AN EVALUATION OF PERIOPERATIVE CARE FOR THE OBSTRUCTIVE SLEEP APNEA PATIENT AT A COMMUNITY HOSPITAL

by

Casey Raye Wallin

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Approved by:

_____
Dr. Kelly Powers

_____
Dr. Job Chen

_____
Dr. Danielle Brown

_____
Dr. Victoria Valencia Casales

_____
Dr. Michael Turner

ABSTRACT

CASEY RAYE WALLIN. An Evaluation of Perioperative Care for the Obstructive Sleep Apnea Patient at a Community Hospital
(Under the direction of DR. KELLY POWERS)

Obstructive sleep apnea (OSA) can lead to difficult airway management and perioperative complications. This necessitates individualized anesthetic planning including the reduction in doses of benzodiazepines and opioids. Risk identification is vital to improve perioperative care, as any patients with OSA are undiagnosed. This can be achieved with the STOP-Bang questionnaire. The purpose of this scholarly project was to evaluate current perioperative care practices for benzodiazepine and opioid administration to patients with a high risk of OSA to aid in formulating future recommendations for practice. The guiding PICOT question was: In adult patients ages 40 to 60, who underwent surgical procedures in a community hospital, did a STOP-Bang score ≥ 3, compared to a STOP-Bang score < 3, result in a reduced dose of benzodiazepines and opioids administered perioperatively during the time period of January 2023 to June 2024?

The project took place at a community hospital that is part of a major urban medical center. Data were collected via a retrospective chart review. The sample size was 100 charts. A descriptive analysis of the data was conducted, and significant differences were detected using t-tests and Pearsons r correlations. Although the data analyses revealed no statistically significant findings, clinically relevant findings were apparent because the STOP-Bang score ≥ 3 should have received significantly lower dosages of benzodiazepines and opioids. The results highlight the need for enhanced provider awareness to STOP-Bang scores. Practice recommendations include the use of the STOP-Bang questionnaire for preoperative screening of all patients and the development of a best practice advisory (BPA) to enhance provider awareness.

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LIST OF ABBREVIATIONS

AHI	Apnea Hypopnea Index
ASC	Ambulatory Surgery Center
ASA	American Society of Anesthesiologists
BPA	Best Practice Advisory
COPD	Chronic Obstructive Pulmonary Disease
CPAP	Continuous Positive Airway Pressure
EBP	Evidence Based Practice
ECT	Electroconvulsive Therapy
HER	Electronic Health Record
ENT	Ear, Eye, Nose, and Throat
GABA	Gama Amino Butyric Acid
ICU	Intensive Care Unit
IV	Intravenous
IRB	Institutional Review Board
LOS	Length of Stay
M	Mean
NORA	Non-Operating Room anesthesia
NPA	Nasopharyngeal Airway
NSAIDs	Non-Steroidal Anti-Inflammatory Drugs
OPA	Oropharyngeal Airway
ORIF	Open Reduction Internal Fixation
OSA	Obstructive Sleep Apnea

PACU	Post Anesthesia Care Unit
PAP	Positive Airway Pressure
PDSA	Plan Do Study Act
PSG	Polysomnography
QI	Quality Improvement
RERA	Respiratory Effort Related Arousals
SD	Standard Deviation
TIVA	Total Intravenous Anesthesia
VP	Ventriculoperitoneal

CHAPTER 1: INTRODUCTION

Introduction

Obstructive sleep apnea (OSA) is a sleep-related breathing disorder characterized by periods of hypopnea (decreased respiratory rate), apnea (respiratory cessation), and ultimately hypercarbia and hypoxia (Hwang et al, 2022). Complications associated with OSA include hypertension, myocardial infarction, obesity, diabetes, and increased mortality (Chung et al., 2016). The subsequent combination of surgery and OSA may result in difficult airway management and postoperative complications such as respiratory distress and delayed awakening (DeJong et al., 2020). As many patients with OSA are not formally diagnosed, risk identification is of the utmost importance to improve perioperative care (Grewal & Joshi, 2019).

The STOP-Bang questionnaire predicts OSA risk by objectively scoring and categorizing patients as low or high risk. It is a quick and sensitive screening tool that has been validated across various populations (Chung et al., 2016; DeJong et al., 2020). In some cases, moderate to severe OSA may be more accurately detected with a higher cutoff score, but most sources, and specifically the healthcare system of the community hospital that is this project's site, classify a score of three or greater as high risk, and this was the cutoff for this project (DeJong et al., 2020; Hwang et al., 2022; Nagelhout & Elisha, 2018).

Benzodiazepines and opioids are common medications utilized in the perioperative period for amnestic and analgesic management of surgical patients. However, these medications can cause respiratory depression or airway occlusion by blunting the intrinsic regulation of breathing and the arousal response (Butterfield, 2017). Patients with OSA are inherently at high risk for airway obstruction, hypopnea, and hypoxemia; the addition of benzodiazepines and/or opioids further exacerbate this risk (Butterfield, 2017). According to Grewal and Joshi (2019),

midazolam, one of the most commonly used benzodiazepines for perioperative sedation, causes respiratory depression and decreases a patient's inherent awakening response to an occluded airway. Opioids are also associated with respiratory depression, but studies are inconsistent as to the correlation between OSA-related respiratory complications and use of this class of medication (Grewal & Joshi, 2019). It is suggested that benzodiazepine use be eliminated for patients at high risk for OSA, and opioids should be utilized sparingly or as a rescue medication (Grewal & Joshi, 2019). Instead, current research recommends the use of analgesic and anesthetic adjuncts such as dexmedetomidine, ketamine, nonsteroidal anti-inflammatory drugs (NSAIDs), acetaminophen, and regional anesthesia techniques (Azizad & Joshi, 2022; Grewal & Joshi, 2019).

Problem Statement

A recent quality improvement (QI) project was conducted at the project site's healthcare system main campus and ambulatory surgery center, with the aim to improve anesthesia providers' awareness of patients at high risk for OSA via implementation of blue wristbands (Casales, 2023; Ushakumari, 2023). The project aimed for blue wristbands to be applied to the wrists of patients whose preoperative STOP-Bang score was ≥ 4. The desired outcome was less administration of benzodiazepines and opioids perioperatively, measured as Yes or No to indicate if the medications were administered or not (Casales, 2023; Ushakumari, 2023). Implementation of the blue wristbands was restricted by stakeholder buy-in and consequently, no significant difference in use of perioperative benzodiazepines and opioids was noted from pre- to post-implementation (Casasles, 2023; Ushakumari, 2023).

One of the limitations identified in the previous project was lack of baseline data on use of benzodiazepines and opioids in the general population versus patients at high risk for OSA

(Casales, 2023; Ushakumari, 2023). Although the STOP-Bang screening questionnaire is utilized throughout AH facilities to identify patients at risk for OSA, there is no evidence-based practice (EBP) guideline in place to limit use of benzodiazepines and opioids in high-risk patients. Additionally, the previous project focused on the singular result of whether or not benzodiazepines and opioids were administered, necessitating the need to evaluate whether a reduction in dosages occurs after patients are categorized as high risk OSA. Patients with a confirmed or suspected diagnosis of OSA are predisposed to cardiac and respiratory complications perioperatively; thus, failure to identify and treat high risk patients appropriately can be costly to both the patient and healthcare system (Butterfield, 2017).

Project Purpose and PICOT Question

This project served as a continuation of the initial QI project performed in 2022. The need for baseline evidence on the use of benzodiazepines and opioids was identified and was this current project's main outcome of interest. Through retrospective chart review, this project aimed to identify any differences in the amount of benzodiazepines and opioids administered perioperatively in the general versus high risk OSA populations, specifically seeking to see if use was reduced among high risk patients. This project was part of a larger QI project that occurred at three locations. It occurred at the initial locations of the first QI project, a major trauma hospital and an ambulatory surgery center, as well as a full-service community hospital that did not adopt the blue wristband project. This specific project occurred at the community hospital. The PICOT question guiding this project was: In adult patients aged 40 to 60 years, who underwent surgical procedures in a community hospital (P), does a STOP-Bang score ≥ 3 (I), compared to STOP-Bang score < 3 (C), result in a reduced dose of benzodiazepines and opioids administered perioperatively (O) during the time period of January 2023 to June 2024 (T)?

Additionally, secondary outcomes were assessed including: post-anesthesia recovery unit (PACU) vital signs, PACU phase I time, total length of PACU stay, use of opioid and/or benzodiazepine reversal medications, blue wristband use, and use of airway adjuncts, such as oropharyngeal airways (OPAs) or nasopharyngeal airways (NPAs).

