SCHOLARLY PAPER: RISK FACTORS AND NAUSEA PROPHYLAXIS IN THE GYNECOLOGICAL (GYN), UROLOGICAL, AND EAR NOSE AND THROAT (ENT) SURGICAL POPULATIONS IN A SUBURBAN HOSPITAL SURGICAL POPULATION

by

Meghan Marie Sullivan

A doctoral scholarly project submitted to the faculty of
The University of North Carolina at Charlotte
in partial fulfillment of the requirements
for the degree of Doctor of Nursing Practice

Charlotte

2023

Approved by:

_____

Dr. Stephanie Woods

_____

Dr. Karen Lucisano

_____

Dr. Jenny Dhingra

_____

Dr. Shanti Kulkarni

_____

Dr. Shue McGuffin

ABSTRACT

MEGHAN MARIE SULLIVAN. Risk factors and Nausea Prophylaxis in the Gynecological (GYN), Urological, and Ear Nose and Throat (ENT) Surgical Populations in a Suburban Hospital Surgical Population (Under the direction of DR. STEPHANIE WOODS PHD)

This is a quality improvement (QI) project that examines post-op nausea and vomiting prophylaxis (PONV) and PONV in the Post Anesthesia Care Unit (PACU) in a Suburban hospital that is part of a large hospital system. Post operative nausea and vomiting (PONV) causes negative health sequelae, increases the financial burden, and decreases patient satisfaction. The clinical question for this QI project is: In the population of Gynecological (GYN), Urological, and Ear, Nose, and Throat (ENT) surgical patients 18 years and older, how do patient, anesthetic, and surgical risk factors for PONV and the delivery of antiemetics affect the incidence of PONV in a Suburban Hospital setting?

Data related to patient anesthesia, and surgical risk factors, and PONV in the PACU was collected via chart review. Data analysis was conducted to determine patient, anesthetic, and surgical risk factors, and PONV prophylaxis administration. The relationship between the Apfel score and the number of antiemetic medications administered during the intraoperative period was determined to not be predictive of antiemetic administration. Patient, anesthetic, and surgical risk factors did not predict PONV. The percentage of PONV was 14.29% at the Suburban hospital location. 60% of the patients in this sample did not receive the appropriate antiemetic prophylaxis, including under and over-administration. Education on patient, anesthetic, and surgical risk factors, and appropriate PONV prophylaxis administration per the Fourth Consensus Guidelines is recommended to improve practice.

Keywords: PONV, gynecologic, ENT, Urologic, surgery, suburban hospital, community hospital, anesthesia

ACKNOWLEDGEMENTS

I would like to thank the committee, Dr. Stephanie Woods, Dr. Karen Lucisano, Dr. Jenny Dhingra, Dr. Shanti Kulkarni, and Dr. Katie Shue-McGuffin, for their support throughout this DNP Project. I would also like to recognize and thank Dr. Zhou Chen for his help with the statistical analysis of the data. Finally, I would like to thank Abby Catherine Sanders and Rebekah Ross as I would not have been able to complete this project without them.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1: INTRODUCTION/BACKGROUND

Antiemetic therapy has evolved over the past decade, those with the following risk factors: female gender and undergoing breast, middle ear, gynecological or obstetrical surgery, experience a 70% incidence of postoperative nausea and vomiting (PONV) (Ugochukwu, 2010). Additionally, according to Smith et al. (2012), PONV is "one of the most commonly reported adverse effects of anesthesia" (p. 94). Excessive PONV leads to deleterious health effects such as electrolyte imbalance, dehydration, hypotension, and other systemic complications (Bhakta et al., 2016). The economic implication of PONV is also significant. In ambulatory centers, a delay in surgical turnover due to PONV can lead to substantial financial losses (Girotto et al., 2010). A study at the University of Rochester Medical Center found that each hour of unused operative time costs $3,600 (Girotto et al., 2010).

Multiple risk factors contribute to the development of PONV. These include patient, anesthetic, and surgical risk factors. Combining multiple risk factors might increase the potential risk for PONV development. Patient risk factors contributing to PONV in the adult patient include female gender, younger age, nonsmoker, history of PONV and/or motion sickness, and receiving opioid analgesia (Murphy et al., 2006).

PROBLEM OF INTEREST

Prevention of PONV requires assessing patient risk factors and treating the likelihood of PONV with antiemetics. A nationally recognized scoring system has been created by Apfel and his colleagues based on the consensus guidelines (Apfel et al., 1999). The Apfel-score includes four associated risk factors for PONV: female gender, nonsmoker, postoperative opioid use, and previous PONV or motion sickness (Weilbach et al., 2006). According to Apfel et al. (1999), if the patient has one risk factor, there is a 10-21% incidence of PONV. This percent risk increases

to 29-78% in patients who exhibit two or more risk factors. Each risk factor increases the percent chance of PONV by 20%, with the baseline risk never being less than 10% (Weilbach et al., 2006). Once the number of risk factors the patient presents with is identified, an estimation of the number of different antiemetics agents the patient requires is based on the Apfel score. With a risk score of 0, no antiemetics are recommended; a score of 1-2 indicates 1-2 antiemetics should be given, and a score of 3-4 means 3 or more antiemetics should be administered (Gan et al., 2020). Additionally, it is essential to utilize combination therapy in high-risk patients using antiemetic drugs of different classes to cover all possible physiologic receptors (Gan et al., 2020).

General anesthesia also increases the risk for PONV. Volatile anesthetics, the primary source of anesthesia for general anesthesia surgeries, independently increases PONV (Morino et al., 2012). While the exact etiology is unknown, volatile anesthetics are thought to stimulate several afferent pathways that stimulate vomiting (Horn et al., 2014). Nitrous Oxide is an inhalational anesthetic commonly used in the operating room. A significant decrease in PONV was noted when nitrous oxide was avoided (Shaikh et al., 2016).

Long-acting opioids, such as morphine, used for pain management in the postoperative anesthesia care unit (PACU) and have an increased risk for respiratory depression, urinary retention, pruritus, and PONV (Lim et al., 2016). The use of postoperative opioids doubles the risk of PONV (Pierre et al., 2003). In addition to the use of long-acting postoperative opioids, short-acting opioids like fentanyl and remifentanil are commonly used to blunt surgical stimulation during the beginning of the case. Lim and colleagues (2016) reported that patients who received 2mcg/kg of fentanyl during induction of anesthesia had a higher incidence of PONV.

Increased length of the surgical procedure is associated with an increased risk for PONV. There are multiple theories and potential hypotheses of why this occurs. Shaikh et al. (2016) estimates that a surgery duration greater than 30 minutes increases the risk of PONV by up to 60%. The scholarly project will also assess the patient's surgery duration as a variable for the risk of developing PONV.

PURPOSE OF THE PROJECT

Negative Patient Health Sequela

Many patients undergoing surgery continue to have an unacceptably high level of PONV. PONV can cause adverse patient health sequelae, which can have detrimental consequences for the patient. In research from Bhakta et al. (2016), postoperative nausea may lead to persistent vomiting, which can cause pulmonary aspiration syndrome, electrolyte imbalances, and dehydration. Excessive retching can lead to even more severe effects, such as wound closure, bleeding, tension on suture lines, and venous hypertension (Manahan et al., 2013). In non-ambulatory surgery, these adverse health effects caused by PONV can lead to increased perioperative morbidity, length of stay, prolonged overall recovery, and thus increased overall costs (Smith et al., 2012).

Financial Burden of PONV

The financial burden of PONV is estimated to be $1.5 million per year in lost surgical revenue (Masiongale et al., 2018). When evaluating the overall cost of PONV, hospitals have looked at the financial benefit of prophylactic treatment versus rescue treatment once the patient develops symptoms. A study at Duke University found that prophylaxis was more cost-effective and provided greater patient satisfaction than rescue treatment (Gress et al., 2020). In an audit completed in the post-anesthesia care unit (PACU), supplies and medications accounted for only

2% of the charges, with most charges arising from an increased length of stay (Gress et al., 2020).

Additionally, Gress and colleagues (2020) found that patients who did not suffer from PONV had a PACU stay of 171 minutes. This duration increased to 234 minutes in patients with PONV (Gress et al., 2020). An additional study also demonstrated that each event of emesis increases patient time in the PACU by an additional 20 minutes (Gress et al., 2020). Increased time in the PACU increase the financial burden by increasing the supplies and nursing staff needed and backing up the surgical schedule (Parra-Sanchez et al., 2012).

PICO QUESTION

PICO: In the population of Gynecological (GYN), Urological, and Ear, Nose, and Throat (ENT) surgical patients 18 years and older, how do patient, anesthetic, and surgical risk factors for PONV and the delivery of antiemetics affect the incidence of PONV in a Suburban Hospital setting?

Intra-operative processes that influence the risk for PONV include patient variables measured by the Apfel score, anesthetic variables, surgical variables, and antiemetics administered. There are four specific aims derived from the PICO for this project. For the first aim, the patients were given an individual Apfel score based on their risk factors for PONV. The second aim determined the relationship between the Apfel score and the number of antiemetic medications administered during the intraoperative period. Aim three assessed the prevalence of anesthetic and surgical risk factors, including the use of Nitrous Oxide, volatile agents, intraoperative opioids, such as fentanyl and remifentanil, and surgery length greater than 30 min. Aim four assessed PACU charting to determine if the patient developed PONV.

LITERATURE REVIEW

A literature review was conducted between January 2022 and March 2022. Databases searched included PubMed, Cochrane Database of Systematic Reviews (CDSR), Google Scholar, and ScienceDirect. The keywords used were PONV, gynecologic, surgery, surgery centers, urban, trauma, Fourth Consensus Guidelines, risk factors, nausea, PACU, volatile anesthetics, opioids, Nitrous Oxide, length of surgery, vomiting, antiemetics, adverse health sequelae, and financial burden. The literature review included research studies and articles published from 1999 to 2022. Inclusion criteria were peer-reviewed articles beginning after 1999, written in English with full-text availability. Exclusion criteria were articles published before 1999, not written in the English language, and articles not peer-reviewed were excluded.

Patient Risk Factors

Female Gender

The female gender is an independent risk factor for PONV due to endocrine and hormonal differences after puberty (Golembiewski & O'Brien, 2002). Women experience PONV one and a half to three times more often than males. When this risk factor is combined with gynecological surgery, the incidence of PONV in this population is approximately 45%, significantly higher than the 30% average for other surgical populations (Apfel & Roewer, 2003).

The overall incidence of PONV varied with the female population depending upon the current day of their menstrual cycle (Beattie et al., 1991). Beattie et al. discovered that the incidence of PONV was four times higher during menses than at other times of the month in the female population (1991). Additionally, as women entered menopause, nausea and vomiting became closer to the incidence of the male gender (Beattie et al., 1991). It has been suggested

that scheduling surgery based on the menstrual cycle may be beneficial to reducing overall PONV incidence in the female population due to hormonal differences between male and female genders (Beattie et al., 1991).

