose.
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Abstract

Problem and Purpose: At a community hospital in Baltimore, Maryland, the incidence of postoperative nausea and vomiting (PONV) among the adult laparoscopic surgical patient population, excluding gynecologic patients, is 21%. At the time, there is no evidence based PONV risk assessment or prevention guideline for anesthesia providers to use to assess patients' risk and create an individualized prophylaxis plan. The purpose of this quality improvement (QI) project was to implement a PONV risk assessment tool (Apfel Score) and prophylactic treatment guideline for non-gynecologic, laparoscopic surgical patients. The outcome goal was to reduce the rate of PONV in this population from a baseline of 21%. *Methods:* The anesthesia department consisting of approximately 60 anesthesia providers received education about use of the Apfel Score and treatment guideline prior to implementation. The Apfel Score and guideline were emailed to staff and posted throughout the preoperative area and at anesthesia workstations for provider reference. Patient charts were reviewed weekly to track compliance with Apfel Score completion, adherence to the treatment guideline, and to monitor PONV occurrences. *Results:* Of the 90 eligible patients, 28% were screened for PONV risk using the Apfel Score. Of the 25 patients with a documented Apfel Score, 84% received the appropriate number of antiemetics per the prophylaxis guideline. The overall rate of PONV decreased 5% from the 21% baseline measurement. *Conclusions:* Use of an evidence based PONV risk assessment tool such as the Apfel Score and an associated treatment guideline are simple, feasible interventions to implement that address the problem of PONV. When staff comply with both the risk assessment and prophylaxis guideline, PONV occurrences decrease. Although PONV incidence decreased from baseline by the end of implementation, bolstered compliance with the two-part intervention has the potential to contribute to a further decrease in PONV.

Postoperative Nausea and Vomiting Screening and Prevention in Laparoscopic Surgical Patients

Postoperative nausea and vomiting (PONV) is a phenomenon in which a person experiences nausea and/or retching, and possibly vomiting in the post anesthesia care unit (PACU) or in the first 24 hours following surgery (Feinleib et al., 2023). It is an unpleasant complication experienced by up to 30% of patients undergoing surgery with anesthesia (Amirshahi et al., 2020). Many patients consider PONV to be worse than postoperative pain (Feinleib et al., 2023). In addition to being unpleasant, PONV can cause complications like dehydration, electrolyte disturbances, aspiration, and surgical site wound dehiscence (Shaikh et al., 2016). Certain populations are at higher risk for experiencing PONV, including the laparoscopic surgical population (Amirshahi et al., 2020). PONV can increase PACU length of stay and healthcare costs (Shaikh et al., 2016), so prevention is in the best interest of both the patient and the hospital.

At a community hospital in Baltimore, Maryland, the rate of PONV in adult laparoscopic surgical patients is 21%. At this site, there is no standardized method for screening patients for PONV risk during the pre-anesthetic assessment. There is also a “one size fits all” approach to PONV prophylaxis in which all surgical patients receive only the antiemetics dexamethasone and ondansetron unless contraindicated. These are plausible root causes of the site’s PONV rate in this population. Recently published guidelines on PONV management and prevention recommend patients be assessed for their risk of developing PONV using an evidence-based screening tool. Once their risk is calculated, antiemetic prophylaxis should be planned accordingly. Research has shown patients with greater than two risk factors require more than two antiemetics to maximally decrease their risk of experiencing PONV. Without a screening tool and treatment guideline for anesthesia providers to use, high risk patients are in danger of

not being identified and treated appropriately. The purpose of this quality improvement (QI) project was to implement the Apfel Score (an evidence based PONV screening tool), and a PONV prophylaxis guideline in adults undergoing laparoscopic surgeries and evaluate their effectiveness on reducing PONV occurrences in this patient population. See Figure 1 for fishbone diagram.

Available Knowledge

A literature review was conducted to determine if use of the Apfel Score to screen patients for PONV risk and guide PONV prophylaxis is effective at reducing the incidence of PONV. Study levels were assigned using the Johns Hopkins Nursing Evidence Based Practice Levels of Evidence Guidelines (Dang & Dearholt, 2018). Quality ratings were assigned to each study using the Newhouse (2006) Rating Scale for Quality of the Evidence. The literature review included two level I studies, two level II studies, three level III studies, one level IV study and one level V study. All studies included were given either A or B ratings.

In a level II, quality A study, Apfel and colleagues (2012) conducted a systematic review that confirmed there are four risk factors that are reliable predictors of PONV. These include female gender, non-smoker status, history of PONV and/or motion sickness, and the use of postoperative opioids (Apfel et al., 2012). From this landmark study, researchers developed an instrument called the Apfel Simplified Score (commonly referred to as Apfel score). Each risk factor is assigned one point, meaning a patient's Apfel score can range from 0-4, with a score higher than 2 indicating increased likelihood of PONV. This tool is regarded as one of the simplest, most accurate predictors of PONV. A level III, quality B, study by Gunawan et al. (2020) compared three popular PONV risk assessment tools and found the Apfel Score to be the best predictor of PONV. The most recent consensus guideline for PONV management, a level III,

quality B work, which is based on multiple systematic reviews, randomized control trials, and observational studies, recommends use of the Apfel score to identify high risk individuals and guide prophylactic treatment (Gan et al., 2020).

Individualized treatment strategies for PONV prevention have been shown to be effective in preventing PONV. In a level I, quality A study, Teshome and colleagues' (2020) conducted a literature review which concluded the use of the Apfel score to assess for PONV risk and to guide individualized PONV prophylaxis was effective at preventing PONV. A level I, quality B study by Ma et al. (2022) also showed the effectiveness of this type of individualized treatment plan in reducing PONV in the gynecologic laparoscopic patient population. A level III, quality B study by Stephenson et al. (2021) supported the same conclusions in the general surgical population, as did a level II, quality A study from Dewinter et al. (2020). See Table 1 for evidence review and Table 2 for evidence synthesis.

Rationale

The Promoting Action on Research Implementation in Healthcare Systems (PARIHS) framework was used to implement the research into practice. This framework contends that successful and sustainable implementations are based on accurate evaluation and integration of three elements, mainly, strength of available evidence, the context of the facility where implementation will take place, and efficacy of facilitation of the intervention (Kitson et al., 1998). High-quality evidence exists supporting the use of Apfel score guided PONV prophylaxis. The facility's context included anesthesia staff who recognized more could be done to prevent PONV, along with staff who did not recognize this yet. The practice change fit into the preexisting workflow because providers already complete a preanesthetic assessment evaluation and electronic documentation where notation of Apfel score could be quickly and easily

documented. Providers had immediate access to all antiemetic medications needed to treat PONV based on Apfel score, supporting the change as a minimal effort intervention. Facilitating members included the project leader, site representative and sponsor, who helped lead the change and supported others in making the change through education, encouragement, and sharing of results. See Figure 2 for framework map.

Methods

Context

The 14-week QI project took place within the anesthesia department at a community hospital in Baltimore, MD. Ninety patients underwent non-gynecologic laparoscopic surgery during the implementation period. Approximately 60 anesthesia providers and 30 nurse anesthesia students were available to participate in enacting the practice change during the implementation period. Prior to project implementation at the site, the standard practice was for anesthesia providers see the patient preoperatively and conduct a pre-anesthetic evaluation which was then documented on a paper form. This form did not include a PONV screening. The patient was then taken to surgery where they received a dose of dexamethasone and ondansetron intraoperatively. After surgery, the patient was transported to the recovery area where they may wake up with nausea and/or vomiting. See Figure 3 for the original process map.

The culture regarding PONV prophylaxis at the site was to administer two antiemetics to each patient regardless of their number of risk factors. Some providers were aware of the Apfel tool and current PONV prophylaxis recommendations while others were not. Staff education on using the tool as a risk assessment and means to guide PONV prophylaxis was needed to help shift the culture towards the practice change. Providers at the site shared a common desire to provide the best care for patients based on evidence, however a shift in culture and attitudes

away from the current practice still presented a barrier to overcome. Staff education and frequent reminders with positive reinforcement throughout implementation were implemented to aid in overcoming this barrier. Once provided with the evidence through education and the project team sharing progress, the culture began to shift. It was important to emphasize this change would fit into the staff's current workflow and not require additional resources. The only resources required were the preexisting anesthesia preoperative form for the provider to document the Apfel score, an information sheet in the preoperative area and in the operating rooms with the Apfel scoring criteria and prophylaxis guideline as a reference for providers, and the actual antiemetic medications to which the providers already has access.

