PERIOPERATIVE CARE OF OBSTRUCTIVE SLEEP APNEA AT A MAJOR URBAN TRAUMA CENTER

by

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

Charlotte

2023

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ABSTRACT

AMBER NICOLE USHAKUMARI. Perioperative Care Of Obstructive Sleep Apnea At A Major Urban Trauma Center
(Under the direction of DR. STEPHANIE WOODS)

Obstructive Sleep Apnea (OSA) is the most common sleep-related breathing disorder in the United States. OSA affects 25 million adults nationally with as many as 80% of patients potentially undiagnosed (Hines & Marschall, 2018). Early identification with a blue wristband will increase the anesthesia providers' awareness of OSA-related concerns for potential airway manipulation, prolonged sedation from anesthetic agents, and increased sensitivity to opioids in the post-operative period. This is a Quality Improvement (QI) project using a descriptive design to identify patients with suspected OSA on the day of surgery and examine the clinical practice of providers' administration of benzodiazepines and opioids to this patient population. The PICOT question is: In patients who are greater than or equal to 18 years old scheduled for elective non-cardiac surgery at a level one trauma medical center (P) how does the implementation of a blue wristband to identify patients with diagnosed or suspected OSA (SB score ≥ 4) (I) compared to current practice (C) affect the perioperative management of OSA patients as defined as receiving benzodiazepines alone or in combination with opioids (O) within the perioperative stay (pre-op, intra-op, PACU) (T)? The setting of the project is a surgery center in a major urban medical center. The sample for this project consisted of a total of 100 patients that have undergone elective non-cardiac surgery during the months of August 2022 (pre-implementation) and October through November 2022 (post-implementation). Data was collected via chart review.

Inclusion criteria for both pre- and post-implementation groups were female and male adults greater than or equal to 18 years old scheduled for elective non-cardiac surgery with a SB

score ≥ 4. Exclusion criteria includes patients younger than 18 years old, emergency surgery, Intensive Care Unit (ICU) admission, or specialized surgeries including trauma, cardiovascular, neurological, and obstetric surgeries. To maintain the confidentiality of data, all patient data collection was de-identified and management was completed via encrypted Excel sheets. This QI project demonstrated that patients with a SB score ≥ 4 received nearly the same percentage of benzodiazepines and narcotics whether they were identified with a blue wristband or not.

ACKNOWLEDGMENTS

I would like to thank my partner, Victoria Valencia for her dedication to the success of this project. Her unrelenting passion and fortitude to execute a meaningful project exemplifies the character I wish to embody as a doctoral-prepared CRNA. Without her contributions, this project would not be possible. Next, I would like to thank Suzi Kukyendall, who used her personal time to elevate this project amongst other leaders in the hospital. She, too, shares a passion for patient safety and advocacy. Dr. Ian Cohen was instrumental in the planning of this project, and offered his knowledge and expertise of anesthesia in patients with Obstructive Sleep Apnea. Lastly, Alicia Tardungo was extremely receptive to this Quality Improvement project, and acted as the Evidence-Based Practice Champion for the implementation of the new process. Among many lessons learned, she taught me the value of teamwork through her example of strong leadership skills.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AHI	Apnea-hypopnea index
ARDS	Acute Respiratory Distress Syndrome
ASA	American Society of Anesthesiologists
ASPAN	American Society of Peri-Anesthesia Nurses
BMI	Body Mass Index
CPAP	Continuous Positive Airway Pressure
CRNA	Certified Registered Nurse Anesthetist
EBP	Evidence-Based Practice
EMR	Electronic Medical Record
ICU	Intensive Care Unit
IRB	International Review Board
OIRD	Opioid-Induced Respiratory Depression
OR	Operating Room
OSA	Obstructive Sleep Apnea
PACU	Post-Anesthesia Care Unit
PDSA	Plan-Do-Study-Act
PSG	Polysomnography
QI	Quality Improvement
REM	Rapid Eye Movement
SASM	Society of Anesthesia and Sleep Medicine
SB	STOP-Bang

CHAPTER 1: INTRODUCTION

Obstructive Sleep Apnea (OSA) is the most common sleep-related breathing disorder in the United States. OSA affects 25 million adults nationally with as many as 80% of patients potentially undiagnosed (Hines & Marschall, 2018). OSA is associated with various health-related consequences such as increased motor vehicle accidents, hypertension, diabetes, congestive heart failure, stroke and all-cause mortality (Vasu, Grewal & Doghramji, 2012). In addition, this patient population is at higher risk for perioperative adverse events such as hypoxemia, respiratory failure, cardiovascular events, unplanned transfer to ICU, and increased hospital length of stay. With an aging population and increasing rates of obesity, the number of patients presenting to surgery with undiagnosed OSA is only expected to grow (Chung et al., 2016). The increased duration of hospital stay and healthcare expenditures in OSA patients poses a tremendous economic burden (Nagappa et al., 2017). Identification of patients with suspected OSA throughout the perioperative process will improve the quality of care of these patients and ameliorate negative financial and clinical complications.

Problem statement

Failure to effectively communicate a patient's OSA status from the pre-optimization clinic to the pre-op holding area, operating room, and post-anesthesia care unit increases the risk of perioperative adverse events due to the potential co-administration of benzodiazepines and opioids. Although patients are screened for OSA using the STOP-Bang (SB) questionnaire weeks before surgery, this information is not easily accessible or communicated on the day of surgery. Identifying patients with suspected OSA with a blue wristband will alert staff about expected problems and their management.

The perioperative outcomes of patients with OSA directly impact all stakeholders including patients, hospital administration, anesthesiologists, Certified Registered Nurse Anesthetists (CRNAs), and perioperative nursing staff. Patients benefit from proper OSA management with improved safety outcomes and patient satisfaction. The economic burden over the management of adverse events of patients with OSA will decrease due to proper identification and management of OSA patients, as well as more efficient allocation of hospital resources. Lastly, anesthesiologists and CRNAs will be positively impacted by confidently providing patient care without substantial respiratory instability. Importantly, no perioperative risks can be mitigated until the patient has been identified on the day of surgery. Failure to identify patients with a high risk of OSA is a problem due to the higher rate of postoperative complications and hypoxemia, postoperative pulmonary and cardiac complications, and significantly longer length of stay in the hospital compared to patients at low risk of OSA (Vasu et al., 2012).

Purpose of Project

Early identification will increase the anesthesia providers' awareness of OSA-related concerns for potential airway manipulation, prolonged sedation from anesthetic agents, and increased sensitivity to opioids in the post-operative period. Undiagnosed OSA can be detrimental in the surgical patient therefore prompt identification is imperative.

Effects of anesthesia and analgesics on breathing control and upper airway muscle tone can exacerbate cardiopulmonary issues in patients with OSA, especially during the postoperative period (Vasu et al., 2010). At the time of surgery, many patients with OSA are undiagnosed and unaware of their OSA. The American Society of Anesthesiologists (ASA), the Society of Anesthesia and Sleep Medicine (SASM), and the American Society of Peri-Anesthesia Nurses

(ASPAN) recommend standardized preoperative screening for OSA (Nagappa et al., 2018). Polysomnography (PSG) is considered the gold standard for diagnosing OSA, however it is time-consuming and expensive. The SB questionnaire is an easy and concise tool that has been validated in surgical patients and has a high sensitivity to identify most patients with OSA. While many studies suggest that suspected OSA patients should be identified on the day of surgery, more research is needed on the perioperative care of patients with suspected OSA.

Clinical Question - PICOT

There is strong evidence that patients with diagnosed or suspected sleep apnea require specialized care for elective surgery to decrease the risk of respiratory complications. This PICOT question was developed after it was found that patients with suspected OSA were not being accurately identified in the Main Operating Room (OR) of a major urban trauma center: In patients who are greater than or equal to 18 years old scheduled for elective non-cardiac surgery at a level one trauma medical center (P) how does the implementation of a blue wristband to identify patients with diagnosed or suspected OSA (SB score ≥ 4) (I) compared to current practice (C) affect the perioperative management of OSA patients as defined as receiving benzodiazepines alone or in combination with opioids (O) within the perioperative stay (pre-op, intra-op, PACU) (T)?