Rationale for Community Hospital Site

It is estimated that 1 billion people are diagnosed with OSA internationally, with the prevalence exceeding 50% in some countries. This does not account for the large population of individuals that remain undiagnosed (Benjafield et al., 2019). Mean intensive care unit (ICU) costs and length of stay (LOS) for a single patient with OSA were $31,574 and 14.4 days for patients requiring mechanical ventilation and $12,931 and 8.5 days for those not requiring mechanical ventilation (Knauert, 2015). Patients with STOP-Bang scores of 3 or greater are predisposed to postoperative complications, extended LOS, and admittance to the ICU regardless of official OSA designation. It is imperative that their anesthetic plan throughout the perioperative period be highly individualized starting with provider awareness to the STOP-Bang questionnaire (Suen et al., 2018). As the initial blue wristband QI project was not implemented at the community hospital site, it provided helpful baseline information about benzodiazepine and opioid use.

Project Objectives

Data were collected through a retrospective chart review. The data were categorized into patients that had a STOP-Bang score ≥ 3 or < 3. Once identified, a comparison was made between groups to examine any differences in the total dose administration of benzodiazepines and opioids. The primary outcome for this project was identifying if there was any reduction in use of benzodiazepines and opioids for patients with a STOP-Bang score of ≥ 3, as compared to

patients with a score of < 3. Secondary outcomes were assessed to determine if the blue wristband was placed on the patient perioperatively and charted, the time spent in PACU phase I, extubation time, postoperative vital signs (VS), and postoperative respiratory complications including use of rescue medications and non-invasive ventilatory devices.

Success can be defined as the accomplishment of an aim or purpose. Success for this project was defined as detecting a statistically significant reduction in the amount of benzodiazepines and opioids used by anesthesia providers for patients that had a STOP-Bang score of ≥ 3. In addition to the primary goal, success was also defined as detecting statistically significant increases (showing negative health outcomes) in secondary outcomes among patients with a STOP-Bang ≥ 3 and no reduction in benzodiazepines/opioids, which would support the overall need for increased OSA provider awareness and EBP guidelines at the project site. Utilizing the Plan, Do, Study, Act (PDSA) framework ensured that adequate recommendations could be made for future projects.

CHAPTER 2: REVIEW OF LITERATURE

Search Method and Results

PubMed, CINAHL, and Web of Science were used to conduct a review of the literature. Limitations included adult population, human subjects, English language, and years 2017-2024. The terms “obstructive sleep apnea” or “OSA” lead to thousands of results across the above databases. The terms “STOP BANG” or “STOP-Bang” and “anesthesia” or “surgery” or “preoperative” or “postoperative” or “intraoperative” or “perioperative” and “opioids” or “opiates” or “benzodiazepines,” or “PACU” and “complications” were used to narrow the search. Many of the results were the same across each database. Of the articles searched, only a handful were randomized controlled trials; the majority of articles were systematic reviews.

Obstructive Sleep Apnea

Under typical conditions, respiratory drive in humans is controlled by the medullary respiratory center located in the brainstem (Nagelhout & Elisha, 2018). While the brainstem automatically modulates respiratory rate, information from different areas of the body may impact the respiratory center including pain sensation, voluntary effort, or central and peripheral chemoreceptors (Nagelhout & Elisha, 2018). Chemoreceptors sense changes in blood oxygen content (PaO2) and blood carbon dioxide content (PaCO2), sending signals to the brainstem to increase or decrease ventilation (Nagelhout & Elisha, 2018). During sleep, these chemoreceptors predominantly influence ventilatory response (Hines & Jones, 2022; Lee & Sundar, 2021).

OSA is a sleep-related breathing disorder defined by partial or complete upper airway obstruction resulting in hypopnea, apnea (periods of respiratory cessation), and ultimately hypercarbia and hypoxia (Hwang et al, 2022; Lee & Sundar, 2021; Risbud et al, 2023; Wang et al, 2022: Waseem et al, 2021). As discussed above, chemoreceptors are triggered by this

hypercarbia and hypoxia, signaling the brainstem to increase RR, but because the apnea or hypopnea is a result of an airway obstruction, arousal occurs, ultimately creating a cycle of these events until final awakening (Hines & Jones, 2022; Lee & Sundar, 2021). Upper airway obstruction may be the result of multiple factors. First, decreased pharyngeal muscle tone or muscle responsiveness causes structures such as the epiglottis, tongue, or the soft palate to collapse and occlude the airway (Antonaglia & Passuti, 2022; Lee & Sundar 2021; Nagelhout & Elisha, 2018). Second, a lowered respiratory arousal threshold causing patients to awaken prior to a severe blood gas abnormality prevents deep sleep, where breathing is more stable, thus creating a cycle of interrupted sleep, ventilatory variability, and decreased signaling to airway muscles (Antonaglia & Passuti, 2022; Azizad & Joshi, 2022; Lee & Sundar 2021). Finally, anatomic factors such as macroglossia, facial or neck tissue abnormalities, enlarged uvula, or airway edema may lead to airway obstruction (Antonaglia & Passuti, 2022; Azizad & Joshi, 2022; Lee & Sundar 2021).

The gold standard for diagnosis is nocturnal polysomnography (PSG) (Abumuamar et al., 2018; Azizad & Joshi, 2022; Hines & Jones, 2022; Hwang et al., 2022; Martins et al., 2020, Nagelhout & Elisha, 2018; Wang et al., 2022; Waseem et al., 2021). Obstructive apnea events can take three forms on the PSG: apnea, hypopnea, or respiratory effort-related arousals (RERAs), each of which needs to last at least 10 seconds to be scored (Hines & Jones, 2022). Apnea is based on airflow measured by an oral or nasal thermal sensor and by respiratory effort, which can be sensed, not sensed, or mixed (Hines & Jones, 2022). Hypopnea uses a nasal pressure sensor that measures airflow and a pulse oximeter to measure oxygen saturation (Hines & Jones, 2022). RERAs use both airflow and respiratory effort measurements as well as EEG and is an optional addition to the PSG (Hines & Jones, 2022). Typically, the number of apnea

and hypopnea events throughout a PSG are totaled and used to calculate the apnea-hypopnea index (AHI), which is the number of apnea and hypopnea events per hour during sleep (Hines & Jones, 2022). An AHI of 15 alone is sufficient to diagnose OSA, or an AHI of 5 or more plus clinical symptoms such as fatigue, snoring, observed apnea, hypertension, stroke, or cognitive dysfunction can earn an OSA diagnosis (Hines & Jones, 2022).

OSA is important to diagnose because of the long-term impacts it can have on every single system of the body. According to a systematic review conducted by Panahi et al. (2021), there are four pathophysiologic processes that increase a patient's risk of morbidity and mortality related to OSA. First, the sympathetic nervous system (SNS) is activated while sleeping even though the parasympathetic nervous system should dominate during this time due to the hypoxia and hypercarbia from hypoventilation (Panahi et al., 2021). The SNS increases release of endogenous catecholamines, but it also activates the renin-angiotensin-aldosterone system, which can lead to increased vasoconstriction and water retention (Panahi et al., 2021). Second, OSA also causes chronic inflammation, as evidenced by an increase in inflammatory biomarkers and reactive oxygen species from the chronic hypoxia (Panahi et al., 2021). Third, endothelial cells function abnormally, decreasing the amount and effectiveness of nitric oxide that would under normal circumstances dilate blood vessels (Panahi et al., 2021). Fourth and final, OSA is correlated with increased prevalence of type 2 diabetes mellitus, which is a significant risk factor for overall cardiovascular disease (Panahi et al., 2021). OSA does not just affect sleep, but it increases risk of cardiovascular events such as myocardial infarction, hypertension, atrial fibrillation, cerebral vascular accidents, pulmonary hypertension, and cor pulmonale (Hwang et al., 2022; Lonia et al., 2020; Nagelhout & Elisha, 2018; Panahi et al., 2021).

Risk factors for OSA include male sex, increasing age, obesity, and craniofacial abnormalities (Antonaglia & Passuti, 2022; Lee & Sundar 2021; Panahi et al., 2021). Sources do vary on the prevalence of OSA. In one systematic review, OSA in men was estimated to be 9-49% and women 3-23% (Antonaglia & Passuti, 2022). In a prospective cohort study, OSA prevalence was estimated to be 6-17% (Waseem et al., 2021). The sources reviewed do agree that OSA is predominant in males and older aged patients (Antonaglia & Passuti, 2022; Nagelhout & Elisha, 2018; Wang et al, 2022: Waseem et al, 2021).

According to a QI project by Kertes (2020), the estimated costs associated with moderate to severe OSA in the United States are anywhere between $65 and $165 billion annually. In addition, the sleep deprivation associated with OSA has an estimated $16 billion annual cost that is associated with motor vehicle accidents and 1400 lives lost (Hines & Jones, 2022; Kertes, 2020). With this economic burden, the significant complications related to OSA, and the portion of the population affected by OSA, it is of the utmost importance to identify these patients.

STOP-Bang Questionnaire

The STOP-Bang questionnaire (Figure 1) was created by Chung et al. (2008) as a means to accurately identify surgical patients at high risk for OSA due to their higher chance of negative perioperative events. The questionnaire predicts OSA risk by objectively scoring and categorizing patients as low or high risk. For each of the 8 items that are answered “yes,” the patient scores one point, and for each item answered “no,” the patient scores zero points. Scoring ranges from 0 to 8 points, with greater than or equal to 3 indicating high risk of OSA and less than 3 is a low risk of OSA (Nagelhout & Elisha, 2018). It is an easy-to-use tool, only taking about 1 minute to complete and is used worldwide across various populations (Hwang et al., 2022).