The risk of PONV between the genders is significant when determining the overall risk factors for PONV in the adult surgical patient. Pierre et al. (2002) found that when examining the incidence of PONV, males had a lower incidence of PONV when compared to females. Another difference regarding PONV is that females often already have the underlying risk factor of motion sickness or previous PONV, while males do not (Krieser et al., 2020). A study comparing the number of prophylactic agents given for PONV prevention showed that even with computer guidance, females received inappropriate PONV prophylaxis while undergoing general anesthesia compared to their male counterparts (Krieser et al., 2020). For example, 96% of the time, females received inappropriate prophylaxis, compared to males only receiving inappropriate prophylaxis 5% of the time (Krieser et al., 2020). This study supports that females are at a higher risk of developing PONV and are often given inadequate PONV prophylaxis, contributing to the overall increased incidence of PONV in female patients (Krieser et al., 2020).

Age

Age also impacts the risk for PONV in the surgical patient. The highest incidence of PONV occurs in the adolescent population and has an inverse relationship with increasing age (Apfel & Roewer, 2003). The peak incidence of PONV is in school-age children, and it is not increased in females until after puberty (Rose & Watcha, 1999). As noted previously, the increase in PONV after puberty in females may be due to the menstrual cycle (Beattie et al., 1991).

Nonsmokers

Nonsmokers have an increased incidence of PONV when compared to smokers. Although the cause of a decreased incidence associated with PONV in smokers has not been determined, there are many potential reasons. Smokers are exposed to the chemicals in tobacco smoke which may desensitize them to volatile anesthetics or cause cytochrome p450 upregulation and increased metabolism of volatile anesthetics (Werner et al., 2008). Because the use of volatile anesthetics increases the risk for PONV, this may be a significant factor for the decreased level of PONV found in smokers (Morino et al., 2012)

History of PONV/Motion Sickness

A history of PONV and/or motion sickness increases the risk for PONV due to the disturbance of the vestibular apparatus in the inner ear. The vestibular system senses body position and helps with balance (Hromatka et al., 2015). The vestibular system also aids in sensing toxins that may contribute to PONV and need to be excreted from the body (Hromatka et al., 2015). Consequently, a disturbance to the vestibular system (i.e., a history of PONV and/or motion sickness) increases the risk for PONV (Hromatka et al., 2015).

Anesthetic Risk Factors

Volatile agents

Using volatile agents to perform a balanced general anesthetic is standard practice. The most common volatile anesthetics today are Sevoflurane, Isoflurane, and Desflurane. These volatile agents are used to induce and maintain anesthesia throughout the surgery. Volatile anesthetics are associated with a two-fold increase in the risk of PONV (Pierre & Whelan, 2012). The risk of PONV increases with the volatile agent dose (Pierre & Whelan, 2012). It has been shown that the usage of volatile anesthetics is the most crucial factor in predicting nausea and vomiting within the first two postoperative hours (Pierre & Whelan, 2012). Substituting propofol

for a volatile anesthetic while performing total intravenous anesthesia (TIVA) reduces the risk of PONV by about 19% (Fernandez-Guisasola et al., 2020). However, no significant difference between these volatile agents and their effect on PONV has been shown (Pierre & Whelan, 2012).

Nitrous Oxide

The emetogenic effects of Nitrous Oxide is a well-discussed topic in the literature and within the hospital setting. Avoiding Nitrous Oxide can reduce the risk of PONV by 20% (Fernandez-Guisasola et al., 2020). Data shows that the increase in PONV seen with the administration of Nitrous Oxide is highly dependent on the duration of exposure (Peyton & Wu, 2014). The emetogenic effects of Nitrous Oxide are not typically significant until one hour of exposure (Peyton & Wu, 2014), offering the anesthesia provider some assurance that using short-term Nitrous Oxide will not increase the chances of PONV. Therefore, Nitrous Oxide may be administered more in the ambulatory setting, where surgeries have a shorter duration of time. A frequent practice for Nitrous Oxide also includes its use at the end of surgery to help decrease the amount of volatile maintenance anesthetic required. Nitrous oxide helps provide amnesia towards the end of the case while supporting a rapid wakeup. When used for a rapid wakeup, nitrous oxide has not been found to cause PONV (Peyton & Wu, 2014).

Opioids

Another anesthetic agent contributing to PONV includes opioids (Shaikh et al., 2016). Opioid receptors are located in the Chemoreceptor Trigger Zone (CTZ). The CTZ is outside the blood-brain barrier and allows substances in the blood and cerebrospinal fluid (CSF) to interact. Toxins or drugs, such as opioids traveling in the blood, stimulate the CTZ. This stimulation triggers the brain's vomiting center, causing nausea and vomiting (Shaikh et al., 2016).

Surgical Risk Factors

Surgery Duration

Surgery duration is a strong predictor of PONV. If the operating time is increased by 30 minutes, the risk for PONV may be increased by as much as 60% (Shaikh et al., 2016). Surgery duration is hypothesized to be linked to increased exposure to volatile anesthetics and potentially additional intraoperative opioid administration, both emetogenic substances (Pierre, S. & Whelan, R., 2013). With increased surgical duration and volatile anesthetic delivery, there is an increased risk of PONV. There is a gap in the literature regarding whether the surgery duration reaches a peak emetogenic effect or not.

Type of Surgery

Patients undergoing some surgeries are more at risk for PONV than others. There is an increased risk of PONV in gynecological surgery compared to other surgical populations. According to Shaikh et al. (2016), this increased risk may be due to the location of the surgery and the potential for delays in gastric emptying, which also increases the risk of PONV. Additionally, the afferent vagal pathways are in the gastrointestinal system, which, when stimulated, can activate the sensation of vomiting (Shaikh et al., 2016).

The risk of PONV following ENT surgery can be as high as 70% (Erkalp et al., 2014). One potential cause is the flow of blood entering the stomach during the procedure. The literature is unclear on whether gastric decompression following the procedure will improve the incidence of PONV. Other potential causes of PONV stemming from ENT surgery are stimulation of the chemoreceptor trigger zone and stimulation of the trigeminal nerve, which causes activation of chemoreceptors and mechanoreceptors in the stomach and oropharynx (Erkalp et al., 2014).

There is currently insufficient data establishing the incidence of PONV following urologic surgery (Vukovic & Dinic, 2018). One study by Stadler et al. (2003) found that patients undergoing urology surgery have an increased risk of developing PONV compared to vascular and orthopedic surgery and less of an incidence when compared to GYN and maxillofacial surgery.

Fourth Consensus Guideline

The risk factors for PONV, as noted above, can be patient-specific, anesthetic-specific, and surgery-specific. Guideline 1 in the Fourth Consensus Guidelines promotes assessing each risk factor to determine the total number of individualized patient risk factors. Prevention of PONV is essential in the surgical patient. Giving appropriate PONV prophylaxis medications reduces the rate of PONV (Gan et al., 2020).

Per the Fourth Consensus Guidelines, the number of risk factors a patient has determines the number of PONV prophylaxis medications to be given. According to Gillman et al. (2019), "Adherence to PONV prophylaxis guidelines … is still remarkably low" (p. 408). Additionally, "Less than half of medium to high-risk patients receive the appropriate PONV prophylaxis" (Kumar et al., 2012, p. 58). If a patient has one to two risk factors, they should receive two prophylactic agents, and if they have greater than two risk factors, they should receive three to four prophylactic agents (Gan et al., 2020).

The Consensus Guidelines also decreased the threshold for administering PONV prophylaxis to make multimodal PONV prophylaxis a common practice. The Fourth Consensus Guidelines now recommends that adults with one or more risk factors receive multimodal PONV prophylaxis due to concerns that these patients were not receiving adequate prophylaxis. In support of compliance with the Consensus Guidelines, the Centers for Medicare and Medicaid

Services has established a "merit-based incentive payment system (MIPS)" for those who follow the PONV prophylaxis protocol (Gan et al., 2020).

Antiemetics

Many antiemetic medications can be utilized for the prevention of PONV. Antiemetic classes are 5HT3 receptor antagonists, NK-1 receptor antagonists, corticosteroids, antidopaminergics, antihistamines, anticholinergics, and other antiemetics such as gabapentin and Midazolam. These drugs can be used in combination therapy for the prevention of PONV. It was found that combining two or more antiemetics for adult prophylaxis is superior to only utilizing one agent for prophylaxis (Gan et al., 2020).

Dexamethasone, a corticosteroid, ondansetron, a 5HT3 receptor antagonist, and droperidol, a dopamine antagonist, show equal efficacy in preventing PONV (Apfel et al., 2004). However, dexamethasone's low cost and high safety profile make it an attractive first-line agent for PONV (Apfel et al., 2004). Dexamethasone shows the most remarkable efficacy when administered at the beginning of surgery to decrease surgery-related inflammation and is not effective as a rescue agent. Saving 5HT3 receptor antagonists as rescue treatments may be the best way to manage PONV (Apfel et al., 2004). Droperidol has fallen out of favor due to causing dysphoria and the black box warning for its potential to cause torsades de pointes, a lethal heart rhythm. Additionally, while effectively decreasing PONV in females, droperidol shows no risk reduction for men (Apfel et al., 2004).

Additional antiemetics such as scopolamine, a centrally acting anticholinergic and aprepitant, which is a NK-1 receptor antagonist, are also effective in preventing PONV. Although a scopolamine patch is an inexpensive, highly effective drug for preventing PONV, it should be avoided in pediatric and elderly patients, as it does have adverse side effects such as

dry mouth, drowsiness, and visual disturbances (Elvir- Lazo et al., 2020; Kassel et al., 2018; White et al., 2007). A study by Gan et al. (2007) shows that aprepitant is superior to preventing vomiting when compared to ondansetron. However, because of its high cost, it should be reserved for extremely high-risk patients (Elvir-Lazo et al., 2020).

PONV Prevention

Prior research has established that adherence to the guidelines significantly decreases PONV (Stephenson et al., 2021). However, minimal research has been conducted to determine facility compliance with the Fourth Consensus Guidelines. Current research has found a knowledge gap between understanding the Apfel scoring system and the consistent application of its antiemetic interventions into practice (Devarakonda et al., 2022). Routine education on utilizing the Apfel score, as well as staff reminders to administer the proper prophylactic agents, aids in significantly decreasing the percentage of patients who develop PONV (Devarakonda et al., 2022). Even when antiemetics are administered, if they are not administered appropriately according to the protocol, they will not assist in preventing PONV (Gillman et al., 2019).

Öbrink et al. (2015) show that preventing PONV has a four-tiered pyramid approach. The foundation begins with assessing and scoring patients' PONV risk factors utilizing the Apfel scoring system. This is used in combination with providing a multimodal opioid-sparing anesthetic. The next level emphasizes the use of multimodal PONV prophylactic medications. A step-up provides a tailored anesthetic plan for each patient and their risk factors finally, if these three steps fail, rescue therapy in the form of a different class of antiemetics is the final step in the escalating pyramid (Öbrink et al., 2015).