CHAPTER 2: LITERATURE REVIEW

Methods

A literature review was conducted and databases searched, including PubMed, Cochrane Database of Systematic Reviews, CINAHL complete, North Carolina AHEC Digital Library, and Google Scholar to examine evidence regarding perioperative care of OSA. The key words used

were elective surgery, anesthesia, complications, anesthesia management, difficult airway, general impatient surgery, obstructive sleep apnea, opioids, polysomnography, and SB. Inclusion criteria included a published date on or after 2008, full text availability, English language, and peer-reviewed articles. Exclusion criteria were articles that did not involve humans or were not written in English.

Anesthetic Implications and Effects of Opioids/Sedatives

To understand why OSA patients are more susceptible to perioperative respiratory complications, it is important to be aware of the mechanisms of respiratory-related arousal response. OSA is associated with repeated episodes of partial or complete obstruction of the upper airway, with nocturnal breathing cessation and hypoxia. Normally, the muscles of the pharynx keep the upper airway open to allow air to flow into the lungs during inspiration. These muscles relax during sleep but typically remain open enough to permit adequate airflow. In patients with a narrow passage in the upper airway, relaxation of the pharyngeal muscles can cause complete collapse so that air cannot flow into the lungs. A common cause of narrowed airway is excess soft tissue, such as thick parapharyngeal fat pads or enlarged tonsils.

Normally, there is a protective respiratory-arousal response stimulated by hypercapnia, hypoxia, upper airway obstruction, and the work of breathing (Hines & Marschall, 2018). In patients with OSA, there is a decreased respiratory-related arousal response and instability of the ventilatory response to chemical stimuli. This can be especially concerning in surgical patients receiving anesthetics, sedatives, opioids, and neuromuscular blocking agents which can all increase the risk of upper airway obstruction and respiratory depression. According to Vasu, Grewal & Doghramji (2012), general anesthetics have been shown to decrease upper airway

dilator muscle activity in a dose-dependent manner, increase upper airway collapsibility and decrease genioglossus muscle activity.

Additionally, opioids depress a patient's ventilatory response to obstruction and inhibit the normal arousal and awakening response to hypoxia and hypercapnia (Liao et al., 2009; Nagappa et al., 2017). In a study by Gupta et al. (2018), OSA was identified as an independent risk factor for Opioid-Induced Respiratory Depression (OIRD). OIRD is a current topic of importance in the anesthesia setting; in fact, The Anesthesia Patient Safety Foundation made it a top priority in 2006 (Hines & Marschall, 2018). OIRD is a result of alveolar hypoventilation along with central respiratory depression, decreased consciousness, and upper airway obstruction (Miller et al., 2011). A review performed by Nagappa et al. (2018) evaluated the incidence of postoperative OIRD and found that eighty-five percent of OIRD events occurred within the first 24 hours. The review also found that the odds of OIRD occurring were 1.4 times higher in OSA than in non-OSA patients (Nagappa et al., 2018). In a similar study, 38% of patients with OIRD had OSA and OSA was present in 50% of the patients who died as a result of OIRD (Ramachandran et al., 2011).

According to the SASM Guideline on Intraoperative Management of Adult Patients with Obstructive Sleep Apnea, the "presence of robust, high-quality scientific evidence to demonstrate the merit of heightened concern and guide safe opioid practice in this population is limited" (Memtsoudis et al., 2018, p. 973). Nevertheless, there is evidence that perioperative adverse events can be attributed to the administration of opioids to patients with OSA. SASM reviewed 17 observational studies that looked at the impact of systemic opioid use in OSA patients. The majority of the studies found an association between opioid use and adverse perioperative outcomes in OSA patients, but was not confirmed by all (Memtsoudis et al., 2018).

Morwald et al. (2018) performed another analysis on the impact of opioids administered to OSA patients and found increased rates of gastrointestinal complications, prolonged length of stay, and increased hospital cost.

There is also considerable evidence of the synergistic side effects of opioids and benzodiazepines in suspected and diagnosed OSA populations. For example, the combination of opioids and benzodiazepines specifically has been shown to cause a substantial reduction of hypoxic ventilatory response (Vasu et al., 2012; Nagappa et al., 2017). Additionally, Nagappa et al (2017), explained that benzodiazepines and narcotics together can reduce the pharyngeal muscle tone, increasing upper airway collapsibility and worsening the existing OSA. Respiratory arrest and sudden unexpected death can ensue with prolonged apnea.

Given the growing evidence regarding the perioperative side effects associated with the co-administration of opioids and benzodiazepines, practice guidelines are available to help guide an appropriate anesthetic technique in patients with OSA. The ASA recommends the use of regional anesthesia, avoiding opioids in neuraxial anesthesia, avoiding basal infusions in Patient-Controlled Analgesia, using a multimodal anesthetic technique including Non-Steroidal Anti-Inflammatory Drugs, and caution administering other sedatives (American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Obstructive Sleep Apnea, 2014). Lastly, patients with OSA are highly vulnerable to the negative effects of neuromuscular blocking drugs. The upper airway muscles are more sensitive to paralytic drugs than the diaphragm or peripheral muscles; therefore residual neuromuscular blockade can be particularly dangerous in patients with OSA (Liao et al, 2009).

In addition to airway collapsibility, patients with OSA are at increased risk of oxygen desaturation, difficult mask ventilation, and endotracheal intubation (Hines & Marschall, 2018).

In a prospective cohort study by Mathangi, Matthews, and Mathangi (2018), 77% of patients with OSA had difficult mask ventilation, 20% had difficult tracheal intubations, and 33% had difficult direct laryngoscopy. In this study, the authors found that the SB score was the single most important predictor for difficult mask ventilation. Individual risk factors for difficult intubations also correlate with OSA including obesity, narrow oropharynx, and crowded oral cavity. Interestingly, the specific distribution of fat may be more important in the development of OSA versus overall Body Mass Index (BMI) in patients with obesity. For example, deposits of fat around the neck and pharyngeal structure contribute to the narrowing and collapsibility of the upper airway.

Associated Complications

It has been well established that patients with OSA have a higher prevalence of pre-existing comorbidities including diabetes, obesity, chronic obstructive pulmonary disease, hypertension, asthma, hypothyroidism, and gastroesophageal reflux disease (Hines & Marschall, 2018; Liao et al., 2009; Mathangi, Matthews & Mathangi, 2018). In addition, patients with OSA have a higher rate of postoperative complications and hypoxemia, postoperative pulmonary and cardiac complications, and a significantly longer length of stay (Vasu et al., 2012). In a retrospective matched cohort study, the authors found that OSA patients had a 33% increased incidence of respiratory complications (Liao et al., 2009). A separate study by Kaw et al. (2012) revealed that patients with OSA had a higher rate of post-op hypoxemia, respiratory failure, and transfer to ICU. Likewise, a case-control study by Memtsoudis et al. (2011) concluded that patients with OSA had a higher rate of aspiration, acute respiratory distress syndrome (ARDS), and need for intubation. The increased need for postoperative intubation and ventilation in this group could possibly be explained by the higher risk of aspiration in patients with OSA.

A major limitation to many of these studies is the lack of documentation on the severity of OSA. The retrospective studies used patient data in which OSA was formally diagnosed using polysomnography. Many of the studies did not capture patients who had high-risk or suspected OSA using the SB score. In a study by Nagappa et al. (2017), SB scores greater than three were used to delineate patients with OSA and without OSA. Undiagnosed OSA patients were found to have a three-fold increased risk of cardiac complications before surgery. In addition, suspected OSA patients had more postoperative complications and increased hospital stays than formally diagnosed OSA patients on Continuous Positive Airway Pressure (CPAP). There was a linear association found between increasing postoperative complications and higher scores of SB. The authors defined postoperative complications as cardiac arrhythmias, reintubations due to respiratory failure, hypoxia or pneumonia, myocardial infarction, ICU admission, laryngospasm, bronchospasm, prolonged mechanical ventilation, acute pulmonary edema, and congestive cardiac failure (Nagappa et al., 2017). Post-op complications were nearly four times higher in high-risk OSA patients versus low-risk OSA patients, and the average hospital length of stay was two days longer.

