AN EVALUATION OF PERIOPERATIVE CARE FOR THE OBSTRUCTIVE SLEEP APNEA PATIENT AT AN AMBULATORY SURGERY CENTER

by

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ABSTRACT

RACHAEL BRINNING. An Evaluation of Perioperative Care for the Obstructive Sleep Apnea Patient at an Ambulatory Surgery Center
(Under the direction of DR. KELLY POWERS)

In the perioperative setting, obstructive sleep apnea (OSA) may result in difficult airway management and postoperative complications, necessitating reduced benzodiazepine and opioid dosages. Because many patients with OSA are not formally diagnosed, risk identification is vital to improve perioperative care and can be achieved with the STOP-BANG questionnaire. This scholarly project examined current care practices for benzodiazepine and opioid administration to perioperative patients with a high-risk of OSA to aid in formulating future best practice recommendations. The guiding PICOT question was: In adult patients ages 40 to 60, who underwent surgical procedures in an ambulatory surgery center, does a STOP-BANG score ≥ 3, compared to STOP-BANG score < 3, result in a reduced dose of benzodiazepines and opioids administered perioperatively during the time frame of May 2024 to June 2024?

This quality improvement project occurred at an ambulatory surgery center. Data were collected via a retrospective chart review of 100 charts, 53 with a STOP-BANG score ≥ 3 and 47 with a STOP-BANG score < 3. Descriptive statistics were conducted for sample demographics. T-tests were used to compare the two groups. No statistically significant differences were noted in the amount of benzodiazepines or opioids administered between the two groups. Clinically, this is a significant finding as it shows there may be room for education and increased awareness on the effects of these medications on high-risk OSA patients. Limitations included convenience sampling, missing data in the electronic health record, and lack of variety in surgical cases. Recommendations include education and guideline implementation at this ambulatory surgery center.

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LIST OF ABBREVIATIONS

AHI	Apnea Hypopnea Index
ASC	Ambulatory Surgery Center
ASA	American Society of Anesthesiologists
COPD	Chronic Obstructive Pulmonary Disease
CPAP	Continuous Positive Airway Pressure
EBP	Evidence-Based Practice
EHR	Electronic Health Record
ENT	Ear, Eye, Nose, and Throat
GABA	Gamma Amino Butyric Acid
ICU	Intensive Care Unit
IV	Intravenous
IRB	Institutional Review Board
NPA	Nasopharyngeal Airway
NSAIDs	Non-Steroidal Anti-Inflammatory Drugs
OPA	Oropharyngeal Airway
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
RR	Respiratory Rate
TIVA	Total Intravenous Anesthesia

CHAPTER I: 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 ambulatory surgery center (ASC) where this project was conducted, classify a score of three or greater as high risk, and thus 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 a major level one trauma center and an ASC with the aim of improving 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 (Casales, 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 this hospital system 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 low- versus high-risk OSA populations, and specifically sought to determine if use is reduced among high-risk patients. This project was a continuation at the ASC where the initial QI project initially occurred. The PICOT question guiding this project was: In adult patients aged 40 to 60 years, who underwent surgical procedures in an ambulatory surgery center (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 frame of May 2024 to June 2024 (T)? Additionally, secondary outcomes that were assessed included: blue wristband use, time in PACU phase I, time in PACU phase II, total time in PACU, baseline and postoperative oxygenation and respiratory rate (RR), and postoperative respiratory

complications including reintubation, use of rescue medications and non-invasive ventilatory devices, such as oropharyngeal airways (OPAs), nasopharyngeal airways (NPAs), or continuous positive airway pressure (CPAP).

In addition to being a follow-up location, ASCs have other appealing attributes. ASCs are becoming increasingly popular as more surgeries are deemed appropriate for outpatient status (Rajan et al., 2021). This increased demand requires selecting patients suitable for this setting, which involves use of screening tools such as STOP-BANG. OSA is not an automatic disqualifier for ASC, but it is important to identify patients with OSA so anesthesia providers can adjust their care accordingly (Rajan et al., 2021). Conducting this project at an ASC provided valuable insight into how patients at high-risk for OSA are cared for in this setting.

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. Comparative and correlational statistics were conducted to examine any differences in the total administration of benzodiazepines and opioids between each group. 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 included blue wristband use, time in PACU phase I, time in PACU phase II, total time in PACU, baseline and postoperative oxygenation and RR, and postoperative respiratory complications including reintubation, use of rescue medications and non-invasive ventilatory devices, such as OPAs, NPAs, and CPAP.

