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Running head: EFFECT OF OBSTRUCTIVE SLEEP APNEA SCREENING ON OUTCOMES
OF ADULT SURGICAL PATIENTS

The Effect of Obstructive Sleep Apnea Screening on Outcomes of
Adult Surgical Patients in a Suburban Hospital

Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Nursing
Practice at the University of Kentucky

By

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Goshen, KY

2019

Abstract

Background: Obstructive sleep apnea (OSA) characteristics are present in up to one-quarter of the U.S. adult population (Fernandez-Bustamante, Bartels, Clavijo, Scott, Kacmar, Bullard, Moss, Henderson, Juarez-Colunga, & Jameson, 2017). It is estimated that 80-90% of patients with moderate to severe OSA have never been diagnosed (Chung, Abdullah, & Liao, 2016a). The high prevalence of OSA combined with low diagnosis rates give rise to an environment with considerable surgical risk, including respiratory failure and cardiac arrhythmias (Kaw, Chung, Pasupuleti, Mehta, Gay, & Hernandez, 2012). Guidelines have been established by the Society of Anesthesia and Sleep (SASM) for preoperative OSA screening in an effort to decrease perioperative complications (Chung, Memtsoudis, Ramachandran, Nagappa, Opperer, Cozowicz, & Auckley, 2016b).

Objective: The goal of this project is to determine whether patients who were identified as high-risk for OSA using the STOP-Bang Questionnaire and noted as such in the electronic medical record (EMR) developed fewer postoperative respiratory complications or were more likely to be referred for outpatient OSA evaluation.

Methods: The study design is nonequivalent control group pre-test and post-test design, using a retrospective chart review. The nonequivalent control group are patients who would have scored greater than or equal to five on the STOP-Bang Questionnaire based on the current preoperative assessments (daytime excessive sleepiness, hypertension, BMI >35 kg/m², age > 50 , neck circumference ≥ 43 cm in males, neck circumference ≥ 41 cm in females, and male gender) during the three months prior to the initiation of the STOP-Bang Questionnaire screening (December 2018-February 2019). This group was compared to preoperative patients screened high-risk for OSA using the STOP-Bang Questionnaire (score 5-8) during the study period (March 2019 to August 2019). Consecutive sampling was used for participant selection.

Running head: EFFECT OF OBSTRUCTIVE SLEEP APNEA SCREENING ON OUTCOMES OF ADULT SURGICAL PATIENTS

Results: There were no statistically significant differences in age, gender, prevalence of comorbid conditions, elective procedure, or STOP-Bang score between Group 1 and Group 2 (n=59). The hospital length of stay for Group 1 ranged from one to three days with a median of one day. For Group 2, the hospital length of stay ranged from one to sixteen days with a median of one day. One patient was not extubated after surgery as planned and four patients received supplemental oxygen after being admitted. No patients used non-invasive ventilation, were re-intubated, or experienced cardiac arrest postoperatively. There were no statistically significant differences between Group 1 and Group 2 in any of the preceding measures. Outpatient polysomnography referral was ordered for one patient in each group.

Conclusion: It was found that there were no statistically significant differences between the group not screened using the STOP-Bang Questionnaire and the group who was screened during the pre-admission testing appointment.

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Table of Contents

Abstract.....ii

Acknowledgements.....1

Background.....3

Purpose.....6

Theoretical/Conceptual Framework.....7

Literature Review.....7

Study Site Description.....9

Project Design.....10

Methods.....10

Data Analysis.....11

Results.....11

Discussion.....13

Implications.....14

Limitations.....16

Conclusion.....16

Appendix A STOP-Bang Questionnaire.....18

List of Tables.....19

 Table 1. Demographics.....19

 Table 2. Elective Procedures.....20

 Table 3. STOP-Bang Score.....20

 Table 4. Length of Hospital Stay.....21

 Table 5. Postoperative Outcomes.....22

References.....23

Background

Obstructive sleep apnea (OSA) is “a condition in which the upper airway becomes obstructed during sleep, causing hypoxia, hypercarbia, fragmented sleep, and a variety of medical complications including daytime drowsiness and an increased risk of hypertension, diabetes, and cardiovascular disease” (Wolfe, Pomerantz, Miller, Weiss-Coleman, and Solomonides, 2016, p. 263). Other types of sleep apnea have been identified, including central sleep apnea and mixed sleep apnea. Rather than an obstructive component, central sleep apnea is secondary to decreased ventilatory effort related to the inability of brain signals to activate the ventilatory muscles. Mixed sleep apnea is a combination of the obstructive component and the decreased ventilatory component.