Intervention

The intervention included the implementation of the Apfel score into the pre-anesthetic evaluation process, and a PONV prophylaxis guideline to follow once level of risk was established. The quality improvement project occurred over 14 weeks from September 2023 through December 2023 within the anesthesia department consisting of 60 anesthesia providers and 30 anesthesia students. Information sheets with the Apfel scoring system and treatment guideline were emailed to staff, posted throughout the preoperative area, and placed at each anesthesia workstation in operating rooms for immediate provider reference. The words "Apfel Score" were initially stamped on paper preoperative assessment forms as a prompt for the anesthesia provider to record the risk assessment. In October, the site transitioned to use of electronic pre-anesthesia evaluations only. The anesthesia providers were then instructed to notate the Apfel score in the electronic medical record. See Appendix A for Apfel Scoring tool and Prophylaxis Guideline. See Figure 4 for the desired process map.

To achieve the project's goals, strategies and tactics were employed based on recommendations of Bingham & Main (2010) and Powell et al. (2015). To achieve accountability, providing clinical supervision and training/education occurred first. The quality improvement project lead (QI-PL) compiled and presented educational material on the Apfel score and the associated prophylaxis guideline to the project team and anesthesia staff. Emphasis was placed on how the change fit into preexisting workflow. Staff were initially educated at a staff meeting where the team leader presented the project. To ensure all anesthesia staff had access to project details and educational materials, the QI-PL sent a departmental email including education on the Apfel score and treatment guideline. The site sponsor and representative encouraged collaboration and communication by acting as champions for the change. They served as role models for the practice change and encouraged others to adapt the change. Food incentives were used to attempt to garner interest and gain buy-in at the start of the project. Weekly data audits were completed by the QI-PL and feedback was provided to the project team and staff monthly to share progress. Ongoing education and reminders from the QI-PL were necessary to ensure the intervention was not forgotten and that the target patient population continued to receive the evidence-based intervention.

Measures

The first process goal was to obtain 100% compliance with Apfel score documentation on laparoscopic surgical patients' paper preanesthetic evaluation or in the electronic record. This was measured by taking the total number of laparoscopic surgical patients with an Apfel score documented in their chart and dividing by the total number of laparoscopic surgical patients. The second process goal was to obtain 100% compliance with adherence to the PONV prophylaxis guideline in patients with a documented Apfel score. This was measured by obtaining the total

number of patients who had the appropriate number of antiemetics given based on their Apfel score and dividing that number by the total number of laparoscopic surgical patients with an Apfel score documented. The outcome goal was to reduce PONV incidence in the laparoscopic surgical population to less than 21%. This was measured by obtaining the number of patients with documented nausea and/or vomiting in their chart after their laparoscopic surgery and dividing by the total number of patients undergoing laparoscopic surgery during the implementation period. Each measure is a numerical value to reflect a percentage and was obtained via chart review. The chart review was to find objective data, for example, documentation of Apfel score preoperatively is either present or not present, and documentation of PONV is either yes or no. According to Siems et al., (2020) objective review criteria with defined, measurable content are likely to have high reliability and validity, though it is important to consider the possibility of human error for the chart reviewer and the initial documenter.

Chart reviews were conducted by the QI-PL weekly. Data was collected into the REDCap database using the chart audit tool created for this DNP project (see Appendix B). This tool allowed for collection of all project data in one place to evaluate all measures, processes, and outcome goals completely and accurately. To ensure the correct patient charts were reviewed, the QI-PL confirmed patients met the criteria of being adult patients (over the age of 18) and having the term “laparoscopic” or “laparoscopy” in their surgical procedure description. To ensure accuracy of data, points of measurement were defined. Risk assessment completion was defined as risk assessment documentation in preoperative documents or intraoperative record. PONV guideline adherence was defined as patients with two risk factors having at least two antiemetics documented in their MAR during the preoperative and intraoperative period, and patients with three risk factors having at least three antiemetics documented. PONV was confirmed if patients

received an antiemetic medication within 24 hours after their surgery or if the PACU nurse noted “further intervention required” in nausea and vomiting section of the anesthesia PARS.

Ethical Considerations

The proposal for this quality improvement project was reviewed by the University of Maryland School of Medicine’s Human Research Protections Office and by the implementation site’s Institutional Review Board. Nonhuman subjects research determination was obtained from both offices. Screening and clinical management complied with expected privacy and confidentiality measures during all patient encounters in the HIPAA-covered entity. Project data risks were mitigated by one individual entering all data into REDCap, a HIPAA compliant, password protected server, accessible to only the QI-PL and project faculty. No other hardware devices or programs were used for data storage. Identifiers were coded as “identifiers” within the REDCap system and removed prior to downloading if downloading was necessary. There were no conflicts of interest in this QI project.

Results

Chart reviews were conducted for a total of 90 adult patients undergoing non-gynecologic laparoscopic surgery over the 14-week implementation period to track process and outcome measures. The implementation of the Apfel score into the pre-anesthesia evaluation process, and an associated PONV prophylaxis guideline to guide provider administration of antiemetic medications was intended to decrease the rate of PONV in the laparoscopic surgical population from the baseline measurement of 21%. The first process goal was to achieve 100% compliance with PONV risk assessment measured by documentation of the Apfel score in the patient record. A total of 25 patients (28%) had documented Apfel scores. A run chart for compliance with Apfel score documentation showed compliance ranged from 0% to 50% on a weekly basis, with a

median of 25% (see Figure 5). There were only two runs in the chart, one occurring from week 2 to week 3 and the other from week 8 to week 9, which is too few runs to show significance according to the Institute for Healthcare Improvement (2019), There were no shifts or trends.

The second process goal was to achieve 100% compliance with adherence to the PONV prophylaxis guideline in patients with a documented Apfel score. Of the 25 patients with a documented Apfel score, 21 (84%) received the appropriate number of antiemetic medications per the PONV prophylaxis guideline. Compliance with the guideline ranged from 0% to 100% on a weekly basis (see Figure 6). There is only one run in the chart occurring from week 3 to week 5 which is not significant. There are no shifts or trends in the data.

The outcome goal was to achieve a decrease in PONV from 21%. Of the 90 patients included in the review, 14 (16%) experienced PONV. See Figure 7 for a run chart of weekly PONV occurrences throughout implementation. There are only three runs in the data which is too few runs to determine significance according to the Institute for Healthcare Improvement (2019). There are no shifts or trends in the data.

Compliance with the Apfel score documentation was highest after initial staff education and after each time staff received a reminder email and progress update. One month after project implementation, the site transitioned from paper pre-anesthetic evaluations, which contained an Apfel score prompt, to electronic pre-anesthetic evaluations, which did not include the prompt. This likely impeded progress on increasing the number of patients screened because staff needed to remember on their own accord to calculate and document the score in the medical record. This created a barrier to implementation. A decrease in compliance with Apfel documentation is seen during this transition. The number of patients who had a documented Apfel score that received the appropriate number of antiemetics per prophylaxis guideline remained relatively high

throughout implementation. As with the Apfel score documentation, compliance with guideline adherence increased after staff reminders and education and decreased as each month continued.

Despite difficulty achieving the two process goals, the total number of PONV occurrences did decrease 5% from the 21% baseline. This reduction was not necessarily expected due to the difficulty in achieving the two process goals. However, it is possible this could be due to an elevated baseline measurement that resulted from unknown extenuating circumstances during the time of measurement, or that providers took mental note of the Apfel score rather than documenting it and compliance was higher than what was documented. The highest rate of PONV was in week 9 when almost 50% of laparoscopic surgical patients experienced PONV. During this week, zero patients had a documented Apfel score and zero patients received the appropriate number of antiemetics based on the guideline. An email was sent to staff with this information which prompted a response from leadership and in the following weeks, Apfel score documentation and guideline adherence was elevated.

The main barrier to project implementation was the transition from a paper preanesthetic evaluation with the Apfel score prompt on it to an electronic evaluation that did not include the prompt. This negatively affected compliance with the project's first and main process goal of achieving 100% compliance with Apfel score documentation. Additionally, multiple QI projects were enacted at the same time within the anesthesia department which created confusion among providers. Facilitators to enacting the practice changes included the use of change champions, monthly progress updates and reminders, and leadership support.

Discussion

Despite low compliance with documentation of Apfel score throughout implementation, adherence to the PONV prophylaxis guideline was high and PONV occurrences did decrease

from the baseline measurement of 21%. This QI project demonstrated that use Apfel score preoperatively is a simple way to quantify PONV risk that can be easily added to the anesthesia provider's pre-existing workflow. Conducting the risk assessment and following the associated prophylaxis guideline are minimal effort actions that could prevent patients from experiencing PONV and its associated complications. The results of this QI project are consistent with conclusions found in the literature review. Studies by Dewinter et al., (2018), Ma et al., (2022), Stephenson et al., (2021), and Moore et al., (2021) all examined the impact of preoperative PONV risk assessment with the Apfel score and use of a prophylaxis guideline to prevent PONV and demonstrated successful mitigation of PONV.