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 have a STOP-BANG

score of ≥ 3. In addition to the primary goal, success also was 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 or opioids, which would support the overall need for increased OSA provider awareness and EBP guidelines at the project sites. Utilizing the Plan, Do, Study, Act (PDSA) framework ensured that adequate recommendations can be made for future projects to create a guideline that supports surgical patients at high risk for OSA.

CHAPTER II: 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).

Obstructive sleep apnea is a sleep-related breathing disorder defined by partial or complete upper airway obstruction resulting in hypopnea, apnea, 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).

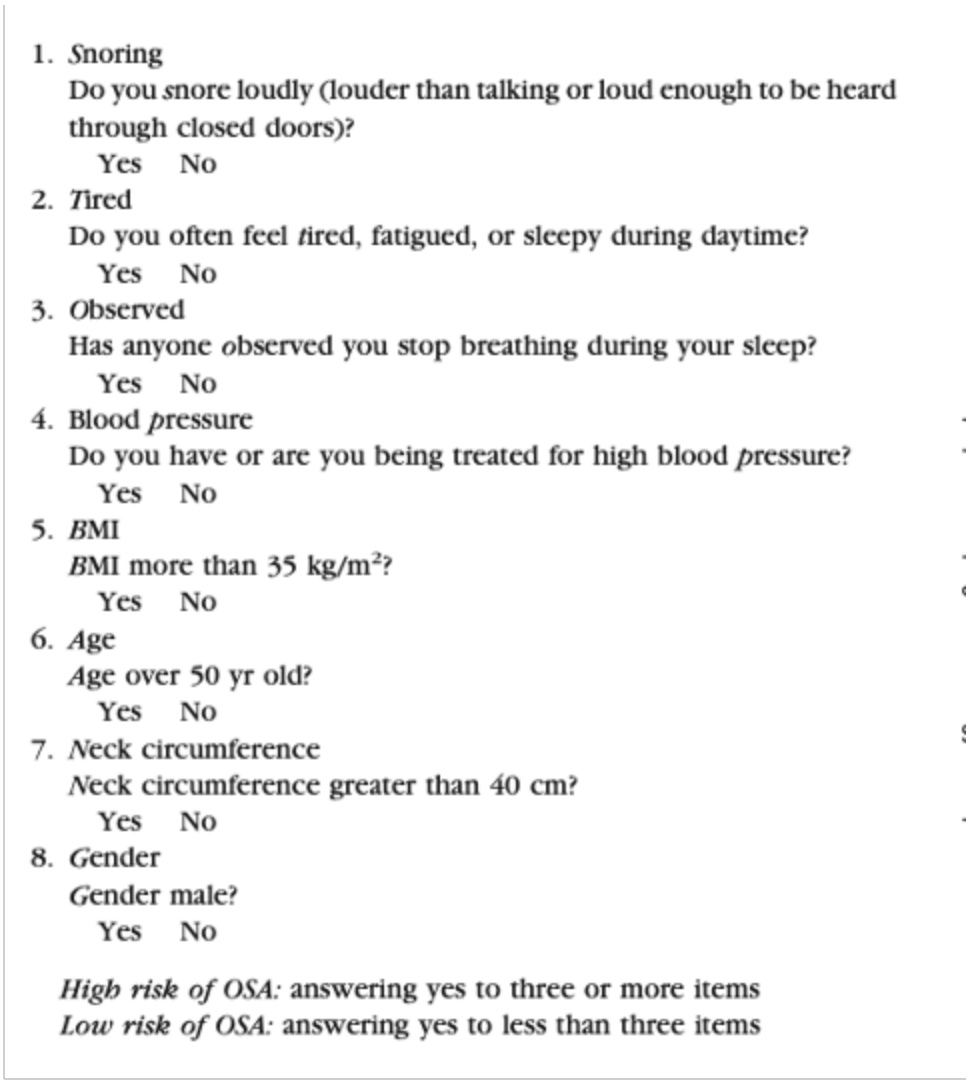
Obstructive sleep apnea is important to diagnose because of the long-term impacts it can have on every single system of the body. According to a systematic review conducted by Panahi et al. (2021), there are four pathophysiologic processes that increase a patient's risk of morbidity and mortality related 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). Obstructive sleep apnea does not only affect sleep, but it also 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 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.

OSA 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).

Benzodiazepines and Opioids

To further understand why benzodiazepine sedatives and opioid analgesics 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 & Elisha, 2018). 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 & Elisha, 2018). 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).

Pharmaceutical Anesthetic Implications

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

Obstructive 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.

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. Obstructive sleep apnea 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" (Seelhammer et al., 2018, abstract).

