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## A Quality Improvement Project to Determine the Incidence and Prevalence of Obstructive Sleep Apnea, Best Practice Anesthesia Guidelines, and the Incidence of Perioperative Cardiac and Respiratory Complications After the Implementation of the STOP-BANG Questionnaire

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A QUALITY IMPROVEMENT PROJECT TO DETERMINE THE INCIDENCE AND  
PREVALENCE OF OBSTRUCTIVE SLEEP APNEA, BEST PRACTICE  
ANESTHESIA GUIDELINES, AND THE INCIDENCE OF PERIOPERATIVE  
CARDIAC AND RESPIRATORY COMPLICATIONS AFTER THE  
IMPLEMENTATION OF THE STOP-BANG QUESTIONNAIRE

by

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A Doctoral Project  
Submitted to the Graduate School,  
the College of Nursing and Health Professions  
and the School of Leadership and Advanced Nursing Practice  
at The University of Southern Mississippi  
in Partial Fulfillment of the Requirements  
for the Degree of Doctor of Nursing Practice

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## ABSTRACT

Patients with obstructive sleep apnea (OSA) are at risk for perioperative respiratory and cardiovascular compromise (Opperer et al., 2016). Unfortunately, almost 90% of patients with moderate-to-severe OSA are not diagnosed and unaware of their disorder; however, they remain at increased perioperative risks (Singh et al., 2015). The STOP-BANG questionnaire was developed to meet the need for a reliable, concise, and efficient screening tool for OSA risk. The facility at which this project was conducted did not utilize a prescreening OSA risk tool. The facility not using a prescreening OSA risk tool is especially important because the State of Mississippi currently ranks as one of the most obese states in the nation, and because obesity positively correlates as one of the greatest risk factors for having OSA (National Heart, Lung, and Blood Institute [NHLBI], 2018).

The purpose of this project was to determine the incidence and prevalence of OSA, best anesthesia practice guidelines, and perioperative cardiac and respiratory complications following implementation of the STOP-BANG questionnaire. A retrospective chart review was completed the month prior to, during, and after the implementation of the STOP-BANG questionnaire. De-identified data was provided by a facility employee.

The calculated prevalence of patients identified as having moderate to high risk of having OSA was 2.8%. During the month of implementation, 2% of patients who met inclusion criteria had completed STOP-BANG questionnaires. Awareness of best practice anesthesia guidelines resulted in a decrease in narcotic usage and an increase in paralytic and reversal agents. Perioperative cardiovascular complications (arrhythmias

and/or hypotension) during the month of implementation showed a decrease of 0.8% along with a decrease of 4.7% in ICU admissions. Perioperative respiratory complications such as hypoxemic events (oxygen saturation <85%) increased by 6.2% and reintubations in the post-anesthesia care unit (PACU) had no change during the month of implementation.

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## DEDICATION

Bradly Diamond

I would like to extend my gratitude to my family and friends for the support and encouragement through many long hours of developing this DNP project. I would like to especially thank my spouse, Shannon Diamond, and my two children, Olivia and Cameron. Your understanding of the long nights and early mornings is sincerely appreciated, and your unwavering support and guidance have been invaluable.

Gregory Guerrier

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Robert Marrero

I would like to dedicate this doctoral project to my spouse, Dr. Belinda Lister, who has stood by my side throughout the many years of school and has been an invaluable source of support and encouragement.

Tyler Nelson

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## LIST OF ABBREVIATIONS

<i>AANA</i>	American Association of Nurse Anesthetists
<i>AHI</i>	Apnea-Hypopnea Index
<i>ASA</i>	American Society of Anesthesiologist
<i>BiPAP</i>	Bilevel Positive Airway Pressure
<i>BMI</i>	Body Mass Index
<i>CHF</i>	Congestive Heart Failure
<i>CPAP</i>	Continuous Positive Airway Pressure
<i>CDC</i>	Centers for Disease Control and Prevention
<i>DNP</i>	Doctor of Nursing Practice
<i>EEG</i>	Electroencephalography
<i>GETA</i>	General Endotracheal Anesthesia
<i>HTN</i>	Hypertension
<i>ICU</i>	Intensive Care Unit
<i>IRB</i>	Institutional Review Board
<i>IV</i>	Intravenous
<i>NMBA</i>	Neuromuscular Blocking Agent
<i>PACU</i>	Post-Anesthesia Care Unit
<i>PNB</i>	Peripheral Nerve Block
<i>PSG</i>	Polysomnography
<i>REM</i>	Rapid Eye Movement
<i>ROS</i>	Reactive Oxygen Species
<i>SAMBA</i>	Society for Ambulatory Anesthesia

<i>SASM</i>	Society of Anesthesia and Sleep Medicine
<i>SaO2</i>	Arterial Oxygen Saturation
<i>SD</i>	Standard Deviation
<i>SRNA</i>	Student Registered Nurse Anesthetist
<i>TOF</i>	Train of Four
<i>USPSTF</i>	United States Preventive Services Task Force

## CHAPTER I – INTRODUCTION AND BACKGROUND

Obstructive sleep apnea (OSA) affects millions of Americans with many of them undiagnosed and untreated due to the signs and symptoms occurring during sleep (National Heart, Lung, and Blood Institute [NHLBI], 2018). Unfortunately, almost 90% of patients with moderate-to-severe OSA are not diagnosed and are left completely unaware of their disorder; however, they have increased postoperative risks secondary to this issue (Singh et al., 2015). The correlation of OSA with cardiovascular disease and mortality was first reported in clinical cases nearly 30 years ago and has since been confirmed over the years through numerous prospective observational studies involving sleep clinic patients and community-based cohorts (Gottlieb, 2017). The lack of awareness, routine screening, significant cost, and an insufficient number of sleep study facilities to diagnose OSA via polysomnography (PSG) play a key role in the number of undiagnosed cases (Dixon, Haas, Klopp, & Carlson, 2016). A prescreening tool, such as the STOP-BANG questionnaire, can be implemented preoperatively to decrease the number of undiagnosed OSA patients and their perioperative complications (Singh et al., 2013).

Undiagnosed OSA may be associated with a variety of perioperative concerns (e.g., difficult intubation, postoperative complications, increased admission to the intensive care unit [ICU], and longer hospitalization) and a three to six-fold increase in morbidity and mortality (Singh et al., 2013). Perioperative respiratory complications may also manifest in cardiac alterations. According to the NHLBI (2018), OSA correlates with an increased risk of high blood pressure, myocardial infarction, cerebral vascular accident, obesity, diabetes, glaucoma, and premature births.



OSA is defined as the absence of airflow or apnea for a minimum of 10 seconds despite ventilatory efforts 5 or more times an hour (Spence, Han, McGuire, & Couture, 2015). The standard for diagnosis of OSA is observed PSG by a trained healthcare provider (Kapur et al., 2017). PSG measures sleep cycles (rapid eye movement [REM] and non-REM) with multiple sensors attached to the body recording brain waves, oxygen levels, body position, breathing effort and rate, muscle activity, lung air flow, eye movement, and heart rate. The severity of OSA is quantified with an apnea-hypopnea index (AHI) per hour of sleep via PSG with mild scoring an AHI of 5 to 15, moderate 15 to 30, and severe OSA as an AHI greater than 30 (Dixon et al., 2016).

Anatomical changes associated with OSA patients may include a narrowed pharyngeal airway secondary to excess adipose tissue, decreased neuromuscular tone of the dilator muscles (genioglossus, tensor palatine, and hyoid muscles), and/or loss of airway dilator reflexes resulting in obstruction of flow (Spence et al., 2015). Chronic obstruction to flow, or apnea, reduces alveolar oxygen tension leading to pulmonary vasoconstriction (decreased nitric oxide levels and increased endothelin levels), pulmonary hypertension (HTN), and increased reactive oxygen species (ROS) in the pulmonary artery smooth muscle cells creating a phenotypical change (Kholdani, Fares, & Mohsenin, 2015). Pulmonary changes associated with OSA account for increased perioperative complications such as reintubation, pneumonia, and pulmonary embolism (Zaremba, Mojica, & Eikermann, 2016).

During obstructive respiratory events, electroencephalography (EEG) displays microarousals from increased ventilatory events signifying sleep fragmentation (Spence et al., 2015). Regulation of normal inspiration is mainly controlled by the dorsal

respiratory group of neurons (mainly the nucleus of the tractus solitarius) located along the medulla (Guyton & Hall, 2016). During periods of apnea, increased levels of carbon dioxide readily cross the blood-brain barrier and react with water to form carbonic acid. Carbonic acid dissociates into hydrogen and bicarbonate ions; the hydrogen ions stimulate the chemosensitive area located bilaterally just beneath the ventral surface of the medulla. The chemosensitive area, in turn, excites the dorsal and ventral respiratory groups along with the pneumotaxic center to increase the strength of motor signals to the respiratory muscles. When the stimulus is strong enough, serotonergic and noradrenergic neurons send excitatory impulses to the upper airway motor neurons, increasing dilator muscle activity and arousal (Zaremba et al., 2016). Microarousals interrupt the normal three to five REM sleep cycles that are responsible for mental recovery (Spence et al., 2015). Fragmented sleep patterns may lead to delirium which is associated with increased mortality, morbidity, as well as long-term cognitive and functional decline (Zaremba et al., 2016).

OSA is an independent risk factor for congestive heart failure, arrhythmias, myocardial ischemia, systemic hypertension, stroke, heart failure, and sudden cardiac death (Kholdani et al., 2015). Cyclic hypoxemia and hypercapnia increase sympathetic activity resulting in elevated levels of noradrenaline plasma levels, catecholamines in urine, and muscle activity (Roca & Shah, 2015). Shifts in intrathoracic pressures due to inspiratory efforts against an obstruction change ventricular loading, increasing intracardiac transmural pressures and changes in autonomic activity (Roca & Shah, 2015). Finally, hypoxemia can lead to the formation of ROS, activating inflammatory pathways such as C-reactive proteins and cytokines, which have been implicated in

atherosclerosis (Roca & Shah, 2015). The resulting systemic hypertension increases the workload of the left ventricle leading to hypertrophy, diastolic failure, pulmonary hypertension, right ventricular failure, and eventually, biventricular failure (Roca & Shah, 2015).