There were differences between observed outcomes and anticipated outcomes. Compliance with Apfel score documentation was anticipated to be higher due to its ease of completion and the existing prompt on the paper pre-anesthetic evaluation. The unexpected transition to an electronic pre-anesthetic assessment that lacked a section addressing PONV one month after the QI project began hindered compliance and resulted in lower than anticipated participation. Another limitation was many different QI projects were implemented at the same time within the anesthesia department, which created confusion and project burnout among staff. Additionally, prior to project start, clearer inclusion and exclusion criteria should have been defined. There were more than anticipated emergency laparoscopic procedures that occurred overnight and on weekends. Following proper PONV protocol is not a priority in these cases, but they were counted in the overall patient case count, which may have skewed the data negatively.

To sustain the intervention, compliance with use of the Apfel score as a preoperative PONV risk assessment needs to be improved. Without it being visible in the electronic pre-anesthetic evaluation, its use is likely to subside. Working with IT to have the Apfel score

incorporated into the electronic pre-anesthetic evaluation may positively impact risk assessment completion and contribute to further decreases in PONV. This intervention can be easily spread and applied beyond laparoscopic patients to all surgical patients.

Conclusion

The results of this QI project have shown that implementation of the Apfel score and a PONV prophylaxis guideline are feasible interventions to address the problem of PONV and reduce PONV occurrences in the laparoscopic patient population. These are low cost, minimal effort interventions that fit into pre-existing anesthesia provider workflow and only serve to benefit surgical patients. Using the Apfel score preoperatively to establish a patient's level of PONV risk can then help guide proper antiemetic prophylaxis based on an associated guideline. A PONV prophylaxis guideline with the most up to date antiemetic recommendations should be available to help guide anesthesia providers with their antiemetic choices.

For this initiative to remain sustainable, the Apfel score needs to be integrated into the electronic version of the pre-anesthetic evaluation. Involving a representative from the IT department could help facilitate this change. With the Apfel score incorporated the pre-anesthetic evaluation, the anesthesia provider can calculate and visualize the patient's risk for PONV and appropriately plan for prophylaxis using the PONV prophylaxis guideline. This intervention can then be extended beyond laparoscopic surgical patients to all surgical patients. Future QI initiatives should focus on incorporating the Apfel score into the electronic health record or working with IT to incorporate a clinical decision-making prompt in the EHR that results from a patient's calculated PONV risk. All surgical patients can benefit from being screened for PONV risk and treated appropriately based on their risk.

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Table 1.

Evidence Review

Citation #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. <i>Anesthesia & Analgesia</i> , 131(2). https://journals.lww.com/anesthesia-analgesia/Fulltext/2020/08000/Fourth_Consensus_Guidelines_for_the_Management_of.16.aspx		Level and Quality: IV-A
Purpose	Review of literature to provide evidence-based set of guidelines for the care of postoperative nausea and vomiting. Guidelines provide recommendations for identifying high risk patients, managing PONV, prophylactic medication choices and rescue medication choices. The consensus also provides recommendations for institutional implementation of PONV protocols.	
Type of Evidence and Research Design	Consensus Guidelines based on literature review	
Sample Population, Size, Setting	<p>Sampling: Purposive Eligible Participants: Studies included adults 18 years and older, and separate studies for pediatrics Setting: Surgical Settings Accepted: Studies of adults and in the English language Control: n/a Intervention: multiple interventions were examined such as risk scoring tools for PONV and individual medications and nonpharmacologic interventions for nausea and vomiting Power Analysis: not conducted for literature review Group Homogeneity: Patients are adult and pediatric surgical populations in hospitals and outpatient surgery centers</p>	
Intervention Procedures	Multiple interventions were examined such as risk scoring tools for PONV and individual medications and nonpharmacologic interventions for nausea and vomiting	
Primary Outcome Measurements	DV: Incidence of PONV	
Results/Conclusions	There are certain factors that contribute to a patient being high risk for PONV, those are female sex, nonsmoker, postoperative opioid use, history of motion sickness or PONV, type of surgery, duration of anesthesia, younger age. Risk scoring tools such as the Apfel score and Koivuranta score have been shown to reduce the rate of PONV at the institutional level. Recommendations of PONV prophylaxis based on risk factors: 1-2 risk factors: 2 agents, > 2 risk factors, give 3-4 agents. Agents are from different classes: corticosteroids, 5HT3 antagonists, antihistamines, dopamine antagonists, propofol anesthesia, NK1 antagonists, anticholinergics, and acupuncture.	

Citation #2: Apfel, C. C., Heidrich, F. M., Jukar-Rao, S., Jalota, L., Hornuss, C., Whelan, R. P., Zhang, K., & Cakmakkaya, O. S. (2012). Evidence-based analysis of risk factors for postoperative nausea and vomiting. <i>British journal of anaesthesia</i> , 109(5), 742–753. https://doi-org.proxy-hs.researchport.umd.edu/10.1093/bja/aes276 (Greater than 5 years but is a seminal article)		Level and Quality: II-A
Purpose	To conduct an evidence-based analysis to determine factors that are considered strong predictors of PONV in the adult surgical population	
Type of Evidence and Research Design	Research: Systematic Review and meta analysis of randomized control trials and observational studies	
Sample Population, Size, Setting	<p>Sampling/Search Strategy: Purposive, literature review conducted using PubMed, EMBASE, and Cochrane databases. Hand search of reference lists of retrieved studies.</p> <p>Eligible Studies: Studies which included adults 15 years and older</p> <p>Setting: Surgical centers and hospitals</p> <p>Accepted: 22 studies. RCTs and epidemiological observational studies that examined adults 15 and older with greater than 500 participants that identified independent predictors of PONV by means of multivariate logistic regression analysis. This included a total of 95,154 patients.</p> <p>Excluded: studies of pediatric patients and studies with less than 500 participants</p> <p>Control: n/a</p> <p>Intervention: literature review with search criteria for studies that met inclusion criteria</p> <p>Power Analysis: not conducted for literature review</p> <p>Group Homogeneity: To limit heterogeneity, heterogeneity was assessed by I^2 analysis. If $I^2 \geq 75\%$, it was considered a high degree of heterogeneity and an outlier, so those outcomes were excluded.</p>	
Intervention Procedures	Literature review and examination of high-quality studies to identify and quantify impact of independent predictors of PONV in adults. Data extraction performed by one author and validated by second author, and statistical analysis conducted	
Primary Outcome Measurements	<p>Dependent variable: incidence of PONV or PN</p> <p>Median incidence of postop nausea or postoperative nausea and vomiting was the primary outcome of the 22 studies reviewed. Of the systematic review itself, Odds Ratios for independent risk factors were measured. CI 95%</p>	
Results/Conclusions	<p>Results: Female gender (OR 2.57) was the strongest overall predictor for PONV, followed by history of motion sickness or PONV (OR 2.09). Nonsmoking status was next with OR 1.82. Anesthetic factors included use of volatile anesthetics (OR 1.82), duration of anesthesia (OR 1.46), and postoperative opioids (OR 1.39). Intraoperative opioids were not a statistically significant predictor.</p> <p>Conclusions: Female gender was the strongest overall predictor of PONV. A history of PONV and/or motion sickness indicates susceptibility to PONV. PONV is also triggered by volatile anesthetics, prolonged anesthesia, postoperative opioids, and nitrous oxide use. PONV incidence decreases with age in the adult population only. The use of the simplified Apfel score and Koivuranta’s risk score are logical choices for a risk assessment in daily practice.</p>	

Citation #3 Amirshahi, M., Behnamfar, N., Badakhsh, M., Rafiemanesh, H., Keikhaie, K. R., Sheyback, M., & Sari, M. (2020). Prevalence of postoperative nausea and vomiting: A systematic review and meta-analysis. <i>Saudi journal of anaesthesia</i> , 14(1), 48–56. https://doi-org.proxy-hs.researchport.umd.edu/10.4103/sja.SJA_401_19		Level and Quality: III-A
Purpose	To determine the global prevalence of PONV.	
Type of Evidence and Research Design	Research: Systematic Review and meta-analysis of cross-sectional, case control, and cohort studies	
Sample Population, Size, Setting	<p>Sampling: purposive sampling Participants: 23 studies performed on 22,683 people from 11 different countries. Participants were between 5 and 73 years old Setting: surgical settings across 11 different countries Accepted: cross-sectional, case control, and cohort studies Excluded: case series, letters to editors, case reports, clinical trials, study protocols, systematic review, and narrative reviews. Control: n/a Intervention: literature review for articles describing PONV prevalence Power Analysis: none conducted Group Homogeneity: participants had the commonality of being surgical patients but type of surgery and anesthesia and age varied widely.</p>	
Intervention Procedures	Literature review of accepted studies	
Primary Outcome Measurements	Prevalence of PONV globally	
Results/Conclusions	Prevalence of PONV is 27.7% and is higher during the first 24 hours after surgery. Prevalence of nausea is 31.4% and vomiting is 16.8%. Considering there is an ability to prevent PONV, the use of guidelines, training of patients prior to procedures, and necessary infrastructure in surgical centers seem necessary for addressing this high prevalence issue.	