Continuous Positive Airway Pressure

Continuous positive airway pressure 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). Continuous positive airway pressure application 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 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 Literature

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.

Ambulatory Surgery Center Setting

An additional literature search was performed to examine the care of patients with OSA in the ASC 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 terms “ambulatory surgery” or “same day surgery” or “one day surgery” were searched in

addition to “STOP BANG” or “STOP-BANG” or “obstructive sleep apnea” or “OSA.” Many of the results were the same across each database, and the majority were systematic reviews.

ASCs were developed to meet the increasing demand for outpatient surgeries, a demand which is being seen worldwide (Rajan et al., 2021). Appropriate screening tools are needed to ensure patients that are selected for surgeries at an ASC are suitable for this setting, which includes screening for OSA. Although OSA does not automatically bar patients from having surgery at an ASC, it is an important factor to identify in order for anesthesia providers to adjust their care accordingly and mitigate risks associated with OSA (Azizad & Joshi, 2022; Rajan et al., 2021). Multiple studies have shown that using STOP-BANG to identify high-risk patients and then closely examining their comorbidities and scheduled surgery are appropriate strategies for selecting these patients for ASC (Azizad & Joshi, 2022; Butterfield, 2017; Grewal & Joshi, 2019; Rajan et al., 2021; Szeto et al., 2019).

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 results of the prior QI 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 the identified need, the plan for this project was to identify if adult surgical patients with suspected OSA, as identified via the STOP-BANG questionnaire, received less benzodiazepines and opioids than patients at low-risk for OSA. Do: A chart review was conducted to determine amount of benzodiazepines and opioids administered in patients with STOP-BANG scores ≥ 3 compared to

those who scored < 3. Study: Analysis of project results involved comparing the doses of benzodiazepines and opioids administered to patients with STOP-BANG scores ≥ 3 versus STOP-BANG scores < 3. The impact on secondary outcomes in the perioperative setting was also examined. Act: The project concluded with suggesting practice recommendations based on the chart review results. This included recommendations for future implementation of a facility-wide protocol and provider education.

CHAPTER III: 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 (Casales, 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's goal was to identify any differences in the amount of benzodiazepines and opioids administered perioperatively in the low- versus high-risk OSA populations at an ASC. This project also aimed to promote further understanding of clinical practice among high-risk OSA patients and the link to postoperative outcomes.

This project utilized a quantitative, non-experimental, retrospective design to compare the amounts of benzodiazepines and opioids administered to surgical patients at an ASC who scored ≥ 3 on the STOP-BANG screening tool versus those that scored < 3. Additionally, correlations to variables such as blue wristband use, time in PACU phase I, time in PACU phase II, total time in PACU, baseline and postoperative oxygenation and respiratory rate (RR), and postoperative respiratory complications including reintubation, use of rescue medications and non-invasive ventilatory devices, such as oropharyngeal airways (OPAs), nasopharyngeal airways (NPAs), or continuous positive airway pressure (CPAP) were also examined.

Sample

This QI project was part of a larger project conducted at two additional sites (level one trauma center and community hospital) (Wallin, 2025; Woodward, 2025) within the same hospital system for a total of 300 chart reviews. At the ASC site specifically, 100 charts were

selected, with a desired 50 in the STOP-BANG ≥ 3 category and the other 50 in the STOP-BANG < 3 category. The convenience sample was selected via chart review of patients who received surgery at the ASC during the time period of May 2024 to June 2024. The time frame was selected based on the completion of the initial QI project and when data collection could occur 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 typically limit their administration of benzodiazepines and opioids to patients older than 60 years due to other undesirable side effects, thus the inclusion of older adults would have influenced the results of this project.

Exclusion criteria were: parturients, patients with a BMI > 40, 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 obstetrics 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. Patients with a BMI of > 40 (severe obesity) were excluded because the current American Society of Anesthesiologists (ASA) guidelines designate these patients as an ASA status of III, which equates to an increased likelihood of extensive existing 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. Appendix A contains a conclusive list of inclusion and exclusion criteria.

Setting

This project was conducted at an ASC located in a major southeastern United States city. This ASC is part of a greater hospital system that serves the population of multiple southern states. Epic is the EHR utilized in this hospital. This ASC has 11 operating rooms (OR) and was meant to serve patients with ASA status less than 3, who are at minimal risk for perioperative complications, and were able to be discharged home the same day. Cases performed at this facility mainly include ear, nose, and throat (ENT), pediatrics, gynecologic, urologic, breast, some oncologic procedures, and some orthopedics. There are 34 CRNAs, 2 full-time anesthesiologists plus anesthesiologists who specialize in pediatrics on rotation, about 60 perioperative nurses, and more than 50 surgeons working at this facility (A. Cook, personal communication, March 24, 2024). On average, this ASC performs 40 procedures per day, or about 1,300 per year (A. Cook, personal communication, March 24, 2024). Out of the various facilities within this hospital system, this ASC was selected because it provided follow-up from the first STOP-BANG QI project and because OSA does not automatically disqualify one from an ASC, but may impact anesthetic care (Rajan et al., 2021).