Inappropriate PONV prophylaxis was associated with an 11% incidence of PONV compared to a 4% incidence with appropriate PONV prophylaxis according to the protocol

(Gillman et al., 2019). Additionally, Gillman et al. (2019) found that compliance to the PONV prophylaxis protocol varied between surgical populations, with gynecological surgical patients only having adherence 41% of the time, while urological surgical patients had a 72% adherence rate. It was also discovered that the rates of insufficient PONV prophylaxis were more significant than both overshooting and correct PONV prophylaxis combined (Gillman et al., 2019). Gillman et al. (2019) discovered that patients with Apfel scores greater than or equal to 3 were often administered insufficient PONV prophylaxis. The study supports the need for further research on the patient, anesthetic, and surgical risk factors for PONV, as well as determining compliance with the PONV prophylaxis guidelines in gynecologic, ENT, and urologic surgical patients.

Outcome Variable

PONV in the PACU

The outcome variable assessed was postoperative nausea and/or vomiting in the PACU. It is well established that PONV increases the PACU stay, and resources utilized (Habib et al., 2006). Vomiting is especially detrimental, as it costs nearly 1.5 times more than an episode of nausea in the PACU (Habib et al., 2006). Also, adverse health effects caused by PONV can cause and increase in length of stay, length of recovery, perioperative morbidity and due to this increase overall costs for patient care (Smith et al., 2012). Increased duration of stay in the PACU increased the burden placed on the hospital by increases resources utilized which include supplies, lags in the surgical schedule, and nursing staff (Parra-Sanchez et al., 2012). PONV in the PACU affects the hospital as a whole if the patient in turn needs to be admitted.

PONV in the Suburban Perioperative Setting

The American Hospital Association defines a hospital system as either three or more single hospitals brought into membership or a multihospital system with two or more hospitals obtained or managed by a central organization (2021). Hospitals can vary in many ways and are primarily categorized based on their size: large, medium, and small. A large hospital has more than 400 beds, a medium-sized hospital has between 100-399 beds, and a small-size hospital has between 20-99 beds (Hamai et al., 2017).

Hospitals can also be categorized based on whether they are community or non-community. The public can access community hospitals, which may also be teaching hospitals or academic medical centers (American Hospital Association, 2021). Community hospitals are non-federal hospitals with the capability for short-term general care or care for a specialty population. North Carolina has 112 community hospitals, which is 2.18% of all community hospitals in the country (American Hospital Association, 2021). A specialty population might be a population such as an orthopedic hospital or rehab hospital (American Hospital Association, 2021).

Suburban Community Hospitals

Patient populations vary based on location. Generally, urban areas have higher poverty rates when compared to rural and suburban areas, but most poor Americans live in the suburbs (Kneebone, 2016). The Pew Research Center determined that the suburbs have increased population size from 2000 to 2016 more than urban and rural areas. Additionally, the poverty level has grown more in the suburban regions when compared to urban and rural areas in the United States since 2000. Approximately 49% of the impoverished in the United States live in the suburbs, 34% in urban areas, and 17% in rural areas (Parker et al., 2020).

Schnake-Mahl & Sommers (2017) compared insurance coverage and healthcare access in different areas such as suburban, urban, and rural areas. This study included 2005-2015 from the

Behavioral Risk Factor Surveillance System (BRFSS). The BRFSS is a national telephone survey across the United States completed by adults over eighteen. The sample size used in the study was 3,259,300 people from all fifty states. Individuals included were the ages of 18-64 years old. The elderly population, more than 64 years old, was omitted because most individuals are insured by Medicare (Schnake-Mahl & Sommers, 2017). Schnake-Mahl & Sommers (2017) determined that suburban areas are 41.2% of the uninsured population. Although uninsured rates after the Affordable Care Act (ACA) between urban and suburban people have decreased, there was less growth of insured in suburban areas. Schnake-Mahl & Sommers (2017) found that insurance coverage and access to care in the suburban population did not significantly improve after the implementation of the ACA.

The emergency department of many hospitals is often a primary care provider for lower socioeconomic classes in the United States, most commonly the uninsured (Weisz, 2015). Many poor, uninsured suburban residents go without primary preventative care. As a result, specific disease processes may progress to later stages before diagnosis, and there may be a lack of continuity of care (Wilper et al., 2009). Uninsured individuals often have employment in low-paying positions but make more money than would allow them to qualify for Medicaid, putting them in a vulnerable and challenging situation (Felland, Lauer, & Cunningham, 2009). Individuals in suburban areas may also have trouble accessing transportation for their healthcare-related visits, a significant barrier to care (Felland, Lauer, & Cunningham, 2009). The emergency departments of suburban hospitals have often become the primary care provider for these low-income, uninsured individuals (Felland, Lauer, & Cunningham, 2009). Access to care varies between urban and other areas. The American College of Obstetrics and Gynecology (2014)

found that women that live in non-urban areas have less access to care and have poorer health outcomes due to the lack of access to care.

Suburban areas have increased in population from 2000-to 2016. The suburbs increased from 53 to 55% (Parker et al., 2020). The increasing population size of suburban areas places a more significant burden on suburban community hospitals for patients to access care and services. However, according to the AHA, since 2017, there has been an increase in the overall number of hospitals in the United States from 5,564 in 2017 to 6,090 in 2021 (American Hospital Association, 2021 & 2017). The number of hospital beds per capita is similar in metropolitan and nonmetropolitan areas, but the number of intensive care unit (ICU) beds will differ. Urban areas typically have an increased number of ICU beds compared to nonmetropolitan areas. Metropolitan areas have approximately 2.9 ICU beds per 10,000 people compared to nonmetropolitan sites, with 1.6 ICU beds per 10,000 people (Joyce, 2020). The difference in the number of ICU beds per capita may affect surgical cases and procedures done in these nonmetropolitan areas. Due to this unique patient population of uninsured individuals and reduced ICU beds, it is imperative to control the number of PONV cases in suburban areas.

Overall Summary

The Fourth Consensus Guideline for the Prevention of PONV is a valuable tool for guiding the management of PONV in the perioperative setting. There is a gap in the literature in determining whether anesthesia providers administer additional antiemetics based on patient, anesthetic, and surgical risk factors. Patients undergoing general anesthesia still experience a 30% incidence of PONV (Pierre, S. & Whelan, R., 2013). Patient risk factors contributing to PONV in the adult population include female gender, younger age, nonsmoker, surgery type, history of PONV and/or motion sickness, and receiving postoperative opioid analgesia (Murphy

et al., 2006). Anesthetic risk factors include Nitrous Oxide, volatile anesthetics, and opioids. Surgical risk factors include the length of surgery greater than 30 minutes. The unique characteristics of each of these patient variables play a role in determining which factors increase the rate of PONV in the PACU. The outcome variable that was assessed is PONV in the PACU. Understanding how risk factors for PONV influence the patient's anesthetic will ultimately help mitigate adverse patient health sequelae and decrease the financial burden caused by PONV.

CONCEPTUAL FRAMEWORK

Quality improvement projects often use a tool to help shape their methods. The conceptual framework used for this DNP project was the Plan, Do, Study, Act (PDSA) framework. Each portion of the framework helps to outline the DNP project. Each term has a meaning, Plan involves planning a change or the focus of the project implementation, Do is the active portion or execution of the Plan, Study is the analysis of the data collected, and Act is what action is going to be taken based on these results (Moran et al., 2020). The PDSA model was applied to this DNP project to help lay out a framework for implementing the project plan.

Plan/Do: This project lays a foundation for a quality improvement project on PONV following GYN, Urology, and ENT procedures. A literature review on patient, anesthetic and surgical risk factors for PONV was conducted. Additionally, the literature review included PONV prophylaxis, negative health sequelae related to PONV, and the financial burden of PONV. Chart reviews were performed at an urban hospital to determine patient, anesthetic, surgical risk factors, and PONV prophylaxis administration.

Study: After the data was collected, it was analyzed, and the results were gathered from the suburban hospital. The incidence of PONV at the suburban hospital site was determined based on anesthetic chart review. Incidence of PONV was compared with the number and class

of antiemetic drugs administered. Finally, the data collected on the outcome variable, PONV in the PACU, was analyzed and compared to the number of patient, anesthetic, and surgical risk factors the patient had, as well as the number and type of PONV prophylactic medications given. The data was then reviewed to determine the compliance by assessing if the number of patient risk factors is consistent with the number of PONV prophylactic medications given, as outlined in the Fourth Consensus Guideline.

Act: Based on the statistical analysis, a plan is recommended to improve PONV prophylaxis and minimize the number of modifiable risk factors. Future Quality Improvement projects can determine barriers to appropriate PONV prophylaxis and differences in anesthetics. Additionally, education can improve providers' knowledge of the patient, anesthetic, and surgical risk factors for PONV and the recommended prophylactic treatment.

CHAPTER II: METHODOLOGY

PROJECT DESIGN, TIMING, AND DATA COLLECTION METHODS

The project design for this quality improvement project on risk factors and nausea prophylaxis in the Gynecological (GYN), Urologic, and Ear Nose and Throat (ENT) surgical population is a descriptive design. A descriptive design emphasizes objective measurements and statistical, mathematical, or numerical analysis of data collected without changing the current environment (Babbie, 2010; Nebeker, n.d.). This project consists of data collection from a suburban hospital. Data was collected on the number of GYN, urologic, and ENT patients who received appropriate prophylaxis for nausea based on the Apfel score for Postoperative Nausea and Vomiting (PONV) as well as an additional anesthetic and surgical risk factors.

SETTING/DEMOGRAPHICS

Suburban Hospital

This project was conducted at a medium size suburban hospital with 12 operating rooms. The average number of surgeries performed is approximately 36 per day, which does not include non-operating room (NORA) procedures; specific to this project, the suburban hospital completes approximately 5 GYN and 4 Urologic surgeries per day, and 1 ENT surgery per week (Atrium Health, 2022). There are 15 anesthesiologists and 57 CRNAs on staff.

The suburban hospital serves a population of 8,749, and most residents rent their homes. The median household income for residents is $52,967, lower than the national average of $62, 843. 12% of the population has a master's degree or higher, 32% has a bachelor's degree, and 30% has an associate degree. The percentage of females is 56%, and males are 44%. Most of the population is between 25-34 years old. The racial diversity of the population is 45% White, 31% African American, 14% Hispanic, and 6% Asian (Niche, 2022). Additionally, a unique characteristic of this suburban hospital is that it is located near the border of two states, thus serving communities in two different states.