1. *S*noring
   Do you *s*nore loudly (louder than talking or loud enough to be heard through closed doors)?
   Yes No
2. *T*ired
   Do you often feel *t*ired, fatigued, or sleepy during daytime?
   Yes No
3. *O*bserved
   Has anyone *o*bserved you stop breathing during your sleep?
   Yes No
4. Blood *p*ressure
   Do you have or are you being treated for high blood *p*ressure?
   Yes No
5. *B*MI
   *B*MI more than 35 kg/m^2?
   Yes No
6. *A*ge
   *A*ge over 50 yr old?
   Yes No
7. *N*eck circumference
   *N*eck circumference greater than 40 cm?
   Yes No
8. *G*ender
   *G*ender male?
   Yes No

High risk of OSA: answering yes to three or more items
Low risk of OSA: answering yes to less than three items

Figure 1. STOP-Bang Scoring Method (Chung et al., 2008).

Multiple articles have discussed the validity and reliability of STOP-Bang across various populations of different ethnicities, genders, ages, and comorbidities. In a systematic review and meta-analysis conducted by Hwang et al. (2022), the validity of STOP-Bang was tested in surgical patients and found to have high sensitivity with a high negative predictive value of 93.2%. Meanwhile, a prospective cohort study of patients with cardiac arrhythmias found that while STOP-Bang may be a sensitive OSA predictor, it had low specificity (Abumuamar et al.,

2018). A cross-sectional study of adults older than 65 found that STOP-Bang had high sensitivity but low specificity; investigators suggested additional testing such as PSG to confirm diagnosis (Martins et al., 2020). Finally, in a prospective observational study looking at the South Indian population and validity of STOP-Bang, the investigators found a poor sensitivity of the questionnaire in this population (Devaraj et al., 2017). Overall, these findings indicate STOP-Bang is helpful to identify persons with OSA but may not be accurate in identifying individuals who do not have OSA. However, more studies are needed among diverse populations. In addition to the STOP-Bang questionnaire, the Berlin Questionnaire, Epworth Sleepiness Scale, Perioperative Sleep Apnea Prediction Score, and the American Society of Anesthesiologists checklist are all tools used to assess OSA risk, but the STOP-Bang is the most validated one for surgical patients (Azizad & Joshi, 2022).

Sources also vary on the cutoff STOP-Bang score for OSA risk stratification, with some designating greater than or equal to 2 (Devaraj et al., 2017), greater than or equal to 3 (Abumuamar et al., 2018; Kertes, 2020; Lonia et al., 2020; Nagelhout & Elisha, 2018; Wang et al., 2022), greater than or equal to 4 (Hwang et al., 2022; Waseem et al., 2021) or greater than or equal to 5 (Azizad & Joshi, 2022; Martins et al., 2020) as high-risk for OSA. The project site's healthcare system uses 3 as their cutoff score for identifying high risk for OSA patients, and thus, this project also used 3. The majority of sources agree that as the cutoff score increases, specificity for diagnosing OSA does as well (Abumuamar et al., 2018; Devaraj et al., 2017; Hwang et al., 2022; Martins et al., 2020, Wang et al., 2022). Due to the implications OSA has on surgery and anesthesia, an efficient and reliable method to identify high risk patients is necessary.

Anesthetic Implications

Despite the low cost and ease of use of the STOP-Bang questionnaire, many surgical patients are not identified as at-risk or having OSA preoperatively (Hwang et al., 2022). As discussed above, OSA affects every body system, which in turn impacts surgical care from an anesthesia standpoint. Multiple studies have demonstrated that OSA is a risk factor for difficult intubations, difficult airway management, airway obstruction on emergence, cardiovascular instability, and postoperative complications such as reintubation, increased length of stay, and overall morbidity and mortality (Azizad & Joshi, 2022; Hwang et al., 2022; Seet et al. 2021; Wang et al., 2022).

According to Nagelhout and Elisha (2018), special considerations must be accounted for in OSA patients such as: the risk for desaturating quickly, increased chance for having a more difficult airway to manage due to extra adipose tissue, and that some medications have varying effects. Discussed further below, patients with OSA may be hypersensitive to the effects of medications such as benzodiazepines and opioids, resulting in respiratory depression, airway obstruction, and increased recovery times (Nagelhout & Elisha, 2018). Anesthesia providers must remain vigilant throughout the perioperative process, with a thorough airway examination preoperatively, cautious use of medications that may suppress respiratory drive, and consider positive pressure ventilation intra- and postoperatively as needed (Nagelhout & Elisha, 2018).

An Introduction to Opioids and Benzodiazepines

To further understand why opioid analgesics and benzodiazepine sedatives predispose the OSA surgical patient to perioperative complications, it is important to understand the mechanism of action of these pharmaceutical agents. Opioid analgesics are primarily administered in the perioperative period to blunt painful stimulations induced by surgery. This

occurs as “opioids attach to proteins called opioid receptors on nerve cells in the brain, spinal cord, gut, and other parts of the body. When this happens, the opioids block pain messages sent from the body through the spinal cord to the brain” (ASA, 2024, p. 1). There are various types of intrinsic opioid receptors; however, the three most prevalent are: delta, kappa, and mu receptors. While each receptor has its own function, the mu receptors are primarily responsible for nociception mitigation in the spinothalamic tract, thus these receptors are the target receptors for the majority of opioid analgesics used in anesthesia practice. Although these receptors are effective at blunting painful stimuli, they are also responsible for augmenting respiratory depression when agonized (Nagelhout, 2023). What this means is any surgical patient exposed to opioid administration is at risk for dulling the intrinsic regulation of breathing.

Benzodiazepines are anesthetic agents used for anxiolysis and sedation. In the perioperative setting, the sedation property of benzodiazepines is additive to other anesthetic agents, for example opioid analgesics, in reducing the conscious awareness of pain. However, the mechanism of action is different from that of opioids. Benzodiazepines bind to the gamma amino butyric acid (GABA) alpha subunit receptors and encourage release of the inhibitory neuromodulator GABA (Nagelhout, 2023). This promotes sedation, hypnosis, anterograde amnesia, and anticonvulsant responses. In comparison to opioid analgesics, benzodiazepines do not frequently cause respiratory depression independently. However, when benzodiazepines are administered in conjunction with opioid analgesics, a common perioperative practice, the additive effects can result in significant respiratory depression (Nagelhout, 2023).

Anesthetic Considerations

Patients with OSA are inherently at high risk for airway obstruction, hypopnea, and hypoxemia; the addition of benzodiazepines and/or opioids further exacerbate this risk

(Butterfield, 2017). A study completed by Weingarten and Sprung (2022) concluded a two-fold increase in measured apneic episodes by utilizing bedside capnography in patients with OSA in the immediate postoperative period. According to the authors, "compared to patients without OSA, OSA patients have double the risk for postoperative pulmonary as well as other complications, and OSA has been linked to critical postoperative respiratory events leading to anoxic brain injury or death" (Weingarten & Sprung, 2022, p.1). These findings were independent of opioid and benzodiazepine administration; further emphasizing the perioperative vulnerability that is present among at-risk OSA patients with concomitant use of opioid analgesics and benzodiazepines.

Another study by Kendzerska et al. (2022) included 300,663 patients diagnosed with OSA. Using a retrospective cohort analysis, it was determined that the greatest hazard of all-cause hospitalizations was via OSA diagnosis and opioid administration (Kendzerska et al., 2022). Furthermore, the Society of Anesthesia and Sleep Medicine (SASM) reviewed 17 observational studies examining the impact of systemic opioid use on OSA. Most of the reviewed studies found an association between opioid use and adverse perioperative outcomes in patients with OSA, but it was not confirmed by all studies (Memtsoudis et al., 2018). Further complications were confirmed in an analysis by Morwald et al. (2018), showing that opioids administered to patients with OSA were associated with increased rates of gastrointestinal complications, prolonged length of stay (LOS), and increased hospital costs.

The current literature is ambiguous to individual causality of benzodiazepine use with poor perioperative outcomes in the OSA patient. Further research is needed to delineate this relationship. However, a study completed by Baillargeon et al. (2019) revealed that concurrent opioid and benzodiazepine administration in patients with chronic obstructive pulmonary

disorder (COPD), a form of OSA, increased hospitalizations and occurrence of adverse respiratory events compared to when either pharmaceutical modality was administered alone. There was insufficient evidence to determine if benzodiazepine administration independently increased perioperative complications in the patient with OSA; however, the combination of benzodiazepines with opioid analgesics did lead to an additive effect with increased perioperative complications.