OSA patients commonly present with complaints of daytime sleepiness, snoring, and gasping for breath while sleeping. Physical characteristics associated with OSA include obesity and large neck size. Males and people of advanced age are more likely to experience OSA. In the current healthcare environment, OSA is particularly important due to the increasing incidence of obesity and its contribution to the condition. In fact, it is estimated that OSA is present in up to 70% of the bariatric surgery population (Chung et al., 2016b).

Diagnosis and severity of OSA is measured through the apnea-hypopnea index (AHI) obtained by polysomnography. The apnea-hypopnea index indicates the number of pauses in breath plus the number of shallow breaths in an hour (Wolfe et al., 2016). Severity of OSA is stratified through the AHI; mild OSA AHI ≥ 5 , moderate OSA AHI 15-29, and severe OSA AHI ≥ 30 (Wolfe et al., 2016).

According to Fernandez-Bustamante et al. (2017), OSA characteristics are present in up to one-quarter of the U.S. population. It is estimated that 80-90% of the patients living with

Running head: EFFECT OF OBSTRUCTIVE SLEEP APNEA SCREENING ON OUTCOMES OF ADULT SURGICAL PATIENTS

moderate to severe OSA in the U.S. have never been diagnosed (Chung et al., 2016a). The high prevalence of the OSA combined with low diagnosis rates give rise to an environment with considerable surgical risk, such as respiratory failure and cardiac arrest. Factors that increase risk for OSA, such as obesity, smoking, and alcohol consumption are prevalent among surgical patients (Chung et al., 2016b). In meta-analysis of thirteen studies, Kaw et al. demonstrated that patients with OSA had increased postoperative oxygen desaturation, respiratory failure, cardiac events, and intensive care unit (ICU) transfers when compared to patients without OSA (Kaw, Chung, Pasupuleti, Mehta, Gay, & Hernandez, 2012). As such, identifying and managing OSA presents an opportunity for minimizing serious complications related to OSA as well as a potential cost savings.

Complications related to OSA include hypertension, stroke, cardiovascular disease, congestive heart failure, atrial fibrillation, type 2 diabetes, and perioperative respiratory depression (National Heart, Lung, and Blood Institute, n.d.). In an eighteen-year mortality follow-up study, the American Academy of Sleep Medicine (AASM) found severe OSA increases “all-cause mortality risk” of death by a factor of three despite age, gender, and BMI (Young, Finn, Peppard, Szklo-Coxe, Austin, Nieto, Stubbs, & Hla, 2008, p. 1075). The cost of untreated OSA in the U.S. is approximately \$149.6 billion dollars annually and the healthcare costs associated with comorbidities related to OSA is estimated to be \$30 billion dollars annually (American Academy of Sleep Medicine, 2016).

Guidelines have been established by the Society of Anesthesia and Sleep Medicine (SASM) for preoperative OSA screening to decrease perioperative complications (Chung et al., 2016b). The SASM recommendations for preoperative OSA screening and management were developed through a literature review and grading system in conjunction with expert evaluation

Running head: EFFECT OF OBSTRUCTIVE SLEEP APNEA SCREENING ON OUTCOMES OF ADULT SURGICAL PATIENTS

(Chung et al., 2016b). The SASM noted the guidelines are limited due to the quantity of high-quality studies utilizing randomization. As such, within the SASM guidelines is the recommendation for each facility to adapt SASM guidelines to facility-specific needs based on patient population, types of surgical procedures, and cost-benefit analysis. Among the SASM recommendations is screening patients preoperatively for OSA using a validated screening tool, notifying the provider of high-risk score, initiating established OSA protocol, and notifying the primary care provider for outpatient OSA evaluation referral (Chung et al., 2016b).