Citation #4 Dewinter, G., Staelens, W., Veef, E., Teunkens, A., Van de Velde, M., & Rex, S. (2018). Simplified algorithm for the prevention of postoperative nausea and vomiting: A before-and-after study. <i>British Journal of Anaesthesia</i> , 120(1), 156–163. https://doi.org/10.1016/j.bja.2017.08.003		Level and Quality: II-A
Purpose	To test the effectiveness of a simplified algorithm for PONV prophylaxis on the incidence of PONV	
Type of Evidence and Research Design	Research: Quasi-experimental	
Sample Population, Size, Setting	<p>Sampling: Purposive sampling</p> <p>Eligible Participants: adult patients 18 and older undergoing non cardiac surgery and having general anesthesia</p> <p>Setting: Perioperative area and operating room</p> <p>Accepted: adult patients 18 and older undergoing non cardiac surgery and having general anesthesia</p> <p>Excluded: emergency procedures for which no preoperative data was available</p> <p>Control: no control</p> <p>Intervention: Simplified algorithm based on Apfel score included in preoperative anesthesia assessment</p> <p>Power Analysis: n/a</p> <p>Group Homogeneity:</p>	
Intervention Procedures	Simplified algorithm for PONV prevention was sent to staff via email and staff was educated on the algorithm. PONV prophylaxis was guided by this algorithm.	
Primary Outcome Measurements	<p>Primary outcomes: incidence of PONV within 1 and 24 hours after surgery</p> <p>Secondary outcomes: whether PONV risk had been correctly calculated during preoperative evaluation, staff compliance with PONV treatment based on the algorithm, the number and type of antiemetics given to the patient, and the use of a rescue antiemetic</p>	
Results/Conclusions	<p>Results:</p> <ul style="list-style-type: none"> -After the implementation of the PONV prophylaxis algorithm, PONV incidence decreased from 33% to 22% (P=0.02) in the 24 hours following surgery. -Using a logistic regression analysis, PONV incidences were significantly related to a patient’s apfel risk score. -There was an increase in number and type of antiemetics given to patients after algorithm implementation -The use of rescue anti-emetics was less after algorithm implementation (P=.002) <p>Conclusions:</p> <p>A simplified algorithm for PONV prophylaxis based on risk factors aided in reducing incidence of PONV. The simplified aspect of it likely also led to increased compliance with the protocol.</p>	

Citation #5 Gunawan, M. Y., Utariani, A., Mauludya, M., & Veterini, A. S. (2020). Sensitivity and Specificity Comparison Between APFEL, KOIVURANTA, and SINCLAIR Score As PONV Predictor In Post General Anesthesia Patient. <i>Qanun Medika: Jurnal Kedokteran Fakultas Kedokteran Universitas Muhammadiyah Surabaya</i> , 4(1), 69-76. https://doi.org/10.30651/jgm.v4i1.2826		Level and Quality: III-B
Purpose	To compare the Apfel, Koivuranta, and Sinclair scoring tools as predictors of PONV in patients undergoing general anesthesia.	
Type of Evidence and Research Design	Nonexperimental Research: Observational Descriptive Cross-Sectional Design	
Sample Population, Size, Setting	<p>Sampling: Random</p> <p>Eligible Participants: Patients 17-65 years old ASA 1-2 undergoing elective surgery with general anesthesia</p> <p>Setting: Surgical center in Indonesia</p> <p>Accepted: Patients 17-65 years old ASA 1-2 undergoing elective surgery with general anesthesia</p> <p>Excluded: patients with perioperative antiemetic drugs, patients with high intracranial pressure, pregnant patients, patients undergoing TIVA, and patients who refused to be included</p> <p>Control: no control</p> <p>Intervention: No intervention as this is an observational study, however the use of different tools for PONV (Apfel, Koivuranta, and Sinclair) were compared in predicting PONV</p> <p>Power Analysis: not conducted</p>	
Intervention Procedures	PONV score calculated and PONV incidence documented. Data was analyzed with SPSS software and data was analyzed to find sensitivity, specificity, and AUC of each score.	
Primary Outcome Measurements	<p>Primary outcomes: sensitivity, specificity, and AUC of scoring tools: Apfel, Koivuranta, and Sinclair. Apfel is 79.5% sensitive, 45.9% specific, and AUC is 0.701. Koivuranta is 95.2% sensitive, 27% specific, and the AUC is 0.628. Sinclair is 73.1% sensitive, 48.6% specific, and its AUC is 0.619.</p> <p>Secondary outcomes: PONV incidence based on type of surgery</p>	
Results/Conclusions	The highest incidence of PONV occurred in surgical populations undergoing digestive system surgeries and head and neck surgeries. It is recommended that the Apfel score is used as a predictor of PONV, as it is more accurate and had a simpler determination variable than the Koivuranta and Sinclair score.	

Citation #6 Ma, W., Qi, Y., Liu, C. <i>et al.</i> Effect of individualized treatment strategy on postoperative nausea and vomiting in gynaecological laparoscopic surgery: a double-blind, randomized, controlled trial. <i>BMC Anesthesiology</i> 22 , 266 (2022). https://doi.org/10.1186/s12871-022-01809-z		Level and Quality: I-B
Purpose	To evaluate the effect of individualized treatment strategies on postoperative nausea and vomiting in gynecological operations	
Type of Evidence and Research Design	Research: Double blind randomized controlled trial	
Sample Population, Size, Setting	<p>Sampling: Random</p> <p>Eligible Participants: adult patients 18-65 years of age undergoing laparoscopic gynecologic surgery under general anesthesia</p> <p>Setting: Hospital of Wunnan Medical College in Wuhu, China</p> <p>Accepted: adult patients 18-65 years of age undergoing laparoscopic gynecologic surgery under intravenous general anesthesia classified as ASA I-II</p> <p>Excluded: patients with known gastrointestinal disease, patients who had taken antiemetic medication 24 hours prior to surgery, and patients who were allergic to drugs</p> <p>Control: group in which only one antiemetic drug was given.</p> <p>Intervention: Apfel risk score assignment then treatment with corresponding PONV prophylaxis</p> <p>Power Analysis: Conducted, minimum participant requirement met</p>	
Intervention Procedures	Assignment of Apfel score 0-4 then treatment with appropriate PONV prophylaxis based on score. Score of 1 = 1 antiemetic administered. Apfel score of 2 = 2 antiemetics administered. Score of 3 = 3 antiemetics administered, score of 4 = 4 antiemetics administered.	
Primary Outcome Measurements	<p>Primary outcomes: episodes of emesis, nausea, and rescue medication within 24 hours postop.</p> <p>Secondary outcome: Severity of nausea and vomiting, adverse events</p>	
Results/Conclusions	<p>Results: The incidence of PONV for gynecologic laparoscopic procedures remains high. However, the incidence of PONV was significantly lower in the intervention group 18.3% than in the control group 44.1% (P<.001). The severity of nausea and vomiting was higher in the control group than in the individualized treatment group.</p> <p>Conclusions: Patients receiving individualized antiemetic prophylaxis based on their Apfel score experienced less nausea and vomiting than patients who did not receive prophylactic treatment based on their Apfel score. Using the Apfel scoring tool is a safe and effective intervention to address PONV.</p>	