Although PSG is the standard for diagnosing OSA, it is neither practical for rapid screening in a fast-paced preoperative environment nor feasible due to unplanned surgical procedures, cost, and inadequate available resources (Dixon et al., 2016). The American Academy of Sleep Medicine recommends that routine health maintenance evaluations incorporate questions evaluating OSA risk factors (U.S. Preventive Services Task Force [USPSTF], 2017). The American Society of Anesthesiologists (ASA) and the Joint Commission recommend the screening of all surgical patients for the risk of OSA; moreover, the Society of Ambulatory Anesthesia (SAMBA) recommends the use of the STOP-BANG questionnaire as a preoperative screening tool to identify a patient's risk for OSA (Stierer & Collop, 2015).

The STOP-BANG questionnaire (Appendix A) was developed to meet the need for a reliable, concise, and efficient screening tool for OSA risk that consists of four yes/no questions and four demographic characteristics. The yes/no questions are listed as: do you snore loud enough to be heard from another room, are you tired during the day, has anyone observed you stop breathing during sleep, and do you have hypertension? The patient characteristics consist of body mass index (BMI) greater than 30, age older than 50, neck circumference greater than 17 inches for men and 16 inches for women, and gender with male scoring a point. STOP-BANG scores range from zero

to eight, with scores greater than three associated with moderate to severe OSA risk (Chung, Abdullah, & Liao, 2016a).

One important key demographic of the STOP-BANG questionnaire includes a BMI greater than 30 (obesity). Obesity is one of the most prevalent risk factors for OSA (70% of patients diagnosed with OSA are obese) and affects approximately 500 million adults worldwide (Peromaa-Haavisto et al., 2015). According to the Trust for America's Health and the Robert Wood Johnson Foundation (2017), Mississippi ranks second to West Virginia as being the most obese state in the United States, is number one for high school obesity, and just over 37% of its residents are obese. An obese patient generates 40% more in medical expenses per year than a non-obese patient and is projected to cost Mississippi \$3.9 billion in 2018 (Forrest General Hospital, 2016). Obesity has become one of the greatest public health concerns and is known to be the most important risk factor for OSA, thus a routine screening for OSA, especially with bariatric surgery, is warranted (Peromaa-Haavisto et al., 2015). Furthermore, with rates of obesity increasing, one can expect a higher prevalence of OSA (Zaremba et al., 2016).

This quality improvement (QI) project consisted of five distinct components. The first component was the implementation of the STOP-BANG questionnaire. Secondly, the STOP-BANG tool was utilized to determine the incidence and prevalence of OSA at a Mississippi hospital and the comparison of anesthesia management with best practice guidelines. Additionally, this quality improvement project focused on the number of perioperative cardiovascular complications (arrhythmias, hypotension, and postoperative admission to ICU) and respiratory complications (hypoxic events, reintubations, and postoperative admission to the ICU) during the month before, during, and after the

implementation of the STOP-BANG questionnaire on all adult elective surgery patients—excluding obstetrics, emergencies, and patients under the age of 18 years old. For this project, hypoxic events are defined as oxygen saturation (SpO<sub>2</sub>) decreasing below 85%, arrhythmias are defined as any rhythm other than normal sinus rhythm (NSR) or paced rhythm, and hypotension is defined as systolic blood pressure (SBP) less than 90 mmHg. This project was part of a larger quality improvement to assess the need for a preoperative OSA prescreening tool, such as the STOP-BANG questionnaire.

### Problem Statement

OSA affects approximately 24% of the population and 90% of individuals with OSA remain undiagnosed (Singh et al., 2013). OSA can affect up to 77% of surgical patients depending on the subpopulation with bariatric being the highest (Zaremba et al., 2016). Patients at risk for OSA without previous diagnosis have increased rates of mechanical ventilation, reintubation, hypoxemic events (SpO<sub>2</sub> < 85%), longer surgical durations, and other comorbidities (Fernandez-Bustamante et al., 2017). Furthermore, a considerable proportion (76%-97%) of surgical patients at risk for OSA but undiagnosed are not recognized by physicians, anesthetists, and surgeons prior to surgery (Singh et al., 2013).

Screening tools exist to identify patients at risk for OSA; however, they are often not utilized. The STOP-BANG questionnaire (prescreening tool) was originally developed for use in the surgical setting and has proven to be effective (validated) in identifying patients at risk for OSA (Nagappa et al., 2015). No prescreening tool for OSA risk, including STOP-BANG, is utilized at a hospital in Southern Mississippi preoperatively. The absence of an OSA screening tool leaves this disease a potentially

underdiagnosed and undertreated problem that can lead to significant postoperative respiratory and cardiovascular consequences such as hypoxemic events ( $SpO_2 < 85\%$ ), reintubations, arrhythmias, hypotension ( $SBP < 90$  mmHg), and unintended admission to the ICU.

In response to an ever-increasing prevalence of patients with diagnosed or suspected OSA, guidelines have been developed for their anesthesia care. The ASA, SAMBA, and the Society of Anesthesia and Sleep Medicine (SASM) have published guidelines related to anesthesia management for these patients. Early identification of OSA patients via the STOP-BANG questionnaire would assist in the implementation of these guidelines by anesthesia providers.

#### Available Knowledge

An online search consisting of queries ranging from 2010 to 2018 was conducted using multiple sources (MEDLINE, Embase, Cochrane Central Register of Controlled Trials, Cochrane Databases of Systematic Reviews, Google Scholar, Web of Sciences, Scopus, CINAHL and PubMed) searching for articles related to OSA, anesthesia guidelines, best practices, respiratory complications, cardiovascular complications, STOP-BANG, anesthesia, OSA, emergence, and best practice guidelines, single and in combination. Study designs such as randomized control trials, cohort studies, prospective and/or retrospective studies, meta-analyses, and systematic reviews of adult surgical patients (>18 years old), were published in the English language and required to define the presence of OSA risk. Exclusion criteria included irrelevant studies, non-diagnostic studies, insufficient data, and no gold standard tests. A total of 7 study designs were referenced for available knowledge.

## *Prevalence*

As the rate of obesity increases across the United States, the prevalence of OSA increases as well (National Heart, Lung, and Blood Institute, 2017). According to the Centers for Disease Control and Prevention (CDC) (2018b), the prevalence of obesity in the United States is 39.8%, Hispanics and non-Hispanic blacks have the highest prevalence of obesity followed by non-Hispanic whites and Asians. In Mississippi, more than 35% of adults are considered obese. These patients frequently experience episodes of hypercarbia, oxygen desaturation, and increased somnolence (Lee, Nagubadi, Kryger, & Mokhlesi, 2008). Depending on the severity of OSA and the period of time the patient has been living with it, patients can be more susceptible to the respiratory depressant effects of narcotics and more easily develop an upper airway obstruction (Porhomayon, Nader, Leissner, & El-Solh, 2012).

Studies in the United States have shown that an estimated 93% of women and 82% of men with moderate to severe OSA have never been formally diagnosed (Fassbender, Herbstreit, Eikermann, Teschler, & Peters, 2016). Cardiovascular mortality rates have been higher in patients with untreated OSA (Hopps & Caimi, 2015). One study has shown that almost 60% of anesthesia providers and 92% of surgeons failed to identify patients with pre-existing OSA (Singh et al., 2013). These numbers demonstrate an avoidable potential perioperative risk that patients are subjected to each time they present for surgery.

According to the World Health Organization (2006), approximately 500 million adults in the world are obese. Obesity by itself increases patients' risk for developing cardiovascular diseases, diabetes, and cancer (Peromaa-Haavisto et al., 2015). Obesity is

the most important risk factor for OSA, approximately 70% of patients with OSA are classified as being obese. OSA affects mostly middle-aged men and women (Peromaa-Haavisto et al., 2015). Approximately 80-90% of patients with OSA worldwide are undiagnosed (Peromaa-Haavisto et al., 2015). Obesity costs the United States about \$150 billion per year, with medical costs being \$1,429 higher than the cost of someone with a normal weight (CDC, 2018b). In Mississippi, \$925 million was spent on healthcare costs related to obesity in 2008. An estimated 22 million people in the United States suffer from OSA (American Sleep Apnea Association, n.d).

### *STOP-BANG Tool*

A high percentage (82%) of family physicians believe OSA is clinically important, but only 11% of sleep complaints during a review of systems received further workup (Wolfe, Pomerantz, Miller, Weiss-Coleman, & Solomonides, 2016). The lack of preoperative OSA screening and sporadic identification of known OSA patients among health care providers have become particularly serious for surgical patients due to increased perioperative morbidity (Dixon et al., 2016). Singh et al. (2013) found that 93% of patients who were not diagnosed with OSA preoperatively were classified as at risk by the STOP-BANG questionnaire.

The USPSTF (2017) recognizes the need for a clinical prediction tool that can accurately determine which persons would benefit from further evaluation and testing for OSA. Dixon et al. (2016) found a 25% increase in the detection of risk for OSA by implementing the STOP-BANG questionnaire preoperatively on 1,625 patients over three months. Singh et al. (2013) also found that by utilizing the STOP-BANG questionnaire



preoperatively, 708 undiagnosed OSA patients were recognized at risk for OSA and that after follow-up with PSG, 69% were identified as having OSA.

The STOP-BANG questionnaire was developed to meet the need for a reliable, concise, and efficient screening tool for OSA risk that consists of four yes/no questions and four demographic characteristics. The yes/no questions are listed as: do you snore loud enough to be heard from another room, are you tired during the day, has anyone observed you stop breathing during sleep, and do you have hypertension? The patient characteristics consist of body mass index (BMI) greater than 30, age – older than 50, neck circumference greater than 16 inches, and gender with male scoring a point. STOP-BANG scores range from zero to eight with scores greater than three associated with moderate to severe OSA risk (Chung et al., 2016a).

A STOP-BANG score of three to six has a negative predictive value (NPV)—the probability that a negative screen equals no risk of disease—of 90% with a probability of OSA increasing from 18% to 60% for moderate risk (Chung et al., 2016a). Furthermore, a STOP-BANG score of seven to eight has an NPV of 100% with a probability of severe OSA rising from 4% to 38% (Chung et al., 2016a). The STOP-BANG questionnaire can identify patients with moderate to severe OSA with 93% sensitivity (true positive for disease), 43% specificity (truly negative for disease), a positive predictive value (PPV)—the probability that a positive screening results in having the disease—of 52%, and a NPV of 90% (Singh et al., 2013).