Measurement Tools

Several tools exist that assess OSA risk preoperatively, but this hospital system uses the STOP-BANG questionnaire. Although this QI project did not involve physically evaluating patients using this tool, it did analyze chart data of patients that already received STOP-BANG scores preoperatively. This score was recorded in each patient's EHR. At this ASC, a STOP-BANG score ≥ 3 is considered high risk for OSA and thus 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 this ASC and thus, a chart review of the Epic EHR was performed from July to August 2024 to extract data. A convenience sample of the first 100 charts meeting inclusion criteria were evaluated. Of the 100 charts selected, 53 had a STOP-BANG score of ≥ 3, and the remaining 47 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, race, height, weight, BMI, and past medical history. Preoperative information collected included: STOP-BANG score, ASA status, type of surgical procedure, and baseline oxygen saturation and RR.

The primary outcome measure was 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, and hydromorphone, and

oxycodone. Midazolam is the only intravenous (IV) benzodiazepine used for preoperative anxiolysis at this ASC and thus was the only benzodiazepine selected for this project. In the adult population at this ASC, IV fentanyl, IV hydromorphone, and oral oxycodone are the most common opioids used in the perioperative period. 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, only fentanyl, hydromorphone, and oxycodone 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, 0.15 mg of hydromorphone, and 2 mg of oxycodone 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 oxygen requirements 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.

REDCap is a secure data management system used to create surveys and store data, such as data collected during chart reviews. At the project site, it is accessible only through a hospital issued username and password. A data collection form was created to include the variables listed above and a codebook was generated based on the form, see Appendix B. Patient charts were

then accessed to obtain the information listed in Appendix A and entered directly into REDCap. After the final chart review, data was exported into Microsoft Excel and shared only with the statistician and committee chair.

Institutional review board (IRB) approval was obtained at both the hospital system and the university, see Appendices C and 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 in REDCap and only accessible with an approved login and password. Only the investigators of this project and the statistician were granted access to the final data set. See Appendix E for the full timeline of this project.

Data Analysis

A descriptive analysis was conducted after all data were collected via chart review. 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 correlations: benzodiazepine and opioid use and ASA, BMI, baseline RR and oxygen saturation, PACU phase I time, PACU phase II time, total time spent in PACU, PACU oxygen saturations and RR for the first 30 minutes, and PACU oxygen requirements for the first 30 minutes.

Finally, a t-test was 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 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. A t-test was also used to compare baseline oxygen saturation and RR versus in PACU, PACU phase I time,

PACU phase II time, and total PACU time in the two STOP-BANG groups. A *p* value was calculated with each statistic, and $p = < 0.05$ was considered statistically significant.

Challenges to Success of Project Implementation

Accessing data via chart review required a significant time commitment and relied on the expertise of the project chair and committee members. It required coordinating time to learn how chart reviews are conducted in Epic and how to utilize the secure data management system REDCap. Because this was a chart review, no staff buy-in was needed for successful completion of this project. There were no costs to the investigators associated with IRB approval, office supplies, REDCap use, or statistical support.

CHAPTER IV: PROJECT RESULTS

This QI project's main goal was to determine the difference, if any, between low- and high-risk OSA patients and the amount of benzodiazepines and opioids they received perioperatively. Secondary outcomes also measured included: blue wristband use, time in PACU phase I, time in PACU phase II, total time in PACU, baseline and postoperative oxygenation and RR, and postoperative respiratory complications including reintubation, use of rescue medications and non-invasive ventilatory devices, such as OPAs, NPAs, and CPAP. The final sample for this project included 100 individuals, 47 with a STOP-BANG < 3 and 53 with a STOP-BANG ≥ 3. The sample was comprised of 73 females and 27 males, with race identified as 62 White, 27 Black, 2 Asian, 2 Indian, 1 Hispanic, and 1 Native American.

First, a descriptive analysis on demographic data was conducted (Table 1). This included age, height (cm), weight (kg), BMI, ASA. The M, sd, and range were collected for all data. The mean age of the sample was 50 years old (sd = 5.69), with a range of 40 to 60 years old. BMI ranged from 18.47 to 39.62, with the average being 29.84 (sd = 5.39). The mean ASA status was 2.38 (sd = 0.6), with a range of 1 to 4.