Anesthetic Practice Recommendations

Current surgery recommendations state that benzodiazepine use should be eliminated for patients at high-risk for OSA, and opioids should be utilized sparingly or as a rescue medication (Grewal & Joshi, 2019). Instead of these medications, current research recommends the use of analgesic and anesthetic adjuncts such as dexmedetomidine, ketamine, NSAIDs, acetaminophen, and regional anesthesia techniques (Azizad & Joshi, 2022; Grewal & Joshi, 2019). A retrospective chart review completed by Stewart et al. (2020) found significant reduction in recovery times in patients with OSA when the anesthetic modality was total intravenous anesthesia (TIVA). Interestingly, the TIVA protocol included a continuous infusion of propofol and remifentanil; this is an extremely short-acting opioid that is broken down via plasma esterases rather than liver enzymes as is the case with most opioid analgesics.

Regional anesthesia is another method of perioperative management that can reduce the need for higher doses of opioid analgesics and sedation. Memtsoudis et al. (2018) stated that regional anesthesia is preferred over general anesthesia in patients with OSA. In an extensive population-based analysis of perioperative outcomes, Nagappa et al. (2018) found that postoperative complications were significantly lower in OSA patients after neuraxial anesthesia versus general anesthesia. Anesthesia is designed to be individualized to patient requirements

and “considerations of local anesthesia or peripheral nerve blocks, neuraxial anesthesia, general anesthesia with a secured airway, and verification of complete reversal of neuromuscular blockade” are imperative for successful outcomes in the patient with OSA (Casales, 2023, p. 13-14).

In a separate review of literature by Chang et al. (2023), OSA was divided into over 150 topic categories and existing research was cross-referenced to determine which perioperative interventions yielded the best outcomes. It was determined that “knowledge gaps and research opportunities include improving the metrics of OSA disease, determining the optimal OSA screening paradigms, developing strategies for positive airway pressures (PAP) adherence and longitudinal care, enhancing selection of PAP alternatives and surgery, understanding health risk outcomes, and translating evidence into individualized approaches to therapy” (Chang et al, 2023, p.1078-1079). In addition to reduction of opioid and benzodiazepine use, and consideration of TIVA or regional methods, patients with OSA should be monitored with continuous pulse oximetry, placed in a “head up” position, and optimally oxygenized for appropriate perioperative management (Casales, 2023).

Secondary Outcomes: Naloxone Administration

Sleep apnea has been fraught with the increased potential for postoperative complications with concomitant benzodiazepine and opioid use that can be seen long after the administration of these agents. The PACU cares for patients who have received various depths of anesthesia. In some instances, patients experience complications related to OSA after receiving benzodiazepines and opioids. One such complication is opioid-induced respiratory depression. Opioid-induced respiratory depression results in activation of the mu opioid receptors at specific sites in the central nervous system which causes alveolar hypoventilation and upper airway

obstruction (Boom et al., 2012). This condition decreases the margin of safety for patients by preventing their ability to ventilate and oxygenate themselves, thereby necessitating a reversal agent such as Naloxone or Flumazenil.

A retrospective case control study by Weingarten et al. (2015) showed the correlation between patients who have been diagnosed with OSA or had risk factors for OSA and the rate at which naloxone (an agent to reverse the physiological effects of opioids) was being administered. The study revealed that 413 patients received naloxone in the PACU yielding an incidence of 2.5 per 1000 anesthetics. OSA was a major contributor in the patients who received naloxone, with statistical significance of P=0.002. It was found that patients who received higher doses of opioids and had OSA were at an increased risk of naloxone administration (Weingarten et al, 2015). This is important because administration of naloxone is not without risk. In fact, the retrospective case control study found an association between patients that had received naloxone and their PACU stay being more complicated as evidenced by longer PACU stay, increased coadministration of neostigmine or flumazenil (other reversal agents), increased transfers to the ICU, and higher use of unplanned noninvasive positive pressure ventilation and/or mechanical ventilation (Weingarten et al, 2015).

Secondary Outcomes: Flumazenil Administration

In addition to the frequent administration of naloxone for OSA patients in the PACU, a retrospective study identified that patients with OSA were at an increased risk of receiving flumazenil during phase 1 recovery (Seelhammer et al., 2018). Flumazenil is a benzodiazepine antagonist and its mechanism of action is “to competitively inhibit the substances that interact with benzodiazepine receptor sites on the GABA/benzodiazepine receptor complex” (Shoar et al, 2023, paragraph 1). This allows for the physiological effects of benzodiazepines to be reversed.

In addition to the respiratory depression and sedative effects caused by the use of benzodiazepines as previously discussed, the increased and necessary use of flumazenil to reverse these harmful effects puts the OSA patient further at risk for postoperative complications. Adverse reactions associated with flumazenil administration are bradycardia, tachycardia, chest pain, impaired cognition, somnolence and in serious cases even further sedation (Shoar et al., 2023). A 2018 retrospective study concluded that "flumazenil use was correlated with a higher rate of unanticipated noninvasive positive pressure ventilation, longer post anesthesia care unit stay, and increased rate of intensive care unit admissions" (Seelhammeret al, 2018, abstract).

Continuous Positive Airway Pressure

Continuous positive airway pressure (CPAP) is a type of respiratory therapy that delivers a set pressure to the airways during inspiration and expiration. The administration of CPAP helps to decrease atelectasis, increase the surface area of the alveolus, and improve ventilation/perfusion matching, all of which helps to improve oxygenation (Pinto & Sharma 2023). Application of CPAP during the perioperative period has been key for patients that are diagnosed with OSA or have increased risk factors. In a recent meta-analysis of nine randomized control trials of patients that underwent abdominal surgery, application of CPAP at 7.5 cm H20 in combination with oxygen reduced the incidence of endotracheal intubation, pneumonia, infection, and sepsis when to compared to oxygen alone in 200 patients who developed hypoxemia immediately in the postoperative period (Chung et al, 2016). CPAP is the gold standard for the management and treatment of OSA and has shown tremendous success in the postoperative period in helping to decrease the incidence of postoperative complications associated with the use of benzodiazepine and opioid administration (Pinto & Sharma, 2023). Postoperative CPAP use, in conjunction with a guideline or protocol for opioid and

benzodiazepine administration, amongst patients with OSA is paramount to the overall success of the patient undergoing surgery in the postoperative period.

Quality Improvement

A recent QI project (Fotino, 2021) utilized the PDSA model to demonstrate how the utilization of preoperative screening for OSA patients, adequate monitoring, and proper education upon discharge mitigated the risks associated with this patient population. This QI project helped shed light on the gaps associated with improper identification of these patients. With the implementation of auditing charts, there was an increased use in the STOP-Bang risk assessment tool in the preoperative area increasing from 40% compliance at week 1 to 100% by week 2 (Fotino, 2021). As previously mentioned, adequate usage of the STOP-Bang risk assessment tool identifies the patients most at risk for OSA. Improper identification of OSA puts the patient at an increased risk of postoperative complications because proper interventions and equipment such as the CPAP machine are not in place. Further, providers are unable to use their knowledge about OSA to guide their decisions on administration of opioids and benzodiazepines, increasing the potential for oversedation that can require naloxone and flumazenil administration. The results of this project demonstrate the promise for improving OSA surgical care through QI work.

Community Hospital Setting

An additional literature search was performed to examine the care of patients with OSA in different surgical settings; specific to this project was the community hospital setting. PubMed, CINAHL, and Web of Science were used to conduct this review of literature. Limitations included adult population, English language, and years 2015-2024. The term

"community hospital" was searched in addition to "stop bang" or "STOP-Bang" or "obstructive sleep apnea" or "OSA."

As of 2022, 5,129 community hospitals are in service in the United States, making this type of surgery facility one of the most prevalent (Statista, 2024). These centers are often not equipped to treat acute emergencies, yet perform procedures on patients with multiple comorbidities daily. OSA affects 25 million adults nationally, with as many as 80% of patients potentially lacking an official diagnosis (Benjafield, 2017). It is rational to conclude that the population utilizing services offered by a community hospital are likely among the patients undiagnosed with OSA. This promotes an arena for potential perioperative complications.

Community hospitals often do not obtain excellence designations and therefore do not have to adhere to protocols and checklists that are required by critical access facilities. A randomized controlled trial by Harris et al. (2020) found that using a surgical checklist for potential known and unknown complications reduced poor perioperative outcomes. A prior QI project stated, "thorough preoperative evaluation of patients at community-hospitals should include the STOP-Bang tool to identify patients with undiagnosed OSA," with a surgical checklist to guide safe anesthesia practice that involves a reduction in the dosage of opioid analgesics and benzodiazepine administration (Casales, 2023, p.11).