The SASM recommends using one of four OSA screening tools for preoperative evaluation of OSA, including the STOP-Bang Questionnaire (Appendix A), Perioperative Sleep Apnea Prediction Score (P-SAP), Berlin Questionnaire, and American Society of Anesthesiologists (ASA) Checklist (Chung et al., 2016b; Updated STOP-Bang Questionnaire, n.d.). The STOP-Bang Questionnaire has been established as a valid tool for identifying patients in multiple types of populations who are likely to have OSA (Chung, Subramanyam, Liao, Sasaki, Shapiro, & Sun, 2012; Seet, Chua, & Liaw, 2015; Chung, Liao, & Farney, 2015). A meta-analysis of seventeen studies including 9206 sleep clinic and surgical patients found a sensitivity of 94% to predict moderate to severe OSA and 96% sensitivity to predict severe OSA (Nagappa, Liao, Wong, Auckley, Ramachandran, Memtsoudis, Mokhlesi, & Chung, 2015). The corresponding specificities were 75% and 90%, respectively. Another study compared three OSA screening tools and found the STOP-Bang Questionnaire to have a sensitivity of 95% for moderate to severe OSA and 100% for severe OSA. The screen results were verified by polysomnography (Bilbech, Yangui, Kharrat, Mrassi, & Abouda, 2018). The lower specificity reported in the meta-analysis is noted to provide the opportunity for false positives and potential for unnecessary polysomnography. A benefit of the STOP-Bang Questionnaire noted by Abrishami et al. is the ease of use of the tool (Abrishami, Khajehdehi, & Chung, 2010).

Running head: EFFECT OF OBSTRUCTIVE SLEEP APNEA SCREENING ON OUTCOMES OF ADULT SURGICAL PATIENTS

Based on the supporting literature, using the STOP-Bang Questionnaire to identify preoperative patients likely to have OSA and notifying the provider potentially decreases perioperative respiratory and cardiac events, ICU transfers, and hospital length of stay (Fernandez-Bustamante et al., 2017). As such, the study site can use the STOP-Bang Questionnaire and provider notification to improve outcomes for surgical patients. Additionally, an opportunity exists to increase diagnosis and treatment of OSA through referral for evaluation. According to the AASM, diagnosed OSA costs 12.4 billion U.S. dollars annually versus 149.6 billion dollars annually for treatment of undiagnosed OSA complications (American Academy of Sleep Medicine, 2016). Through identification of OSA and suspected OSA patients, the study site also has the opportunity to decrease the cost of care.

Purpose

The goal of this project is to determine whether patients who were identified as high-risk for OSA using the STOP-Bang Questionnaire and noted as such in the electronic medical record (EMR) developed fewer postoperative respiratory complications or were more likely to be referred for outpatient OSA evaluation.

The aims of this project include:

1. Screen and identify patients at high-risk for OSA using the STOP-Bang Questionnaire during the preoperative assessment.
2. Notify physician of high-risk OSA screen by documenting in EMR.
3. Compare patient outcomes (unplanned inability to extubate postoperatively, reintubated, new non-invasive ventilation use, new O₂ use, and cardiac arrest) prior to and after initiation of STOP-Bang Questionnaire using a chart review.
4. Determine whether providers were more likely to order outpatient OSA evaluation after initiation of Stop-Bang Questionnaire.

Theoretical/Conceptual Framework

This project was guided by the five phases of the Stetler Model of Research Utilization (Stetler, 2001). The Stetler Model of Research Utilization's five phases include preparation, validation, comparative evaluation/decision-making, translation/application, and evaluation. The preparation phase of this project was acknowledging the high number of potential OSA patients and the risks for these patients in the surgical setting related to both outcomes and cost of care. The evidence suggests a simple, low-cost screening tool can identify patients at risk for post-surgical respiratory complications, thus providing the opportunity to mitigate risks through greater surveillance and/or protocols. The validation phase of the Stetler Model included a literature review of current research and review of quality of available evidence. The comparative evaluation/decision-making phase included synthesizing the information found in literature review and evaluating recommendations. The translation/application phase of the Stetler Model was accomplished by considering the target hospital environment, available resources, and specific goals of the project. It was determined that the project would include a pilot use of the OSA screen and compare outcomes before and after use of Stop-Bang Questionnaire. The data obtained in the study became the primary focus of the Stetler Model evaluation stage.