Early postoperative complications may be attributed to the negative effects of drugs given during anesthesia. However, later complications are more likely related to postoperative Rapid Eye Movement (REM) sleep rebound (Kaw et al., 2012). There is an important link between REM sleep rebound and sympathetic tone that may lead to a myocardial infarction or unexplained postoperative death. According to Vasu, Grewal, and Doghramji (2012), surgical patients have highly fragmented sleep on the first and second postoperative nights. Surgical stress, pain, and the use of pain medications are the main factors that disrupt sleep. On recovery nights 3-5, the amount and density of REM sleep is strongly increased, which worsens episodes

of sleep-disordered breathing and hypoxemia. This is due to hypotonia and unstable breathing. Subsequently, OSA patients had higher Apnea-Hypopnea Index and oxygen desaturation index on the third postoperative night compared with preoperatively or on the first postoperative night (Kaw et al., 2012).

STOP-Bang Questionnaire versus Polysomnography

The gold standard for diagnosis of OSA is nocturnal polysomnography (PSG). This diagnostic procedure requires an evaluation at a sleep clinic followed by overnight monitoring in a sleep clinic or at home with a portable monitor (Carr et al., 2020). Disease severity is determined by the Respiratory Disturbance Index, or the Apnea-Hypopnea Index (AHI). AHI is defined as the average number of abnormal breathing events per hour of sleep. The severity of OSA is graded according to the recorded abnormal breathing events per hour of sleep and classified as mild (AHI > 5 to < 15), moderate (AHI > 15 to < 30) or severe (AHI >30) (Nagappa et al., 2018). While PSG is considered to be the gold standard, it has limitations. A systematic review by Nagappa et al. (2015) revealed that PSG is time-consuming, labor-intensive, and costly. PSG requires the expertise of sleep medicine specialists, which may not be available at many hospitals. PSG is difficult to implement in the perioperative setting because it prolongs the process of surgery and contributes to overall increases in costs (Vasu, Grewal & Doghramji, 2012). An analysis determined that the cost-effectiveness of preoperative OSA screening depends on timing. Preoperative screening with SB followed by immediate confirmatory testing with PSG is less cost-effective when only considering the perioperative period. It is more beneficial to complete PSG testing after screening with SB for the lifetime of the patient. (Sankar et al., 2020).

A review of literature shows that there are a variety of questionnaires suitable for assessing the probability and severity of undiagnosed sleep apnea including the SB, Berlin questionnaire, Epworth Sleepiness Scale, and the NoSAS. These questionnaires are easy to use, however, there is much variability in the sensitivity, specificity, positive predictive value, and negative predictive value when used in different populations. Unfortunately, studies suggesting which questionnaire can be useful in the general population are sparse (Malolpesza et al., 2021).

SB is the most commonly used questionnaire in the perioperative setting and is highly sensitive for categorizing the severity of sleep apnea (American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Obstructive Sleep Apnea, 2014). SB is a self-reporting tool and easy to use in this setting. It has been validated in surgical patients and has a high sensitivity to identify most patients with OSA, especially moderate and severe OSA (Vasu et al., 2010). SB includes four subjective items (STOP: Snoring, Tiredness, Observed Apnea, and High Blood Pressure) and four demographic items (Bang: BMI, age, neck circumference, and gender) (Nagappa et al., 2015). For each item, the clinician answers "yes/no" if it applies to the patient. For each question, answering "yes" scores one point and "no" response scores zero points. For the demographic items, one point is obtained for BMI > 35 kg/m^2, age > 50 years old, neck circumference in male ≥ 43 cm and female ≥ 41 cm, or male gender. The total score ranges from zero to eight points (Malolepsza et al., 2021).

A systematic review titled, *Association of SB Questionnaire as a Screening Tool for Sleep Apnea and Postoperative Complication*, indicates that a SB score of three or greater has the best balance between sensitivity and specificity. For example, there was almost 100% for detecting severe OSA (AHI > 30), 93% for detecting moderate to severe OSA (AHI > 15), and 84% for detecting any OSA (AHI> 5). (Nagappa et al., 2017). Unless specifically defined, the

standard cutoff of the SB score for diagnosis of OSA is greater than or equal to three (Nagappa et al.,2015). Moderate to severe OSA can be detected with a higher accuracy if the cutoff for the SB score is increased, which is why for this QI project a cutoff score of ≥ 4 was chosen (Naggappa et al., 2017).

The ASA, the SASM, and the ASPAN recommend standardized preoperative screening for OSA. Patients with high-risk OSA (SB ≥ 3) were found to be associated with an increased risk of postoperative complications and prolonged length of stay compared with low-risk OSA (SB 0-2) (Nagappa et al., 2018). Another study of 746 patients screened with the SB questionnaire and PSG concluded that increasing SB scores result in increased predicted probability, odds ratio, and specificity for having mild, moderate, and severe OSA (Carr et al., 2020).

There are several studies in which the use of the SB questionnaire has been standardized as a perioperative screening tool. One study concluded the identification of early at-risk OSA patients increased from 23% (based on a medical diagnosis of OSA) to 54% with an intermediate and high-risk OSA (Kertes, 2020). Another QI project concluded that the SB questionnaire increased the identification of surgical patients at risk for OSA but did not affect Post-Anesthesia Care Unit (PACU) length of stay or unanticipated admissions (Carr et al., 2020).

General Inpatient Surgery

According to a large case-control study using data from the National Inpatient Sample, patients with OSA undergoing orthopedic and general surgeries were at higher risk of aspiration and pneumonia, ARDS, and the need for intubation and mechanical ventilation (Memtsoudis et al., 2011). Similarly, Vasu, Grewal, and Doghramji (2012) found that patients coming in for general surgery have a higher prevalence of OSA. Using the SB score, 41% of general surgery

patients were found to be at risk for OSA, and greater than 80% of those patients were unaware they had sleep apnea prior to undergoing surgery (Vasu, Grewal and Doghramji, 2012). Current practice at the hospital facility for this QI project is to refer patients to sleep studies prior to surgery. However, this is not always feasible due to lack of availability, cost, and time constraints.

The prevalence of OSA in the general surgical population is expected to increase due to increasing age and obesity (Vasu, Grewal & Doghramji, 2012). Given that general surgical patients with OSA are at increased risk of having perioperative complications, it is prudent that this population is accurately identified prior to surgery. The ASA Task Force on Perioperative Management of Patients with Obstructive Sleep Apnea outlines practice guideline recommendations specific to the care patients who will be undergoing general surgery with OSA. These recommendations cover preoperative evaluation, intraoperative management, and postoperative management.

Perioperative Management of OSA Patients

Preoperative evaluation of patients should include a thorough medical record review and a screening tool such as the SB questionnaire to detect suspected OSA. Physical examination includes evaluation of the patient's airway, nasopharyngeal characteristics, neck circumference, tonsil size, and tongue volume.

Intraoperative management of patients with OSA involves an individualized plan of anesthesia to minimize postoperative complications. This includes considerations of local anesthesia or peripheral nerve blocks, neuraxial anesthesia, general anesthesia with a secured airway, and verification of full reversal of neuromuscular blockade. Airway management is of utmost importance given the high risk of airway collapse. Memtsoudis et al. (2018) provided a

strong recommendation that when applicable, regional anesthesia is preferred over general anesthesia in patients with OSA. Moreover, Nagappa et al. (2018) in a large population-based analysis of perioperative outcomes found that OSA patients had significantly lower postoperative complications after receiving neuraxial anesthesia compared to general anesthesia.

Postoperative management encompasses consideration of analgesia selection, oxygenation, patient positioning, and continuous pulse oximetry monitoring. Patients with OSA require a longer period of monitored recovery time to lessen the chance of postoperative complications in the ambulatory setting (Avitsian & Galway, 2015). Raveendran & Chung (2014) indicated that patients with known or suspected OSA receiving general anesthesia should have extended monitoring for an additional 60 minutes. Patients should continue using CPAP or Non-Invasive Positive Pressure Ventilation postoperatively if they were using it prior to surgery, unless contraindicated.