Table 1. Sample Demographics.

	mean	sd	min	max
Age	50.00	5.69	40.00	60.00
Height (cm)	167.63	8.72	147.30	190.50
Weight (kg)	83.99	17.64	49.00	120.00
BMI	29.84	5.39	18.47	39.62
ASA	2.38	0.60	1.00	4.00

Next, a descriptive analysis of the key variables was conducted (Table 2) and t-tests were used to compare these key variables between the STOP-BANG < 3 and STOP-BANG ≥ 3 groups (Table 3). There was no statistically significant difference in the amount of benzodiazepines administered between the two groups (t = 1.26, p = 0.213), meaning the higher risk OSA patients

received the same amount of benzodiazepines as the lower risk OSA patients. Although there was no statistically significant difference, the STOP-BANG ≥ 3 group received more benzodiazepines than the STOP-BANG < 3 group (M = 2.85mg versus M = 1.98mg). There was also no statistically significant difference in the amount of opioids administered between the two groups (t = -1.26, p = 0.212), meaning the higher risk OSA patients received the same amount of opioids as the lower risk OSA patients. Again, although there was no statistically significant difference, the STOP-BANG ≥ 3 group received more opioids than the STOP-BANG < 3 group (M = 1028.97mg versus M = 920.65mg). There was a statistically significant difference in baseline SpO2 (t = 4.01, p = < .001), and the STOP-BANG < 3 group had a higher baseline SpO2 reading (M = 99.45%) than the STOP-BANG ≥ 3 group (M = 98.50%). There were no significant differences between the two groups for the rest of the secondary variables: baseline RR, PACU SpO2, PACU RR, PACU oxygen requirements, PACU phase I time, PACU phase II time, or PACU total time. No individuals in either group had a blue wristband applied, were reintubated, or received flumazenil or naloxone. The amount of OPA (n = 9), NPA (n = 1), and CPAP (n = 7) use was too infrequent to conduct a formal analysis.

Table 2. Descriptive statistics of key variables.

	STOP-BANG < 3 (n = 47)				STOP-BANG >= 3 (n = 53)			
	mean	sd	min	max	mean	sd	min	max
Benzodiazepines	1.98	0.15	1.00	2.00	2.85	0.57	1.00	4.00
Opioids	920.65	407.85	0.00	2002.58	1028.97	453.94	0.00	2500.15
Baseline SPO2	99.45	0.95	97.00	100.00	98.50	1.38	95.00	100.00
Baseline RR	19.38	9.52	16.00	22.00	17.24	1.56	12.00	20.00
PACU SPO2	98.28	1.85	93.00	100.00	97.04	2.18	92.00	100.00
PACU RR	15.38	2.44	11.00	20.00	15.84	4.46	9.00	34.00
PACU Oxygen	0.28	0.85	0.00	4.00	0.49	1.59	0.00	10.00
PACU Time Phase 1	91.36	38.29	28.00	187.00	96.31	39.35	24.00	257.00
PACU Time Phase 2	111.85	74.75	30.00	365.00	113.17	63.10	30.00	335.00
PACU Time Total	185.28	96.94	82.00	505.00	202.17	74.28	92.00	465.00

Table 3. Comparative Results of Key Variables.

	t values	p values
Benzodiazepines	1.26	.213
Opioids	-1.26	.212
Baseline SPO2	4.01	< .001
Baseline RR	1.44	.157
PACU SPO2	3.05	.003
PACU RR	-0.64	.521
PACU Oxygen	-0.85	.397
PACU Time Phase 1	-0.59	.555
PACU Time Phase 2	-0.09	.925
PACU Time Total	-0.96	.335

Finally, Pearson r correlations were conducted on demographics, secondary variables, and the amount of benzodiazepines and opioids received (Table 4). There was a weak, negative association between ASA status and amount of benzodiazepines administered (r = -0.22); those that had a lower ASA status received more benzodiazepines. There was also a weak, negative

association between PACU SpO2 and the amount of opioids received (r = -0.31); those that received more opioids had lower PACU SpO2 readings. There was a weak positive correlation with PACU oxygen requirements and amount of benzodiazepines given (r = 0.29); those that received more benzodiazepines had higher oxygen requirements during the first 30 minutes in PACU.

Table 4. Correlation Results (Coefficient r) of Key Variables.