Literature Review

A CINAHL and Medline database search was conducted using the search terms obstructive sleep apnea, obstructive sleep apnea screen, STOP-Bang Questionnaire, perioperative complications, surgery, adverse events, surgical protocols, and surgical guidelines. Excluded from the search were articles greater than ten years-old, animal studies, and pediatric studies. A Google Scholar search was also conducted using the same criteria. Fifteen articles were

identified and included in the review. Additional articles were identified using the reference lists of the original chosen articles.

Three focus areas of the literature review included perioperative consequences related to OSA, screening tools for predicting OSA, and guidelines or protocols established to decrease perioperative complications of OSA. A trend identified during the literature review was the lack of randomized-controlled trials. A majority of the identified literature is based on retrospective chart reviews, cross-sectional studies, and meta-analyses.

Three studies found complications in recovery of surgical patients ranging from oxygen desaturation to ICU admission for patients either diagnosed with OSA or with suspected OSA based on a screening tool (Fernandez-Bustamante et al., 2017; Kaw et al., 2012; & Wolfe et al., 2016). One study was an 18-year follow-up study of the Wisconsin Sleep Cohort that found sleep-disordered breathing was associated with a triple risk of death compared to those without sleep-disordered breathing (Young et al., 2008). Together, these studies established evidence for considerable risk associated with OSA in the surgical setting as well as for long-term mortality.

The Society of Anesthesia and Sleep Medicine (SASM) was responsible for the most recent guidelines related to the care of OSA patients and potential OSA patients in the perioperative environment (Chung et al., 2016b). The guidelines were established based on a multidisciplinary review and grading of available literature. Ultimately, the SASM determined there is no firm set of guidelines for this population but rather a set of recommendations from which institutions must choose to create appropriate protocols.

Appropriate protocols should take into consideration patient population, procedures, and cost-benefit analysis.

In its guidelines, the SASM did identify the STOP-Bang Questionnaire as the most sensitive and efficient OSA screen available for multiple populations. Three studies support the

Running head: EFFECT OF OBSTRUCTIVE SLEEP APNEA SCREENING ON OUTCOMES OF ADULT SURGICAL PATIENTS

use of the STOP-Bang Questionnaire by comparing it to other screening tools, by comparing STOP-Bang Questionnaire score to polysomnography results, and for risk stratification related to screening score (Bilbech et al., 2018; Chung et al., 2012; & Seet, Chua, & Liaw, 2015). Two meta-analyses, including a total of twenty-seven studies and 10,690 patients confirmed the STOP-Bang questionnaire has a high sensitivity tool for predicting OSA; however, a low specificity was also identified. As such, a risk for false positive results exists (Abrishami, Khajehdehi, & Chung, 2010; Nagappa et al., 2015). False positives could potentially delay surgery and increase cost of care.

Study Site Description

The project took place at Norton Brownsboro Hospital (NBH), a 127-bed suburban hospital in Louisville, Kentucky. NBH is part of the Norton Healthcare (NHC) system. The mission of NHC is to provide quality patient-centered care within the context of its faith heritage (Norton Healthcare, n.d.). NBH serves Louisville and surrounding counties. The patient population at NBH includes adults with complexity ranging from outpatient surgery to intensive care (ICU). Specifically, this project will take place in the perioperative areas within the hospital. On average, NBH performs approximately 300 elective inpatient surgeries per month.

The study population includes adults undergoing elective inpatient surgery at NBH. Inclusion criteria for the study is age greater than 18 years and undergoing elective surgery at NBH. Patients undergoing emergent surgery and those who are less than 18 years of age were excluded from the study. The sample included patients who were identified as high-risk for OSA using the STOP-Bang questionnaire in the preoperative evaluation. The sample size was estimated to be approximately 200 patients based on positive STOP-Bang screen.

Project Design

The study design is nonequivalent control group pre-test and post-test design using a retrospective chart review. The nonequivalent control group consisted of a retrospective chart review of patients between December 2018 and February 2019 who would have scored greater than or equal to five on STOP-Bang Questionnaire based on the current preoperative assessments (daytime excessive sleepiness, hypertension, BMI >35 kg/m², age > 50, neck circumference ≥43 cm in males, neck circumference ≥41 cm in females, and male gender). This group was compared to patients who screened high-risk for OSA using the STOP-Bang Questionnaire during the preoperative screening appointment between March 2019 and August 2019.