Conceptual Framework/Theory

The conceptual framework chosen for this QI project is the Plan-Do-Study-Act (PDSA). The PDSA cycle has become a widely adopted and effective approach to testing and learning about change on a small scale (Melnyk & Fineout-Overholt, 2019). Plan: The plan was to identify adult surgical patients with suspected OSA on the day of surgery using results from the SB questionnaire completed in the pre-optimization clinic prior to surgery. Do: Implement a new process of applying blue wristbands in the preoperative area for patients with a STOP Bang score ≥ 4. Educate perioperative nurses and anesthesia providers on the new process as well as the rationale for avoiding the co-administration of benzodiazepines and opioids in this population. Study: Compare the amount of benzodiazepines and opioids co-administered to patients with suspected OSA before and after implementation of this project. This outcome measure will

reveal if there is a change in practice by anesthesia providers (anesthesiologists and nurse anesthetists) after patients with suspected OSA are identified with a wristband. Act: Evaluate the effectiveness of the process for identifying patients. Assess the need for reinforced education to anesthesia providers and perioperative nurses on the adverse effects of co-administering benzodiazepines and opioids to suspected OSA patients during the perioperative period.

CHAPTER 3: METHODOLOGY

Project Design

This is a QI project using a descriptive design aimed at identifying patients with suspected OSA with a wristband on the day of surgery, and examining the clinical practice of providers' co-administration of benzodiazepines and opioids to patients with and without a wristband. The project was conducted at a level one trauma center in an urban city in North Carolina. International Review Board (IRB) approval was obtained from the University of North Carolina at Charlotte as well as the hospital system (Appendices A and B). The project PICOT question is: In patients who are greater than or equal to 18 years old scheduled for elective non-cardiac surgery at a level one trauma medical center (P) how does the implementation of a blue wristband to identify patients with diagnosed or suspected OSA (SB score ≥4) (I) compared to current practice (C) affect the perioperative management of OSA patients as defined as receiving benzodiazepines alone or in combination with opioids (O) within the perioperative stay (pre-op, intra-op, PACU) (T)?

Sample with Inclusion & Exclusion Criteria

The sample for this project will consist of a total of 100 patients that have undergone elective non-cardiac surgery at a large level one trauma center during the month of August 2022,

or who will undergo elective non-cardiac surgery during October and November 2022. Data will be collected via chart review. A convenience sample of the first 50 patients that meet the inclusion criteria for both the pre- and post-implementation of the blue wristband intervention will be included. Inclusion criteria for pre- and post-implementation groups are both female and male adults who are greater than or equal to 18 years old scheduled for elective non cardiac surgery and who have a SB score ≥ 4. Exclusion criteria include patients younger than 18 years old, emergency surgery, ICU admission, or specialized surgeries including trauma, cardiovascular, and obstetric surgeries.

Setting

The setting of the project took place at a major urban trauma center. Based in an urban location in North Carolina, the hospital is an integrated, nonprofit health system with more than 70,000 employees serving patients at 40 hospitals and more than 1,400 care locations. The setting is the only level one trauma center in the region and offers a wide range of medical services from 24-hour emergency care services to specialty care. Including four dedicated open-heart ORs and one trauma OR, there are currently 33 total ORs. For federal fiscal year 2018, this major urban trauma center performed 32,066 cases with a total of 95,278 surgical hours. For the same year, the total number of outpatient surgical cases was 16,412.

Methods and Interventions

There are three phases of implementation of the blue wristband intervention: (1) pre-implementation, (2) implementation, and (3) post-implementation. Phase one, pre-implementation, consisted of gaining hospital approval for the use of the wristband, and obtaining buy-in from stakeholders. Phase two, implementation, consisted of applying blue wristbands to patients in the pre-op area who had a SB score ≥ 4. This phase also included education to pre-op nurses on the process of finding the SB score during chart-review, and

documentation of the application of the wristband in the patient's Electronic Medical Record (EMR). A diagram showing the criteria for who gets a wristband and when it should be removed was used as a poster (see Appendix D). This phase also included education to anesthesia providers of the purpose of this QI project and rationale for avoiding the co-administration of benzodiazepines and narcotics.

Phase three, post-implementation, consisted of chart review of patients with SB scores ≥ 4 who received benzodiazepines and narcotics alone or in combination after implementation of the blue wristband. A convenience sample of the first 50 patients that met the inclusion and exclusion criteria was selected for both the pre-and post-implementation groups, for a total of 100 patients (See Figure 1). A retrospective chart review of surgeries during the months of August 2022 and October/November 2022 was conducted. Data was collected via chart review using the EPIC platform for the month of August 2022, pre-implementation of the blue wristband intervention. During the month of October/November 2022, following blue wristband implementation, a separate chart review was completed.

A data collection sheet of the variables of interest was developed. Microsoft Excel was used for data management and to organize data collection findings from the patient's charts. Appendix E provides an example of the measurement collection tool that was used. For each patient, the following variables were noted: age, sex, SB score, BMI, ASA score, total anesthesia time and if they received any benzodiazepines or narcotics alone or in combination during the perioperative period.

To maintain the confidentiality of data, all patient data collection and management was de-identified prior to input into Microsoft Excel. Patient Health Information such as name and Medical Record Number were not stored; this information was temporarily available in a report

built in EPIC and then deleted prior to use in Microsoft Excel. To ensure accuracy in the data retrieved from patients' EMRs, data collection was performed solely by this author. Appendix F references a Gantt Chart that extrapolates the timeline of this project. This doctoral project started in the month of August 2021 and is projected to finish in December 2022.

Tools & Measures

The project used statistical analysis to organize data and transform numbers to meaningful information that can be interpreted (Moran et al., 2019). Descriptive analysis was completed on all data. Means, standard deviations, and frequencies of the independent variable (SB ≥ 4) and the dependent variables (benzodiazepines and narcotics) was analyzed. *T*-test was used to compare the No Wristband (N) and Wristband (W) intervention groups on the use of benzodiazepines and opioid administration on the day of surgery. The wristband was documented as "Obstructive Sleep Apnea" in the flowsheet tab of the patient's chart in EPIC.

Project Implementation

The implementation of this QI project required project management and change management strategies, and focused heavily on education. The project structure encompassed a cyclical process using the PDSA model, as mentioned earlier. Leaders within the perioperative units (pre-op and PACU) were educated on the purpose of the project and the roll-out date was chosen after obtaining buy-in. Leaders included the Perioperative Nursing Director, the Nursing Manager and Charge Nurse. In addition, approval for the wristband was obtained through the Patient Safety Council at the hospital facility for regulatory compliance. At the request of the hospital Patient Safety Officer, a policy was written for the implementation of the blue wristbands in order to comply with the hospital Nursing Department and Safety Department requirements (see Appendix C). There was facility-wide support for the implementation of this

project from stakeholders including hospital administrators, department leaders, pre-op RNs, PACU RNs, CRNAs and Anesthesiologists. The wristband was ordered by hospital administration once IRB approval was obtained. Thirty posters for the project were printed, laminated and placed in all patient care areas in the pre-op holding area, OR and PACU one week prior to roll-out of the blue wristband (Appendix D). The original roll-out date was delayed by four days due to a delay in the shipment of the blue wristbands.

Simultaneously, in-person education was given to the perioperative nurses and reinforced by electronic education to prepare the nursing unit for the new process of applying blue wristbands to patients with SB scores ≥4. Education also included writing the SB score on the hand-off communication tool as well as verbalizing the score during the safety huddle to increase awareness to all providers who are in direct care of these patients. Education was provided separately to CRNAs. In a PowerPoint presentation, the author discussed the purpose of the QI project and the rationale to avoid the co-administration of benzodiazepines and narcotics to patients with a blue wristband. In addition, an email was sent to CRNAs and Anesthesiologists communicating a summary of the project as well as what data would be collected pre- and post-implementation.