<p>Citation # 7 Stephenson, S. J., Jiwanmall, M., Cherian, N. E., Kamakshi, S., & Williams, A. (2021). Reduction in post-operative nausea and vomiting (PONV) by preoperative risk stratification and adherence to a standardized anti emetic prophylaxis protocol in the day-care surgical population. <i>Journal of family medicine and primary care</i>, 10(2), 865–870. https://doi-org.proxy-hs.researchport.umd.edu/10.4103/jfmpc.jfmpc_1692_20</p>		<p>Level and Quality: III-A</p>
<p>Purpose</p>	<p>To study the prevalence of PONV, associated risk factors, and effect of following PONV prophylaxis protocol</p>	
<p>Type of Evidence and Research Design</p>	<p>Research: Prospective cohort study</p>	
<p>Sample Population, Size, Setting</p>	<p>Sampling: Purposive Eligible Participants: Adults undergoing same day surgery under general anesthesia Setting: Tertiary care hospital in South India Accepted: 447 patients 18-60 years old undergoing same day surgery under general anesthesia ASA I-II Excluded: patients who refused, patients less than 18 or older than 60, ASA >3, patients on chemotherapy, patients on palliative therapy with chronic opioid intake, pregnant patients, patients on antiemetic therapy within 24 hours of surgery, patients with renal, hepatic, cardiopulmonary and gastrointestinal disorders. Control: no control Intervention: assignment of Apfel risk score and treatment prophylaxis Power Analysis: Conducted. 80% power, total sample of 300 (150 males and 150 females) required and met.</p>	
<p>Intervention Procedures</p>	<p>Assignment of Apfel risk score during preoperative assessment</p>	
<p>Primary Outcome Measurements</p>	<p>Primary outcomes: PONV Secondary outcome: identification risk factors associated with PONV</p>	
<p>Results/Conclusions</p>	<p>Results: According to literature PONV has overall incidence of 30% and up to 80% in high risk individuals. Prevalence of nausea in PACU is 20% and vomiting prevalence was 5%. The prevalence of nausea in this study was 2.05% and vomiting was 2.45%. patients with history of PON (p=0.0019) and history of POV (p=0.005) were independent predictors of PON. Patients who consume alcohol were more prone to PONV (p=0.028). Patients with surgery > 1 hour had higher prevalence of PONV (p=0.029). No statistically significant association was found between intraoperative and postoperative opioid use. Conclusions: Conducting a simplified risk stratification score (Apfel score) and prophylaxis protocol reduced the incidence of PONV.</p>	

Citation #8 Teshome, D., Fenta, E., & Hailu, S. (2020). Preoperative prevention and postoperative management of nausea and vomiting in resource limited setting: A systematic review and guideline. <i>International Journal of Surgery Open</i> , 27, 10–17. https://doi.org/10.1016/j.ijso.2020.10.002		Level and Quality: I-A
Purpose	To support the clinical decision making of PONV management based on available evidence	
Type of Evidence and Research Design	Research: systematic review of meta-analyses, RCTs, literature reviews, and cross-sectional studies	
Sample Population, Size, Setting	<p>Study Selection: literature from PubMed/PMC, Google Scholar, and Cochrane library search engines resulted in meta-analyses, RCTs, literature reviews, and cross-sectional studies</p> <p>Setting: perioperative settings</p> <p>Accepted: Studies examining antiemetic drugs, PONV risk factors, and risk assessment tools</p> <p>Intervention: literature review</p> <p>Power Analysis: n/a for systematic review</p>	
Intervention Procedures	Literature review using PubMed/PMC, Google Scholar, and Cochrane library and analysis of articles obtained from search.	
Primary Outcome Measurements	Efficacy of multiple antiemetic drugs, risk assessment tools	
Results/Conclusions	<p>Results: 5 systematic reviews, one guideline, 4 meta-analysis of RCTs, 3 multicenter RCTs, 13 single center RCTs, and 2 cross sectional studies were examined and results summarized.</p> <p>Conclusions: The Apfel risk assessment tool should be used preoperatively to assess for PONV risk. Acetylcholine and histamine antagonists are useful when vestibular triggers are present. Dopamine blockade influences emetogenic effects of opioids. Serotonin antagonists act in CTZ and gut to prevent PONV. Preoperative hydration to maintain normovolemia is effective for reducing PONV. Low dose propofol 0.5mg/kg at the end of surgery can be effective in reducing PONV. Ondansetron, palonosetron, dexamethasone, haldoperidol, and metoclopramide are effective to reduce PONV when used in certain combinations, however one drug alone is not enough.</p>	

Citation #9 Moore, C. C., Bledsoe, L. T. R., Bonds, C. R., Keller, M., & King, C. H. (2021). Preventing Postoperative Nausea and Vomiting During an Ondansetron Shortage. <i>AANA journal</i> , 89(2), 161–167.		Level and Quality: V-A
Purpose	To reduce incidence of PONV by educating providers and implementing the Apfel scoring tool into the EHR.	
Type of Evidence and Research Design	Quality Improvement	
Sample Population, Size, Setting	<p>Sampling: n/a, all staff received education and all patients in for orthopedics, gynecology, general surgery, urology, and otolaryngology intended to receive scoring and prophylactic treatment</p> <p>Eligible Participants: all staff received education and all patients within 5 above listed specialties intended to receive scoring and prophylactic treatment</p> <p>Setting: Naval Hospital in Jacksonville, Florida</p> <p>Accepted: adult patients 18-89 years old and ASA I-III.</p> <p>Excluded: cases involving monitored anesthesia care, regional anesthesia, pregnant women, or patients who were already nauseous during the preoperative period.</p> <p>Control: n/a</p> <p>Intervention: Staff education and Apfel Scoring tool for PONV, appropriate antiemetics administered according to the PONV prophylaxis guideline, Implementation of Apfel score into EHR and reminder cards posted t anesthesia stations.</p> <p>Power Analysis: n/a</p>	
Intervention Procedures	Anesthesia provider education and training and Apfel Scoring tool for PONV	
Primary Outcome Measurements	Outcomes: Provider adherence to apfel scoring and appropriate prophylactic treatment based on score, PONV rates.	
Results/Conclusions	<p>Results: Based on chi squared tests, provider adherence was significantly improved between baseline phase and early phase and was maintained during final phase of measurement. There was a modest reduction in PONV rates from baseline to final phase, 38.8% to 26.5%, but this difference was not statistically significant. The proportion of appropriately medicated patients (appropriate number of antiemetic administered based on score) increased from 47% to 59& from baseline to final phases.</p> <p>Conclusions: The Apfel score is a good tool for predicant PONV risk, and when the prophylaxis guidelines are followed, PONV rates tend to decrease. Permanent integration of Apfel tool into EHR and use of reminder cards may have contributed to the modest decrease in PONV incidence and increase in provider adherence.</p>	

Table 2.

Evidence Synthesis Table

PICOT: In the laparoscopic surgical population, does the implementation of an evidence-based preoperative risk assessment and prophylactic treatment guideline compared to no evidence-based risk assessment and treatment guideline decrease the incidence of postoperative nausea and vomiting?			
Category (Level Type)	Total Number of Sources	Quality Rating/Study	Synthesis of Findings
Level I Experimental study, randomized controlled trial(RCT), systematic review of RCTs with or without meta-analysis	2	I-A/Teshome et al., (2020) I-B/Ma et al., (2022)	The Apfel risk assessment tool and treatment based on Apfel score is appropriate for identifying high risk patients and preventing PONV. Individualized treatment strategies are effective for PONV prophylaxis in high risk patients. The Apfel Simplified Score is an example of an accurate individualized risk score that can then dictate an individualized treatment plan.
Level II: Quasi-experimental study Explanatory mixed method design that includes only a level II quantitative study Systematic review of a combination of RCTs and quasi-experimental studies, or quasi- experimental studies only, with or without meta-analysis	2	II-A/Apfel et al., (2012) II-A/Dewinter et al., (2018)	The risk factors for developing PONV are female gender, nonsmoker, history of PONV and/or motion sickness, and postoperative opioid use. These factors are combined into the Apfel Simplified Score and should be used preoperatively to identify patients at risk. Based on risk factors, patients should be treated prophylactically with antiemetics based on the evidence. A treatment protocol or guideline is useful for providers and effective in reducing PONV.
Level III: Nonexperimental study Systematic review of a combination of RCTs, quasi-experimental and nonexperimental studies, or nonexperimental studies only, with or without meta-analysis Exploratory, convergent, or multiphasic mixed methods studies Explanatory mixed method design that includes only a level III quantitative study Qualitative study Meta-synthesis	3	III-A/Stephenson et al., (2021) III-B/Gunawan et al., (2020) III-A/Amirshahi et al., (2020)	The incidence of PONV remains high despite available prophylactic antiemetic medications. The Apfel scoring tool is the simplest and most accurate PONV risk assessment tool out of the three most popular tools that exist. A prophylactic antiemetic regimen should be individualized to each patient based on their risk factors. Individualization of PONV prophylaxis treatment using the Apfel score has been shown to decrease the incidence of PONV.