SAMPLE

Determining the sample size and composition was a crucial step in implementation of this DNP project. This scholarly project included patients at a suburban hospital undergoing several surgical procedures that typically experience PONV: GYN, ENT, and urologic surgeries to have a diverse sample of men and women. Data was collected from chart review of patients who meet the inclusion criteria of patients over 18 receiving general anesthesia for GYN, ENT, and urologic surgeries and were cared for by certified registered nurse anesthetists (CRNAs) maintain employment at the suburban hospital setting. Convenience sampling was used for this project and is often used based on the accessibility of obtaining the data (Lavrakas, 2008). The convenience sample for this project consisted of the first 35 people undergoing gynecological

surgery, urological surgery, and ear, nose, and throat surgery at the Suburban hospital setting. An equal number of patients from each surgical population was attempted to be acquired. It was challenging to obtain an equal number of patients from each surgical population due to the case variety at this suburban hospital location. The data collected was then placed into an excel spreadsheet to organize the variables.

Chart review and data collection was completed for those participants meeting the project inclusion criteria having surgery between August 1st, 2022, and August 30th, 2022. The inclusion criteria were individuals over 18 years old who had GYN, ENT, or Urology procedures performed under general anesthesia at the suburban hospital location. The exclusion criteria were individuals under 18 years old who did not have general anesthesia or did not undergo GYN, Urology, or ENT procedures at the suburban hospital location.

TOOLS/MEASURMENTS

An excel spreadsheet was created with a list of patient, anesthetic, and surgical risk factors for PONV, as well as the prophylactic antiemetics outlined in the Fourth Consensus Guidelines (1999). Patient risk factors for PONV, as outlined by Apfel et al., included female gender, nonsmoker, history of PONV or motion sickness, and receiving opioid analgesia post-operatively (Murphy et al., 2006). Anesthetic risk factors assessed included the use of Nitrous Oxide, volatile anesthetics, and intraoperative opioids such as remifentanil and fentanyl. Finally, the surgical risk factor assessed is the length of surgery being greater than 30 minutes. This excel spreadsheet served as the data collection sheet for performing chart reviews. The antiemetic drugs for the prevention of PONV that are outlined in the Fourth Consensus Guidelines and that are listed on the data collection sheet include 5-hydroxytryptamine (5-HT 3) receptor antagonists, neurokinin-1 (NK-1) receptor antagonists, corticosteroids, antidopaminergics,

antihistamines, anticholinergics, gabapentin, intramuscular Ephedrine, and Midazolam given at the end of the case (Gan et al., 2020).

METHODS

The sample population was limited to 35 patients aged 18 years or older undergoing GYN, urologic, and ENT procedures between August 1st, 2022, and August 30th, 2022. 35 patients were collected from the suburban surgical site. This included the first 35 patients who meet the inclusion criteria from the surgery type: GYN, urologic, and ENT. The sample was collected from the electronic health record (EHR). Data collection was consistent by setting limitations on the sample population. The data collection sheet outlined above was utilized to organize the data.

A thorough and well-planned data collection sheet was created, an EHR champion was recruited to decode the EHR. The EHR champion was educated on the risk factors and prophylactic medications for PONV before they collected the data from the EHR charts. The EHR champion provided education on how data on PONV risk factors and prophylactic medications are recorded in the chart. Together this allowed the ability to be confident that the information needed was accurately conveyed on the data collection sheet.

After the data was collected, each patient encounter was assessed on four variables. First, each patient received an Apfel score of 0-4 based on patient risk factors for PONV, as outlined above. Second, additional anesthetic and surgical risk factors were tallied. Third, the amount and type of antiemetics the patient received during the intraoperative period was counted. Finally, compliance with the Fourth Consensus Guidelines was determined based on the number of antiemetics given compared to the number of patient risk factors. Compliance was determined by comparing this data to the recommended number of prophylactic agents as outlined by the Apfel

score. After these four variables were assessed and counted, a tally of each risk factor was counted for all 35 patients. The data was then compared.

Accuracy of data retrieved from the chart was ensured by limiting the sample to patients older than 18 and undergoing GYN, Urologic, and ENT procedures, as well as by reviewing the same patient, anesthetic, and surgical risk factors, and prophylactic medications for each patient. The data collector thoroughly reviewed the input in the excel sheet to ensure it was accurate. Close communication with the data collector occurred to continue to answer any questions which may have come up.

Intervention/Project Protocol

The data collection protocol consisted of a patient, anesthetic, and surgical risk factors, antiemetics, and PONV in the PACU at the Suburban Hospital facility. Data collection occurred from charts from August 1st, 2022, and August 30th, 2022. to reach a sample size of 35 from the suburban surgical site from GYN, Urological, and ENT surgical populations. After data was collected, the statistical analysis was completed, and a conclusion was formed based on the statistical significance of the data results.

DATA MANAGEMENT STRATGIES & CONFIDENTIALITY OF DATA

The EHR used for chart review was Epic. To protect patient privacy, only the data collector only had access to identifying patient data. The sample population was de-identified before access to the patient data occurred. The patient names and MRN numbers were only available to the data collector and not listed in the data collection sheet. The data management programs used included Excel.

TIMELINE

The first step to obtaining IRB approval was completing the Quality Improvement template and sending it to the Atrium Health DNP council. Once approved, the project was then submitted to Wake Forest Baptist Health IRB and UNC Charlotte IRB. During that time, the recruitment of an EHR champion to assist with chart reviews occurred. Chart reviews began on August 1, 2022. Analysis of the data occurred between August and September of 2022. At that time, the final draft of the final project defense began. The final written project defense will be submitted in November 2022. The oral defense of the project will be presented at the beginning of December 2022.

DATA ANALYSIS AND EVAULATION

Data analysis was completed with basic descriptive statistics. After data was collected and compiled, identifying missing data was performed. The missing data was identified and managed. Identifying and managing the missing information was essential step in evaluating the collected data.

The statistical analysis was conducted based on the DNP project clinical question. A descriptive analysis of the sample characteristics was conducted on data gathered from the suburban surgical facility. Descriptive analysis did include a description of the sample, risk factors, and PONV prophylactic medications. The mean Apfel score, the mean number of anesthetic risk factors, the mean number of surgical risk factors, and the mean number of antiemetics given was determined. A paired t-test calculated a statistically significant difference between the mean of each risk factor. The standard deviation and range for the suburban location's data was calculated.

Additionally, descriptive analysis of the data collected and the Apfel scores was completed and summed. This included the frequency of the individual patient risk factors

according to the Apfel score, anesthetic risk factors, and surgical risk factors. For example, the number of patients who received Nitrous Oxide. Next, the aggregate means Apfel score was calculated and compared with the aggregate mean number of prophylactic antiemetic medications given to determine the suburban hospital facility compliance with the Fourth Consensus Guidelines.

If the patient experienced nausea, they received a score of 1 in that particular data collection spreadsheet column. If the patient experienced an episode of vomiting, then a separate column was created where they received a score of 1. No nausea or vomiting earned the patient a 0 in each of the aforementioned data collection spreadsheet columns.

The incidence of PONV in the PACU was compared to the patient's anesthetic, surgical and individual risk factors to assess correlation. Finally, the incidence of PONV was compared to the number of prophylactic antiemetic agents given to determine if the data was inversely related. For example, did an increase in the number of antiemetic agents administered decrease the incidence of PONV. In conclusion, PONV in the PACU was the outcome variable assessed.

ANALYSIS DESCRIPTION

All data was analyzed with descriptive statistics initially including means and standard deviations and frequencies. Multiple linear regression analysis was incorporated to test associations between patient risk factors, anesthesia risk factors and surgical risk factors effect on post-op nausea and vomiting. Regression analysis tested associations of the Apfel score, anesthesia risk factors, and surgical risk factors on antiemetics administered. A paired T-test analysis was conducted comparing actual antiemetics administered with expected antiemetic administration.

CHAPTER III: FINDINGS

PROJECT FINDINGS

The Suburban Hospital that was used for this quality improvement project is a Suburban Hospital that is part of a larger hospital system. This Suburban Hospital is located approximately 10 miles outside of the city of Charlotte, North Carolina. A variety of surgical procedures are performed at this hospital on the adult patient population. The patient sample for this quality improvement project represents a cross section of this community's population. Thirty-five patients 18 years and older undergoing GYN (n = 17) urologic (n = 17), and ENT (n = 1) procedures at a suburban community hospital made up the sample in this quality improvement project. The average age of the sample population was 54.2 years (sd =17.38) with a range of 25 to 81 years. The patient and anesthesia risk factors and presence of post-op nausea/vomiting are noted in Table 1. The surgical risk factor of length of surgery was surgery greater than 30 minutes. The data on the frequency of antiemetic medications administered was collected. The most commonly administered antiemetic was 5HT3 receptor antagonist.

Table 1.

Patient and anesthesia risk factors and post-op nausea/vomiting

Item	Descriptor	Frequency
Gender	Female = 23 Male = 12	65.7% were female
History of PONV/motion sickness	Yes = 1 No = 34	2.86% had History of PONV/motion sickness
Nonsmoker	Yes = 31 No = 4	88.6 % were non-smokers
Post op opioid administration	Yes = 2 No = 33	5.71% received a post op opioid
General anesthesia	Yes = 35 No = 0	100.00% received general anesthesia
Volatile Anesthetics	Yes = 35 No = 0	100.00% received volatile anesthetics
Nitrous Oxide Use	Yes = 12 No = 23	34.29% received nitrous oxide
Intraoperative opioid use	Yes = 1 No = 34	97.14% received an intraoperative opioid

Surgery greater than 30 minutes	Yes = 23 No = 12	65.71% had a surgery length greater than 30 minutes
5-HT3 receptor antagonist	Yes = 32 No =3	91.43% received a 5-HT3 receptor antagonist
NK-1 receptor antagonist	Yes = 0 No = 35	0.00% received a NK-1 receptor antagonist
Butyrophenones	Yes = 0 No = 35	0.00% received a butyrophenone
Metoclopramide	Yes = 0 No = 35	0.00% received metoclopramide
Phenothiazine	Yes = 0 No = 35	0.00% received a phenothiazine
Prochlorperazine	Yes = 0 No = 35	0.00% received prochlorperazine
Antidopaminergics	Yes = 0 No = 35	0.00% received an antidopaminergic
Versed	Yes = 0 No = 35	0.00% received versed
Gabapentin	Yes = 0 No = 35	0.00% received gabapentin
Anticholinergic	Yes = 5 No = 30	14.29% received an anticholinergic
Antiemetic steroids	Yes = 18 No = 17	51.43% received an antiemetic steroid
PACU: post-op nausea and vomiting	Yes = 5 No = 30	14.29% had PACU: post-op nausea and vomiting

The PICO question for this quality improvement project was: In the population of Gynecological (GYN), Urological, and Ear, Nose, and Throat (ENT) surgical patients 18 years and older, how do patient, anesthetic, and surgical risk factors for PONV and the delivery of antiemetics affect the incidence of PONV in a Suburban Hospital setting?