A meta-analysis conducted by Nagappa et al. (2015) encompassed 9,206 adult patients (11 studies in sleep clinics and 3 studies in the surgical population) and found that as STOP-BANG scores increased greater than three, an increase in the probability of

moderate-to-severe OSA was noted. The validity of STOP-BANG scores were confirmed by referencing PSG studies (Nagappa et al., 2015). Predictive parameters of the STOP-BANG questionnaire in the surgical population for moderate OSA are listed as prevalence 39.2%, sensitivity of 91%, negative predictive value (NPV) 84%, positive predictive value (PPV) 46%, and a specificity of 32% (Nagappa et al., 2015). Severe OSA predictive parameters of STOP-BANG in the surgical population are listed as a prevalence of 18.7%, sensitivity of 96%, NPV of 97%, PPV of 24%, and a specificity of 29% (Nagappa et al., 2015).

### *Best Practice Guidelines*

In 2012, the ASA determined there was a need to evaluate if their 2006 guidelines for the perioperative management of patients with OSA were still supported by evidence. After this review, an updated report was published in 2014. The new report includes recommendations for preoperative evaluation, preoperative preparation, intraoperative management, and postoperative management. The SAMBA and SASM concentrate their guidelines on preoperative screening and management only. These guidelines are not meant to be implemented as standards or requirements but to merely provide basic recommendations supported by a synthesis of current literature, expert opinion, open forum commentary, and clinical data (American Society of Anesthesiologists [ASA], 2014).

*Preoperative.* To ensure optimal care for patients identified to be at risk for or who are suspected to have OSA, a protocol should be developed between the anesthesia provider and the surgeon to make sure these patients are evaluated in the days leading to surgery to allow preparation for an individualized anesthesia plan (Adesanya, Lee,

Greilich, & Joshi, 2010). While a phone interview may offer beneficial information, an in-person interview and assessment would be preferable as a physical assessment can be completed. Included in the preoperative evaluation is a comprehensive review of previous medical records, an interview with the patient or family, and a complete physical examination (ASA, 2014). Sleep studies should be reviewed when available (Joshi, Ankichetty, Gan, & Chung, 2012). The SAMBA also advocates for the use of the STOP-BANG Questionnaire during a preoperative evaluation due to its simplicity to administer (Joshi et al., 2012).

A complete physical examination should include a detailed oral and nasal airway assessment, neck circumference, tongue size, and tonsil volume (ASA, 2014). Upon completion of a thorough preoperative evaluation, any indications of potential OSA should be noted and jointly reviewed by the anesthesia provider and the surgeon to determine the best course of action. Based on current clinical evaluations the decision must be made to either proceed or delay the planned procedure. Proceeding with the planned procedure will necessitate individualized perioperative management. Often, if the choice is made to delay the procedure it is due to a need for further studies, more extensive examinations, and to optimize a patient's health status. (ASA, 2014).

According to the SASM, initiation of continuous positive airway pressure (CPAP) should be considered in the preoperative setting when preparing for patients who have suspected or severe OSA (Chung et al., 2016b). This intervention is believed to possibly improve apnea time in patients with a decreased functional residual capacity. In contrast to the guidelines proposed by the ASA and SASM for preparation of OSA patients before surgery, the SAMBA believes the completion of a sleep study and the use of preoperative

CPAP or bi-level positive airway pressure (BiPap) may not improve perioperative outcomes in this patient population (Joshi et al., 2012). More research is clearly needed to determine if this intervention is beneficial and what the optimal duration should be.

*Intraoperative.* The flexibility of the intraoperative anesthesia plan is an important factor for optimal management of OSA patients. These patients present many issues the anesthesia provider must concern themselves with such as a choice of anesthesia technique, airway management, and patient monitoring (ASA, 2014). ASA members and their consultants agree on the anesthesia management plan presented in the guidelines, while also acknowledging a lack of current literature and evidence to evaluate their effects.

Definitive airway management of OSA patients is crucial throughout the surgical procedure (Brousseau, Dobson, & Milne, 2014). Several studies have shown a correlation between difficult intubation and OSA patients, while other studies have reported no relationship (Brousseau et al., 2014). For this reason, emergency airway devices and equipment should be readily available. For patients at risk for or have OSA and plan to undergo general anesthesia, guidelines recommend a secure airway (e.g., endotracheal tube) over deep sedation without a secure airway (ASA, 2014).

Adesanya and colleagues (2010) stated that the use of sedatives when preparing for induction of anesthesia should be slowly titrated in OSA patients or avoided entirely. The use of local anesthesia or peripheral nerve blocks (PNB), with or without moderate sedation, should be considered for superficial procedures, and spinal or epidural anesthesia should be used for peripheral procedures (ASA, 2014). CPAP is suggested to be used during sedation cases if the patient is routinely using these modalities outside of

the current surgical setting (ASA, 2014). CPAP will assist in maintaining upper airway patency.

During the intraoperative anesthesia management of a patient with OSA, the anesthesia provider must consider the increased risk for respiratory compromise. For this reason, medications must be chosen carefully due to their potential to affect not only intraoperative care but because of the medication's potential to carry over into the postoperative setting as well. Patients with OSA are shown to have increased susceptibility to benzodiazepines, volatile anesthetics, and opioids due to their respiratory depressant effects and should be carefully monitored for postoperative respiratory compromise (ASA, 2014). The model anesthesia technique would be one in which short-acting medications were used that allow for a prompt return of baseline respiratory function and patient consciousness (Adesanya et al., 2010). Guidelines explaining a specific anesthetic drug therapy regimen for patients with suspected or severe OSA have not been established (Fassbender, Burgener, Haddad, Silvanus, & Peters, 2018).

Emergence from anesthesia can be one of the most daunting aspects for patients with OSA (Klowden, Nimmagadda, & Salter, 2009). Unless otherwise contraindicated, patients at risk for OSA should be extubated fully awake, in the lateral, semi-upright, or other non-supine positions (ASA, 2014). In a study of postoperative positioning in patients with supine-related OSA, patients placed in a semi-upright position had a significantly lower AHI when compared to patients in a supine position (Singh et al., 2015). Emergence can be further complicated when muscle relaxants have been utilized for surgery. Guidelines strongly suggest extubation only occurring after a full reversal of any muscle relaxant is verified by a train of four (TOF) nerve stimulation (ASA, 2014).

TOF nerve stimulation is an intraoperative tool used to assess the degree of paralysis by neuromuscular blocking agents (NMBAs) (Donati, 2013). Assessment of the ulnar nerve via the adductor pollicis is best suited for the measurement of recovery from paralyzing muscle relaxants (Donati, 2013). A twitch response of 0-1 out of 4 indicates 90-100% nerve blockade and is an indicator of adequate surgical paralysis (Donati, 2013). In contrast, 4 out of 4 twitches via nerve stimulation indicates a 70% blockade or less and should be the goal prior to the removal of an endotracheal tube (Donati, 2013).

*Postoperative.* The postoperative care for the OSA patient should be considered throughout the perioperative process. A detailed preoperative assessment and meticulous intraoperative care can assist in negating any potential negative postoperative outcomes in patients at increased risk related to OSA. To combat postoperative pain, guidelines encourage the use of regional anesthesia techniques, thus reducing the need for intravenous (IV) opioid administration (ASA, 2014). Continuous background infusions should be avoided if patient-controlled IV opioid administration is used for pain management. The use of caution is recommended when administering opioid analgesics simultaneously with other sedatives (e.g., benzodiazepines), as the risk for respiratory depression and airway obstruction is significantly increased (ASA, 2014). Supplemental oxygen and the use of CPAP in the postoperative setting could be beneficial for those patients who use these modalities on a regular basis.

If not otherwise contraindicated from the surgical procedure, patients should be placed in a non-supine position while in the postoperative setting (ASA, 2014). A non-supine position will help prevent airway obstruction and subsequent oxygen desaturation in these OSA patients. Upon discharge from the post-anesthesia care unit, continuous

monitoring to include pulse oximetry should be used to help detect hypoxic events in those patients admitted to the hospital (ASA, 2014).

To ensure the highest quality care of the patient at increased perioperative risk for OSA complications, the anesthesia provider should be involved with the multidisciplinary approach to developing and implementing an individualized and comprehensive care plan (ASA, 2014). Consensus for these updated ASA guidelines were obtained from multiple sources, including updated surveys sent to consultants, testimony from attendees of two national ASA public open forums and ASA task force opinion and interpretation (ASA, 2014). A search for studies that have implemented all these best practice guidelines to determine their effectiveness revealed no results. Table 1 is an abbreviated list of the best practice guidelines for the anesthesia management of OSA patients as determined by the ASA.

Table 1

*Best Practices Guidelines for Anesthesia Management of OSA Patients*

<i>Preoperative Preparation</i>	<i>Intraoperative Management</i>	<i>Postoperative Management</i>
<ul style="list-style-type: none"> <li>Preoperative treatment/optimization for obstructive sleep apnea (e.g., continuous positive airway pressure [CPAP], noninvasive positive pressure ventilation, mandibular appliances, and medical treatment)</li> </ul>	<p>Anesthesia technique</p> <ul style="list-style-type: none"> <li>Local or regional anesthesia versus general anesthesia</li> <li>Combined regional and general anesthesia versus general anesthesia</li> <li>Sedation versus general anesthesia</li> </ul>	<p>Analgesic use</p> <ul style="list-style-type: none"> <li>Regional analgesic technique without neuraxial opioids versus systemic opioids</li> <li>Neuraxial opioids versus systemic opioids</li> </ul>

Table Continued

<i>Preoperative Preparation</i>	<i>Intraoperative Management</i>	<i>Postoperative Management</i>
<ul style="list-style-type: none"> <li>Limit procedures to facilities with full hospital services</li> </ul>	<p>Monitoring</p> <ul style="list-style-type: none"> <li>Continuously monitor the respiratory depressant effects of sedatives and/or opioids (e.g., level of consciousness, pulmonary ventilation, oxygenation, and automated apnea monitoring)</li> <li>Special intraoperative monitoring techniques (arterial line, pulmonary artery catheter)</li> </ul> <p>Extubation</p> <ul style="list-style-type: none"> <li>Verify full reversal of neuromuscular block before extubation</li> <li>Extubate patients after they are fully awake (vs. asleep or partially awake)</li> <li>Extubate patients in the semi-upright, lateral, or prone positions (vs. supine)</li> </ul>	<ul style="list-style-type: none"> <li>Oral analgesics versus parenteral opioids</li> <li>Patient-controlled analgesia without a background infusion versus patient-controlled analgesia with a background infusion</li> <li>Titration or lower dosage levels of systemic opioids</li> </ul> <p>Oxygenation</p> <ul style="list-style-type: none"> <li>Supplemental oxygen versus no supplemental oxygen</li> <li>CPAP versus no CPAP (oxygen or room air)</li> <li>CPAP for patients who had previously been on CPAP versus CPAP for patients not previously on CPAP</li> <li>Noninvasive positive pressure ventilation versus no noninvasive positive pressure ventilation (CPAP, oxygen, or room air)</li> </ul> <p>Patient positioning</p> <ul style="list-style-type: none"> <li>Lateral, prone, or tonsil positions versus the supine position</li> </ul> <p>Monitoring</p> <ul style="list-style-type: none"> <li>Telemetry monitoring systems versus no telemetry monitoring systems</li> <li>Monitored setting versus routine hospital wards</li> </ul>



### *Pulmonary and Cardiovascular Complications*

A systematic review conducted by Opperer et al. (2016) found that OSA is linked to abnormal airway anatomy predisposing patients to difficult airway management and intubation. Patients at moderate to severe risk for OSA have a five times greater increase in intubation and mechanical ventilation after orthopedic surgery and the risk doubles after general surgery (Opperer et al., 2016). Opperer et al. (2016) also found an increased incidence of respiratory failure, desaturation episodes (oxygen saturation < 85%), lengthened hospital stay, and emergent intubation and mechanical ventilation within the first 24 hours postoperatively. Wolfe et al. (2016) found that OSA is associated with perioperative respiratory complications such as pneumonia, pulmonary embolism, reintubation, and pulmonary hypertension which can lead to an increase in admission to the intensive care unit and length of hospital stay. These respiratory complications can easily manifest into cardiovascular events in the OSA patient, arrhythmias, and damaging alterations in the patient's blood pressure leading to potential ICU admission.