Conceptual Framework

The conceptual framework selected for this QI project was the PDSA model. The PDSA cycle is an effective tool to learn, test, and evaluate implementation measures that change clinical practice (Melnyk & Fineout-Overholt, 2019). The PDSA was used as follows: Plan: Careful planning of this QI project considered prior results of the blue wristband project as well as findings and recommendations from the literature. A gap was identified: Do patients at

high-risk for OSA receive less benzodiazepines and opioids perioperatively? Based on this gap, the project plan was to identify if adult surgical patients with suspected OSA, as identified via the STOP-Bang questionnaire, receive less benzodiazepines and opioids than patients without OSA risk. Do: A chart review was performed to determine what type of anesthetic management occurred in patients with STOP-Bang scores ≥ 3 as compared to those who scored less than 3. Study: Analysis of project results involved comparing the doses of benzodiazepines and opioids administered to patients with suspected OSA to those without OSA risk. Further, this project evaluated how the amount of benzodiazepines and opioids impacted primary and secondary outcomes in the perioperative setting. Act: The project concludes with recommendations based on the chart review results.

CHAPTER 3: METHODS

Project Design

Previous implementation of blue wristbands for patients at risk for OSA was restricted by stakeholder buy-in. Consequently, there was no significant difference in the use of perioperative benzodiazepines and opioids, scored as yes or no, from pre- to post-implementation (Casasles, 2023; Ushakumari, 2023). As a continuation, this current QI project sought to determine what measures, if any, were occurring in individualized anesthetic plans for patients with STOP-Bang scores of 3 or greater. Thus, this QI project identified differences in the amount of benzodiazepines and opioids administered perioperatively in the general versus high-risk OSA populations. Specifically, the prevalence of high-risk patients receiving less perioperative benzodiazepines and opioids was determined. This project also sought further understanding of clinical practice among high-risk OSA patients and the link to postoperative outcomes.

This QI project utilized a quantitative, non-experimental, retrospective design to compare the amounts of benzodiazepines and opioids administered to surgical patients who scored ≥ 3 on the STOP-Bang screening tool versus those that scored < 3. Additionally, correlations to variables such as PACU vital signs, PACU phase I time, total length of PACU stay, use of emergency reversals (flumazenil or narcan), blue wristband use, and airway adjuncts (oral or nasopharyngeal airways, CPAP) were also examined.

Sample

This QI project was part of a larger project (Brinning, 2025; Woodward, 2025) conducted at three sites with a total sample of 300 surgical patients (100 per site). At this project's community hospital site, 100 charts were evaluated; half scored ≥ 3 on the STOP-Bang screening tool and the other half scored < 3. The convenience sample was selected via chart review of

patients who received surgery at the community hospital during the time period of January 2023 to June 2024. The time frame was selected based on the completion of the initial QI project and when data collection was completed for this QI project. The most recent 100 charts that met inclusion criteria were included in the analysis.

Inclusion criteria were: any sex or gender, adults aged 40 to 60 years, having received surgery at the chosen project site, and documentation of STOP-Bang score in the EHR. The 40 to 60 age range was chosen to limit the confounder of comorbidities, or lack thereof, that can occur in younger and older populations. CRNAs limit their administration of benzodiazepines and opioids to patients older than 60 years due to other undesirable effects, thus the inclusion of older adults would have negatively impacted the results of this project.

Exclusion criteria were: parturients and specialized surgeries including emergency, trauma, cardiovascular, and obstetrics. This project did not include vulnerable populations such as pediatric, obstetric, and elderly. As procedures that are performed in the setting of emergency, trauma, cardiovascular, and obstetric require different practice protocols, including different requirements for opioid and benzodiazepine administration, it was determined that a reduction in dosing of these pharmacological agents may be viewed as not ethical and therefore not beneficial to include in this project. Excluding a BMI of > 40 (severe obesity) was set because the current American Society of Anesthesiologists (ASA) guidelines designate these patients an a ASA status of 3, which is an increased likelihood of comorbidities requiring specialized practice protocols (ASA, 2024, p.1). ASA classifies patients on a scale of 1 to 6, with 1 being the least acute and 6 being the most, and is used to quantify a patient's systemic acuity level prior to surgical intervention. While the BMI restriction was set, data collection at the community hospital site was complicated by STOP-Bang no longer being charted. Therefore, this calculation

was done by hand, and the sample did include some patients with elevated BMI. Appendix A contains a conclusive list of inclusion and exclusion criteria.

Setting

The project was conducted at a community hospital in an urban area of the southeast United States. The hospital is part of a large integrated health system that has around 70,000 employees and over 1,400 locations across multiple states. The healthcare system utilizes Epic as their EHR and charting system.

The project site was a 196-bed full-service community hospital that cares for a wide range of acute patients, usually up to ASA status 4. It is one of the few locations in the state that has received Planetree designation emphasizing patient autonomy and beneficence at the forefront of patient care. It has 17 operating rooms in conjunction with two new edition procedural suites. Types of cases performed at this facility include: open reduction internal fixation (ORIF), electroconvulsive therapy (ECT), endoscopy, bariatric, general surgery, vascular, total joint, urological, spine, revision of ventriculoperitoneal (VP) shunts, sports medicine, and hands. Pediatric and obstetric/gynecological services are not offered at this location. In 2023, the project site completed 13,586 OR cases and 2,827 Non-OR (NORA) cases (K. Timmons, personal communication, February 27, 2024). This averages to roughly 342 cases per week that require anesthesia. This facility was selected to gather pertinent information regarding current clinical practices of patients with STOP-Bang scores of three or greater in general community sites; this site was not part of the initial blue wristband implementation.

Measurement Tools

Several tools exist that assess OSA risk preoperatively, but the healthcare system that the community hospital belongs to uses the STOP-Bang questionnaire. Although this QI project did

not involve physically evaluating patients using this tool, it intended to analyze chart data of patients that already received STOP-Bang scores preoperatively. However, it was found that this community hospital does not routinely document STOP-Bang scores. Instead, patients are prescreened with four perioperative questions related to sleep. These four questions correlate to the STOP portion of the STOP-Bang questionnaire. This information, in conjunction with BMI, age, and gender (listed in the chart) was used to manually calculate STOP-Bang scores. The healthcare system of the project site uses a STOP-Bang score ≥ 3 to indicate high risk for OSA and this was the cutoff score used in this project.

The STOP-Bang questionnaire was originally created in 2008 by a team who wished to identify patients at high risk for OSA preoperatively (Chung et al., 2008). In this pilot study, validity of the questionnaire was confirmed by screening patients using the tool and then conducting an overnight polysomnography study, the gold standard for OSA diagnosis (Chung et al., 2008). Initially, the STOP portion of the tool was solely used, but when combined with the Bang portion, sensitivity and negative predictive values greatly increased (Chung et al., 2008). In a recent systematic review conducted by Hwang et al. (2022), STOP-Bang was confirmed to be a valid screening tool with high sensitivity and negative predictive values.

Data Collection Procedures

Patient data is collected and stored via the Epic EHR system at the community hospital project site and a chart review was performed in August 2024 to extract data. The first 100 charts meeting inclusion criteria were evaluated. Of the 100 charts selected, 49 had a STOP-Bang score of ≥ 3, and the remaining 51 had a STOP-Bang score of < 3.

Appendix A contains a conclusive list of variables that were extracted during the chart review. The following demographic variables were extracted from each selected EHR: patient

age in years, sex, gender, race, height, weight, BMI, allergies, past medical history, and past surgical history. Preoperative information collected included: STOP-Bang score, ASA status, type of surgical procedure, and baseline respiratory rate and oxygen saturation.

The primary outcome measure was the dosages of benzodiazepines and/or opioids that were administered in pre-, intra-, and postoperative periods. Therefore, this data was collected from the EHR for all 3 surgical periods. Specifically, name, dose, and time of administration was collected for the following medications: midazolam, fentanyl, hydromorphone, and oxycodone. Midazolam is the only intravenous (IV) benzodiazepine used for preoperative anxiolysis at the project site and thus was the only benzodiazepine selected for this project. In the adult population, IV fentanyl is the most common short-acting opioid used, and IV hydromorphone is the most common long-acting opioid used. Remifentanil was excluded due to the rapid-acting nature of the drug and having minimal effect once discontinued. It is very rare to see alfentanil or sufentanil used, and for the ease of equivalency dosing, fentanyl and hydromorphone were used in this project. Opioids were converted to the morphine equivalent dosing to standardize amounts across patients. Morphine is the prototypical opioid and as such is what all other opioids are compared to, consequently the equivalency dosing conversion was based on this medication (Nagelhout & Elisha, 2018). Roughly 0.01 mg of fentanyl and 0.15 mg of hydromorphone are equivalent to 1 mg of morphine (Nagelhout & Elisha, 2018).

Additionally, chart data on secondary outcomes was collected: if a blue wristband was applied, time admitted to PACU, time moved to PACU phase II, time discharged from PACU, dose and time of administration of flumazenil or naloxone, OPA/NPA use (yes or no), need for reintubation (yes or no), respiratory rate and oxygen saturation in the PACU during the first 30 minutes of admission to PACU, and amount and type of oxygen during the first 30 minutes of

admission to PACU. From the different times collected, length of time spent in PACU phase I and total PACU time were calculated.