Findings addressing the specific aims derived from the PICO for this project are as follows: For the first aim, the patients were given an individual Apfel score based on their risk factors for PONV which were female gender, younger age, non-smoker, history of PONV and/or motion sickness, and receiving opioid analgesia. The average Apfel score was determined to be 1.63 with a standard deviation (SD) of 0.65, and range of 1 to 3. The minimum Apfel score was 1 and the maximum score was 3. The most common Apfel score across the suburban hospital

data set was 1. The median Apfel score was 2. The risk factors of female gender, non-smoking, history of PONV/motion sickness, and postoperative opioid use are the risk factors that comprise the Apfel score. Female and non-smoker were the two variables that contributed most to the average Apfel score.

The second aim compared the Apfel score, and the number of antiemetic medications administered during the intraoperative period. Table 2 depicts the actual number of antiemetics administered and the number of antiemetics recommended by the Fourth Consensus guidelines for PONV prophylaxis per Apfel score. Paired-sample t-test showed that the number of actual antiemetics administered ($M = 1.57$, $SD = 0.74$) was significantly less than the number of expected antiemetics administered ($M = 2.17$, $SD = 0.57$), $t = 3.88$, $p < .001$). The Fourth Consensus Guidelines are a clinical guide for practitioners to help administer the appropriate number of antiemetic medications based on the patients individual Apfel score. An Apfel score of 0, per the Fourth Consensus Guidelines, no antiemetics are recommended. An Apfel score of 1-2, it is recommended 2 antiemetics should be given, and a score of 3-4 means 3-4 antiemetics should be given (Moore et al., 2021).

The Apfel score at this Suburban Hospital was not associated with the number of actual antiemetics administered. The number of antiemetic medications that patients should have received based off their individual Apfel score was less than number recommended by the Fourth Consensus Guidelines. The patients at this suburban hospital location did not receive appropriate PONV prophylaxis as per the Fourth Consensus Guidelines. Table 2 outlines actual amount of antiemetics administered versus antiemetics recommended as per Apfel score based on the Fourth Consensus guidelines.

There were no patients in this sample with an Apfel score of 0. 16 patients in this sample had an Apfel score of 1, 16 patients had an Apfel score of 2, and 3 patients had an Apfel score of 3. There were no patients that had an Apfel score of 4. Patients with an Apfel score of 1, 62.5% of patients did not receive the appropriate number of antiemetics. Patients with an Apfel score of 2, 31.25% of these patients received an incorrect number of antiemetics per the Fourth Consensus Guidelines. Finally, patients with an Apfel score of 3, 100% received an inadequate number of antiemetic prophylactic medications. Overall, 60% of the patients in this sample did not receive the appropriate antiemetic prophylaxis, including both under and over administration. 51% of the sample received an inadequate number of antiemetics meaning that they did not receive enough prophylaxis. 8.57% of the sample received more than the recommend number of antiemetics meaning they received more than recommended prophylaxis.

Table 2.

Apfel Score vs Actual number of antiemetics administered vs Recommended antiemetics administered

Apfel score – patient risk factors	Actual number of antiemetics administered for the Apfel score	PONV Prophylaxis – number of antiemetics recommended per Apfel score based on Fourth Consensus guidelines
Less than 1	-	0
1	2 patients received 0 antiemetics 8 patients received 1 antiemetic 5 patients received 2 antiemetics 1 patient received 3 antiemetics	2
2	5 patients received 1 antiemetic 9 patients received 2 antiemetics 2 patients received 3 antiemetics	2

3	1 patient received 1 antiemetic 2 patients received 2 antiemetics	3-4
4	-	3-4

Aim three assessed the prevalence of anesthetic and surgical risk factors, including the use of Nitrous Oxide, volatile agents, intraoperative opioids, such as fentanyl and remifentanil, and surgery length greater than 30 min. The suburban hospital population studied received a combination of antiemetic prophylaxis per Table 1. 5.71% of patients in the sample received a post operative opioid. All sample participants received general anesthesia with a volatile anesthetic gas. Approximately one third of the sample received Nitrous Oxide during surgery. Almost all patients in the sample received an opioid. 65.71% of the sample had a surgery length 30 minutes or longer. 91.43% of the sample received a 5-HT3 receptor antagonist as part of their antiemetic prophylaxis. None of the sample received a NK-1 receptor antagonist, butyrophenones, metoclopramide, phenothiazine, prochlorperazine, antidopaminergics, versed, or gabapentin. 14.29% of the sample received an anticholinergic. Approximately half of the sample received an antiemetic steroid.

Aim four assessed PACU charting to determine if the patient developed PONV. Logistic regression tested associations of risk factors with incidence of post-op nausea and vomiting (PONV). 14.29% of the sample suffered from PACU postoperative nausea and vomiting as per Table 1. Patient risk factors, anesthesia risk factors, and surgical risk factors did not predict post-op nausea and vomiting as highlighted in Table 2. Actual antiemetics administered pre- or intra-operatively did not predict PONV.

Based on the statistical analysis there were no statistically significant associations between the patient, anesthetic, and surgical risk factors on post-op nausea and vomiting. There

was no statistically significant association for the delivery of antiemetics agents, and the incidence of PONV in this Suburban Hospital setting population studied. Multiple linear regression tested associations of Apfel, anesthesia risk, surgical risk with actual antiemetics administered and found no significance with any of the risk factors on antiemetics given. Skledar et al., advocate for administering 1-2 prophylactic antiemetic medications due to risk scores, such as the Apfel, not being utterly anticipatory of actual PONV (2007). Skledar et al., stated that PONV rates in their study, with prophylactic antiemetic administration, were found to be 20%, which supports that following prophylactic administration protocols might not be predictive of actual PONV rates (2007). The data from the suburban hospital location on the Apfel score and antiemetic administration are not entirely predictive of PONV in the PACU.

CHAPTER IV DISCUSSION

IMPLICATIONS FOR PRACTICE

In this retrospective chart review, it was found through data analysis that in this suburban hospital setting, there was no statistically significant correlation between the patient characteristics, anesthetic, and surgical risk factors for PONV, the delivery of antiemetics agents, and the incidence of PONV.

The Fourth Consensus Guidelines guide practitioners to administer the appropriate number of antiemetic medications based on the patient's individual Apfel score (Moore et al., 2021). Aim one of this project was assessed from the collected data; the average Apfel score was 1.63. Based on the Apfel score calculated for each patient, the number of prophylactic antiemetics was then determined following the Apfel score. An Apfel score of 0, no antiemetics are recommended; a score of 1-2 indicates 1-2 antiemetics should be administered, and a score of 3-4 recommends three or more antiemetics should be administered (Gan et al., 2020). Each

patient at the Suburban hospital should have an Apfel score calculated and an appropriate number of antiemetics administered as PONV prophylaxis based on the Fourth Consensus Guidelines.

As researched by Devarakonda et al. 2022, electronic medical record reminders have been shown to increase adherence to PONV prophylaxis guidelines. Additionally, Wax et al., 2007, tells us that implementing a visual interactive electronic reminder regarding the administration of medications is associated with increased compliance with guidelines. According to Alidina et al., 2018, successful implementation of cognitive aids in the OR increases compliance with a multi-step implementation process. A visual chart of the Apfel scoring system and its recommended antiemetics could be posted in each operating room to assist with successful prophylactic antiemetic administration.

Anesthetists administer many medications throughout any surgical case majority of the time not required to scan these medications. The Anesthesia Safety Foundation recommends using medication barcode scanning for all medications given by an anesthesia provider (Brown, 2014). In addition to a visual chart of the Apfel scoring system, scanning the drugs, similar to the requirement for blood products to be scanned, would increase the patient's safety and ensure appropriate antiemetic prophylaxis was being administered versus hand charting the medications. Additionally, it was found that the barcode medication administration systems increased documentation capturing (Dunn & Anderson, 2019).

The data associated with aim two of determining the relationship between the Apfel score and the number of antiemetic medications administered during the intraoperative period revealed that the number of expected antiemetics to be administered was less than the actual antiemetics administered. 60% of the patients in the Suburban hospital sample did not receive the appropriate

antiemetic prophylaxis. The inappropriate PONV prophylaxis included both under and over-administration of antiemetics. 51% of the patients did not receive enough antiemetics for appropriate PONV prophylaxis based on their Apfel score. None of the patients with an Apfel score of 3 received enough antiemetics according to the Fourth Consensus Guidelines. The data from this study can assist this hospital in further educating its staff on appropriate antiemetic prophylaxis since the data shows that the antiemetic prophylaxis protocol is currently not being followed.

Adherence to the Fourth Consensus Guidelines for PONV prophylaxis is an ongoing issue (Gan et al., 2014). PONV risk assessments such as the Apfel score have a 65-70% sensitivity and specificity rate of predicting PONV, which further supports appropriately administering antiemetics based on the Apfel score (Apfel et al., 2012). An excellent understanding of the Fourth Consensus Guidelines as a practitioner will allow practitioners to identify individuals at risk and appropriately administer prophylaxis.

Based on the findings in this quality improvement project, anesthesia providers give two antiemetics 45.7% of the time, regardless of the Apfel score. Giving two antiemetics is common within anesthesia practice. Assessing anesthesia providers willingness to change is the first step to increasing compliance with the fourth consensus guidelines. Gabutti et al. 2022, tells us that organizations that encourage bottom-up communication respond better to timely change requests. Communication must be had with the nurse anesthetist on the negative implications of PONV and the willingness to change their practice to follow the fourth consensus guidelines.

Statistical conclusions drawn from aims 3 and 4 determined that there was no correlation between any of the variables of anesthesia risk factors, surgical risk factors, Apfel score, and actual antiemetics administered predicting PONV. Like the results that Skledar et al. reported,

the statistical analysis from the suburban hospital data confirms that the prophylactic antiemetic risk scores are not entirely predictive of PONV (2007). Some implications for practice might be a more liberal administration of prophylactic antiemetics to avoid PONV-triggering risk factors. Skledar et al. recommends identifying PONV risk factors, aggressive avoiding the use of volatile agents, avoidance of opioid administration, advocates for multimodal analgesia, and specific prophylactic antiemetic administration to prevent PONV (2007).

Although specific surgeries increasing your risk for PONV varies in the literature, there is a consensus that laparoscopic and gynecological surgery increases the risk for PONV. In this quality improvement project, 17 of 35 patients underwent gynecologic surgery. Based on the knowledge from the literature that these patients may experience higher rates of PONV, anesthesia providers should consider this when determining the number of antiemetics to administer (Gan, 2006).

The literature shows that combination therapy is the best method for preventing PONV (Weibel et al., 2020). However, what should the third-line antiemetic agent be after the two most common drugs, Zofran and Decadron, are given? The Fourth Consensus Guidelines do not dictate which specific antiemetics to give but rather provide a comprehensive list of potential options, including all of the options listed in table 1. Some of the most common and readily available antiemetics with high efficacy for preventing PONV include: Scopolamine, gabapentin, promethazine, haloperidol, droperidol, intramuscular Ephedrine, and Aprepitant (Gan et al., 2020).