Blue wristbands were placed in each patient bay along with other hospital wristbands for the ease of application by the pre-op nurse. Two days after the roll-out of the project, this author met with nurses in person to evaluate the new process. It was crucial to use an Evidence-Based Practice (EBP) Champion identified as the charge nurse in the pre-op holding area. All questions were answered regarding the new process, and assistance was given to any staff who did not know how to find the SB score in the chart or document the application of the blue wristband. Once a week, this author met with nursing staff to reevaluate the process, identify any barriers,

and reinforce education. In addition, this author spoke at an in-person CRNA staff meeting one week after implementation to reinforce the rationale for the project. Lessons learned included unforeseen delays in obtaining IRB approval, shipping delays of supplies, identification of local EBP Champions, and incentivizing RNs. Resources for this project included the cost of wristbands, the cost of paper for poster printouts, the use of secure email for communication, and use of EPIC for confidential data collection by the author.

Anticipated challenges to the implementation of this project included a facility-wide transition from Cerner to EPIC Electronic Health Records. Fortunately, the transition to EPIC indeed simplified the ability to complete retrospective data collection through the use of built-in reports. Despite support for the implementation of this project by stakeholders, there was a concern for buy-in from providers to change their practice of administering benzodiazepines in combination with opioids, in addition to compliance with the new process of placing wristbands on patients. For the success of this project, it was important to practice effective interprofessional communication using both verbal and written methods. A Clinical Practice Model was used to create a culture of collaboration amongst the perioperative and anesthesia staff, with a central focus of improving patient safety.

CHAPTER 4: RESULTS

Data Analysis & Interpretation

Patients were randomly selected for this project, and all patients who met inclusion criteria were included. ANOVA was used to determine if the two groups were comparable. For the No Wristband (N) group, the first 50 patients who met the inclusion criteria were used for this project. The Wristband (W) group consisted of the first 50 patients with a documented

wristband. Post-implementation, 91 patients met the inclusion criteria and 41 of those patients were excluded because no wristband was documented (Figure 1).

Figure 1. Flowchart of patient selection

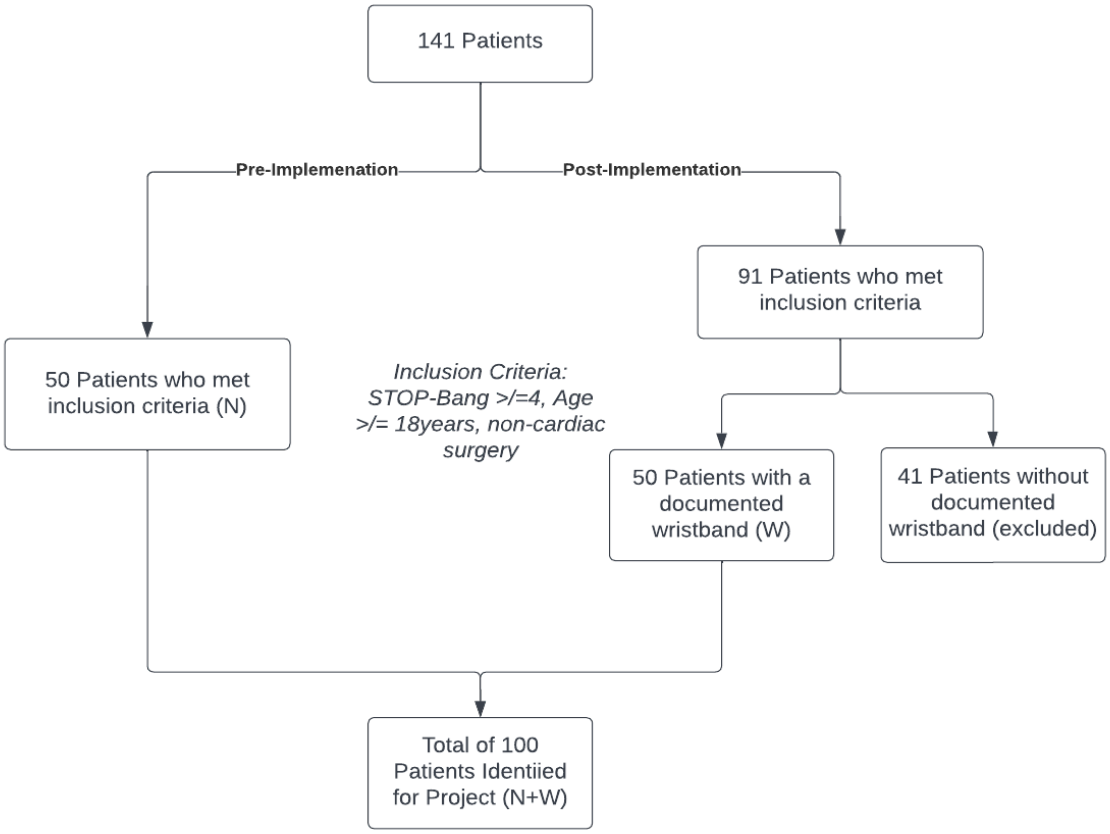

Table 1 shows the descriptive analysis and comparison between the N and W groups. Analysis of variance showed that there were no significant differences between the two groups in age ($F = 1.82$, $p = .181$), ASA ($F = 0.04$, $p = .843$), BMI ($F = 0.76$, $p = .384$) or anesthesia time ($F = 1.64$, $p = .203$). There was a significant difference in the number of female patients ($\chi^2 = 5.76$, $p = .016$) and SB score ($F = 4.34$, $p = .040$). Both groups were generally comparable in number of demographic variables, however group W had a significantly higher percentage of females (42% versus 18%), and group N had significantly lower SB score (4.56 versus 4.96).

Logistic regression, controlling for both gender and SB score, tested whether the W group differed from the N group on the use of benzodiazepine, narcotics, or the combination of both. There was no significant difference between the two groups in use of benzodiazepine, b = -0.34, p = .424; narcotics, b = 0.35, p = .593; or the combination of both, b = -0.02, p = .956. These results show that the application of a blue wristband did not change the amount of benzodiazepines and narcotics administered alone or in combination to patients with suspected OSA.

Table 1. Descriptive analysis and comparison between no wristband (N) and wristband (W) groups

Characteristics	No Wristband (N) (n = 50)	Wristband (W) (n = 50)
Age	64.00 ± 10.83	60.84 ± 12.55
Gender (% of female)	n = 9, 18.0%	n = 21, 42.0%
ASA	3.00 ± 0.49	2.98 ± 0.51
SB score	4.56 ± 0.79	4.96 ± 1.11
BMI, kg/m^2	32.71 ± 11.09	34.47 ± 8.87
Anesthesia time (minutes)	107.46 ± 66.86	129.64 ± 102.55
Benzodiazepine	n = 24, 48.0%	n = 21, 42.0%
Narcotics	n = 43, 86.0%	n = 45, 92.0%
Benzos & Narcotics	n = 20, 40.0%	n = 21, 42.0%

CHAPTER 5: DISCUSSION

Implications for Practice

There is an existing problem in accurately identifying patients with SB scores ≥ 4 at a large urban general inpatient surgical center on the day of surgery. The purpose of this project

was to identify patients with a SB score ≥ 4 with a blue wristband on the day of surgery. A SB score ≥ 4 was chosen as a cutoff since it has been validated in surgical patients and has a high sensitivity and negative predictive value in diagnosing moderate to severe OSA. A wristband was chosen as an alert to capitalize on an already established practice of looking at the wrist for patient identification and other alerts. In addition, the blue wristband serves as an alert that follows the patient from pre-op to the OR and finally to PACU. This alert is simple, cost-effective, and does not require access to a patient's EMR. The color blue was chosen due to its availability for use within the hospital, as well as blue being associated with hypoxia. Education to the anesthesia providers focused on avoiding the co-administration of narcotics and benzodiazepines, since the review of literature conducted for this project found that these two drugs together act synergistically to worsen sleep apnea postoperatively. Benzodiazepines alone do not produce significant respiratory depression, however, when given with narcotics there is an increase in pharyngeal collapse, a decrease in ventilatory response to hypercarbia, and an overall impairment in arousal response.