Methods

IRB, Norton Healthcare Research Office, and NBH approvals were obtained. A waiver of documentation of informed consent was granted by the IRB. The pre-admission testing nurses were trained to identify which patients could be included as potential study participants, how to obtain informed consent, administer the STOP-Bang Questionnaire, document a high-risk screen, and securely store completed screens.

After obtaining informed consent, the pre-admission testing nurse or principal investigator completed the STOP-Bang questionnaire on paper during preoperative patient screening. A patient label was placed on questionnaires prior to storing in a secured file. A score of five to eight on the screening tool prompted the nurse to document high-risk screen in a nursing note. For the nonequivalent control group, the Norton Healthcare data specialists provided the primary investigator with a list of medical record numbers of NBH's inpatient elective surgery patients without a previous diagnosis of OSA, greater than eighteen years-old, and documented to have any of the following characteristics (daytime excessive sleepiness, hypertension, BMI >35

Running head: EFFECT OF OBSTRUCTIVE SLEEP APNEA SCREENING ON OUTCOMES OF ADULT SURGICAL PATIENTS

kg/m², age > 50, neck circumference \geq 43 cm in males, neck circumference \geq 41 cm in females, and male gender) documented in EPIC during the preoperative screening process during the three months prior to the initiation of the STOP-Bang Questionnaire (December 2018-February 2019). The principal investigator created a crosswalk table from the original MRN to de-identify data. The list of MRNs and crosswalk table were stored on the password protected H drive maintained by Norton Healthcare. The data will be maintained for six years then be destroyed by Norton Healthcare per research policy.

Data Analysis

Descriptive statistics including means, standard deviations, frequency distribution, and medians were used to describe patient demographics, patient procedures, comorbid conditions, STOP-Bang score, length of hospital stay, and patient outcomes (Appendix B). The two-sample t-test was used to compare the STOP-Bang Questionnaire scores calculated from the medical record to the STOP-Bang Questionnaire scores collected in pre-admission testing. The chi-squared test was used to compare differences in gender, patient procedure, comorbid conditions, and outcomes between the pre and post STOP-Bang Questionnaire groups. The Mann-Whitney u-test was used to assess differences in length of hospital stay. Statistical analysis was completed using SPSS software version 26 with an alpha level of .05 throughout.

Results

The mean ages of the pre-STOP-Bang Questionnaire group (GROUP 1) and the post-STOP-Bang Questionnaire group (GROUP 2) were 61.5 (SD=9.2) years and 64.5 (SD=10.5) (p=0.25) (Table 1) years, respectively. In both samples, the majority of patients were male (73% and 66%, respectively). There were no statistically significant differences in age or gender

Running head: EFFECT OF OBSTRUCTIVE SLEEP APNEA SCREENING ON OUTCOMES OF ADULT SURGICAL PATIENTS

between groups. There was no difference in the prevalence of comorbid conditions between groups. The most commonly documented conditions were hypertension, obesity, and diabetes.

Elective procedures among the two groups included knee arthroplasty, ankle arthroplasty, shoulder arthroplasty, hip arthroplasty, abdominal hernia repair, laparoscopic bowel resection, carotid stent/endarterectomy, spinal fusion/decompression, cranioplasty, transsphenoidal hypophysectomy, and deep brain stimulator insertion. There was no statistically significant difference in the representation of elective procedures between Group 1 and Group 2 ($p=.44$), with the majority being joint arthroplasty for both time periods (Table 2).

The mean STOP-Bang Questionnaire scores for Group 1 and Group 2 were 5.23 ($SD=.50$) and 5.52 ($SD=.87$) ($p=.13$), respectively. There were no statistically significant differences in STOP-Bang Questionnaire score between the two groups (Table 3). The hospital length of stay for Group 1 ranged from 1 to 3 days with a median of 1 day. For Group 2, the hospital length of stay ranged from 1 to 16 days with a median of 1 day (Table 4).