<p>Level IV: Opinion of respected authorities and/or nationally recognized expert committees or consensus panels based on scientific evidence</p>	<p>1</p>	<p>IV-A/Gan et al. (2020)</p>	<p>A comprehensive and evidence-based set of guidelines for care of PONV in adult and pediatric patients. There are certain factors that contribute to a patient being high risk for PONV, those are female sex, nonsmoker, postoperative opioid use, history of motion sickness or PONV, type of surgery, duration of anesthesia, younger age. Risk scoring tools such as the Apfel score and Koivuranta score have been shown to reduce the rate of PONV at the institutional level. Recommendations of PONV prophylaxis based on risk factors: 1-2 risk factors: 2 agents, > 2 risk factors, give 3-4 agents. Agents are from different classes: corticosteroids, 5HT3 antagonists, antihistamines, dopamine antagonists, propofol anesthesia, NK1 antagonists, anticholinergics, and acupuncture.</p>
<p>Level V: Based on experiential and nonresearch evidenceIncludes: Integrative reviews, Literature reviews, Quality improvement, program, or financial evaluation, Case reports, Opinion of nationally recognized expert(s)based on experiential evidence</p>	<p>1</p>	<p>V-A/Moore et al., (2021)</p>	<p>The Apfel simplified score is an easy and feasible tool to implement to identify high risk patients and guide prophylactic treatment of PONV. Training providers on how to use it and then implementing it into the clinical environment is simple and cost effective. It has been shown to reduce PONV incidence.</p>
<p>Overall Quality Rating and Recommendations Based on Evidence Synthesis: A, strong, consistent evidence in support of practice change</p>			

Figures

Figure 1.

Fishbone Diagram

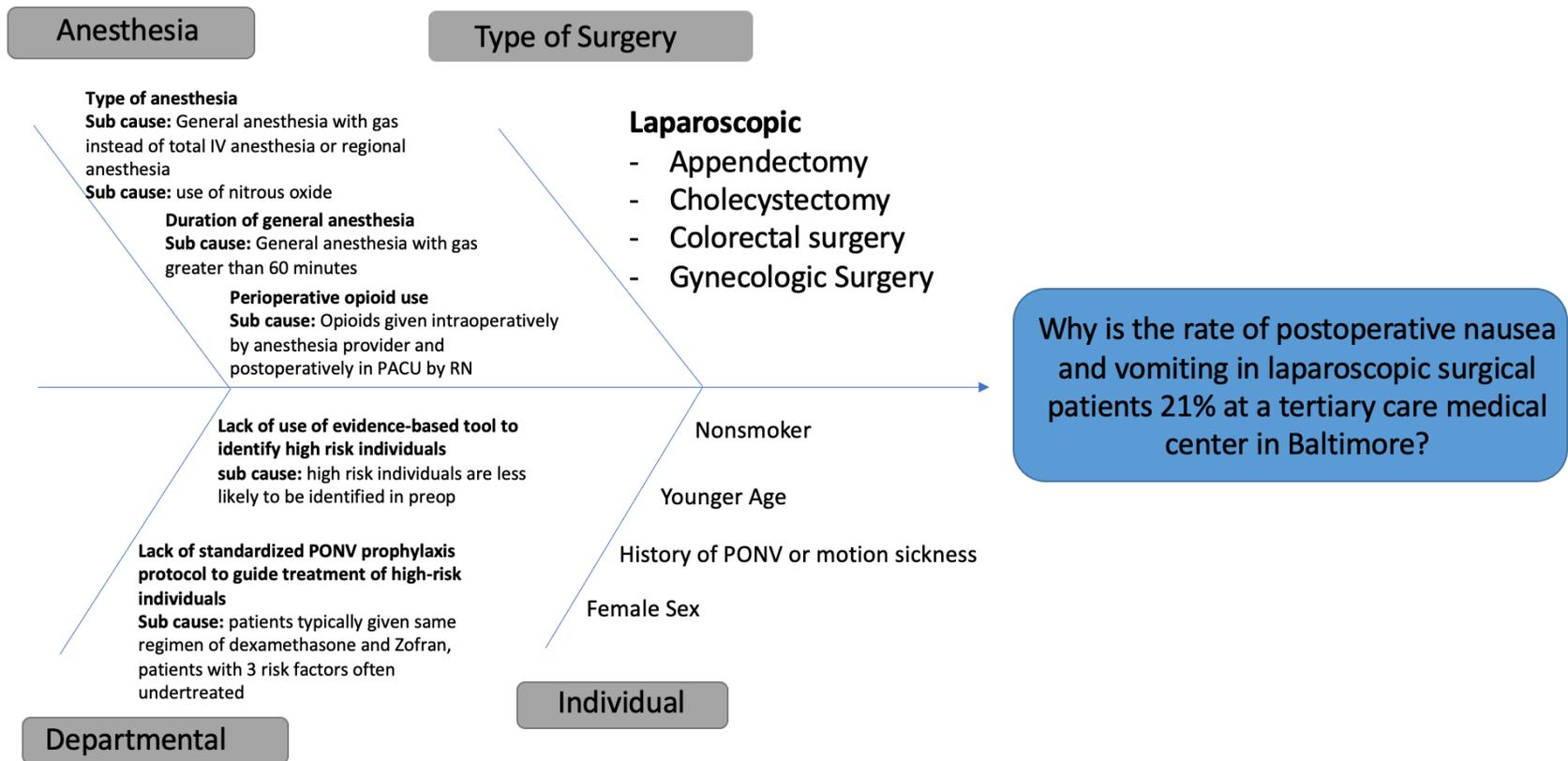


Figure 2.

PARIHS Framework (Adapted from Kitson et al., 2008) (University of Maryland School of Nursing, n.d.)

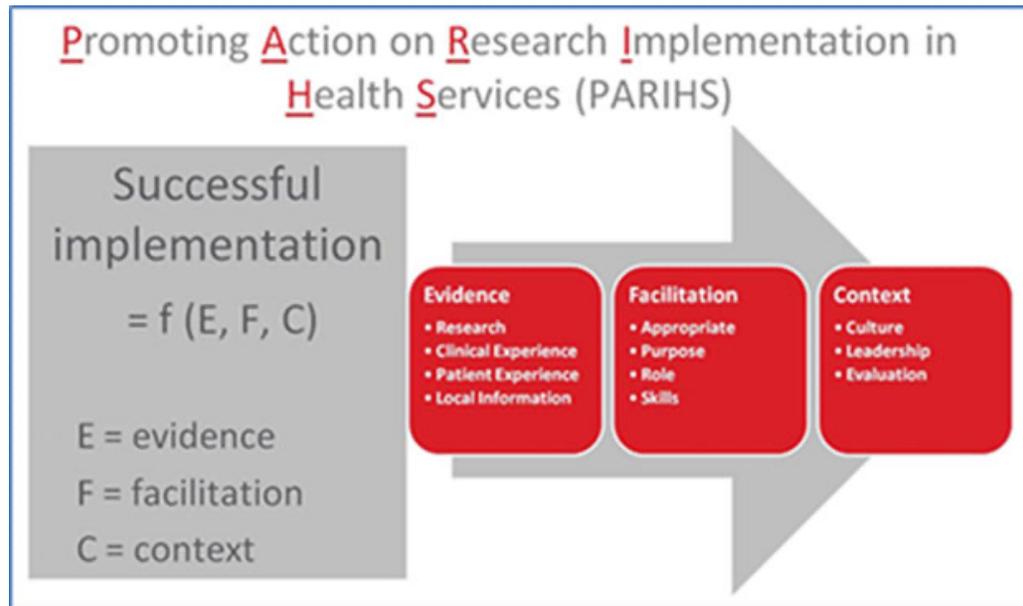


Figure 3.