To evaluate the effectiveness of the blue wristband as an alert to the provider, data was collected on the administration of benzodiazepines, narcotics and the combination of both before and after the intervention. The primary outcome showed there were no significant differences in the amount of benzodiazepines and narcotics given to patients with or without a blue wristband. The SASM and ASA recommend that patients with suspected OSA are identified on the day of surgery to prevent perioperative complications. Many studies revealed a significant correlation between SB scores ≥ 3 and increased risk of desaturation, critical care admission, and difficult airway. As previously mentioned, the SB is the most validated screening tool to identify surgical patients at high risk of OSA.

Improved perioperative management of patients who may have undiagnosed OSA is possible through the use of the SB questionnaire. The SB score can help risk stratify patients for a modified anesthesia technique and postoperative monitoring, but there remains challenges to the use of the tool (Memtsoudis et al., 2018). For example, it is unknown how this information should be used on the day of surgery by clinicians. The SB questionnaire can add clinical value to the preoperative assessment if it is effectively communicated to providers on the day of surgery. Despite no significant differences in the co-administration of benzodiazepines and narcotics to these patients, the use of a blue wristband to further identify patients at high risk of OSA can still be a useful tool to ensure this information is being accurately communicated.

Limitations

An important limitation of this project is that there are no concrete guidelines for the type of anesthesia that should be given to patients with suspected or diagnosed OSA. Rather, there are soft recommendations that have been released from various anesthesia professional organizations. Additionally, this project did not factor in patient history that may have revealed that patients are currently prescribed benzodiazepines or narcotics at home. Furthermore, the decision to administer midazolam prior to a patient rolling into the OR does not require an indication or comment from the provider as to why the patient received it. This study did not look at the anesthesia provider's perception of the chosen alert, if it was seen by the provider, and what that meant to their practice.

This QI project looked at the amount of benzodiazepines and narcotics that patients with a SB score of ≥ 4 received, and not the general population. Therefore, it is not possible to draw conclusions to the overall behavior of anesthesia providers' choice to give these two drugs together. Another limitation was the low compliance with documenting the wristband. Only 55%

of patients who met inclusion criteria post-intervention had a documented wristband in their chart. A limitation to the SB questionnaire itself is the difficulty in measuring the neck circumference. Some patients did not have a completed SB score in the chart because the neck circumference was left blank during screening by the preoptimization clinic.

Recommendations

A future project could compare two similar groups of patients, and post-op pulmonary complications could be evaluated. In addition, a future project could compare patients with a SB Score ≥ 4 to the general population to see the variability in the co-administrations of benzodiazepines and narcotics. The facility in which this project was conducted would benefit from a hospital-wide protocol on the perioperative care of patients with suspected or diagnosed OSA. Not only would a hospital protocol provide education on preferred anesthesia methods, it could also outline minimum monitoring recommendations to increase patient safety. For example, if a patient has suspected or diagnosed OSA, this could trigger automatic increased respiratory monitoring in PACU and beyond.

It is unknown if the use of a wristband as an alert increases a provider's awareness of the potential complications of administering the combination of benzodiazepines and narcotics to patients with suspected or diagnosed OSA. Evaluating the perception of the blue wristband by anesthesia providers through a survey or focus group could be a useful QI project. Repeating the project with a larger sample size may yield a different result. A yearly online education module on the use of the SB score to identify patients with suspected OSA on the day of surgery would be valuable, as well as education on the effects of various types of anesthesia (i.e. the combination of benzodiazepines and narcotics) in this population. Additionally, it may be prudent to consider a clinical decision support tool in EPIC for providers who order

benzodiazepines or narcotics to patients with suspected or diagnosed OSA. This function may be more suitable in departments outside the OR in this hospital.

This is the first project in published literature that looks at the use of a wristband as an alert to providers of patients with suspected or diagnosed OSA. The biggest strength of this project is that an active intervention was utilized to improve patient outcomes. This QI project required strong communication in a standardized fashion during implementation. The rollout of this project required collaboration amongst hospital administrators, nursing leaders, perioperative nurses and anesthesia providers. The project was well planned, and constantly re-evaluated throughout all phases to ensure maximal success. This project highlighted an important patient safety issue of patients not being accurately identified on the day of surgery with moderate to high-risk suspected OSA.

Conclusion

This QI project demonstrates that patients with a SB score ≥ 4 received nearly the same percentage of benzodiazepines and narcotics whether they were identified with a blue wristband or not. It is well documented that patients with OSA have an increased incidence of postoperative complications if they receive both of these drugs, with hypoxemia being one of the most common complications. Ultimately, the decision of whether to co-administer benzodiazepines and narcotics to patients with suspected or diagnosed OSA remains at the discretion of the anesthesia provider. With the use of a simple alert such as a wristband, providers may be more aware of the potential complications of patients in this population.

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APPENDIX A: UNCC IRB APPROVAL

CHARLOTTE
RESEARCH AND ECONOMIC DEVELOPMENT

To:	Amber Ushakumari
	University of North Carolina at Charlotte
From:	Office of Research Protections and Integrity
Date:	26-Sep-2022
Expiration Date:	03-Aug-2023
RE:	Agreement to Rely on External IRB
Study #:	IRB-23-0096
External Organization:	Wake Forest School of Medicine
Study Title:	Perioperative Care of Obstructive Sleep Apnea

This confirms that an IRB Authorization Agreement with the organization identified above has been executed to rely on their IRB for continuing oversight of this study. This agreement specifies the roles and responsibilities of the respective entities.

Study Description:

Obstructive Sleep Apnea (OSA) is the most common sleep-related breathing disorder in the United States. OSA affects 25 million adults nationally with as many as 80% of patients potentially undiagnosed (Hines & Marschall, 2018). We aim to identify OSA patients with a blue wristband to increase the anesthesia providers' awareness of OSA-related concerns for potential airway manipulation, prolonged sedation from anesthetic agents, and increased sensitivity to opioids in the post-operative period. This is a Quality Improvement (QI) project using a descriptive design aimed at identifying patients with suspected OSA using a blue wristband on the Day of Surgery (DOS) and examining the clinical practice of providers' administration of benzodiazepines and opioids to this patient population. The PICOT question is: In patients who are greater than or equal to 18 years old scheduled for elective non-cardiac surgery at a level one trauma medical center (P) how does the implementation of a blue wristband to identify patients with diagnosed or suspected OSA (STOP-Bang score >/=4) (I) compared to current practice (C) affect the perioperative management of OSA patients as defined as receiving benzodiazepines alone or in combination with opioids (O) within the perioperative stay (pre-op, intra-op, PACU) (T)? The setting of the project will take place through Atrium Health. The sample for this project will consist of a total of 200 patients that have either undergone elective non-cardiac surgery at CMC Main or Atrium Health ODS during the month of July 2022, or who will undergo elective non-cardiac surgery during September 2022. Data will be collected via chart review.

It is your responsibility to:

1. Inform the UNC Charlotte IRB about any actions by the external IRB affecting their approval to conduct the study, including suspension or termination of approval.
2. Submit a modification to the UNC Charlotte IRB (via Niner Research) if/when new personnel are added to the study team or the study is modified in such a way that additional institutional approvals are required (e.g., radiation safety, biosafety).
3. Submit a copy of the external IRB approval letter and current approved consent document to the UNC Charlotte IRB (via Niner Research) when the study is renewed; you will continue to receive reminder notices from the UNC Charlotte IRB for renewal, and should provide the external approval and consent documents within 30 days of receipt.
4. Report all Unanticipated Problems protocol violations and unresolved subject complaints to the UNC Charlotte IRB *in addition to the external IRB*. You may submit a copy of the report you submitted to the external IRB; this should be done via the Adverse Event form in Niner Research.
5. Maintain compliance with all other UNC Charlotte policies (e.g., data security, conflict of interest).