A data collection sheet of the variables of interest was developed. REDCap was used for collection and organization of data obtained from the chart review. Data were coded. For example, data entered in yes or no columns were coded as 1 for yes and 2 for no. For the airway adjuncts column, 1 was for OPA, 2 was for NPA, 3 was for CPAP, and 4 represented none. Appendix B provides an example of the measurement collection tool that was used.

Institutional review board (IRB) approval was obtained at both the hospital system and the university (see Appendix D). To maintain confidentiality of data, all collected information was de-identified prior to input into REDCap. Identifying patient information such as name, date of birth, and medical record number was not obtained or stored from the chart review. Data collected were stored on a password protected device, with only the investigators of this project and the statistician granted access to it. See Appendix C for the full timeline of this project.

Data Analysis

Following chart review data extraction, a descriptive analysis was perfomed. To depict the sample's overall characteristics, the descriptive analysis included the mean (M), standard deviation (sd), and range. A Pearson r correlation was calculated for the following: STOP-Bang score and the morphine equivalent dosing of opioids, the dose of midazolam, PACU phase I time, total time spent in PACU, PACU oxygen saturations and respiratory rate for the first 30 minutes, and PACU oxygen requirements for the first 30 minutes.

Finally, t-tests were used to compare the two groups in this project (STOP-Bang ≥ 3 and STOP-Bang < 3) according to the amount of opioids (morphine equivalent dosing) and midazolam each patient received. This was the main outcome of interest, and the desire was that

there would be a statistically significant reduction in the amount of opioids and benzodiazepines administered to those in the STOP-Bang ≥ 3 group compared to the STOP-Bang < 3 group. Also, t-tests were used to compare oxygen saturation and RR preoperatively versus postoperatively in the two STOP-Bang groups. A p value was calculated with each statistic, and $p = < 0.05$ was considered statistically significant.

CHAPTER 4: RESULTS

Data Analysis and Interpretation

A statistical analysis was conducted after all data were collected via chart review. The final sample for this project included 100 individuals, 49 with a STOP-Bang < 3 and 51 with a STOP-Bang ≥ 3. Table 1 depicts the sample's demographic characteristics. The descriptive analysis included the mean (M), standard deviation (sd), and range for all demographic variables (age, height, weight, BMI, and ASA). Of the 100 individuals, 58 women and 42 men composed this sample, and the race composition was 62 White, 28 Black, 1 European, 1 Arab, 7 Hispanic, and 1 Native American persons.

Table 1. Sample Demographics

	mean	sd	min	max
Age	50.94	5.58	40.00	60.00
Height (cm)	169.81	14.14	82.00	193.00
Weight (kg)	98.42	23.85	37.00	177.80
BMI	33.09	7.80	15.90	54.00
ASA	2.70	0.75	1.00	4.00

Table 2 displays the M, sd, and range of variables of interest for the two groups in this project (STOP-Bang ≥ 3 and STOP-Bang < 3) and the dose of opioids (fentanyl and/or dilaudid converted to morphine equivalent dosing) and benzodiazepines (midazolam) each patient received. This was the main outcome of inquiry. Patients in the STOP-Bang ≥ 3 group did receive a lower amount of benzodiazepines (M = 1.33mg) and opioids (M = 848.35mg) than the STOP-Bang < 3 group (M = 1.51 mg benzodiazepines and M = 940.12mg opioids). Secondary

variables that were assessed are also included in Table 2. Interestingly, patients in the STOP-Bang ≥ 3 group had lower total PACU times than the STOP-Bang < 3 group (M = 203.61 min vs M = 217.08 min). Lastly, the oxygen requirements in PACU were doubled (M = 4.33 L/min) for the STOP-Bang ≥ 3 group compared to the STOP-Bang < 3 group (M = 2.80 L/min).

Table 2. Descriptive statistics of primary and secondary variables

	STOP-Bang < 3 (n = 49)				STOP-Bang ≥ (n = 51)			
	mean	sd	min	max	mean	sd	min	max
Benzodiazepines (mg)	1.51	0.84	0.00	2.00	1.33	1.24	0.00	4.00
Opioids (mg)	940.12	628.13	0.00	4000.15	848.35	642.54	0.00	3000.53
Baseline SPO2 (%)	98.67	1.82	94.00	100.00	98.86	1.58	94.00	100.00
Baseline RR (bpm)	14.20	12.29	4.00	94.00	13.67	3.99	5.00	22.00
PACU SPO2 (%)	97.55	2.96	88.00	100.00	98.37	1.80	94.00	100.00
PACU RR (bpm)	15.02	4.38	6.00	25.00	14.71	4.74	5.00	25.00
PACU Oxygen (L/min)	2.80	1.86	0.00	6.00	4.33	2.71	0.00	15.00
PACU Time Phase 1 (min.)	123.67	59.97	28.00	307.00	114.53	67.29	17.00	386.00
PACU Time Phase 2 (min.)	111.46	90.98	15.00	430.00	116.70	61.55	20.00	230.00
PACU Time Total (min.)	217.08	116.34	45.00	622.00	203.61	99.06	38.00	466.00

Independent samples t-tests were used to compare the mean key variable outcomes between the two STOP-Bang groups. A p value was calculated for each, and a $p < 0.05$ was considered statistically significant. Table 3 lists the t-values and p values. While the STOP-Bang ≥ 3 group did receive a lower amount of benzodiazepines and opioids than the STOP-Bang < 3 group, this difference was not statistically significant. There was a statistically significant group difference for PACU Oxygen, $t = -3.31$, $p = .001$. The STOP-Bang < 3 group had a significantly

lower value (M = 2.80) than the STOP-Bang ≥ 3 group (M = 4.33). Given this result, it is rational to conclude that patients with STOP-Bang scores of 3 or greater did have higher PACU oxygen requirements compared to patients with scores of less than 3.

Table 3. Statistics for group comparisons

	t values	p values
Benzodiazepines	0.83	0.406
Opioids	0.72	0.472
Baseline SPO2	-0.56	0.58
Baseline RR	0.29	0.772
PACU SPO2	-1.67	0.099
PACU RR	0.34	0.731
PACU Oxygen	**-3.32**	**0.001**
PACU Time Phase 1	0.58	0.566
PACU Time Phase 2	-0.28	0.78
PACU Time Total	0.61	0.541

A Pearsons r correlation was used to detect if administration of opioids and administration of benzodiazepines significantly correlated with PACU time (phase 1, 2, and 3), total time spent in PACU, PACU SPO2, PACU RR, BMI, ASA, and baseline SPO2 and RR. Table 4 revealed one significant ($p < .05$) correlation in the data set. There was a negative correlation between dose of opioids and total time spent in PACU ($r = -0.20$). Though a weak correlation, this suggests that patients who received more opioids had a lower total PACU time. There were no other significant correlations.

Table 4. Pearsons r correlation

	Benzodiazepines	Opioids
BMI	0.09	-0.04
ASA	-0.02	-0.17
Baseline SPO2	0.05	0.11
Baseline RR	0.02	-0.11
PACU SPO2	0.09	0.08
PACU RR	-0.14	-0.09
PACU Oxygen	-0.06	0.03
PACU Time Phase 1	0.03	0.02
PACU Time Phase 2	0.11	-0.20
PACU Time Total	0.02	-0.20*

Note: *p < .05

CHAPTER 5: DISCUSSION

Discussion

This QI project sought to evaluate current anesthetic practice for patients at high-risk for OSA at a community hospital. To further continue a previous QI project, a community hospital setting was selected where blue wrist bands were not implemented to gain insight on benzodiazepine and opioid use among patients with STOP-Bang scores of ≥ 3. This is important because OSA contributes to various perioperative complications including difficult airway management, congestive heart failure exacerbation, and respiratory failure (Grewal & Joshi, 2019). The project site and its hospital system did not have any policies, guidelines, or BPAs in place to guide provider practice for patients with diagnosed or undiagnosed OSA (Casasles, 2023).

The literature review revealed that recommended anesthetic practice for patients with OSA involves the avoidance or reduced use of benzodiazepines and opioid analgesics (Grewal & Joshi, 2019). Additional evidence-based recommendations include the exclusive use of TIVA or regional anesthesia as the primary pain modality eliminating the need for traditional opioids and benzodiazepines altogether (Azizad & Joshi, 2022; Memtsoudis et al., 2018; Stewart et al., 2020). The QI project that initiated implementation of the blue wrist bands at a level 1 trauma center and outpatient surgery center determined that knowledge gaps and reduced awareness to STOP-Bang scores contributed to lack of reduction in dosages of benzodiazepines and opioids, placing patients at risk for perioperative complications (Casasles, 2023; Ushakumari, 2023).

The data collected and analyzed from this project's chart review did not reveal any statistically significant findings that aligned with recommendations from the literature review. While the STOP-Bang ≥ 3 group did receive less total benzodiazepines and opioids, the

difference was not statistically significant. Based on current literature recommendations for lower benzodiazepine and opioid doses (Azizad & Joshi, 2022), it was anticipated that the doses for the STOP-Bang ≥ 3 group would be significantly lower. The sample included patients that received various surgical procedures. It could be postulated that if the sample for each group (STOP-Bang scores of < 3 and ≥ 3) was instead taken based on specific types of anesthesia, the main outcome and postoperative outcome results may have better correlated with the literature results and recommendations.