### Rationale

Healthcare organizations are elaborate adaptive systems where change is a complex process, yet they must respond to an ever-changing environment to maintain patient safety. Anesthesia practice management requires the implementation of methods that promote high-quality care based on consensus standards, guidelines, and performance metrics (Sutton, 2015). The purpose of developed practice guidelines related to OSA is to improve anesthetic care during surgery and to minimize risks of adverse outcomes in those patients who have, or who are suspected to have, OSA (ASA,

2014). Patients receiving anesthetic care include those who receive sedation, anesthesia, or analgesia for diagnostic or therapeutic procedures while in the care of an anesthesia provider.

To guide the development and implementation of this project, the logic model was used. The model consists of four basic components that include inputs, activities, outputs, and outcomes (CDC, 2018a). What goes into making the quality improvement project work is having anesthesia providers and/or student registered nurse anesthetists (SRNAs) educated and available to implement. The resources/inputs included organization “buy-in” (letter of support from clinical information systems director) and anesthesia providers implementing STOP-BANG questionnaire. The activities were: (1) preoperative implementation of STOP-BANG for adult patients having elective surgery and (2) retrospective chart reviews one month prior to STOP-BANG implementation, the month of implementation, as well as the month after. The outputs were an increase in the implementation of an OSA prescreening tool, evaluation of anesthesia management on adult patients at risk for OSA having elective surgery, and perioperative respiratory and cardiac complications before, during, and after the implementation of the STOP-BANG questionnaire. The expected outcomes included identification of potential quality improvement of OSA anesthesia management, according to best practice guidelines, and to improve perioperative respiratory and cardiac complications associated with patients at moderate to severe risk for OSA.

#### Specific Aims

The overall project consisted of five distinct specific aims. These specific aims set out to determine the incidence and prevalence of OSA risk at a facility in Southern

Mississippi, implementation of the STOP-BANG tool, and compare best-practice guidelines. Following implementation, two more specific aims were to determine perioperative pulmonary and cardiac complications.

#### *Determining Incidence and Prevalence*

The prevalence of patients who had been identified as having moderate or high-risk OSA over a 30-day period was further classified according to age, gender, BMI, type/length of surgery, and the ASA physical status. The purpose of further classifying patient demographics and characteristics was to identify trends or patterns so anesthesia providers would be more aware of which patients were at increased risk of having OSA. By identifying the number of patients that presented to this facility in Southern Mississippi over a 30-day period, providers could see how important it was to utilize this screening tool. This project was part of a larger QI project, and it may lead to an improvement in the quality of care. Best practice recommendations were made based upon the results and were intended to lead to decreased post-operative OSA complications and costs.

#### *Implementation of the STOP-BANG Tool*

Another purpose of this project was to implement an effective, evidence-based OSA screening tool preoperatively to identify patients at risk for OSA and ultimately aid the anesthesia provider in developing an anesthetic plan of care for each patient. The implementation of the STOP-BANG questionnaire was then used as a part of the larger OSA quality improvement project. The STOP-BANG questionnaire was periodically used in the facility in which implementation took place; however, it was not consistently used during the pre-anesthetic evaluation.

### *Comparing Best-Practice Guidelines*

The third purpose of this project was to review anesthetic management of patients at risk for OSA at a Southern Mississippi hospital and compare it to best practice guidelines. The previous management was compared to current best practice guidelines. Practice guidelines assist to improve anesthetic management and decrease the risks of adverse outcomes.

### *Postoperative Respiratory and Cardiac Complications*

The final two aims of this project were to determine if perioperative respiratory and cardiac complications decreased. The questionnaire was implemented during the preoperative screening process via anesthesia providers and/or SRNAs. Postoperative respiratory complications were defined as hypoxemic events (oxygen saturation <85%), reintubations in PACU, and admission to the ICU. Postoperative cardiovascular complications were defined as any arrhythmia (ECG rhythms other than NSR or paced rhythm), hypotension (SBP < 90 mmHg), and admission to the ICU.

### Summary

Symptoms of OSA usually tend to occur at night, leaving the disorder highly unrecognized. The gold standard for diagnosing OSA is PSG, which is expensive and inconvenient. Morbidity and mortality are increased with patients having undiagnosed OSA. Obesity is the most important key factor associated with OSA leaving Mississippians at high risk due to it being ranked second in the nation for obesity. The STOP-BANG questionnaire was developed to be a reliable and concise tool to identify surgical patients at risk for OSA. Numerous studies have revealed that adverse outcomes are decreased when the STOP-BANG questionnaire is utilized prior to surgery.

Identification of patients at risk for OSA affords the anesthesia provider a chance to direct their care accordingly. Practice guidelines serve to improve anesthetic care during surgery and minimize the risks of adverse outcomes in OSA patients.

## CHAPTER II – METHODS

### Context

This quality improvement doctoral project was implemented at a hospital in Southern Mississippi after approval from The University of Southern Mississippi Institutional Review Board (IRB). During the time of this project, the facility serviced 19 counties including many southern rural areas often characterized as being older, less educated, having increased poverty rates, chronic disease, and less economic diversity. The facility contained 23 operating rooms and conducted approximately 1,140 surgeries each month.

The demographics of the local county during implementation were 57.2% Caucasian, 37.3% African American, 0.4% Native American, 1.1% Asian, 0.1% Pacific Islander, 3.2% Hispanic or Latino, and 1.8% from other races. Roughly 70% of these patients came from an urban community and the remaining 30% from southern rural communities (Community Facts, United States Population, 2010). The patients from the rural community were more likely to develop chronic diseases and be uneducated people living in poverty. With the lack of education and low income, patients were more likely to choose unhealthy food options which only further contribute to the obesity epidemic.

### Interventions

Education and training for the proper administration of the STOP-BANG questionnaire were provided to all users (anesthesia providers and/or SRNAs) prior to administration. Education consisted of a digital slide (PowerPoint, Microsoft) presentation on the identification of STOP-BANG components and implementers were trained on how to complete and score the STOP-BANG questionnaire. If any users

wanted more information about STOP-BANG, its official website, [www.stopbang.ca/osa/screening.php](http://www.stopbang.ca/osa/screening.php), was provided. Thereafter, the STOP-BANG questionnaire was provided as a paper copy and incorporated into the preoperative screening process for all adult elective surgeries over a one-month period. The patients' medical record numbers were placed on every STOP-BANG questionnaire. The questionnaire was placed in a locked box in the preoperative area. The clinical information specialist was the only person with a key to the box. The patients' medical record numbers were only used for data collection related to a retrospective chart review. Demographic data was collected and reported in aggregation. No personal identifying information was collected and/or reported. The STOP-BANG score and risk category were written on a brightly colored sticky note and attached to the anesthesia consent form. Exclusion criteria consisted of obstetric and emergency surgeries and patients under 18 years of age. Also excluded were patients admitted to the ICU needing prolonged ventilator management due to these patients not being extubated during the perioperative setting, per facility protocol. All data was destroyed after project acceptance and finalization.

### Study of the Intervention

#### *Determining Incidence and Prevalence*

A retrospective chart review, looking for trends among patients presenting for surgery that correlated with having a moderate to high-risk score on the STOP-BANG questionnaires, was conducted to synthesize data obtained over a 30-day period. The percentage of patients identified as having a moderate to high-risk score on the STOP-BANG questionnaires was then compared to the number of patients who presented for

surgery during the month of October. The calculated prevalence was then compared to the prevalence of obesity across Mississippi

#### *Implementation of the STOP-BANG Tool*

A historical cohort study was used to determine the number of completed STOP-BANG questionnaires utilized on patients for the month of implementation and compared them to the number of surgical patients who met inclusion criteria during the same month. The percentage of surgeries that meet inclusion criteria which utilized the STOP-BANG questionnaire was then reported. Inclusion criteria consisted of elective surgeries on adult patients excluding emergency, obstetric, and patients under the age of 18.

#### *Comparing Best-Practice Guidelines*

The first retrospective chart review took place one month prior to the implementation of the STOP-BANG questionnaire and included all adult elective surgical patients that had a BMI of at least 30. The second retrospective chart review took place the month of implementation of the STOP-BANG questionnaire and included all adult patients having elective surgery who were identified as having moderate to high risk for OSA. The third chart review was completed the month following the implementation and included all adult elective surgical patients who had a BMI of at least 30. By comparing a BMI greater than or equal to 30, a positive correlation was made to STOP-BANG scores greater than 3, indicating moderate to severe risk.

#### *Postoperative Respiratory and Cardiac Complications*

A one-month historical cohort study was conducted to assess the number and type of postoperative respiratory and cardiovascular complications prior to the implementation of the STOP-BANG questionnaire. Postoperative respiratory complications were defined



as hypoxemic events (oxygen saturation < 85%), reintubations in PACU, and admission to the ICU. Postoperative cardiovascular complications were defined as any arrhythmia (ECG rhythms other than NSR or paced rhythm), hypotension (SBP < 90 mmHg), and admission to the ICU. During and after the one-month implementation of the STOP-BANG questionnaire on adult surgical patients who met inclusion criteria, de-identified requested data was reviewed and compared based on respiratory and cardiovascular complications.