	Benzodiazepines	Opioids
BMI	0.01	0.03
ASA	-0.22*	0.02
Baseline SPO2	0.04	0.02
Baseline RR	0.02	-0.01
PACU SPO2	-0.01	-0.31*
PACU RR	-0.09	-0.01
PACU Oxygen	0.29*	-0.16
PACU Time Phase 1	0.18	-0.04
PACU Time Phase 2	-0.07	0.07
PACU Time Total	0.04	0.10

Note: * $p < .05$

CHAPTER V: SIGNIFICANCE AND IMPLICATIONS

Discussion

The purpose of this QI project was to answer the PICOT question: In adult patients aged 40 to 60 years, who underwent surgical procedures in an ASC (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 May 2024 to June 2024 (T)? The following secondary variables were also considered in the chart review: blue wristband use, baseline oxygenation and RR, PACU oxygenation and RR, PACU phase I and II time, total PACU time, OPA, NPA, or CPAP use, reintubation, and flumazenil or naloxone use. A retrospective chart review was conducted and a convenience sample of 100 total individuals was obtained, 47 in the STOP-BANG < 3 group and 53 in the STOP-BANG ≥ 3 group. Exclusion criteria were BMI > 40, parturients, and specialized surgeries including emergency, trauma, cardiovascular, and obstetrics.

This project was also a follow-up to the initial QI project completed in 2022 that looked at the impact of blue wristband application to denote high-risk OSA patients and whether benzodiazepines and opioids were administered pre- to post-implementation, scored as Yes or No (Casales, 2023; Ushakumari, 2023). This current QI project was conducted at one of the same sites where the blue wristband implementation occurred, and out of the 53 high-risk OSA charts pulled for review, not one patient had a blue wristband documented as “on” prior to surgery. Clinical implications of this finding at this ASC most likely suggest there was no formal continuation of blue wristband use in the perioperative setting following the initial implementation in 2022. This signifies that provider education is needed if this hospital system wishes to move forward with implementing an EBP guideline using the blue wristbands.

Based on the literature review, there are extensive recommendations for limiting benzodiazepines and opioids in the high-risk OSA population (Azizad & Joshi, 2022; Butterfield 2017; Grewal & Joshi, 2019). Despite what the literature recommends, the results of this project showed there was no statistically significant difference between the STOP-BANG < 3 group and STOP-BANG ≥ 3 group in terms of amount of benzodiazepine or opioid administration. Although STOP-BANG score should impact the amount of benzodiazepines and opioids that patients receive (Azizad & Joshi, 2022; Butterfield 2017; Grewal & Joshi, 2019; Nagappa et al., 2018), there was no difference found at this ASC. In addition, when looking at the mean scores from the data collected, the STOP-BANG ≥ 3 group received more benzodiazepines and opioids than the STOP-BANG < 3 group. This finding, although not statistically significant, is clinically significant. Not only are providers administering benzodiazepines and opioids to high-risk OSA patients, they are doing so in an increased amount. It seems that in this clinical setting, anesthesia providers may not be as influenced by STOP-BANG scores as literature suggests, and an education opportunity has been identified.

There also were no statistically significant differences between the two groups in terms of use of reversal agents, reintubations, airway adjunct use, PACU times, or oxygen requirements in PACU. Providers did not seem to adjust their practice based on STOP-BANG score, but still delivered patients safely to recovery. From the variables collected, it seems the patients in this chart review were not adversely impacted by the lack of difference in benzodiazepine and opioid administration (i.e. lack of reduced dosages for STOP-BANG ≥ 3). This was an interesting finding because the literature states that patients at high risk for OSA can require reversal agents, reintubation, airway adjuncts, and increased oxygen if the dose of benzodiazepines and opioids is

not reduced (Azizad & Joshi, 2022; Pinto & Sharma, 2023; Shoar et al., 2023; Weingarten et al., 2015).

Finally, when looking at the data of this project as a whole, the other two clinical sites produced similar results. There were no statistically significant differences in the amount of benzodiazepines or opioids administered to the STOP-BANG < 3 group and STOP-BANG ≥ 3 group (Wallin, 2025; Woodward, 2025). The trauma center was a follow-up site as well, and out of the 100 charts collected there, none had documented use of the blue wristband perioperatively (Woodward, 2025). Combined, these results suggest the hospital system as a whole may benefit from education regarding OSA and concomitant use of benzodiazepines and opioids in the perioperative setting.

Overall, there was no reduction in the amount of benzodiazepines and opioids administered to individuals in the STOP-BANG ≥ 3 and thus the PICOT question for this project was not supported. This finding could have occurred for multiple reasons including lack of provider awareness and/or education, the culture of the facility surrounding these medications, or the type of procedures and consequently the anesthetic being performed. It was also anticipated that blue wristbands would be applied to high-risk patients preoperatively and charted, but that was refuted as well. The absence of blue wristbands may be the result of limited staff buy-in, missing charting, insufficient education, difficult accessibility to the blue wristbands, or lack of EBP guideline.