The PONV rate of 14.29% found at this Suburban hospital location is not unexpected because, as a baseline, there is a 10% risk of PONV (Weilbach et al., 2006). Each risk factor within the Apfel score increases the percentage of PONV by 20% while never having less than

10% risk at baseline (Weilbach et al., 2006). No patients within the sample had an Apfel score of 0, meaning that each patient started with a risk of at least 10% of developing PONV (Weilbach et al., 2006). Additionally, all patients received volatile anesthetics, which have been shown to independently increase the risk for PONV, which may explain the 14.29% rate of PONV in the sample population (Morino et al., 2012). More than half of the sample had a surgery length greater than 30 mins, and surgery length exceeding 30 mins has been shown to increase the risk of developing PONV by up to 60% (Shaikh et al., 2016). Promoting efficiency in the operating room is one way to help combat extended surgical times. However, this variable is difficult to control because certain surgeries take an extended time to complete.

As the Fourth Consensus Guidelines mentioned, treating PONV with appropriate rescue antiemetics is essential. For a patient suffering from PONV in the PACU, it is vital to treat them with an antiemetic from a different drug class than the one they received. There was no benefit shown in giving the same class of antiemetic as rescue therapy. Additionally, The Fourth Consensus Guidelines does not recommend a particular combination of antiemetics to treat established PONV. Still, it is recommended that practitioners make a clinical decision based on the antiemetics already administered and stress the importance of treating established PONV with a different class of antiemetic than already administered (Gan et al., 2020). Healthcare providers assessing the patient for additional causes of PONV, such as bowel obstruction, is also essential (Gan et al., 2020).

LIMITATIONS AND STRENGTHS

Some limitations of this DNP project were the small sample size, and only one suburban hospital location was analyzed, restricted to specific surgical populations. The small sample size of 35 patients makes it difficult to generalize the results to other hospitals. Additionally,

analyzing data from only a suburban hospital location does not give a complete picture of other hospitals within a hospital system. The narrowed selection of only patients from three surgical populations makes it difficult to apply the results to all surgical populations within a specific hospital or, more broadly, other hospitals. Also, patients in the GYN and ENT population are already at an increased risk of PONV from the type of surgery being performed, which might have contributed to the PONV rate.

Some strengths of this project were that it was the first look at PONV prophylaxis compliance within a suburban hospital and that this DNP project was conducted in a hospital that is part of a more extensive hospital system. The resources accompanying a large hospital system allowed for the expedited collection of data and more support for the DNP project. The findings of this project might have applied to the hospital system-wide if the findings indicated a reduction in PONV was demonstrated by following the Fourth Consensus Guidelines.

RECOMMENDATIONS

Based on the statistical analysis of the data collected, some suggested next steps for modification in anesthetic practice could be applied to prevent PONV. Reducing volatile anesthetics agents and limiting opioid administration might be one step in reducing PONV due to the PONV-provoking nature of specific anesthetic agents. Additionally, education of the anesthesia staff on appropriate antiemetic administration and the implementation of the PONV prophylaxis protocol is essential since the data concluded that the expected amount of antiemetics administered was higher than the administered antiemetics.

A reduction in the administered antiemetics implies a knowledge gap that must be closed to provide better patient care and reduce PONV. Additionally, over-administering antiemetics to patients that do not require as many is not beneficial and adds additional cost to patient care.

More prompts in the electronic health record might help remind practitioners of the number of appropriate antiemetics to administer per the Apfel score.

Adding an intraoperative reminder into the EHR, which displays the patients calculated Apfel score and the recommended antiemetics to be administered, will help increase compliance with the fourth consensus guidelines. Another way to translate this quality improvement project into practice would be to keep a visual copy of the Apfel scoring system and recommended antiemetics in each operating room as a visual aid. Cognitive aids in the operating room have been shown to increase compliance with multi-step implementation processes such as the Apfel scoring system and its antiemetic administration. Additionally, implementing a medication barcode scanning requirement for antiemetics in the EHR may be one step in helping adherence to the Fourth Consensus Guidelines and reducing PONV. Using a bar code medication administration charting would increase overall patient safety and more accuracy of documentation of antiemetic medications.

A survey could be administered to assess providers willingness to change their practice, asking anesthesia providers how willing they would be to follow the fourth consensus guidelines if a visual aid was implemented into the charting system. Assessing willingness to change in the urban facility is the first step towards increasing compliance with the fourth consensus guidelines. Additionally, the survey should include a spot for providers years of experience to determine if the amount of experience correlates to the anesthesia provider's antiemetic administration habits. With more years of experience, the providers are less likely to change personal practice based on evidence-based practice guidelines.

Gynecologic and laparoscopic surgeries have a higher incidence of PONV. It should be recommended to anesthesia providers to administer an additional antiemetic to this patient population. Increasing antiemetic administration to high-risk groups should help reduce PONV. There are many antiemetics that anesthesia providers can choose from to administer to their patients. However, it can be challenging to have them all memorized. Additionally, a barrier to administering the correct number of antiemetics could be related to patient-specific allergies. Suppose a patient is allergic to Decadron or Zofran. In that case, this narrows the options for which antiemetics to administer, and the anesthesia provider may not know what other antiemetics are available to supplement with. A medication list could be posted in the operating room highlighting the different antiemetics that anesthesia providers can choose from to reach the correct number of antiemetics recommended based on the Apfel score and Fourth Consensus Guidelines.

Further education of the PACU nurses help identify PONV, and swift treatment may prevent patients from suffering from the prolonged effects of PONV. Educating the anesthesia and PACU staff on proper rescue antiemetic administration is crucial to treating already established PONV. Making these providers aware of the necessity for an assessment of the different classes of antiemetics administered and treating some potential causes of PONV when occurring in the PACU.

References

Alidina, S., Goldhaber-Fiebert, S.N., Hannenberg, A.A. *et al.* Factors associated with the use of cognitive aids in operating room crises: a cross-sectional study of US hospitals and ambulatory surgical centers. *Implementation Sci* 13, 50 (2018). https://doi.org/10.1186/s13012-018-0739-4

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

Apfel, C. C., & Roewer, N. (2003). Risk assessment of postoperative nausea and vomiting. *International anesthesiology clinics*, *41*(4), 13–32. https://doi.org/10.1097/00004311-200341040-00004

Apfel, C. C., Korttila, K., Abdalla, M., Kerger, H., Turan, A., Vedder, I., Zernak, C., Danner, K., Jokela, R., Pocock, S. J., Trenkler, S., Kredel, M., Biedler, A., Sessler, D. I., Roewer, N., & IMPACT Investigators (2004). A factorial trial of six interventions for the prevention of postoperative nausea and vomiting. *The New England journal of medicine*, *350*(24), 2441–2451. https://doi.org/10.1056/NEJMoa032196

Apfel, C. C., Philip, B. K., Cakmakkaya, O. S., Shilling, A., Shi, Y. Y., Leslie, J. B., Allard, M., Turan, A., Windle, P., Odom-Forren, J., Hooper, V. D., Radke, O. C., Ruiz, J., & Kovac, A. (2012). Who is at risk for postdischarge nausea and vomiting after ambulatory

surgery?. *Anesthesiology*, *117*(3), 475–486. https://doi.org/10.1097/ALN.0b013e318267ef31

Atrium Health. *(*2022). *Surgery Schedule*. Retrieved February 24, 2022, from Canopy-PowerChart.

Atrium Health (personal communication, February 25th, 2022).

Babbie, Earl R. *The Practice of Social Research*. 12th ed. Belmont, CA: Wadsworth Cengage, 2010; Muijs, Daniel. *Doing Quantitative Research in Education with SPSS*. 2nd edition. London: SAGE Publications, 2010.

Beattie, W. S., Lindblad, T., Buckley, D. N., & Forrest, J. B. (1991). The incidence of postoperative nausea and vomiting in women undergoing laparoscopy is influenced by the day of menstrual cycle. Canadian journal of anaesthesia = Journal canadien d'anesthesie, 38(3), 298–302. https://doi.org/10.1007/BF03007618

Bhakta, P., Ghosh, B. R., Singh, U., Govind, P. S., Gupta, A., Kapoor, K. S., Jain, R. K., Nag, T., Mitra, D., Ray, M., Singh, V., & Mukherjee, G. (2016, December 23). *Incidence of postoperative nausea and vomiting following gynecological laparoscopy: A comparison of standard anesthetic technique and propofol infusion*. Acta Anaesthesiologica Taiwanica. Retrieved January 25, 2022, from https://www.sciencedirect.com/science/article/pii/S1875459716300145

Brown L. B. (2014). Medication administration in the operating room: new standards and recommendations. *AANA journal*, *82*(6), 465–469.

Committee opinion Health Disparities in Rural Women. (2014). *Obstetrics & Gynecology*, *123*(2), 384–388. https://doi.org/10.1097/01.aog.0000443278.06393.d6

Devarakonda, B. V., Goel, A., Singh, S., Kumar Sreevastava, D., Vadapalli, K., & Mohan Reddy, M. (2022). Efficacy of evidence-based institutional protocol for prevention of postoperative nausea and vomiting: A prospective observational study. *Medical journal, Armed Forces India*, *78*(1), 36–41. https://doi.org/10.1016/j.mjafi.2020.02.004

Dunn, L., & Anderson, J. (2019). Barcode Medication Administration implementation in the operating room. *American Journal of Health-System Pharmacy*, *76*(10), 636–637. https://doi.org/10.1093/ajhp/zxz039

Erkalp, K., Kalekoglu Erkalp, N., Sevdi, M. S., Korkut, A. Y., Yeter, H., Ege, S. S., Alagol, A., & Erden, V. (2014). Gastric Decompression Decreases Postoperative Nausea and Vomiting in ENT Surgery. International journal of otolaryngology, 2014, 275860. https://doi.org/10.1155/2014/275860

Elvir-Lazo, O. L., White, P. F., Yumul, R., & Cruz Eng, H. (2020). Management strategies for the treatment and prevention of postoperative/postdischarge nausea and vomiting: an updated review. *F1000Research*, *9*, F1000 Faculty Rev-983. https://doi.org/10.12688/f1000research.21832.1

Fast facts on U.S. Hospitals, 2021. American Hospital Association. (2021). Retrieved February 15, 2022, from https://www.aha.org/statistics/fast-facts-us-hospitals

Fast facts on U.S. hospitals - 2017 pie charts: AHA. American Hospital Association. (2017). Retrieved February 16, 2022, from https://www.aha.org/statistics/2016-12-09-fast-facts-us-hospitals-2017-pie-charts

Felland, L. E., Lauer, J. R., & Cunningham, P. J. (2009). Suburban poverty and the health care safety net. Research brief, (13), 1–12. Retrieved January 29, 2022, from https://pubmed.ncbi.nlm.nih.gov/19685599/