APPENDIX B: WAKE FOREST HEALTH BAPTIST IRB APPROVAL

Office of Research
INSTITUTIONAL REVIEW BOARD

MEMORANDUM

To: Lorraine Schoen
Atrium/Carolinas Healthcare System

From: Brian Moore, Chair, Institutional Review Board

Date Approved: 8/4/2022

Subject: Expedited Review: IRB00086371
Perioperative Care of Obstructive Sleep Apnea

Amber N. Ushakumari and Victoria Valencia
University of North Carolina Charlotte/Atrium Health Nurse Anesthesia Program

Study Documents:
Protocol Version: Project Protocol: Perioperative Care of Obstructive Sleep Apnea

This research study qualifies for expedited review under the Federal Regulations [45CFR46.110]. These regulations allow an IRB to approve certain kinds of research involving no more than minimal risk to human subjects. The risks of harm anticipated in the proposed research are not greater than those ordinarily encountered by the general population in daily life or during the performance of routine physical, laboratory, or psychological exams or tests. [45CFR46.102(i)].

Upon review of the research, the IRB finds that this study is classified as Expedited Category 5.

This research meets the criteria for a waiver of consent entirely according to 45 CFR 46(d).

This research meets the criteria for a waiver of HIPAA authorization according to 45 CFR 164.512.

IRB approval is for a period of 12 months from 8/4/2022**.** Please notify the Office of Research when the project is complete.

The Wake Forest School of Medicine IRB is duly constituted, has written procedures for initial and continuing review of clinical trials; prepares written minutes of convened meetings, and retains records pertaining to the review and approval process; all in compliance with requirements of FDA regulations 21 CFR Parts 50 and 56, HHS regulations 45 CFR 46, and International Conference on Harmonisation (ICH) E6, Good Clinical Practice (GCP), as applicable. WFSM IRB is registered with OHRP/FDA; our

Medical Center Boulevard, Winston-Salem, NC 27157-1023 (336) 716-4542 / fax (336) 716-4480

IRB registration numbers are IRB00000212, IRB00002432, IRB00002433, IRB00002434, IRB00008492, IRB00008493, IRB00008494, and IRB00008495.
WFSM IRB has been continually fully accredited by the Association for the Accreditation of Human Research Protection Programs (AAHRPP) since 2011.

APPENDIX C: HOSPITAL POLICY FOR BLUE WRISTBAND APPLICATION

Atrium Health Carolinas Medical Center (CMC)
Sites: CMC Main and One Day Surgery (ODS)
Pilot Project Policy - Perioperative Care of Obstructive Sleep Apnea
UNC Charlotte; Atrium Health Nurse Anesthesia Program
Sep 4, 2022

TITLE: **Obstructive Sleep Apnea (OSA) in the Perioperative Period Assessment of Risk Protocol and Application of Blue Wristband**

PURPOSE: To improve patient safety and minimize respiratory complications in adult patients with possible obstructive sleep apnea during the perioperative period by identification with a blue wristband

APPLIES TO: Female and male adults who are greater than or equal to 18 years old scheduled for elective non cardiac surgery and have a STOP-Bang score >/=4.

DOES NOT APPLY TO: Patients younger than 18 years old, emergency surgery, ICU admission, or specialized surgeries including trauma, cardiovascular, neurological, and obstetric surgeries.

AUTHOR(S): Victoria Valencia SRNA and Amber Ushakumari SRNA

OBSTRUCTIVE SLEEP APNEA:

- OSA is characterized by periodic partial or complete obstruction of the upper airway
- Patients with OSA are more likely to experience postoperative pulmonary complications such as aspiration pneumonia, ARDS, and pulmonary embolism

POLICY STATEMENTS:

1) Patients who may have OSA will be identified by the anesthesia team in the pre-optimization clinic as early as possible in the admission process prior to planned surgery.
2) Patients will undergo a preoperative anesthesia evaluation and be screened for OSA using the STOP-Bang questionnaire by the Department of Anesthesia. *Patients with a STOP-Bang score greater than five will be flagged for a formal sleep evaluation prior to surgery.*
3) All efforts will be made by the interdisciplinary health care team (MDAs, CRNAs and RNs) to minimize co-administration of opioid analgesia and benzodiazepines in patients identified with possible or diagnosed OSA.

4) All members of the interdisciplinary health care team are responsible for ensuring best practices for patients with suspected or diagnosed OSA to reduce any complications due to the pathophysiology of sleep apnea.
5) For patients identified with possible OSA, a blue wristband will be applied to the patient's wrist in the pre-operative area. The wristband will remain on the patient until discharge from PACU in which the wristband will be removed.

PROCEDURE:

Preoperative Period:

1) All patients will be screened using the STOP-Bang questionnaire.
2) Pre-op nurses will apply a blue wristband to all patients with a STOP-Bang score >/= 4 as documented in EPIC.
    a) The blue wristband identifies those patients at risk for OSA to alert all members of the healthcare team and allow for proper management of the patient with respiratory distress/difficulty
3) Pre-op benzodiazepines will be avoided if possible.

Intraoperative Period:

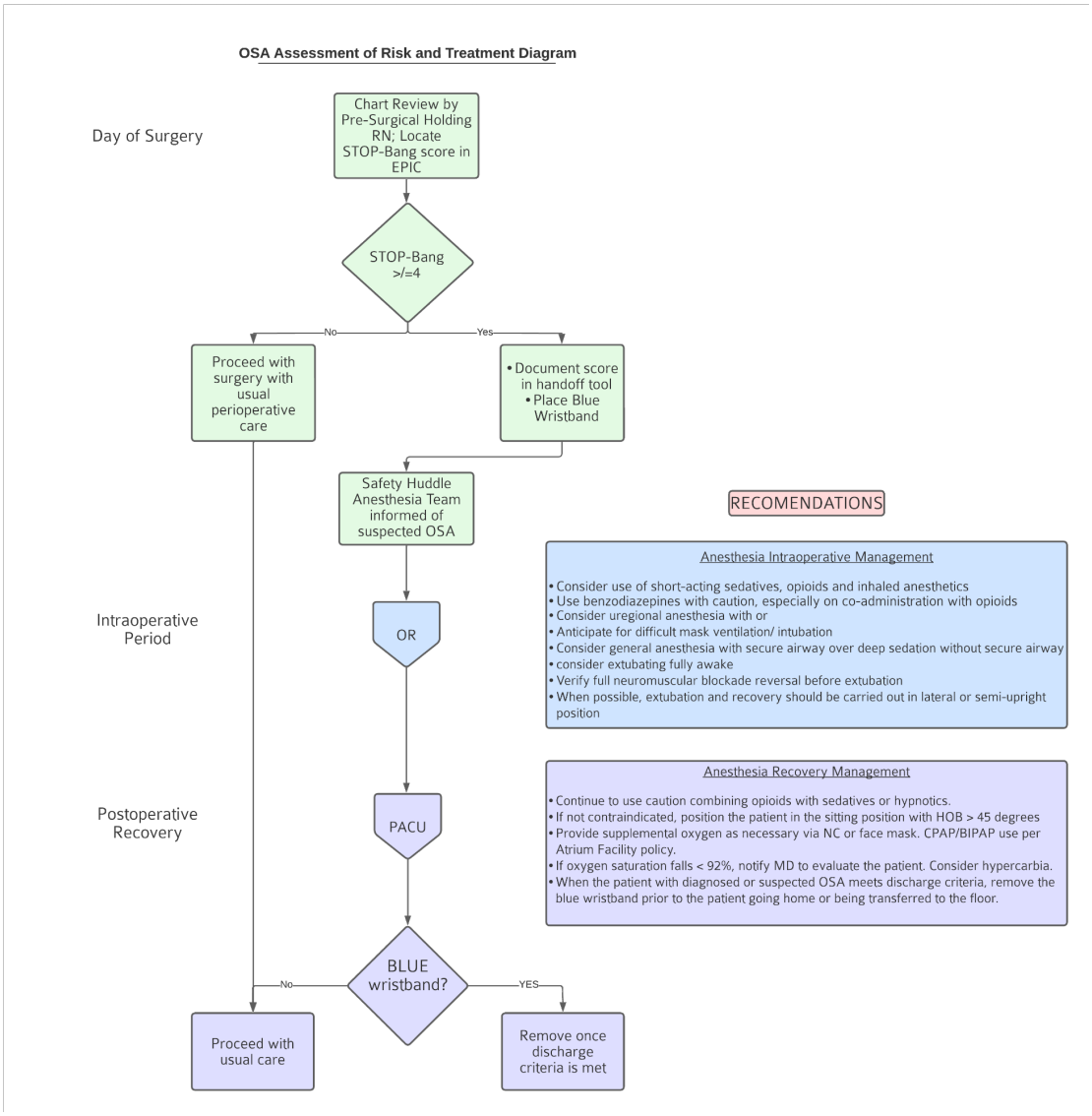
1) The anesthesia team will consider recommendations per the American Society of Anesthesiologists Guidelines on the Perioperative Care of Obstructive Sleep Apnea:
    a) Consider use of short-acting sedatives, opioids and inhaled anesthetics
    b) Use benzodiazepines with caution, especially on co-administration with opioids
    c) Consider use of regional anesthesia with or without moderate sedation for superficial procedures
    d) Anticipate for difficult mask ventilation and difficult intubation
    e) Consider general anesthesia with secure airway over deep sedation without secure airway
    f) Unless a contraindication, consider extubating fully awake
    g) Verify full neuromuscular blockade reversal before extubation
    h) When possible, extubation and recovery should be carried out in lateral or semi-upright position
2) The anesthesia team will consider using and prescribing (in the post-operative period) non-opioid analgesics such as non-steroidal anti-inflammatory drugs (NSAIDs) with OSA patients whenever possible.