Strengths and Limitations

One strength of this project includes the sample size of 100 patient charts. Further, when combined with the other sites, 300 total charts were reviewed. Another strength was the ability to re-implement this project at the same ASC used in the 2022 QI project. Valuable baseline and

follow-up data gathered on anesthesia provider practices two years post-blue wristband implementation. Finally, following the PDSA framework, this project was able to identify an area of need for this hospital system, creating an opportunity for future projects to improve facility and anesthesia practice.

A limitation was the use of convenience sampling which limits the generalizability of the results. The first 100 charts to meet criteria were included, and this resulted in the majority of individuals in this sample being female sex. Yet, this project's goal was to gather baseline information on anesthesia providers' use of benzodiazepines and opioids in low- versus high-risk OSA patients and thus a convenience sample was warranted. In the future, a larger and more diverse sample is suggested. Another limitation includes incomplete charting in the EHR. There were multiple missing data points, mainly for the secondary variables, which could have impacted those results. Further studies should consider in-person data collection to ensure completeness. In addition, although BMI was considered, patient weight was not. This could have impacted the amount of benzodiazepines and opioids patients received if providers utilized weight-based dosing. Future studies should consider the range of weight-based dosing for these medications. Finally, there was limited variability in the type of surgical procedures each individual received. The majority of procedures were gynecologic in nature, which could have impacted the amount of benzodiazepines and opioids administered due to the type of anesthetic. Unfortunately, the type of cases at this ASC are mainly gynecologic, so future studies should include various ASCs and be intentional about the type of cases selected.

Recommendations for Clinical Practice and Future Projects

The PDSA framework is meant to be a cyclical model allowing for advancement of clinical practice based on updated information (Melnyk & Fineout-Overholt, 2019). After

progressing through each step of the PDSA for this QI project, the next step is planning future projects. This QI project has collected valuable baseline information on the differences, or lack thereof, in benzodiazepine and opioid administration to high-risk OSA patients. Based on the results, a recommended next step would be implementing provider education on the importance of adjusting anesthesia practice related to benzodiazepine and opioid administration to high-risk OSA patients. A QI project could be conducted to provide education, with pre- and post-surveys used to assess provider knowledge on the subject. After assessment of knowledge, a subsequent project could determine if improved knowledge actually changed providers' clinical practice. One step further could be creation and implementation of an EBP guideline on the use of benzodiazepines, opioids, and alternative medications in this population of patients. Guidelines should be accompanied by provider education, representing another opportunity for QI project data collection.

Increased provider awareness of the risks surrounding OSA will be key to changes in clinical practice. During the timeline of this project, a best practice advisory (BPA) was created in the project site's Epic EHR to alert providers to high-risk OSA patients. A future project could examine the differences in benzodiazepine and opioid administration pre- to post-BPA, but this is a good step in increasing provider awareness. Educational modules, included in yearly training, may also be a way to increase provider awareness.

Summary

OSA is a common breathing disorder that can negatively affect the outcomes of surgical patients, especially when medications such as benzodiazepines and opioids are used (Butterfield, 2017; Hwang et al, 2022). High-risk OSA patients can be identified using the STOP-BANG screening tool (Chung et al., 2008). The purpose of this QI project was to gather baseline

information on the clinical practices of anesthesia providers in caring for high-risk OSA patients at an ASC, as well as provide follow-up to the blue wristband QI project conducted in 2022. Specifically, this project sought to answer the PICOT question: In adult patients aged 40 to 60 years, who underwent surgical procedures in an ASC (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 May 2024 to June 2024 (T)?

A retrospective chart review of a convenience sample of 100 total charts, 53 with a STOP-BANG score ≥ 3 and 47 with a STOP-BANG score < 3, was performed in August 2024. Data analysis refuted the PICOT question by showing no statistically significant difference in the amount of benzodiazepines or opioids administered to low- versus high-risk OSA patients. In addition, blue wristbands were not found to be applied to any of the 53 high-risk patients. A need for increased education on the risks of postoperative complications in high-risk OSA patients was identified. Future projects may examine the difference in benzodiazepine and opioid administration pre- to post-education.