When looking at all three project sites, an intriguing finding was that the community hospital had lower doses of administered opioids and benzodiazepines for patients with STOP-Bang scores ≥ 3 compared to the level 1 trauma center and outpatient surgery center (Brining, 2025; Woodward, 2025). This is an interesting finding because the community hospital site was not part of the initial blue wrist band implementation, and it was also found that this site is not calculating or charting full STOP-Bang scores. Further exploration of this difference at the community hospital site is recommended.

The project findings highlight the need for strategies to enhance provider awareness of STOP-Bang scores and associated care recommendations. There currently is no system-wide protocol in place that can guide anesthesia providers to comply with evidenced-based recommendations for the diagnosed or at risk OSA patient. Having a protocol may help improve patient outcomes, reduce hospital LOS, and reduce healthcare costs because anesthesia providers would be individualizing the anesthetic to be consistent with research on surgical care of the OSA patient.

Project Strengths and Limitations

There were various strengths associated with the completion of this project. Because this was a chart review, no staff buy-in was required for successful completion of this project. There were no costs associated with IRB approval, supplies, or statistical support. As this was a continuation from a previous QI project, an evaluation of that implementation was available to review offering important information on current project site culture regarding anesthetic management for patients with diagnosed or undiagnosed OSA. Lastly, the sample size of this project was sufficient for a meaningful statistical analysis as it included 100 individuals for the community hospital site and 300 patients total among the three sites.

Conversely, this project was not without limitations. Accessing data via chart review did necessitate a significant time commitment and relied on the expertise of the project chair and committee members. It required coordinating a time to learn how chart reviews are conducted in Epic and how to utilize REDCap. The tool used to navigate the Epic chart reviews did not allow for the filtering of charts based on STOP-Bang score which was inconvenient. Once the data was documented in REDCap, it then had to be transferred to a custom Excel spreadsheet codebook. This process was rather tedious as each column needed to be reviewed thoroughly to prevent error during the statistical analysis.

Another limitation was that the data collected in this chart review was retrospective. As these charts were not designed for the sole purpose of this review, data were subject to poor documentation and/or missing pertinent information. A major obstacle was the discovery of the community hospital no longer routinely using the STOP-Bang questionnaire during the patient preoperative interview. Instead, four questions were asked relating to patient sleep patterns. These four questions were subjective in nature; it would have been nearly impossible to validate

patient transparency in their answers. Nonetheless, these answers were used in conjunction with other patient information to manually calculate a STOP-Bang score. This resulted in discounting an initial exclusion criterion (BMI > 40). As BMI is one of the points for the STOP-Bang scores, and increases the sensitivity of the questionnaire, patients with BMIs of > 40 were included to accumulate an appropriate sample size. Additionally, it is possible that dosages reflected patient's body weight contributing to increased doses administered to patients with STOP-Bang scores of ≥ 3.

This project aimed to look at various secondary variables that required PACU nurses' documentation. At this community hospital, the usage of NPAs or OPAs in the PACU setting requires the patient to be 1:1, meaning that a nurse could only care for that one patient until the OPA or NPA was removed. Based on project findings, this appears to have led to a practice culture of reduced OPA and NPA use, and the at risk OSA patients may have benefited from this intervention. Additionally, the PACU documentation for the target secondary variables was fragmentary. This could have skewed the statistical analysis.

Future projects should focus on the collection of prospective data, in conjunction with a clinical intervention. Additional categorization of anesthetic techniques for surgical procedures would prove useful. For example, the evaluation of high risk OSA patients receiving regional blocks versus those receiving TIVA versus those receiving general anesthesia. Lastly, a continuation should aim to address the discrepancy in PACU charting; this would result in more valid data for analysis.

Recommendations for Clinical Practice

This QI project provided important information that highlights the need for change in clinical practice. The dosages of opioids and benzodiazepines among at risk OSA patients was

the lowest at the community hospital compared to the level 1 trauma center and outpatient surgery center (Brinning, 2025; Woodward, 2025). As the community hospital used more regional anesthesia, it is rational to recommend that regional anesthesia should be considered in the anesthetic planning of patients with STOP-Bang scores of ≥ 3 (Memtsoudis et al., 2018) as this may reduce the use of benzodiazepines and opioids.

Various strategies could be implemented to improve provider awareness of patient risk for OSA and potential surgical complications. Consistency in patient care is a critical step to cultivating a culture of awareness. As the other facilities use the STOP-Bang questionnaire, a recommendation would be for the community hospital to also use the STOP-Bang tool during the patient preoperative interview. This questionnaire has been validated as an effective resource in assessment of patients with undiagnosed OSA (Hwang et al., 2022). Using the STOP-Bang tool could better detect patients at risk for OSA and would provide consistency in OSA identification for anesthesia providers who work at more than one site in the healthcare system. In addition to the use of the STOP-Bang questionnaire, another recommendation is to create a best practice advisory that alerts the anesthetic provider to the patient's STOP-Bang score. This would require provider acknowledgement of STOP-Bang scores of ≥ 3 prior to administration of opioids and/or benzodiazepines. Additionally, education on current recommendations to reduce benzodiazepines and opioids for at risk OSA patients would benefit anesthesia providers, as would having a protocol to guide the surgical care of patients.

Recommendations for Future Projects and Research

Ongoing projects and research in this area could pave the road for future guidelines or protocols in the anesthetic management of undiagnosed and diagnosed OSA patients. A recommendation for future evaluation would be assessing the efficacy of implementing incentive

spirometry in the preoperative period and use of the high-flow nasal cannula (i.e. Optiflow) during induction of general anesthesia as a part of a system-wide protocol. These interventions reduce atelectasis and improve lung function (Pinto & Sharma, 2023). It would be worth evaluating if patients with STOP-Bang scores of ≥ 3 that received this intervention had improved postoperative outcomes despite administration of opioids and/or benzodiazepines.

Future evaluation based on anesthesia type could provide useful information on postoperative outcomes. The literature review suggested that regional anesthesia or TIVA with Remifentanil may be superior options for patients at risk for OSA compared to traditional opioid-based anesthesia. The eventuality of a QI project that specifically addresses the postoperative outcomes related to anesthetic type could prove invaluable in the development of a future system-wide protocol. Additionally, future projects should evaluate provider knowledge and practice changes following education, BPA implementation, and institution of protocol or policy.

Summary

This QI project evaluated current anesthetic practice for patients that are diagnosed or undiagnosed with OSA as evidenced by STOP-Bang scores of ≥ 3. The primary focus was to determine if benzodiazepine and opioid dosages were reduced in the presence of STOP-Bang scores ≥ 3 at a community hospital. Secondary variables included: PACU time (phase 1, 2, and 3), total time spent in PACU, PACU SPO2, PACU RR, BMI, ASA, and baseline SPO2 and RR. Interestingly, the community hospital setting did administer lower doses of benzodiazepines and opioids to patients with STOP-Bang scores of ≥ 3 compared to <3, which was not the case at the level 1 trauma center and outpatient surgery center. However, the reduced dosages at the community hospital were not statistically significant. Also, there were no statistically significant data to show that patients with STOP-Bang scores of ≥ 3 had worse perioperative outcomes as a

result of opioid and benzodiazepine administration. Project results highlight the need for thorough documentation, preoperative screening with the STOP-Bang questionnaire, and enhanced provider awareness to STOP-Bang scores and associated practice recommendations. Future recommendations are to evaluate clinical interventions such as preoperative incentive spirometry, the use of the Optifow during induction, and the use of a BPA. Additionally, there could be benefit in evaluating perioperative outcomes for patients at-risk for OSA by comparing data based on anesthesia type (TIVA, regional, and general anesthesia), with the end goal of developing a system wide guideline or protocol for patients with STOP-Bang scores of ≥ 3.

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APPENDIX A: DATA COLLECTION PLAN FOR CHART REVIEW

Setting:

- Community Hospital

Patient Characteristics/ Inclusion Criteria:

- Age 40-60 years
- Underwent any surgical procedure except emergent, trauma, cardiac, or obstetric surgeries
- Documented pre-operative STOP-Bang score in the EHR
- Any sex, gender, or race

Exclusion Criteria:

- Parturients
- Specialized surgeries including emergency, trauma, cardiovascular, and obstetrics

Data Needed:

- 100 charts from each site, 50 with STOP-Bang ≥ 3 and 50 with STOP-Bang < 3
- Demographics
    - Age, sex, race
    - Height, weight, BMI
    - Allergies, past medical history, past surgical history
- Preoperative characteristics:
    - STOP-Bang Score
    - Baseline respiratory rate and oxygen saturation
    - ASA status
    - Type of surgical procedure
- Main outcome of interest:
    - Name, time, and dose of benzodiazepine and opioids administered- pre-, intra-, and post-operative
- Secondary outcomes of interest:
    - Blue wristband applied
    - PACU admission time, PACU phase II time, PACU discharge time
    - Dose and time of flumazenil and/or naloxone administration
    - PACU oxygen saturation and respiratory rate during the first 30 minutes
    - OPA, NPA, CPAP use (yes/no)
    - Need for reintubation (yes/no)
    - PACU oxygen requirements during first 30 minutes

APPENDIX B: EXCEL CODEBOOK

Patient #	STOP-Bang Score Preoperatively	Received Benzodiazepines?	Dose of Benzodiazepines	Received Opioids?
101				
102				
103				
104				
105				

Dose of Opioids	Blue wristband on?	Length of time spent in PACU Phase I	Total length of time spent in PACU	Received Flumazenil?