Postoperative Period:

1) Continue to use caution combining opioids with sedatives or hypnotics.
2) If not contraindicated, position the patient in the sitting position with head of bed greater than 45 degrees (obstruction to breathing is worse when patients lie flat on their back).

3) Use standard airway maneuvers such as mandibular advancement and/or oral airways to maintain a patent airway.
4) Provide supplemental oxygen as necessary via nasal cannula or face mask. CPAP/BIPAP use per Atrium Facility policy.
5) If oxygen saturation falls below 92%, notify MD to evaluate the patient. Consider hypercarbia.
6) When the patient with diagnosed or suspected OSA meets discharge criteria, remove the blue wristband prior to the patient going home or being transferred to the floor.

APPENDIX D: OSA ASSESSMENT OF RISK AND TREATMENT DIAGRAM



APPENDIX E: EXCEL WORKSHEET TEMPLATE

The excel worksheet depicted below was utilized to record the information from each column through the patient's EMR. For each patient the following was recorded: Anesthesia date, SB Score, Age, Gender, Anesthesia length in minutes, benzodiazepine received Y/N, narcotic

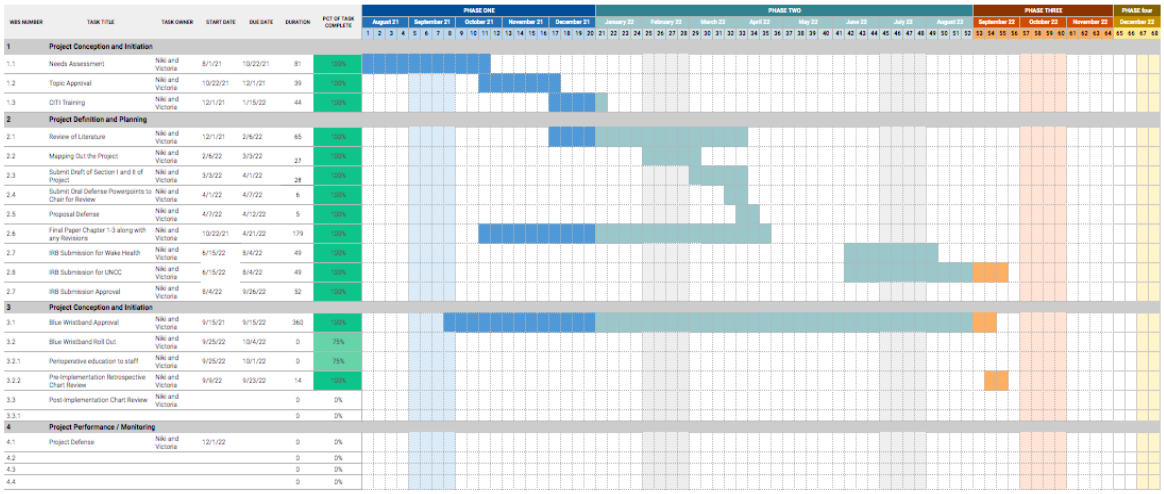
received Y/N, Benzodiazepines and narcotic combination received, ASA Score, Anesthesia type, and BMI.

#	Anesthesia date	STOP-Bang score	AGE	Gender	Anesthesia time (min)	Benzos Y/N	Narcotic Yes/No	Benzos/narc combo	ASA score	Anesthesia type	BMI

APPENDIX F: GANTT CHART

The following Gantt Chart exemplifies the timeline for this doctoral project. Project conception and initiation included our Needs Assessment, Topic Approval, and CITI Training. Navigating through the project definition and planning phase including the Review of Literature and Mapping of the project were completed. Oral Defense was completed April 12, 2022. IRB approval was obtained by the hospital facility and the University of North Carolina at Charlotte in September 2022. Retrospective data collection began in September 2022 for the month of August 2022. The implementation phase of this project began October 2022. The final Project Defense and submission of the Final Scholarly Paper is planned for December 2022.

PROJECT NAME	PERIOPERATIVE CARE OF THE OSA PATIENT	**INSTITUTION NAME**	UNCC/ATRIUM HEALTH NAP
PRINCIPAL INVESTIGATOR	Stephanie Woods	**DATE**	September 28, 2022



WBS NUMBER	TASK TITLE	TASK OWNER	START DATE	DUE DATE	DURATION	PCT OF TASK COMPLETE
1	**Project Conception and Initiation**					
1.1	Needs Assessment	Niki and Victoria	8/1/21	10/22/21	81	100%
1.2	Topic Approval	Niki and Victoria	10/22/21	12/1/21	39	100%
1.3	CITI Training	Niki and Victoria	12/1/21	1/15/22	44	100%
2	**Project Definition and Planning**					
2.1	Review of Literature	Niki and Victoria	12/1/21	2/5/22	65	100%
2.2	Mapping Out the Project	Niki and Victoria	2/5/22	3/3/22	27	100%
2.3	Submit Draft of Section I and II of Project	Niki and Victoria	3/3/22	4/1/22	28	100%
2.4	Submit Oral Defense Powerpoints to Chair for Review	Niki and Victoria	4/1/22	4/7/22	6	100%
2.5	Proposal Defense	Niki and Victoria	4/7/22	4/12/22	5	100%
2.6	Final Paper Chapter 1-3 along with any Revisions	Niki and Victoria	10/22/21	4/21/22	179	100%
2.7	IRB Submission for Wake Health	Niki and Victoria	5/15/22	8/4/22	49	100%
2.8	IRB Submission for UNCC	Niki and Victoria	5/15/22	8/4/22	49	100%
2.7	IRB Submission Approval	Niki and Victoria	8/4/22	9/26/22	52	100%
3	**Project Conception and Initiation**					
3.1	Blue Wristband Approval	Niki and Victoria	9/15/21	9/15/22	360	100%
3.2	Blue Wristband Roll Out	Niki and Victoria	9/25/22	10/4/22	9	75%
3.2.1	Perioperative education to staff	Niki and Victoria	9/25/22	10/1/22	6	75%
3.2.2	Pre-Implementation Retrospective Chart Review	Niki and Victoria	9/9/22	9/23/22	14	100%
3.3	Post-Implementation Chart Review	Niki and Victoria			0	0%
3.3.1					0	0%
4	**Project Performance / Monitoring**					
4.1	Project Defense	Niki and Victoria	12/1/22		0	0%
4.2					0	0%
4.3					0	0%
4.4					0	0%