## Measures

### *Determining Incidence and Prevalence*

The de-identified data included patients age, gender, BMI, ASA physical status, and type/length of surgery. The STOP-BANG score was obtained from the de-identified STOP-BANG questionnaires. The number of patients identified as at risk for OSA over a one-month period was noted. The data on these patients were further stratified into low, moderate, and high risk. The inclusion criteria for the data provided included: cases performed in the main operating room (OR) and in the GYN OR's, patient age >50, and elective procedures.

### *Implementation of the STOP-BANG Tool*

The total number of STOP-BANG questionnaires completed was measured during the 30-day implementation period. Elective surgeries for patients 18 years or older who met inclusion criteria were also measured. Thereafter, the analysis was made based on these measurements from the implementation phase of the STOP-BANG questionnaire.

### *Comparing Best Practice Guidelines*

Data for this project included the type of anesthesia provided (general, general endotracheal anesthesia (GETA), IV sedation, or regional), amount of fentanyl (in micrograms) used, and the amount of rocuronium used (in milligrams). Data also included if the paralytic reversal agent Sugammadex was administered and if paralytic reversal was confirmed by TOF nerve stimulation at the conclusion of the surgical case. This data was compared between the three retrospective chart reviews and with best practice guidelines.

### *Postoperative Respiratory and Cardiac Complications*

By comparing a key preoperative variable for OSA (BMI greater than or equal to 30) to STOP-BANG scores greater than 3 (indicates moderate to severe risk), an assessment was made to see if patients at moderate to severe risk for OSA were at an increased risk for perioperative respiratory and cardiovascular complications. Perioperative respiratory complications were listed as hypoxemic events ( $\text{SaO}_2 < 85\%$ ), reintubations in PACU, and ICU admission; whereas, cardiac complications were listed as dysrhythmias, hypotension ( $\text{SBP} < 90$ ), and ICU admission. Demographic data and patients' health status (age, ASA score, BMI, gender, type of surgery, etc.) were compared pre-implementation, during, and post-implementation of the STOP-BANG questionnaire to eliminate exclusion criteria and gather necessary information related to perioperative respiratory and cardiovascular events.

## Analysis

### *Determining Incidence and Prevalence*

The data gathered over the 30-day period was analyzed and separated on a Microsoft Excel® spreadsheet. Descriptive statistics were used to describe the population. Frequencies were used to determine the prevalence of patients with OSA over a one-month period. The proportion of patients who were identified as at risk for OSA were determined by computing the number of patients that presented for surgery over a month and compared to the number of those identified as moderate or high risk on the STOP-BANG questionnaires. The data were further stratified into low-risk, moderate-risk, and high risk. The national demographics and OSA statistics were compared to the demographics and statistics at the facility in Southern Mississippi.

### *Implementation of the STOP-BANG Tool*

Data was recorded utilizing Microsoft Excel®. A comparison was made based on the STOP-BANG questionnaire frequency in relation to the total number of elective surgeries. Once data was analyzed to ensure inclusion and exclusion criteria were met, the frequency of completed STOP-BANG questionnaires was calculated as a percentage.

### *Comparing Best Practice Guidelines*

Descriptive statistics and frequencies were used to analyze the data from all three retrospective chart reviews. Each analysis was reviewed and compared to best practice guidelines. Data are presented as means and percentages for categorical variables. An executive summary was created from this data to provide feedback for potential practice changes, if necessary, according to best practice guidelines for OSA surgical patients.

### *Postoperative Respiratory and Cardiac Complications*

Data were analyzed utilizing Microsoft Excel<sup>®</sup> and presented as means with standard deviation for continuous variables. Categorical variables were reported as percentages. Continuous and categorical variables were listed and compared to note if there were any changes in perioperative respiratory and cardiovascular complications after the implementation of STOP-BANG.

### Ethical Considerations

The University of Southern Mississippi IRB approval (18091109) was obtained prior to initiating the quality improvement project. All patient health information was protected by the Health Insurance Portability and Accountability Act of 1996. The list of medical record numbers was kept in locked storage only accessible to the clinical information specialist. All electronic files containing identifiable information were password protected to prevent access by unauthorized users. The password was known to the authors only. All information was properly disposed of after project completion according to university policy.

### DNP Essentials

The Doctor of Nursing Practice (DNP) Essentials outline the central competencies for all advanced nursing practice roles. The DNP graduate is expected to demonstrate scholarly activity through a theory-driven research project. The essentials and how they were met by this doctoral project are listed in Appendix B.

### Summary

A local facility in Southern Mississippi did not utilize a prescreening tool for determining OSA risk factors during the implementation of this quality improvement

project. The STOP-BANG questionnaire was provided as a paper copy in the preoperative setting and completed by SRNAs and/or anesthesia staff during the preoperative assessment on all patients that met inclusion criteria. The scores were placed on a brightly colored sticky note and placed on the patient's chart for visualization by the anesthesia staff. A one-month retrospective chart review was completed prior to, during, and after the implementation of the STOP-BANG questionnaire for analysis of anesthesia management in comparison with best-practice guidelines as well as perioperative respiratory and cardiovascular complications. The de-identified data was provided by a facility employee via a password-protected electronic file. This file was destroyed upon completion of graduation requirements.

## CHAPTER III – RESULTS

### Results

#### *Determining Incidence and Prevalence*

In October, there were 348 surgical procedures that met the inclusion criteria. De-identified data was provided by the Director of Clinical Informatics for the month of October. Seventeen STOP-BANG questionnaires were filled out during October. Of those 17, only 3 were filled out properly with identifiers to match their STOP-BANG scores to their ASA physical status and type/length of surgery. From the three surveys, two were male patients who were identified as being low risk and one was identified as being a high risk of having sleep apnea. The patient with the high-risk score was in a laparoscopic umbilical hernia repair that lasted four hours; he was an ASA 2 and had a BMI of 32.8. One of the patients with a low-risk score was in an insertion of a ventriculoperitoneal shunt that lasted two hours; he was an ASA 3 and had a BMI of 20.1. The other patient with a low-risk score was in an endoscopic retrograde cholangiopancreatography laparoscopic cholecystectomy that lasted three hours; he was an ASA 2 and had a BMI of 32.3. Of the 17 questionnaires, 10 were identified as having a moderate or high-risk score, 8 were male, and 2 were female.

#### *Implementation of the STOP-BANG Tool*

During the month of STOP-BANG implementation, 348 elective surgeries met inclusion criteria. Seven adult elective surgery patients who met inclusion criteria had completed STOP-BANG questionnaires. For the purpose of this study, the results of the frequency of use (implementation) of the STOP-BANG equaled 2%. Of those seven, only three of the questionnaires could be disseminated for further data due to lack of

patient identifiers. The ability to adequately assess the ages of patients for which those questionnaires belonged to, was established by handwritten notation of patient ages on the STOP-BANG questionnaire by the anesthesia provider at the time of assessment. In turn, 4 of the questionnaires were deemed to be reliable and fell within the inclusion criteria. As a result, there was a 2% frequency of use of the STOP-BANG questionnaire during the preoperative evaluation for the month of implementation.

#### *Comparing Best-Practice Guidelines*

De-identified data for the month prior to STOP-BANG implementation, and the month following was provided by the director of clinical information in a timely manner as planned. The actual implementation of the questionnaire in the preoperative setting began and finished per the specified time frame planned, and de-identified data was subsequently provided as previously described. Due to decreased numbers of completed STOP-BANG questionnaires for the implementation month, a comparison of anesthesia care for all adult elective surgeries meeting inclusion criteria was completed for the month of implementation in addition to those identified as at moderate to severe risk for OSA, as originally planned.

There were 319 patients having elective surgeries during the month prior to the STOP-BANG implementation. Of these surgical patients, 38.6% (n=123) were deemed to have at least a moderate risk for OSA due to a BMI greater than 30. Of this group (n=123) there were 86 GETA cases, 25 general cases, 8 regional cases, and 4 IV sedation cases. The average dose of fentanyl, rocuronium, and sugammadex was 145.9 mcg, 37 mg, and 117.6 mg respectively. No surgical case involving administration of the paralytic, rocuronium, or the paralytic reversal agent, sugammadex, was confirmed to be

reversed via TOF nerve stimulation. A total of 14 (11.3%) fentanyl free, 8 (6.5%) regional, and 4 (3.2%) IV sedation surgical cases occurred during this period

During the month of STOP-BANG implementation, 348 patients having elective surgeries met inclusion criteria. Of these surgical patients, 42.5% (n=148), were deemed to have at least a moderate risk for OSA due to a BMI greater than 30. Of this group (n=148), there were 103 GETA cases, 26 general cases, 8 regional cases, and 11 IV sedation cases. The average dose of fentanyl, rocuronium, and sugammadex was 139.5 mcg, 38 mg, and 124.4 mg respectively. No surgical case involving administration of the paralytic, rocuronium, or the paralytic reversal agent, sugammadex, was confirmed to be reversed via TOF nerve stimulation. A total of 20 (13.5%) fentanyl free, 8 (5.4%) regional, and 11 (7.4%) IV sedation surgical cases occurred during this period.

During the month of STOP-BANG implementation, 2% (n=7) of the adult elective surgery patients who met inclusion criteria had completed questionnaires. Of those, less than 1% (n=3) could be used for data results due to missing patient identifiers. Of this population (n=3) only 1 patient was identified as a moderate or severe risk for OSA, with a score of 7. This patient received 250 mcg of fentanyl, 50 mg of rocuronium, and 200 mg of sugammadex as a paralytic reversal. No TOF nerve stimulation was performed to confirm the reversal of paralysis.

There were 300 patients having elective surgeries meeting inclusion criteria the month following STOP-BANG implementation. Of these surgical patients, 34.3% (n=103) were deemed to have at least a moderate risk for OSA due to a BMI greater than 30. Of this group (n=103), there were 66 GETA cases, 20 general cases, 10 regional cases, and 7 IV sedation cases. The average dose of fentanyl, rocuronium, and



sugammadex for this month was 134.2 mcg, 44 mg, and 163.5 mg respectively. No surgical case involving administration of the paralytic, rocuronium, or the paralytic reversal agent, sugammadex, was confirmed to be reversed via TOF nerve stimulation. A total of 16 (15.5%) fentanyl free, 10 (9.7%) regional, and 7 (6.8%) IV sedation surgical cases occurred during this third month.