Received Nalaxone?	PACU SpO2	PACU RR	Reintubation Required?	Airway Adjuncts Required in PACU?

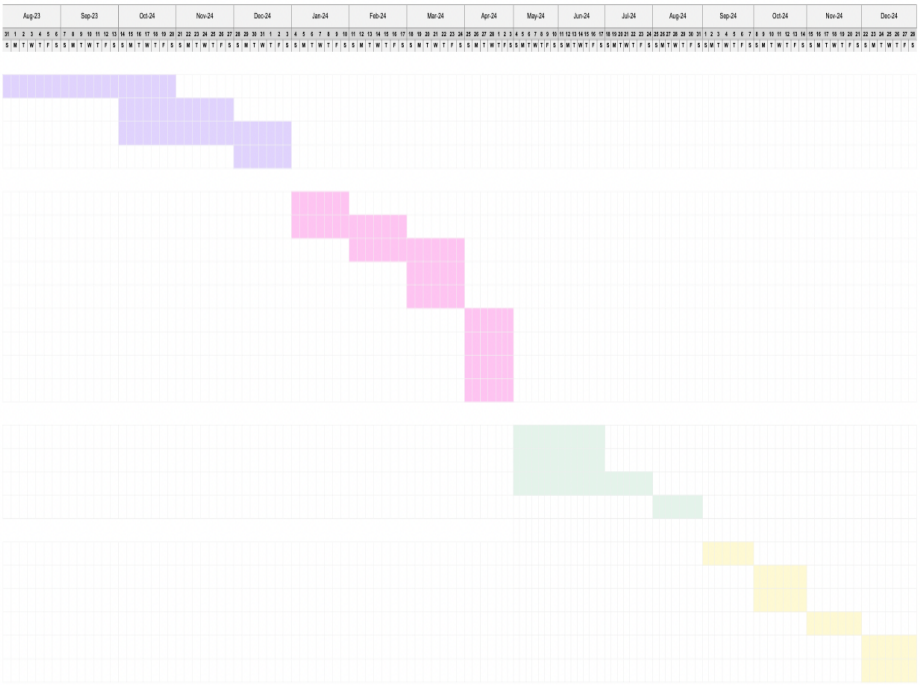
APPENDIX C: GANTT CHART

The following Gantt Chart illustrates the timeline for this doctoral project. Project conception and initiation included the Needs Assessment Paper, Topic Approval Paper, Topic Approval PowerPoint, and Topic Approval Oral Defense. The planning phase included the CITI Training Modules, Review of Literature, Mapping of the Project, Drafts presented for review by chair and committee, and the Oral Proposal Defense. The Oral Proposal Defense was completed April 6th, 2024. IRB approvals were obtained in July 2024. A retrospective chart review of the three predetermined facilities was completed in August 2024. Further data analysis and evaluation was completed in the fall of 2024 with the goal of providing practice change recommendations. The final Project Defense in conjunction with submission of the Final Scholarly Paper was presented in December 2024.

Project Timeline

Project start: August 21st, 2023

TASK	ASSIGNED TO	PROGRESS	START	END	DAYS
1 Project Conception Initiation					
Needs Assessment Paper	Casey, Precious, & Rachael	100%	8/1/23	10/22/23	81
Topic Approval PPT	Casey, Precious, & Rachael	100%	10/23/23	11/29/23	31
Topic Approval Paper	Casey, Precious, & Rachael	100%	10/23/23	12/3/23	42
Topic Approval Defense	Casey, Precious, & Rachael	100%	12/6/23	12/6/23	1
2 Project Definition and Planning					
CITI Training	Casey, Precious, & Rachael	100%	1/10/24	1/31/24	21
Review of Literature	Casey, Precious, & Rachael	100%	1/16/24	2/16/24	32
Mapping Out The Project	Casey, Precious, & Rachael	100%	2/17/24	3/5/24	17
Draft of Paper to Chair	Casey, Precious, & Rachael	100%	3/5/24	3/23/24	19
Revised Draft to Committee	Casey, Precious, & Rachael	100%	3/23/24	4/5/24	14
PPT Draft to Faculty	Casey, Precious, & Rachael	100%	4/6/24	4/10/24	4
Oral Defense	Casey, Precious, & Rachael	100%	4/16/24	4/16/24	1
UNCC Online Oral Defense Form	Casey, Precious, & Rachael	100%	4/16/24	4/23/24	7
Sections I&V of Scholary Paper	Casey, Precious, & Rachael	100%	4/16/24	4/26/24	10
3 Chart Review and Statisitcal Analysis					
Wake Forest IRB Application	Casey, Precious, & Rachael	100%	5/15/24	7/15/24	
UNCC IRB Application	Casey, Precious, & Rachael	100%	5/16/24	6/21/24	
IRB Approval	Casey, Precious, & Rachael	100%	7/15/24	7/15/24	
Data Collection	Casey, Precious, & Rachael	100%	7/16/24	8/23/24	
4 Project Performance and Evaluation					
Data Analysis	Casey, Precious, & Rachael	100%	8/23/24	10/1/24	
Complete Chapter 3	Casey, Precious, & Rachael	100%	3/23/24	8/9/24	
Complete Chapter 4	Casey, Precious, & Rachael	100%	8/9/24	10/14/24	
Submit Final Draft	Casey, Precious, & Rachael	100%	11/3/24	11/8/24	
Public Defense	Casey, Precious, & Rachael	100%	12/6/24	12/9/24	
Dissemination	Casey, Precious, & Rachael	100%	10/31/24	11/21/24	



APPENDIX D: IRB APPROVALS

IRB: Notification of IRB Approval

eirb@wakehealth.edu <eirb@wakehealth.edu>
Mon 7/15/2024 11:07 AM
To:Wallin, Casey <Casey.Wallin@atriumhealth.org>
Advocate Health - Wake Forest University School of Medicine

IRB APPLICATION APPROVED

To:	Casey Wallin
Study Title:	Perioperative Care of Obstructive Sleep Apnea Patients
IRB #:	IRB00115065
PI:	Danielle Brown
Link to Workspace:	IRB00115065

PLEASE DO NOT RESPOND TO THIS EMAIL- Call (336) 716-4542 if you have questions.

The Insitutional Review Board has reviewed and approved the above referenced research study. Please use the "Link to Workspace" above to access the approval memo, consent forms, assent forms, and other items associated with this study.

Advocate Health - Wake Forest University School of Medicine Institutional Review Board WFUHS: (336) 716-4542

Please do not respond to this email by using the "reply" address. This account is configured exclusively for outgoing messages from eIRB.

WFUBMC users may access eIRB remotely via WFUBMC Citrix Portal. If you have Citrix portal access, click here. If you need access, contact the **WFUHS** HELP Desk at 716-HELP (716-4357).

If the link provided does not work, please see the instructions below for accessing eIRB through your web browser.

Please use the following link for academic applications- Education and Research

https://www.wfusmapphub.com/

for access to eIRB click the Research Applications button and then Huron IRB

Choose the following and enter your Wakehealth.edu username and password

Casey Raye Wallin <cwallin@charlotte.edu>

IRB-24-0958 - NHSR Submission Acknowledged

1 message

Tyler Steven Forgette <tforgett@uncc.edu> Fri, Jun 21, 2024 at 4:39 PM
To: Rachael Christina Brinning <rbrinnin@uncc.edu>
Cc: Precious Iriaghomo Woodward <piriagho@uncc.edu>, "Mrs. Casey Raye Wallin" <cwallin@uncc.edu>, "Dr. Kelly Ann Powers" <kpower15@uncc.edu>

UNIVERSITY OF NORTH CAROLINA CHARLOTTE | DIVISION OF RESEARCH

To:	Rachael Brinning University of North Carolina at Charlotte
From:	Office of Research Protections and Integrity
Date:	21-Jun-2024
RE:	Determination that Activity is not Research and does not require IRB Approval
Study #:	IRB-24-0958
Study Title:	An Evaluation of Perioperative Care for the Obstructive Sleep Apnea Patient

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

Study Description:
Project Purpose: This is a quality improvement (QI) project being conducted as part of the DNP in Nurse Anesthesia program. The project topic is a practice issue selected by the Anesthesia Quality and Safety