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APPENDIX A: DATA COLLECTION PLAN FOR CHART REVIEW

Setting:

- Ambulatory Surgery Center

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:

- BMI > 40
- Parturients
- Specialized surgeries including emergency, trauma, cardiovascular, and obstetrics

Data Collected:

- 100 charts, 50 with STOP-BANG ≥ 3 and 50 with STOP-BANG < 3
- Demographics
    - Age, sex, race
    - Height, weight, BMI
- 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: CODEBOOK

Variable Name	**Coding**
Location	1 = ASC, 2 = Trauma Center, 3 = Community-hospital
STOP-BANG Score	0 = 0, 1 = 1, 2 = 2, 3 = 3, 4 = 4, 5 = 5. 6 = 6, 7 7 = 7, 8 = 8
Race	1= White/Caucasian, 2 = Black/ African American, 3 = Indian, 4 = American Indian, 5 = Hispanic or Latino, 6 = Declined, 7 = Arab, 8 = Asian
ASA Status	1 = 1, 2 = 2, 3 = 3, 4 = 4
Blue Wristband Applied	1 = Yes, 0 = No
Reintubated Required	1 = Yes, 0 = No
CPAP Required	1 = Yes, 0 = No
NPA Required	1 = Yes, 0 = No
OPA Required	1 = Yes, 0 = No
Flumazenil Administered	1 = Yes, 0 = No
Naloxone Administered	1 = Yes, 0 = No

APPENDIX C: UNIVERSITY IRB APPROVAL

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 Committee at Atrium Health aimed at improving the quality and outcome of care within the Atrium facilities identified for the project. This project serves as a follow-up to the initial QI project performed in 2022. One of the limitations identified in the previous project was lack of baseline data on use of benzodiazepines and opioids in the general population vs patients at high-risk for obstructive sleep apnea (OSA), thus, the main focus of this project will be to gather and compare baseline information on the use of benzodiazepines and opioids in high-risk OSA patients vs. low-risk OSA patients. We will categorize patients as high-risk OSA or low-risk OSA using the screening tool STOP-BANG, which scores patients one point for answering yes to any of the following questions, and zero points for no: Do you Snore? Do you often feel Tired? Has anyone Observed you stop breathing during sleep? Do you have high blood Pressure? Is your body mass index (BMI) > 35kg/m2? Are you older than 50 years old? Is your Neck circumference greater than 40cm? Are you male Gender? High-risk qualification would equate to answering yes to three or more of the above questions. Objectives: Compare patients with STOP-BANG scores greater than or equal to 3 (high-risk OSA) to patients with STOP-BANG scores less than 3 (low-risk OSA) and identify any differences in the amounts of benzodiazepines/ opioids administered. Identify any correlation between the high and low amounts of benzodiazepines and opioids administered within the STOP-BANG greater than or equal to 3 group and postoperative outcomes.

You must inform the IRB office of any changes to the project so that it can be determined whether the changes impact this determination.

This determination did not include consideration of HIPAA requirements. If this project involves activities that are subject to HIPAA (e.g., access to or use of protected health information), it is your responsibility to obtain approval from the HIPAA covered entity and comply with all applicable requirements.

Please be aware that approval may still be required from other relevant authorities or "gatekeepers" (e.g., school principals, facility directors, custodians of records).

APPENDIX D: HOSPITAL SYSTEM IRB APPROVAL

To:	Rachael C Brinning
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.

APPENDIX E: GANTT CHART

TASK	START	END
1 Project Conception Initiation		
Needs Assessment Paper	8/1/23	10/22/23
Topic Approval PPT	10/23/23	11/29/23
Topic Approval Paper	10/23/23	12/3/23
Topic Approval Defense	12/6/23	12/6/23
2 Project Definition and Planning		
CITI Training	1/10/24	1/31/24
Review of Literature	1/16/24	2/16/24
Mapping Out The Project	2/17/24	3/5/24
Draft of Paper to Chair	3/5/24	3/23/24
Revised Draft to Committee	3/23/24	4/5/24
PPT Draft to Faculty	4/6/24	4/10/24
Oral Defense	4/16/24	4/16/24
UNCC Online Oral Defense Form	4/16/24	4/23/24
Sections I&II of Scholary Paper	4/16/24	4/26/24
3 Chart Review and Statisitcal Analysis		
Wake Forest IRB Application	5/10/24	7/15/24
UNCC IRB Application	5/10/24	6/21/24
IRB Approval	7/15/24	7/15/24
Data Collection	7/16/24	8/23/24
4 Project Performance and Evaluation		
Data Analysis	8/23/24	10/1/24
Complete Chapter 3	61/24	8/9/24
Complete Chapter 4	8/9/24	10/14/24
Submit Final Draft	10/28/24	TBD
Public Defense	TBD	TBD
Dissemination	TBD	TBD