The outcomes measured for Group 1 and Group 2 included extubation in post-anesthesia care unit (PACU), non-invasive ventilation after PACU, oxygen supplementation after PACU, re-intubation after extubation, post-surgical cardiac arrest, and outpatient referral for polysomnography. There were no statistically significant differences between Group 1 and Group 2 in any of these measures. All of Group 1 patients and most (97%) 28 ($p=.99$) of Group 2 patients were extubated as planned prior to PACU. Oxygen supplementation was documented in few patients at either time point (7% for both, $p>.99$).

Outpatient polysomnography referral was ordered for one patient in Group 1 and one Group 2 patient. None of either Group 1 or Group 2 patients were documented to have been ordered non-invasive ventilation, experienced re-intubation after extubation, or post-surgical cardiac arrest (Table 5).

Discussion

Based on the literature, the expectation was to find poorer postoperative respiratory outcomes in patients with a STOP-Bang score indicating high-risk for OSA. This sample had no statistically significant differences in age, gender, comorbid conditions, elective procedure, or STOP-Bang score. The mean STOP-Bang scores were 5.23 for Group 1 and 5.52 for Group 2, indicating high-risk for OSA. Both groups experienced nearly equal outcomes and few postoperative respiratory complications. Only one patient in Group 2 remained intubated after PACU and two people in each group received supplemental oxygen after PACU.

The similarities in demographics, comorbid conditions, and elective procedures provided an acceptable basis for comparison. While the homogeneity of the sample created an acceptable basis for comparison, it may have also limited outcomes. A more diverse sample or multi-site study may have included patients who presented with comorbid conditions more likely to be associated with respiratory risk or more complex surgeries.

The hospital length of stay was skewed by one patient with a sixteen-day length of stay. This patient was also the one person not extubated after surgery (Group 2) and one of the two patients in Group 2 who received supplemental oxygen after PACU. It is noted that this patient did not receive outpatient polysomnography referral. Statistical analysis was conducted after removing this outlier and it produced no statistically significant differences in outcomes.

An unexpected aspect of the study implementation was the method the nurses used to communicate high-risk OSA screens to providers. They were instructed to make a nursing note in the EMR indicating a high-risk for OSA STOP-Bang Score. Instead, the nursing staff placed a note on the patient folder that goes with the patient to the operating room. After the patient is admitted to the floor, the contents of the folder are either shredded or scanned into the medical

record. This process potentially impaired the communication to the discharging team regarding high-risk OSA screen, thus limiting opportunity for outpatient referral for polysomnography.

The primary comorbid conditions represented in both groups (hypertension, obesity, diabetes, and atrial fibrillation) are commonly associated with OSA. As such, this was an expected finding.

Implications for Future Nursing Research

Research suggests identifying potential OSA patients prior to surgery and notifying providers can decrease risk of perioperative respiratory complications and may prompt outpatient OSA evaluation. As a validated screening tool, the STOP-Bang Questionnaire offers a standardized method for assessing OSA risk and communicating high-risk score to providers. The current PAT assessment at the study site includes some questions from the STOP-Bang Questionnaire; however, interpretation and communication of the results are not standardized. Adjusting the current PAT assessment to include the entire STOP-Bang Questionnaire would structure the OSA assessment and provide a standardized method for communicating the information to providers. The high-risk score could potentially be added to the history and physical completed by the PAT nurse practitioner or it could trigger an automatic notification to surgeon, anesthesia, or the primary care provider.

In this scenario, future research could indicate where to focus education and resources. For example, determining which services were more likely to order outpatient sleep evaluation could provide administration with information on where to focus provider education regarding OSA evaluation. Additionally, it would be valuable to learn how many patients completed outpatient PSG, how many patients were diagnosed with OSA, and how many patients were treated for OSA. This would provide information on where to focus education and resources for

patients. A further question for patient education would be whether to begin provider notification of intermediate-risk OSA patients. At the intermediate-risk stage, an opportunity to begin patient education on prevention of further development of OSA characteristics and developing OSA-related comorbidities exists.