Fernandez-Guisasola, J., Gomez-Arnau, J., Cabrera, Y., & Garcia del Valle, S. (2020, March 17). *Association between nitrous oxide and the incidence of postoperative nausea and vomiting in adults: a systematic review and meta-analysis*. Anaesthesia - Perioperative medicine, critical care and pain. Retrieved March 26, 2022, from https://associationofanaesthetists publications.onlinelibrary.wiley.com/doi/10.1111/j.1365-2044.2010.06249.x

Gabutti, I., Colizzi, C., & Sanna, T. (2022). Assessing Organizational Readiness to Change through a Framework Applied to Hospitals. *Public Organization Review*, 1–22. Advance online publication. https://doi.org/10.1007/s11115-022-00628-7

Gan, T. J. (2006). Risk factors for postoperative nausea and vomiting. *Anesthesia & Analgesia*, *102*(6), 1884–1898. https://doi.org/10.1213/01.ane.0000219597.16143.4d

Gan, T. J., Apfel, C. C., Kovac, A., Philip, B. K., Singla, N., Minkowitz, H., Habib, A. S., Knighton, J., Carides, A. D., Zhang, H., Horgan, K. J., Evans, J. K., Lawson, F. C., & Aprepitant-PONV Study Group (2007). A randomized, double-blind comparison of the NK1 antagonist, aprepitant, versus ondansetron for the prevention of postoperative

nausea and vomiting. *Anesthesia and analgesia*, *104*(5), .
https://doi.org/10.1213/01.ane.0000263277.35140.a3

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., Minkowitz, H. S., Philip, B. K. (2020). Fourth Consensus Guidelines for the Management of Postoperative Nausea and Vomiting. *Anesthesia and analgesia*, *131*(2), 411–448.
https://doi.org/10.1213/ANE.0000000000004833

Gan, T. J., Diemunsch, P., Habib, A. S., Kovac, A., Kranke, P., Meyer, T. A., Watcha, M., Chung, F., Angus, S., Apfel, C. C., Bergese, S. D., Candiotti, K. A., Chan, M. T., Davis, P. J., Hooper, V. D., Lagoo-Deenadayalan, S., Myles, P., Nezat, G., Philip, B. K., Tramèr, M. R., … Society for Ambulatory Anesthesia (2014). Consensus guidelines for the management of postoperative nausea and vomiting. *Anesthesia and analgesia*, *118*(1), 85–113. https://doi.org/10.1213/ANE.0000000000000002

Gillmann, H. J., Wasilenko, S., Züger, J., Petersen, A., Klemann, A., Leffler, A., & Stueber, T. (2019). Standardised electronic algorithms for monitoring prophylaxis of postoperative nausea and vomiting. *Archives of medical science : AMS*, *15*(2), 408–415. https://doi.org/10.5114/aoms.2019.83293

Girotto, J. A., Koltz, P. F., & Drugas, G. (2010). Optimizing your operating room: or, why large, traditional hospitals don't work. *International journal of surgery (London, England)*, *8*(5), 359–367. https://doi.org/10.1016/j.ijsu.2010.05.002

Gao, J. (2020). P-values – a chronic conundrum. *BMC Medical Research Methodology*, *20*(1). https://doi.org/10.1186/s12874-020-01051-6

Golembiewski, J. A., & O'Brien, D. (2002). A systematic approach to the management of postoperative nausea and vomiting. *Journal of perianesthesia nursing: official journal of the American Society of PeriAnesthesia Nurses*, *17*(6), 364–376. https://doi.org/10.1053/jpan.2002.36596

Gress, K., Urits, I., Viswanath, O., & Urman, R. D. (2020). Clinical and economic burden of postoperative nausea and vomiting: Analysis of existing cost data. *Best practice & research. Clinical anaesthesiology*, *34*(4), 681–686. https://doi.org/10.1016/j.bpa.2020.07.003

Habib, A. S., Chen, Y. T., Taguchi, A., Hu, X. H., & Gan, T. J. (2006). Postoperative nausea and vomiting following inpatient surgeries in a teaching hospital: a retrospective database analysis. Current medical research and opinion, 22(6), 1093–1099. https://doi.org/10.1185/030079906X104830

Hamai, T., Nagata, A., & Nishikawa, H. (2017). *Japanese journal of public health*, *64*(11), 672–683. https://doi.org/10.11236/jph.64.11_672

Hromatka, B. S., Tung, J. Y., Kiefer, A. K., Do, C. B., Hinds, D. A., & Eriksson, N. (2015). Genetic variants associated with motion sickness point to roles for inner ear development, neurological processes and glucose homeostasis. *Human Molecular Genetics*, *24*(9), 2700–2708. https://doi.org/10.1093/hmg/ddv028

Joyce, A. (2020, April 23). *Interactive maps highlight urban-rural differences in hospital bed capacity*. KFF. Retrieved January 23, 2022, from https://www.kff.org/health-costs/press-release/interactive-maps-highlight-urban-rural differences-in-hospital-bed-capacity/#:~:text=While%20metro%20and%20non%2Dmetro,to%202.8%20in%20urban%20areas.

Kassel, L., Nelson, M., Shine, J., Jones, L. R., & Kassel, C. (2018). Scopolamine Use in the Perioperative Patient: A Systematic Review. *AORN journal*, *108*(3), 287–295. https://doi.org/10.1002/aorn.12336

Kneebone, E. (2016, July 29). *The growth and spread of concentrated poverty, 2000 to 2008-2012*. Brookings. Retrieved January 23, 2022, from https://www.brookings.edu/interactives/the-growth-and-spread-of-concentrated-poverty-2000-to-2008-2012/

Krieser , K. A., Riley , J. B., Baus, J. E., Hoffman , J. T., & Sullivan , J. N. (2020). Ponv prophylaxis failure disproportionately affects female patients, despite intraoperative computerized decision support guidance. *Graduate Medical Education Research Journal*, *2*(1). https://doi.org/10.32873/unmc.dc.gmerj.2.1.091

Lavrakas, P. J. (2008). *Encyclopedia of survey research methods* (Vols. 1-0). Thousand Oaks, CA: Sage Publications, Inc. doi: 10.4135/9781412963947

Masiongale, A. J., Garvin, J. T., Murphy, M. J., Hooper, V. D., Odom-Forren, J., Masiongale, J. I., & Looney, S. W. (2018). Reexamining Metoclopramide's role in the prevention of

postoperative nausea and vomiting: A secondary analysis. American Association Nurse Anesthesia Journal, 86(3), 213–219.

Manahan, M. A., Basdag, B., Kalmar, C. L., Shridharani, S. M., Magarakis, M., Jacobs, L. K., Thomsen, R. W., & Rosson, G. D. (2013). Risk of severe and refractory postoperative nausea and vomiting in patients undergoing diep flap breast reconstruction. *Microsurgery*, *34*(2), 112–121. https://doi.org/10.1002/micr.22155

Moran, K. J., Burson, R., & Conrad, D. (2020). *The doctor of nursing practice project: A framework for success*. Jones & Bartlett Learning.

Morino, R., Ozaki, M., Nagata, O., & Yokota, M. (2012). Incidence of and risk factors for postoperative nausea and vomiting at a Japanese cancer center: First large-scale study in japan. *Journal of Anesthesia*, *27*(1), 18–24. https://doi.org/10.1007/s00540-012-1468-5

Moore, C., Bledsoe, R., Bonds, R., Keller, M., & King, H. (2021, April). *Preventing postoperative nausea and vomiting during an ...* Preventing Postoperative Nausea and Vomiting During an Ondansetron Shortage. Retrieved March 19, 2022, from https://www.aana.com/docs/default-source/aana-journal-web-documents-1/moore-r.pdf?sfvrsn=3eb87dbe_4

Murphy, M. J., Hooper, V. D., Sullivan, E., Clifford, T., & Apfel, C. C. (2006). Identification of risk factors for postoperative nausea and vomiting in the perianesthesia adult patient. *Journal of perianesthesia nursing : official journal of the American Society of PeriAnesthesia Nurses*, *21*(6), 377–384. https://doi.org/10.1016/j.jopan.2006.09.002

Nebeker, C. (n.d.). *Descriptive Studies*. Research design: Descriptive studies. Retrieved February 17, 2022, from https://ori.hhs.gov/education/products/sdsu/res_des1.htm

Niche.com. (2022). *Pineville demographics and statistics*. Retrieved February 20, 2022, from https://www.niche.com/places-to-live/pineville-mecklenburg-nc/residents/

Öbrink, E., Jildenstål, P., Oddby, E., & Jakobsson, J. G. (2015). Postoperative nausea and vomiting: Update on predicting the probability and ways to minimize its occurrence, with focus on ambulatory surgery. *International Journal of Surgery*, *15*, 100–106. https://doi.org/10.1016/j.ijsu.2015.01.024

Parker, K., Horowitz, J. M., Brown, A., Fry, R., Cohn, D. V., & Igielnik, R. (2020, May 30). *Demographic and economic trends in urban, suburban and rural communities*. Pew Research Center's Social & Demographic Trends Project. Retrieved February 15, 2022, from https://www.pewresearch.org/social-trends/2018/05/22/demographic-and-economic-trends-in-urban-suburban-and-rural-communities/

Parra-Sanchez, I., Abdallah, R., You, J., Fu, A. Z., Grady, M., Cummings, K., Apfel, C., & Sessler, D. I. (2012). A time-motion economic analysis of postoperative nausea and vomiting in ambulatory surgery. *Canadian Journal of Anesthesia/Journal Canadien d'anesthésie*, *59*(4), 366–375. https://doi.org/10.1007/s12630-011-9660-x

Peyton, P. J., & Wu, C. Y. (2014, May 1). *Nitrous oxide–related postoperative nausea and vomiting depends on duration of exposure*. American Society of Anesthesiologists. Retrieved March 26, 2022, from

https://pubs.asahq.org/anesthesiology/article/120/5/1137/13778/Nitrous-Oxide-related-Postoperative-Nausea-and

Pierre, S., Benais, H., & Pouymayou, J. (2002). Apfel's simplified score may favourably predict the risk of postoperative nausea and vomiting. *Canadian Journal of Anesthesia/Journal Canadien D'anesthésie*, *49*(3), 237–242. https://doi.org/10.1007/bf03020521

Pierre, S., Benais, H., & Pouymayou, J. (2003). *Apfel's simplified score may favourably predict the risk of postoperative nausea and vomiting*. General Anesthesia. Retrieved March 26, 2022, from https://link.springer.com/content/pdf/10.1007%2FBF03020521.pdf

Pierre, S., & Whelan, R. (2012, August 11). *Nausea and vomiting after surgery*. OUP Academic. Retrieved March 26, 2022, from https://academic.oup.com/bjaed/article/13/1/28/281153