Current Process Map

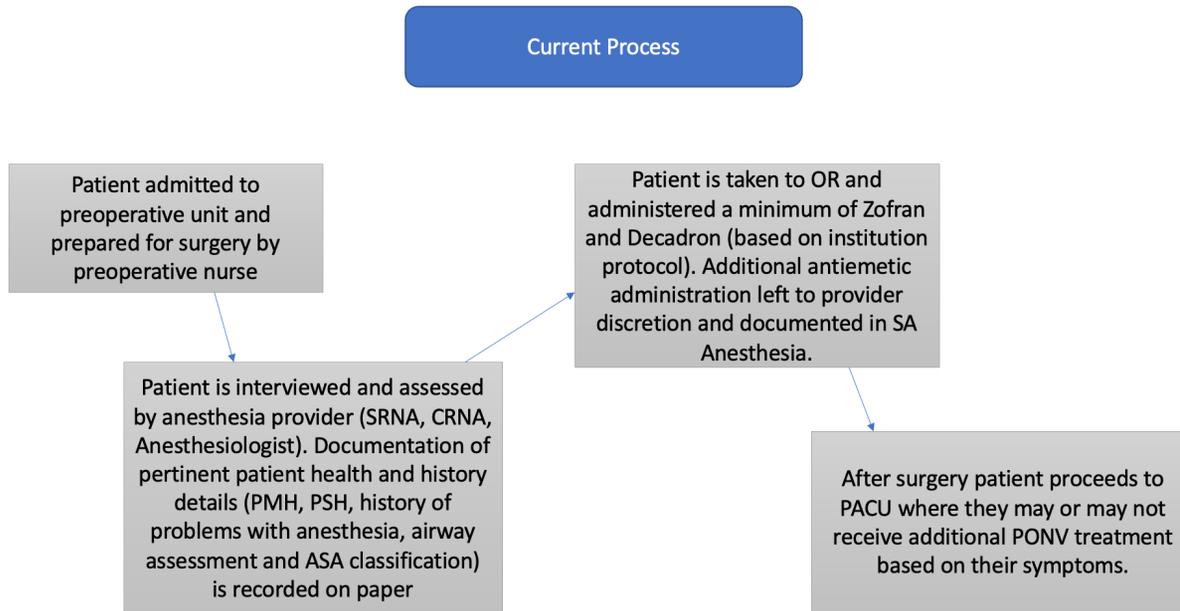


Figure 4.

Desired Process Map

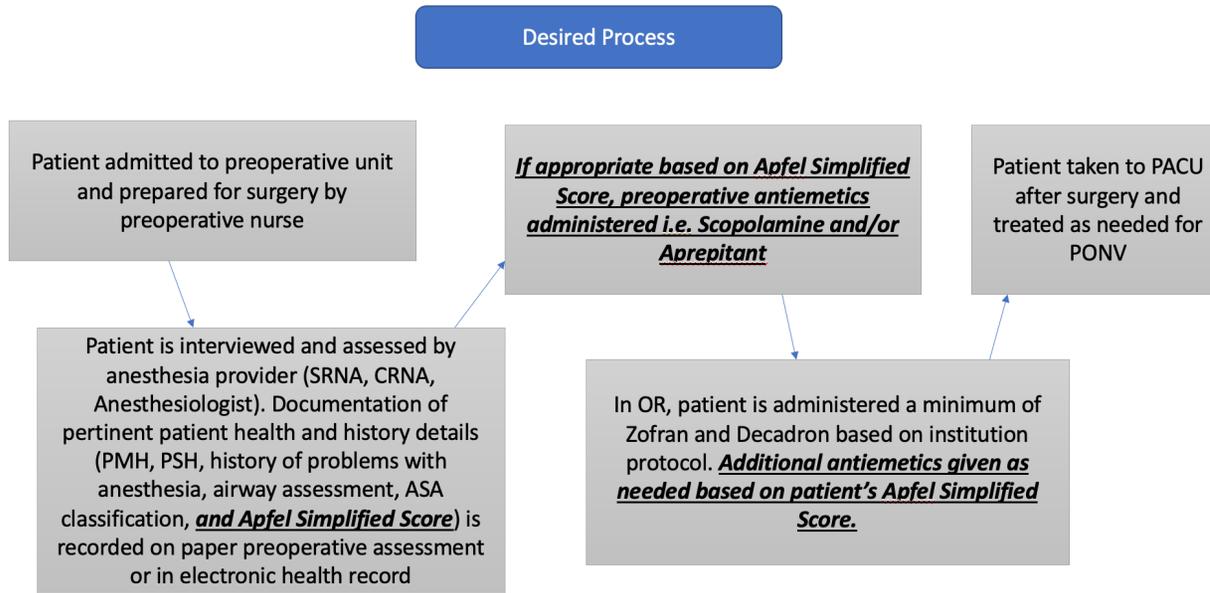


Figure 5.

Run Chart for PONV Risk Assessment (Apfel Score) Completion

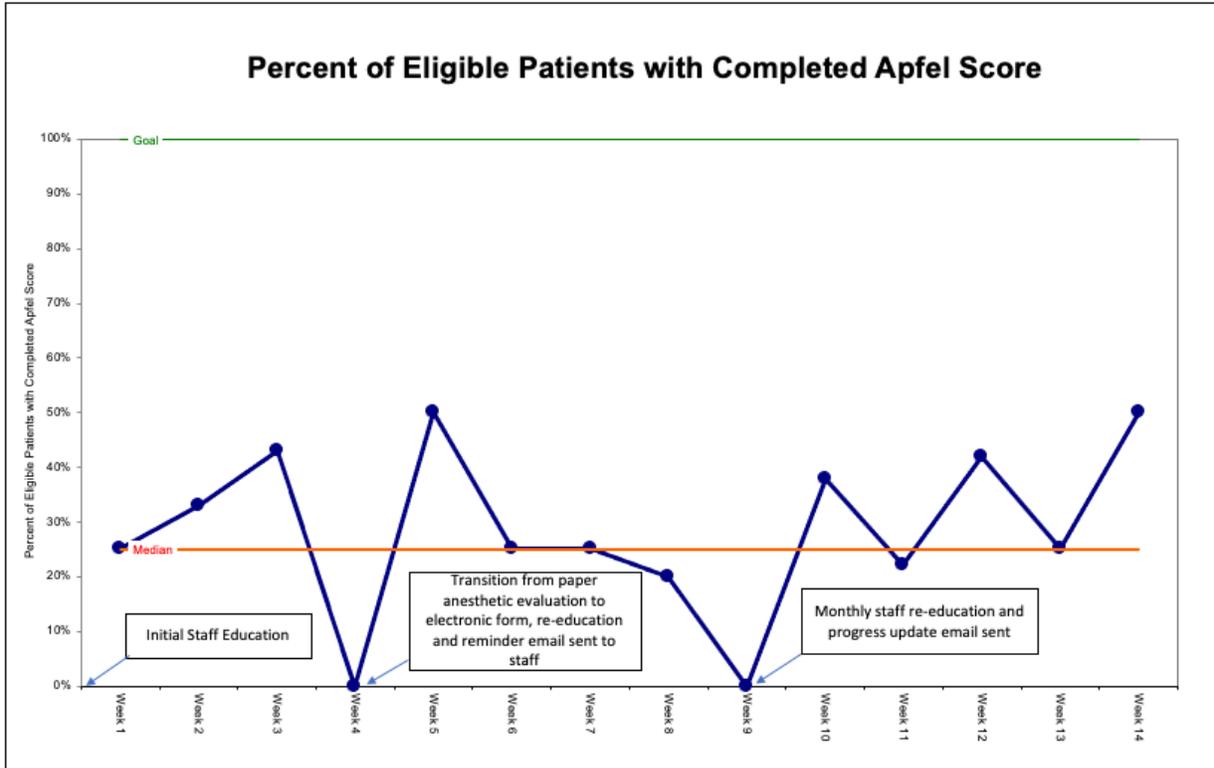


Figure 6.