#### *Postoperative Respiratory and Cardiac Complications*

During the first month of the retrospective chart review, 45.8% out of 319 (n = 146) surgical patients, at a hospital in Southern Mississippi, met the inclusion criteria (i.e., elective surgical procedure, age greater than 18, and BMI greater than 30). Of these patients with moderate risk for OSA, there were no reintubations in PACU, 17.8% (n = 26) had a hypoxemic event, 15.1% (n = 22) had an arrhythmia, 17.1% (n = 25) experienced hypotension, and 11.2% (n = 13) were transferred to the ICU. Cardiothoracic surgeries and craniotomies were excluded from the ICU transfers due to these surgeries being transferred there per facility protocol. Detailed demographic and clinical characteristics prior to the month of STOP-BANG implementation are listed in Table 2 (respiratory) and Table 3 (cardiac).

Table 2

*Demographics and clinical characteristics prior to implementation of STOP-BANG**(respiratory)*

	Hypoxemic Event	Reintubation	ICU Transfer
	Sao2 < 85%	In PACU	Excluding cardiothoracic surgeries & craniotomies
Age, Y, mean (SD)	68 (1.09)	0	68.9 (1.63)
ASA class, mean (SD)	3.6 (0.63)	0	3.5 (0.5)
BMI, mean (SD)	37.39 (9.08)	0	38.8 (2.15)
Gender, male, No. (%)	19 (73%)	0	9 (69%)
Event total, No. (%)	26 (17.8%)	0 (0%)	13 (11.2%)

Patients with at least a moderate risk for OSA: Abbreviations: ASA, American Society of Anesthesiologist; Y, Years; BMI, Body

Mass Index; No, Number; SD, Standard Deviation; PACU, Post Anesthesia Care Unit;

Table 3

*Demographics and clinical characteristics prior to implementation of STOP-BANG**(cardiac)*

	Arrhythmias (Any rhythm other than NSR or paced)	Hypotension (SBP < 90 mmHg)	ICU Transfer (Excluding cardiothoracic surgeries & craniotomies)
Age, Y, mean (SD)	65.3 (9.64)	63.6 (6.90)	68.9 (1.63)
ASA class, mean (SD)	3.5 (0.58)	3.6 (0.69)	3.5 (0.5)
BMI, mean (SD)	36.1 (3.98)	41.3 (10.27)	38.8 (2.15)
Gender, male, No. (%)	15 (68.2%)	15 (60.0%)	9 (69%)
Event total, No. (%)	22 (15.1%)	25 (17.1%)	13 (11.2%)

Patients with at least a moderate risk for OSA:

Abbreviations: ASA, American Society of Anesthesiologist; Y, Years; BMI, Body Mass Index; No, Number; SD, Standard Deviation;

PACU, Post Anesthesia Care Unit;

The month of STOP-BANG implementation yielded 48.6% out of 348 (n = 169) surgical patients that met inclusion criteria. The patients with a moderate risk for OSA

had no reintubations in PACU, 20% (n = 34) developed a hypoxemic event, 11.2% (n = 19) had an arrhythmia, 16.6% (n = 28) experienced hypotension, and 15.9% (n = 27) were transferred to the ICU. Cardiothoracic surgeries and craniotomies were excluded from the ICU transfers due to these surgeries being transferred there per facility protocol. Detailed demographic and clinical characteristics for the month of STOP-BANG implementation are listed in Table 4 (respiratory) and Table 5 (cardiac).

Table 4

*Demographics and clinical characteristics during the implementation of STOP-BANG (respiratory)*

	Hypoxemic Event Sao2 < 85%	Reintubation In PACU	ICU Transfer Excluding cardiothoracic surgeries & craniotomies
Age, Y, mean (SD)	70 (11.27)	0	68.15 (10.47)
ASA class, mean (SD)	3.5 (0.6)	0	3.44 (0.5)
BMI, mean (SD)	36.87 (5.87)	0	35.24 (3.87)
Gender, male, No. (%)	18 (53%)	0	11 (41%)
Event total, No. (%)	34 (24%)	0 (0%)	27 (15.9%)

Patients with at least a moderate risk for OSA:

Abbreviations: ASA, American Society of Anesthesiologist; Y, Years; BMI, Body Mass Index; No, Number; SD, Standard Deviation; PACU, Post Anesthesia Care Unit;

Table 5

*Demographics and clinical characteristics during the implementation of STOP-BANG (cardiac)*

	Arrhythmias (Any rhythm other than NSR or paced)	Hypotension (SBP < 90 mmHg)	ICU Transfer (Excluding cardiothoracic surgeries & craniotomies)
Age, Y, mean (SD)	65.1 (9.02)	65.4 (11.34)	68.2 (10.47)
ASA class, mean (SD)	2.9 (0.69)	3.6 (0.49)	3.44 (0.50)

*Table Continued*

BMI, mean (SD)	Arrhythmias (Any rhythm other than NSR or paced)	Hypotension (SBP < 90 mmHg)	ICU Transfer (Excluding cardiothoracic surgeries & craniotomies)
BMI, mean (SD)	35.8 (5.74)	36.9 (3.68)	35.2 (3.87)
Gender, male, No. (%)	6 (31.6%)	13(46.4%)	11 (41%)
Event total, No. (%)	19 (11.2%)	28 (16.6%)	27 (15.9%)

Patients with at least a moderate risk for OSA: Abbreviations: ASA, American Society of Anesthesiologist; Y, Years; BMI, Body

Mass Index; No, Number; SD, Standard Deviation; PACU, Post Anesthesia Care Unit;

During the month of STOP-BANG implementation, 2% (n = 7) of the adult elective surgery patients that met inclusion criteria had completed questionnaires. Of those, only three could be used for data results due to incomplete data. Thus, just under 1% (n = 3) of questionnaires were available for data collection. One of the three completed STOP-BANG scores was greater than three (moderate risk for OSA) and none of these patients had any respiratory complications. One patient did report a history of HTN but did not experience any perioperative cardiovascular complications including arrhythmias or hypotension. Demographic and clinical characteristics of patients with completed STOP-BANG questionnaires are listed in Table 6.

Table 6

*Demographics and clinical characteristics of STOP-BANG scores*

	STOP-BANG < 3 (N= 2)	STOP-BANG > 3 (N= 1)
Age, Y, Mean (SD)	61.5 (6.36)	56 (0)
Neck > 16 in for Female, No. (%)	0 (100%)	1 (100%)
Neck > 17 in for Male, No. (%)	0 (100%)	0 (100%)
BMI > 30, No. (%)	0 (100%)	1 (100%)
Gender, male, No. (%)	2 (100%)	1 (100%)
Snoring, No. (%)	0 (100%)	1 (100%)

Table Continued

	STOP-BANG < 3 (N= 2)	STOP-BANG > 3 (N= 1)
Tiredness, No. (%)	0 (100%)	1 (100%)
Observed Apnea, No. (%)	0 (100%)	0 (100%)
HTN, No. (%)	0 (100%)	1 (100%)
ASA class, mean (SD)	2.5 (0.7)	2 (0)
Sao2 < 85%, No. (%)	0 (100%)	0 (100%)
PACU Intubation, No. (%)	0 (100%)	0 (100%)
Arrhythmias, No. (%)	1 (50%)	0 (100%)
Hypotension, No. (%)	0 (100%)	0 (100%)
ICU Transfer, No. (%)	0 (100%)	0 (100%)
STOP-BANG score, No. (%)	2 (100%)	7 (100%)

Patients with completed STOP-BANG scores: Abbreviations: ASA, American Society of Anesthesiologist; Y, Years; BMI, Body

Mass Index; No, Number; SD, Standard Deviation; PACU, Post Anesthesia Care Unit; SB, STOP-BANG score; HTN, hypertension; SB, STOP-BANG;

During the final month of the retrospective chart review—the month after STOP-BANG implementation—38.8% out of 299 (n = 116) surgical patients met inclusion criteria. The patients with a moderate risk for OSA had no reintubations in PACU, 22% (n = 21) developed a hypoxemic event, 6.9% (n = 8) had an arrhythmia, 21.6% (n = 25) experienced hypotension, and 12.4% (n = 12) were transferred to the ICU. Cardiothoracic surgeries and craniotomies were excluded from the ICU transfers due to these surgeries being transferred there per facility protocol. Detailed demographic and clinical characteristics prior to the month of STOP-BANG implementation are listed in Table 7 (respiratory) and Table 8 (cardiac).

Table 7

*Demographics and clinical characteristics after the implementation of STOP-BANG**(respiratory)*

	Hypoxemic Event	Reintubation	ICU Transfer
	Sao2 < 85%	In PACU	Excluding cardiothoracic surgeries & craniotomies
Age, Y, mean (SD)	67.2(9.32)	0	70.3 (6.83)
ASA class, mean (SD)	3.42 (0.59)	0	3.50 (0.5)
BMI, mean (SD)	38.42 (8.91)	0	37.2 (9.52)
Gender, male, No. (%)	10 (47%)	0	8 (66.7%)
Event total, No. (%)	21 (22%)	0 (0%)	12 (12.4%)

Patients with at least a moderate risk for OSA:

Abbreviations: ASA, American Society of Anesthesiologist; Y, Years; BMI, Body Mass Index; No, Number; SD, Standard Deviation;

PACU, Post Anesthesia Care Unit

Table 8

*Demographics and clinical characteristics after the implementation of STOP-BANG**(cardiac)*

	Arrhythmias (Any rhythm other than NSR or paced)	Hypotension (SBP < 90 mmHg)	ICU Transfer (Excluding cardiothoracic surgeries & craniotomies)
Age, Y, mean (SD)	67.4 (9.59)	67.1 (7.54)	70.3 (6.83)
ASA class, mean (SD)	3.1 (0.60)	3.4 (0.57)	3.50 (0.5)
BMI, mean (SD)	41.3 (7.29)	38.0 (8.32)	37.2 (9.52)
Gender, male, No. (%)	1 (12.5%)	13 (52.0%)	8 (66.7%)
Event total, No. (%)	8 (6.9%)	25 (21.6%)	12 (12.4%)

Patients with at least a moderate risk for OSA:

Abbreviations: ASA, American Society of Anesthesiologist; Y, Years; BMI, Body Mass Index; No, Number; SD, Standard Deviation;

PACU, Post Anesthesia Care Unit;

## Summary

Two percent of surgeries that met inclusion criteria during the month of implementation had a completed and usable STOP-BANG questionnaire. Therefore, an

increase in the frequency of use of an OSA prescreening tool (STOP-BANG) was noted since there was no evidence of a prescreening tool being utilized at this facility prior to implementation. The results of comparing anesthesia management indicated an overall decrease in the amount of fentanyl utilized during the month of implementation as well as the month following. A greater percentage of fentanyl free and IV sedation anesthesia techniques were utilized during the month of implementation as well as the following month. The percentage of surgical cases using regional anesthesia increased during the month after implementation. The amount of rocuronium given for GETA surgical cases did not drastically change from any month. However, the amount of sugammadex given per GETA case that received rocuronium paralysis did increase both the month of STOP-BANG implementation and the month following. No anesthesia cases utilized rocuronium for paralysis followed by confirmation of reversal via TOF nerve stimulation for any of the three months.