Pierre, S. & Whelan, R. (2013). Nausea and vomiting after surgery, *Continuing Education in Anaesthesia Critical Care & Pain*, 13(1), 28-32. https://doi.org/10.1093/bjaceaccp/mks046

Rose, J. B., & Watcha, M. F. (1999). Postoperative nausea and vomiting in paediatric patients. *British journal of anaesthesia*, *83*(1), 104–117. https://doi.org/10.1093/bja/83.1.104

Schnake-Mahl, A. S., & Sommers, B. D. (2017). Health care in the suburbs: An analysis of suburban poverty and Health Care Access. *Health Affairs*, *36*(10), 1777–1785. https://doi.org/10.1377/hlthaff.20170545

Shaikh, S. I., Nagarekha, D., Hegade, G., & Marutheesh, M. (2016). Postoperative nausea and vomiting: A simple yet complex problem. *Anesthesia: essays and researches*, *10*(3), 388–396. https://doi.org/10.4103/0259-1162.179310

Skledar, S. J., Williams, B. A., Vallejo, M. C., Dalby, P. L., Waters, J. H., Glick, R., & Kentor, M. L. (2007). Eliminating postoperative nausea and vomiting in outpatient surgery with multimodal strategies including low doses of nonsedating, off-patent antiemetics: is "zero tolerance" achievable?. *TheScientificWorldJournal*, *7*, 959–977. https://doi.org/10.1100/tsw.2007.131

Smith, A. (2020, November 24). *Rural areas send their sickest patients to cities, straining hospitals*. Kaiser Health News. Retrieved January 23, 2022, from https://khn.org/news/rural-areas-send-their-sickest-patients-to-cities-straining-hospitals/

Smith, H.,Smith, E., & Smith, B. (2012). Postoperative nausea and vomiting. *Annals Of Palliative Medicine*, 1(2), 94-102. Retrieved from https://apm.amergroups.com/atricle/view/1035

Stadler, M., Bardiau, F., Seidel, L., Albert, A., & Boogaerts, J. (2003). Difference in risk factors for postoperative nausea and vomiting. *Anesthesiology*, *98*(1), 46–52. https://doi.org/10.1097/00000542-200301000-00011

Stephenson, S. J., Jiwanmall, M., Cherian, N. E., Kamakshi, S., & Williams, A. (2021). Reduction in postoperative nausea and vomiting (PONV) by preoperative risk stratification and adherence to a standardized anti emetic prophylaxis protocol in the

day-care surgical population. *Journal of family medicine and primary care*, *10*(2), 865–870. https://doi.org/10.4103/jfmpc.jfmpc_1692_20

Ugochukwu, O., Adaobi, A., Ewah, R.,& Obioma, O. (2010). Postoperative nausea and vomiting in a gynecological and obstetrical population in South Eastern Nigeria. The Pan African medical journal, 7, 6. https://doi.org/10.4314/pamj.v7i1.69111

Ugoni, A., & Walker, B. F. (1995). The Chi square test: an introduction. *COMSIG review*, *4*(3), 61–64.

Vukovic, N., & Dinic, L. (2018). Enhanced Recovery After Surgery Protocols in Major Urologic Surgery. Frontiers in medicine, 5, 93. https://doi.org/10.3389/fmed.2018.00093

Wax, D. B., Beilin, Y., Levin, M., Chadha, N., Krol, M., & Reich, D. L. (2007). The effect of an interactive visual reminder in an anesthesia information management system on timeliness of prophylactic antibiotic administration. *Anesthesia and analgesia*, *104*(6), . https://doi.org/10.1213/01.ane.0000263043.56372.5f

Weilbach, C., Rahe-meyer, N., Raymondos, K., Weissig, A., Scheinichen, D., & Piepenbrock, S. (2006). Postoperative nausea and vomiting (PONV): usefulness of the Apfel-score for identification of high risk patients for PONV. *Acta anaesthesiologica Belgica*, *57*(4), 361–363.

Weibel, S., Rücker, G., Eberhart, L. H., Pace, N. L., Hartl, H. M., Jordan, O. L., Mayer, D., Riemer, M., Schaefer, M. S., Raj, D., Backhaus, I., Helf, A., Schlesinger, T., Kienbaum, P., & Kranke, P. (2020). Drugs for preventing postoperative nausea and vomiting in adults after general anaesthesia: a network meta-analysis. *The Cochrane database of*

systematic reviews, *10*(10), CD012859. https://doi.org/10.1002/14651858.CD012859.pub2

Weisz, D., Gusmano, M. K., Wong, G., & Trombley, J. (2015). Emergency department use: a reflection of poor primary care access?. The American journal of managed care, 21(2), e152–e160.

Werner, J., Fernandez, S., & Awad, H. (2008). The role of smoking history in the development of postoperative nausea and vomiting. *Anesthesiology*, *109*(1), 156–157. https://doi.org/10.1097/aln.0b013e31817b5afd

White, P. F., Tang, J., Song, D., Coleman, J. E., Wender, R. H., Ogunnaike, B., Sloninsky, A., Kapu, R., Shah, M., & Webb, T. (2007). Transdermal scopolamine: an alternative to ondansetron and droperidol for the prevention of postoperative and postdischarge emetic symptoms. *Anesthesia and analgesia*, *104*(1), 92–96. https://doi.org/10.1213/01.ane.0000250364.91567.72

Wilper, A. P., Woolhandler, S., Lasser, K. E., McCormick, D., Bor, D. H., & Himmelstein, D. U. (2009). Health insurance and mortality in US adults. *American journal of public health*, *99*(12), 2289–2295. https://doi.org/10.2105/AJPH.2008.157685

Appendix A

Wake Forest IRB Approval

MEMORANDUM

To: Karen Lucisano
Clinical and Translational Science Institute {CTSI}

From: Brian Moore, Director
Institutional Review Board

Date: 7/14/2022

Subject: Not Human Subjects Research: IRB00085740
Assessing Risk Factors and Nausea Prophylaxis in the Gynecologic, Urologic, and Ear, Nose and Throat Surgical Population

The Wake Forest University School of Medicine Institutional Review Board has reviewed your protocol and determined that it does not meet the federal definition of research involving human subject research as outlined in the federal regulations 45 CFR 46. 45 CFR 46.102(f) defines human subjects as "a living individual about whom an investigator (whether professional or student) conducting research obtains (1) data through intervention or interaction with the individual, or (2) identifiable private information."

The information you are receiving is not individually identifiable. In recent guidance published by the Office of Human Research Protections (OHRP) on the Guidance on Research Involving Coded Private Information or Biological Specimens, OHRP emphasizes the importance on what is being obtained by the investigator and states "if investigators are not obtaining either data through intervention or interaction with living individuals, or identifiable private information, then the research activity does not involve human subjects."

Note that only the Wake Forest University School of Medicine IRB can make the determination for its investigators that a research study does not meet the federal definition of human subject research. Investigators do not have the authority to make an independent determination that a study does not meet the federal requirements for human subject research. Each project requires a separate review and determination by the Board. The Board must be informed of any changes to this project, so that the Board can determine whether it continues to not meet the federal requirements for human subject research. If you have any questions or concerns about this information, please feel free to contact our office at 716-4542.

The Wake Forest School of Medicine IRB is duly constituted, has written procedures for initial and continuing review of clinical trials; prepares written minutes of convened meetings, and

retains records pertaining to the review and approval process; all in compliance with requirements of FDA regulations 21 CFR Parts 50 and 56, HHS regulations 45 CFR 46, and International Conference on Harmonisation (ICH) E6, Good Clinical Practice (GCP), as applicable. WFSM IRB is registered with OHRP/FDA; our IRB registration numbers are IRB00000212, IRB00002432, IRB00002433, IRB00002434, IRB00008492, IRB00008493, IRB00008494, and IRB00008495. WFSM IRB has been continually fully accredited by the Association for the Accreditation of Human Research Protection Programs (AAHRPP) since 2011.

Appendix B

University of North Carolina Charlotte IRB Approval

From: **Runden, Catherine Price** Received: **27-Jul-2022**

To: **Sanders, Abby Catherine** - *University of North Carolina at Charlotte*
Dr. Woods, Stephanie Joan - *School of Nursing*

CC: **Ross, Rebekah Caroline Peterson** - *University of North Carolina at Charlotte*
Sullivan, Meghan Marie - *University of North Carolina at Charlotte*
Dr. Woods, Stephanie Joan - *School of Nursing*

Subject: **IRB-23-0040 - NHSR Submission Acknowledged**

UNIVERSITY OF NORTH CAROLINA CHARLOTTE | RESEARCH AND ECONOMIC DEVELOPMENT

To:	Abby Sanders University of North Carolina at Charlotte
From:	Office of Research Protections and Integrity
Date:	27-Jul-2022
RE:	Determination that Research is not Human Subjects and does not require IRB Approval
Study #:	IRB-23-0040
Study Title:	Assessing Risk Factors and Nausea Prophylaxis in the Gynecologic, Urologic, and Ear, Nose and Throat Surgical Population

This submission was reviewed by the Office of Research Protections and Integrity, which has determined that this submission does not constitute human subjects as defined under federal regulations 45 CFR 46.102(e) and 21 CFR 56.102(e) and does not require IRB approval.

Study Description:
This is a quality improvement (QI) project chosen by the Safety and Quality Coordinator for Metro and Anesthesia Departments across multiple Atrium Health facilities. The project addresses practice, quality, and safety issues related to anesthesia providers. Participants of the QI project are Gynecologic, Ear Nose, and Throat, and Urologic surgery patients greater than 18 years old at Atrium Health Pineville, Atrium Health Carolinas Medical Center, and Atrium Health One Day Surgery Center. These individual hospitals are covered by one anesthesia team who provides care across multiple sites. PONV causes negative health sequelae, increases the financial burden, and decreases patient satisfaction. The purpose of this project is to compare anesthetic, surgical, and patient risk factors with the number of antiemetics given, in order to determine anesthesia providers compliance with the Fourth Consensus Guidelines, a guideline created for clinicians to utilize to prevent PONV. Our proposed instrument is an Excel spreadsheet with a list of risk factors for PONV, as well as the prophylactic antiemetics that are outlined in the Fourth Consensus Guidelines. Chart reviews and data analysis will be conducted to determine patient, anesthetic, and surgical risk factors, and PONV prophylaxis administration. A t-test will be used to calculate a statistically significant difference between the mean of each individual risk factor. The project design is a descriptive design; a comparative study design will also be implemented by comparing the data collected from the urban, suburban, and ambulatory hospitals utilizing a Chi-square test. Keywords: PONV, gynecologic, ENT, Urologic, surgery, ambulatory surgery centers, urban, suburban, anesthesia

Please be aware that approval may still be required from other relevant authorities or "gatekeepers" (e.g., school principals, facility directors, custodians of records), even though IRB approval is not required.

If your study protocol changes in such a way that this determination will no longer apply, you should contact the above IRB before making the changes.