Adherence to PONV Prophylaxis Guideline in Patients with Completed Apfel Score

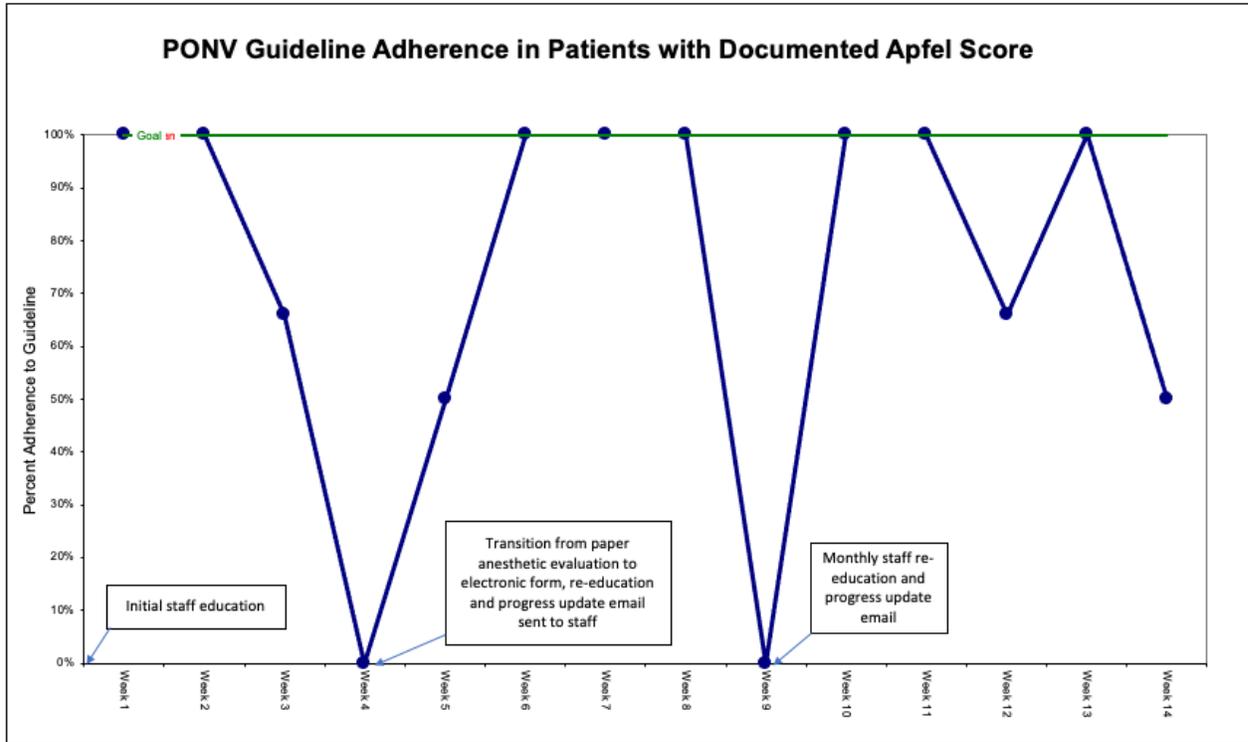
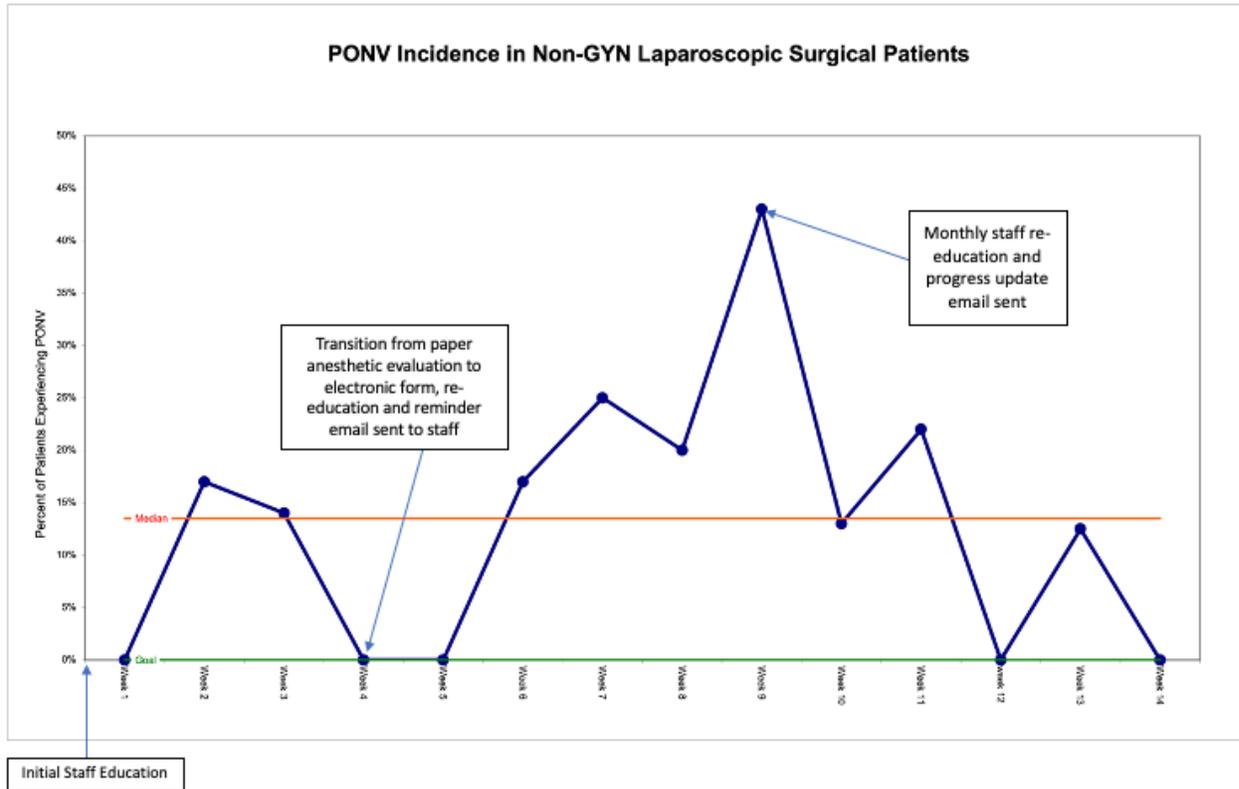


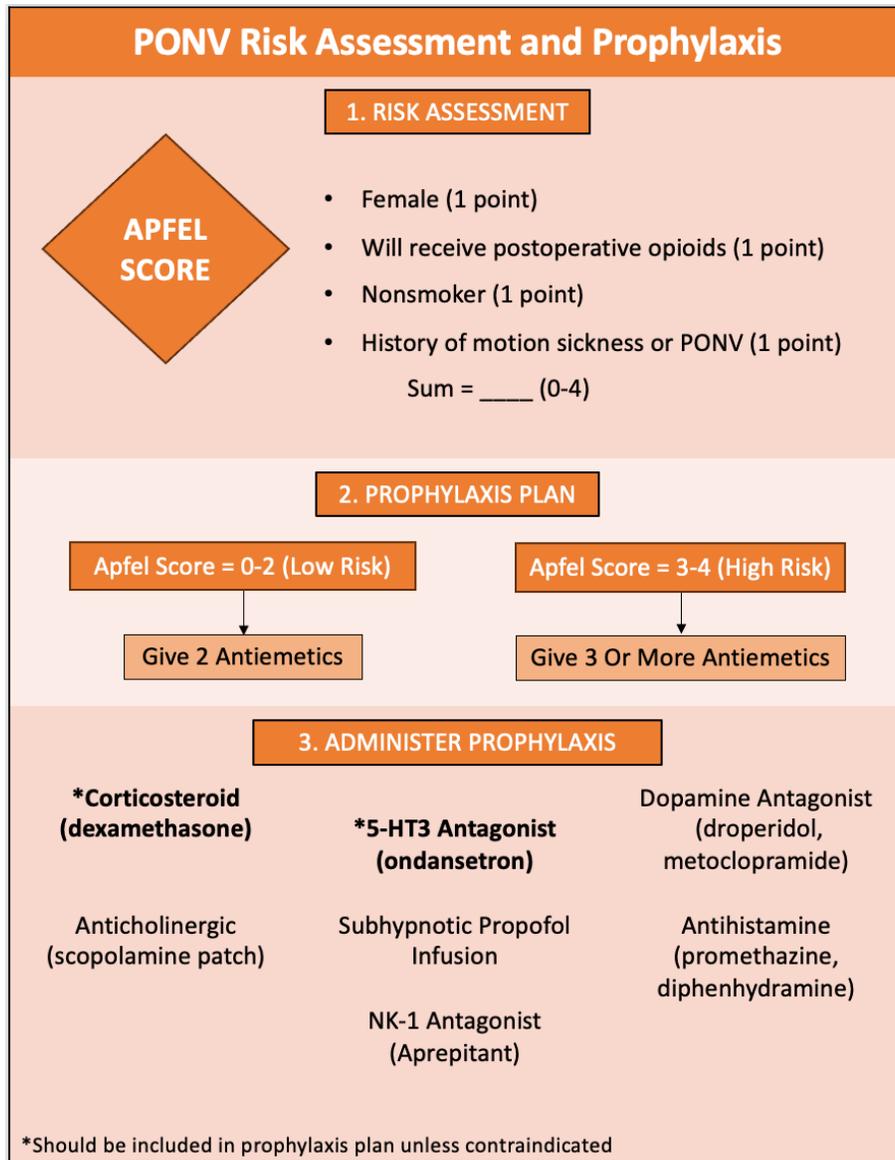
Figure 7.

Weekly Incidence of PONV in Non-Gynecologic Laparoscopic Surgical Patients



Appendix A

PONV Risk Assessment and Prophylaxis Guideline



Appendix B
Chart Audit Tool

Record ID _____

MRN _____

Was the Apfel Score accurately completed on the preoperative assessment? Yes
 No

Apfel Score _____

Total number of antiemetics administered preoperatively and intraoperatively _____

Were the correct number of antiemetics administered per the patient's Apfel Score and corresponding guideline? Yes
 No

Did the patient experience nausea and/or vomiting in PACU? Yes
 No