De-identified data were compared for the month prior to, during, and after the implementation of the STOP-BANG questionnaire for respiratory and cardiac complications. Seven different tables list patient demographics and/or perioperative respiratory and cardiovascular complications. Data was represented in the tables above using percentages and means with standard deviation.

## CHAPTER IV DISCUSSION

### Summary

#### *Determining Incidence and Prevalence*

The prevalence of obesity among adults in Southern Mississippi is greater than 35%. Obesity is a major predictor of patients who are at an increased risk of developing or already having OSA. Therefore, it can be inferred that a large percentage of patients presenting for surgery will have OSA. OSA is associated with numerous anesthetic complications including difficult intubations, difficult mask ventilation, CO<sub>2</sub> narcosis, and rapid desaturation.

Due to the lack of anesthesia provider participation in gathering data, an accurate prevalence rate cannot be calculated. Using the 17 filled out questionnaires, the prevalence was calculated as 2.8% because only 10 of those surveys had a moderate or high-risk STOP-BANG score. The calculated prevalence of moderate to high-risk OSA patients is inaccurate and does not correlate with the prevalence of obesity in Southern Mississippi. With Mississippi having the second highest rate of obesity, the STOP-BANG questionnaire is an invaluable resource for pre-operative assessments to help reduce post-operative anesthetic complications.

#### *Implementation of the STOP-BANG Tool*

All anesthesia providers (i.e., anesthesiologists, certified registered nurse anesthetists, and SRNAs) were properly educated the month prior to STOP-BANG implementation on how to accurately utilize the STOP-BANG questionnaire preoperatively. Brightly colored pamphlets and postings were made visible throughout the anesthesia lounge and the same-day surgery unit beginning the month prior to



implementation through the month of implementation. However, 2% of questionnaires completed fell within qualifying criteria and less than 1% (n = 3) of the surgeries that met inclusion criteria had completed questionnaires with useful information for data collection. Alternatively, the use of preoperative STOP-BANG assessments increased during the month of implementation and positively correlated with provider education regarding this topic.

#### *Comparing Best Practice Guidelines*

While the originally planned data was not made available through the process of STOP-BANG implementation, some important nuances of patient anesthetic care were able to be made and compared month to month. An inference was drawn that the knowledge of the ongoing project and education may have influenced patient care during and after the month of implementation. During the month prior to STOP-BANG implementation, the average dose of fentanyl per surgical case was 145.9 mcg. This decreased during the implementation month to an average of 139.5 mcg per surgical case, a 6.4 mcg per case decrease. The month following STOP-BANG implementation had an average of 134.2 mcg of fentanyl per surgical case. Thus, the average fentanyl dose decreased by 5.3 mcg from the month of implementation and an 11.7 mcg per surgical case decrease from the month prior to implementation. The average dose of rocuronium for GETA cases did not change drastically during the first two months. The average dose of rocuronium for these cases was 37 mg during the month prior to implementation as compared to 38 mg for the month of implementation. The month following implementation showed an average of 44 mg of rocuronium per GETA surgical case. During the month prior to STOP-BANG implementation, GETA cases received an

average of 117 mg of sugammadex to reverse rocuronium paralysis. The sugammadex average increased the following month to 124 mg. The third month showed an average of 163.5 mg of sugammadex per GETA surgical case.

The data indicated that during these 3 months not all patients receiving more than the average defasciculating dose (5-10 mg) of rocuronium paralysis were reversed by sugammadex. It also indicated 0 patients were confirmed fully reversed via TOF nerve stimulation for any of the three months. The ASA and the American Association of Nurse Anesthetists (AANA) are clear in their support for extubating a patient only after full reversal of chemical paralysis is confirmed by TOF nerve stimulation.

Additional data retrieved showed fentanyl free anesthesia increased during the month of STOP-BANG implementation and the month following to 13.5% and 15.5% of surgical cases respectively. The occurrence of fentanyl free anesthesia increased compared to 11.3% during the month prior to implementation. Also, the percentage of IV sedation cases, allowing patients to maintain spontaneous respirations, increased to 7.4% during the month of implementation. There was also a noted increase of IV sedation cases during the third month to 6.8% of surgical cases. The increase in IV sedation cases are a noticeable difference from only 3.2% IV sedation cases the month before implementation. The month prior to STOP-BANG implementation showed that 6.5% of surgical cases were done under regional anesthesia. The regional anesthesia percentage declined to 5.4% during the month of implementation and increased to 9.7% the month following.

### *Postoperative Respiratory and Cardiac Complications*

During the month of STOP-BANG implementation, perioperative respiratory complications increased. Hypoxemic events and ICU transfers both increased by 6.2% and 4.7% respectively. However, there was a 0.4% and 3.5% decrease in hypoxemic events and ICU transfers respectively when comparing the month of implementation and post-implementation of STOP-BANG. During the month of STOP-BANG implementation, arrhythmias (3.9%) and hypotension (0.5%) decreased. While there was an increase in ICU transfers (4.7%), it is presumed that this increase was not related to any perioperative cardiovascular complications. During the month after STOP-BANG implementation, arrhythmias (4.3%) and ICU transfers (3.5%) decreased while hypotensive events (5.0%) increased. Once again, it is presumed that this increase was not related to any perioperative complication related to OSA, but rather anesthetic dosage and/or patient-specific baseline hypotension.

### Interpretation

#### *Determining Incidence and Prevalence*

Drawing any correlation from such a small patient sample is difficult. The 17 questionnaires that were completed are only representative of 4.8% of the patients who presented for surgery over the month of October. Using the 10 surveys with a high-risk score, the prevalence of OSA was 2.8% over a one-month period. A conclusion cannot be drawn from this sample size to determine that 4.8% is an accurate portrayal of OSA prevalence in this facility.

### *Implementation of the STOP-BANG Tool*

The facility in which implementation was performed completed 348 elective surgeries that met inclusion criteria. Seventeen STOP-BANG questionnaires in total were collected from the dropbox. Ten of the 17 questionnaires did not meet inclusion criteria. Four of the 7 questionnaires did not have a patient identifier but did have handwritten ages on them which met inclusion criteria. For the purpose of this project, 7 of the STOP-BANG questionnaires met the project criteria. After calculations were made, 2% of completed STOP-BANG questionnaires fell within the defined criteria. Therefore, the implementation month (30 days) of the STOP-BANG questionnaire at this facility resulted in a 2% frequency of use when compared to the total number of elective surgeries that met inclusion criteria.

### *Comparing Best-Practice Guidelines*

The amount of fentanyl used per case during the month of STOP-BANG implementation decreased by 6.4 mcg and decreased an additional 5.3 mcg the month following implementation. The fentanyl dose decrease could be attributed to an increased awareness of patients at risk for OSA during the month of implementation and their need for decreased narcotic usage. An increase of 6.8 mg in the average dose of sugammadex per GETA case to reverse chemically paralyzed patients during the month of implementation was shown. The average dose of sugammadex increased by an additional 39.5 mg per case during the third month and could be attributed to increased anesthesia provider awareness as well. The average dose of sugammadex could also be attributed to the increasing average dose of rocuronium per GETA case during the month

following implementation. No cases for any month of the project used a TOF nerve stimulation to confirm the full reversal of chemical paralysis.

An increase of fentanyl free surgical cases for both the month of implementation and the month following was noted. Fentanyl free surgical cases increased to 13.5% during the month of implementation and 15.5% the month after. IV sedation cases increased from 3.2% the month prior to STOP-BANG implementation to 7.4% the month of, and 6.8% the month following. Regional anesthesia cases fluctuated from month to month. The month prior to STOP-BANG implementation, 6.5% of surgical cases primarily utilized regional anesthesia. Regional anesthesia declined to 5.4% during the month of implementation but subsequently increased the month following to 9.7%. While these numbers are not dramatic, it is possible the anesthesia provider chose these anesthesia types due to an increased awareness of patients at risk of OSA. Currently, there are no studies correlating positive STOP-BANG scores (greater than 3) and changes in the anesthetic plan in order to reduce perioperative complications.

#### *Postoperative Respiratory and Cardiac Complications*

Postoperative respiratory complications during the month of STOP-BANG implementation increased; hypoxic events by 6.2% and ICU transfers by 4.7%. No reintubations in the PACU was noted. Perioperative cardiovascular complications, including arrhythmias and hypotension, decreased during the month of STOP-BANG implementation—arrhythmias by 3.9% and hypotension by 0.5%. While research shows there is an increased risk for complications with STOP-BANG scores greater than three, this quality improvement project showed no type of respiratory compromise and only one documented rhythm change. Furthermore, there are currently no studies correlating

positive STOP-BANG scores greater than three with recommended changes in anesthetic plans to combat perioperative respiratory or cardiovascular complications.

### Limitations

Less than 1% of completed questionnaires during the month of STOP-BANG implementation were usable for this project as originally planned. Due to a lack of buy-in, an inference was drawn that anesthesia provider education on current best practice guidelines for anesthesia care of the OSA patient possibly altered the anesthesia plan, but this inference cannot be confirmed. Also included as a limitation should be a consideration that a patient's comorbidities, outside of OSA, could alter anesthetic care. Additional limitations include the lack of additional data variables. Fentanyl, rocuronium, and sugammadex were only anesthetic medications reviewed.

Oxygen desaturation during this quality improvement project could be explained by several factors other than the moderate risk for OSA: the residual effects of opioids and neuromuscular blocking drugs, general anesthesia versus regional, and different demographic data. During this quality improvement project, arrhythmias were considered any documented ECG reading other than NSR or paced rhythm. The non-NSR ECG was a limitation because, for some patients, sinus tachycardia or bradycardia may be a normal baseline for their heart rate. The same is true for hypotension (SBP < 90 mmHg); for some patients, hypotension may be considered normal at resting states. Also, postoperative ICU admissions can be caused by a number of adverse events occurring other than OSA. Examine the reason for ICU admission and expand exclusion criteria for these events to focus on OSA related complications would be useful. Finally,

another limitation to this project was the lack of OSA diagnoses with PSG in patients with inferred risk for OSA.

### Conclusion

The limited number of completed STOP-BANG questionnaires was a limitation to this project. However, the limited number of STOP-BANG questionnaires did not have anything to do with the coexisting evidence from the retrospective chart reviews. Data received provided the opportunity to create an executive summary to provide awareness to the hospital of any potential practice changes it deems necessary.

Future research should be conducted on how to increase anesthesia provider buy-in for a STOP-BANG questionnaire implementation and could also entail a more detailed look at intraoperative anesthesia care for patients identified as at risk for moderate to severe OSA. This project should include not only common anesthetic drugs, as in this project but others as well. For example, other narcotics, benzodiazepines, paralytics, and reversal agents should be studied and compared to best practice guidelines. Education on the importance of TOF nerve stimulation to confirm chemical paralysis reversal could also prove beneficial.

Although there was a lack of anesthesia staff buy-in and participation, the usefulness of results may guide future researchers and project designers in how to obtain sustainability in future implementations and practice changes. In this case, the opportunity for staff and stakeholders to see considerable areas for growth was revealed by the overall project outcomes. The data may superficially illustrate the lack of implementation to make profound changes or effects at the facility, but the revelation of areas needing to be strengthened will supersede this result. Future projects should be

conducted on how to provide competent and eager staff with the resources and tools needed to increase staff and student buy-in to facilitate meaningful and sustainable implementation. This quality improvement project provided evidence that a prescreening tool for OSA, such as STOP-BANG, is useful to reduce the risk of perioperative respiratory and cardiovascular complications, especially with Mississippi having the second highest rate of obesity in the nation.



## APPENDIX A – STOP-BANG Questionnaire

Name \_\_\_\_\_  
 Height \_\_\_\_\_ Weight \_\_\_\_\_  
 Age \_\_\_\_\_ Male / Female \_\_\_\_\_

### STOP-BANG Sleep Apnea Questionnaire

*Chang F et al Anesthesiology 2008 and RJA 2012*

<b>STOP</b>		
Do you <b>SNORE</b> loudly (louder than talking or loud enough to be heard through closed doors)?	Yes	No
Do you often feel <b>TIRED</b> , fatigued, or sleepy during daytime?	Yes	No
Has anyone <b>OBSERVED</b> you stop breathing during your sleep?	Yes	No
Do you have or are you being treated for high blood <b>PRESSURE</b> ?	Yes	No
<b>BANG</b>		
<b>BMI</b> more than 35kg/m <sup>2</sup> ?	Yes	No
<b>AGE</b> over 50 years old?	Yes	No
<b>NECK</b> circumference > 16 inches (40cm)?	Yes	No
<b>GENDER</b> : Male?	Yes	No
<b>TOTAL SCORE</b>		

**High risk of OSA: Yes 5 - 8**

**Intermediate risk of OSA: Yes 3 - 4**

**Low risk of OSA: Yes 0 - 2**

APPENDIX B – DNP Essentials

Doctor of Nursing Essentials	How the Essential was Achieved
I. Scientific Underpinning for Practice	This project uses current evidenced-based research concerning the STOP-BANG questionnaire and reducing adverse patient outcomes.
II. Organizational and Systems Leadership for Quality Improvement and Systems Thinking	The objective of this project was to improve patient outcomes by implementing a prescreening OSA tool in the preoperative arena.
III. Clinical Scholarship and Analytical Methods for Evidence-Based Practice	Providing a STOP-BANG score for anesthesia staff via a sticky note on every patient's chart that met inclusion criteria.
IV. Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care	Deidentified data provided by the facility employee was analyzed via Microsoft Excel® This data was given to the facility for clinical decision making.
V. Health Care Policy for Advocacy in Health Care	An OSA prescreening tool was not utilized at the facility during implementation. Negotiations with multiple facility departments made implementation of this project possible.
VI. Interprofessional Collaboration for Improving Patient and Population Health Outcomes	Development, education, and implementation of the STOP-BANG questionnaire.
VII. Clinical Prevention and Population Health for Improving the Nation's Health	Mississippi ranks 2 <sup>nd</sup> in the nation for obesity which is a key factor with patients at risk for OSA. Bringing attention to anesthesia staff of patient OSA risk has the potential to change perioperative adverse outcomes.
VIII. Advanced Nursing Practice	The STOP-BANG questionnaire is proven to decrease perioperative adverse outcomes associated with OSA.

## APPENDIX C – IRB Approval Letter



**INSTITUTIONAL REVIEW BOARD**  
118 College Drive #5147 | Hattiesburg, MS 39406-0001  
Phone: 601.266.5997 | Fax: 601.266.4377 | [www.usm.edu/research/institutional.review.board](http://www.usm.edu/research/institutional.review.board)

### NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months.  
Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: 18091109

PROJECT TITLE: A Quality Improvement Project to Decrease Perioperative Respiratory and Cardiac Complications by Implementing the STOP-BANG Questionnaire Preoperatively

PROJECT TYPE: Doctoral Dissertation

RESEARCHER(S): Cody Holliman, Robert Marrero, Bradly Diamond, Tyler Nelson, and Gregory Guerrier

COLLEGE/DIVISION: College of Nursing and Health Professions

DEPARTMENT: School of Leadership and Advanced Nursing Practice

FUNDING AGENCY/SPONSOR: N/A

IRB COMMITTEE ACTION: Expedited Review Approval

PERIOD OF APPROVAL: 09/13/2018 to 09/13/2019

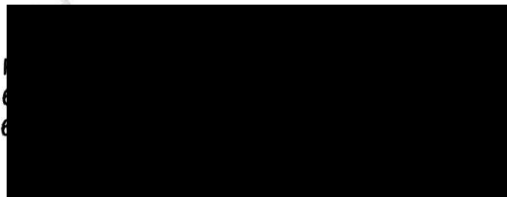
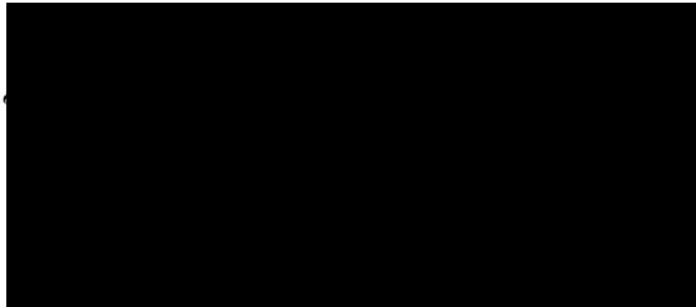
**Edward L. Goshorn, Ph.D.**  
**Institutional Review Board**

## APPENDIX D – Letter of Support



To Whom It May Concern:

This letter serves to provide my support for Marrero's DNP project to determine improvements in postoperative patient outcomes in the post anesthesia recovery unit (PACU) for patients with undiagnosed Obstructive Sleep Apnea (OSA). Following the implementation of the STOP-BANG questionnaire to identify individuals who have symptoms indicative of OSA as part of the pre-operative anesthesia assessment at [REDACTED], Mr. Marrero's project will focus on post anesthesia patient and quality care outcomes related to the impact of the identification of OSA in the adult surgical patient undergoing elective procedures. This project is planned to commence no later than September 2018 and conclude no later than December 2018.



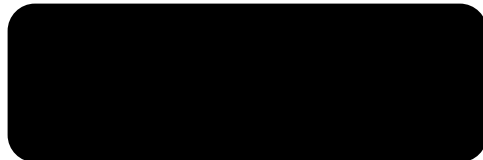


7/24/2018

To Whom It May Concern:

This letter serves to provide my support for Bradly Diamond's DNP project comparing current perioperative anesthesia management with best practice guidelines for the perioperative management of adult patients with Obstructive Sleep Apnea (OSA). All adult patients undergoing elective surgical procedures at [REDACTED] will be screened for OSA using the STOP-BANG screening tool and the management of anesthesia compared to published best practice guidelines. The information gained from the project will be used to validate and/or improve the quality of care provided in the perioperative setting for patients with OSA. This project is planned to commence no later than September 2018 and conclude no later than December 2019.

Sincerely,

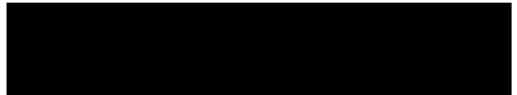
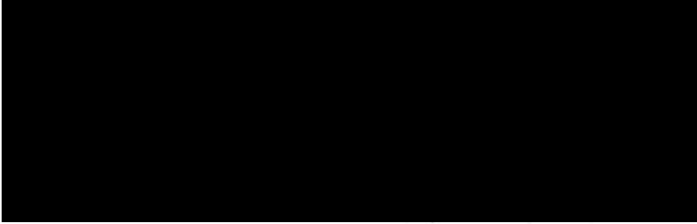




To Whom It May Concern:

This letter serves to provide my support for Tyler Nelson's DNP project to determine improvements in postoperative patient outcomes in the post anesthesia recovery unit (PACU) for patients with previously undiagnosed obstructive sleep apnea (OSA). The presence of OSA will be identified through the addition of the STOP-BANG questionnaire in the pre-anesthesia assessment of adult patients undergoing elective surgery at [REDACTED] al. Mr.

Nelson's project will focus on post anesthesia patient outcomes related to the identification of OSA in previously undiagnosed adult surgical patients. This project is planned to commence no later than September 2018 and conclude no later than December 2019.



7/24/2018

**To Whom It May Concern:**

This letter serves to provide my support for Cody Holliman's DNP project implementing the STOP-BANG questionnaire at Forrest General Hospital. The STOP-BANG questionnaire is a validated screening tool used to identify individuals with previously undiagnosed obstructive sleep apnea (OSA). All adult patients undergoing elective surgical procedures will be screened for OSA using the STOP-BANG screening tool during their pre-anesthesia assessment. At the conclusion of the project the organization may elect to incorporate the screening tool as a part of the routine assessment of adult surgical patients. This project is planned to commence no later than September 2018 and conclude no later than December 2019.





8/1/2018

To Whom It May Concern:

This letter serves to provide my support for Gregory Guerrier's DNP project to determine the prevalence of adult surgical patients who are identified as being likely to be at moderate or high risk for obstructive sleep apnea (OSA). Risk of OSA will be evaluated using the STOP BANG questionnaire for OSA as part of the preoperative assessment prior to elective surgical treatment at ~~Forrest General Hospital~~. Mr. Guerrier's project will focus on the prevalence of OSA in adults presenting for elective surgical procedures at Forrest General Hospital. Data collection will occur for a 30 day period beginning no later than September 2018 and concluding no later than December 2018.





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