As confounding variables, the numerous comorbidities related to OSA make it difficult to precisely quantify the cost-effectiveness of OSA screening in the acute care setting. In the current literature, the cost-benefit analysis of screening for OSA in the acute care setting is commonly discussed in terms of postoperative complications and hospital length of stay. A particularly important focus in the acute care setting is hospital readmission rates. Future nursing research quantifying the cost-savings related to hospital readmission rates for known OSA patients with treatment compared to those without treatment could highlight the need for hospitals to focus on methods for identifying and treating OSA patients in the acute care environment.

In contrast with previous published studies, it is noted that this study found few respiratory complications in patients with a high-risk STOP-Bang score. Perhaps reproducing the study as a multi-site study or at a hospital within the NHC system where more diverse types of surgeries are performed, such as thoracic surgeries or bariatric surgeries, etc. would produce different results.

Results may have also been affected by the method nurses used to communicate high-risk screen to providers. They were trained to write a nursing note in the EMR; however, they chose to indicate high-risk screen on the folder that follows the patient to the operating room. As such, discharging provider likely had no knowledge of high-risk score. One training session was provided by principal investigator prior to study period. The session included a written description of the study as well as directions for consent, screening, documentation, and storage

of screens. In future research, it may be beneficial to follow-up with data collectors during data collection period to confirm process is carried out as planned.

Limitations

Limitations of the study included small sample size, single site, and homogeneity of surgical procedures at the site. A further limitation was the method the nurses used to communicate high-risk OSA screens to providers. Having the score documented in the EMR has a higher probability of reaching the discharging provider.

Conclusion

The purpose of this project was to screen and identify patients at high-risk for OSA using a validated, simple to administer screening tool during the pre-admission assessment. The STOP-Bang Questionnaire was chosen based on ease of use and reliability as documented by multiple studies. The next step was to notify the provider of high-risk OSA screen by documenting in EMR. The respiratory postoperative outcomes (inability to extubate post-op, reintubated, new non-invasive ventilation, new supplemental oxygen use, cardiac arrest) prior to and after initiation of STOP-Bang Questionnaire were measured using a using a chart review. It was found that there were no statistically significant differences between the group prior to the use of the screening tool and the group who was screened during the pre-admission testing appointment.

An additional objective was to determine whether providers were more likely to order outpatient OSA evaluation after initiation of Stop-Bang Questionnaire and documentation of the high-risk score in EMR. Of the 59 patients who scored high-risk for OSA using the STOP-Bang screen, two patients received an outpatient polysomnography referral. There was a potential missed opportunity in the method the pre-admission testing nurses used to communicate the high-

Running head: EFFECT OF OBSTRUCTIVE SLEEP APNEA SCREENING ON OUTCOMES OF ADULT SURGICAL PATIENTS

risk score to providers. The planned approach was to note the score in the EMR in an effort alert discharging provider.

While the results of this study indicated few postoperative respiratory complications in patients who screened high-risk for OSA using the STOP-Bang Questionnaire, literature suggests identifying potential OSA patients preoperatively can decrease postoperative complications. The current PAT assessment at the study site includes some questions from the STOP-Bang Questionnaire. The interpretation of the current OSA assessment is not standardized and does not provide a uniform communication with providers. As a validated screening tool, the STOP-Bang Questionnaire offers clear method for assessment and communication of OSA risk.

From a cost perspective, missing the opportunity to refer for outpatient evaluation for OSA potentially contributes to the \$149.6 billion dollars spent annually on untreated OSA complications (American Academy of Sleep Medicine, 2016). Most importantly, patients identified at risk for OSA, diagnosed, and treated have decreased risk for complications related to OSA, such as hypertension, stroke, cardiovascular disease, congestive heart failure, atrial fibrillation, type 2 diabetes, and perioperative respiratory depression (National Heart, Lung, and Blood Institute, n.d.).

Appendix A

STOP-Bang Questionnaire

Snoring?

Yes No
partner Do you **Snore Loudly** (loud enough to be heard through closed doors or your bed-
elbows you for snoring at night)?

Tired?

Yes No
asleep Do you often feel **Tired, Fatigued, or Sleepy** during the daytime (such as falling
during driving or talking to someone)?

Yes No **O**bserved?

Has anyone **Observed** you **Stop Breathing** or **Choking/Gasping** during your sleep?

Yes No **P**ressure?

Do you have or are being treated for **High Blood Pressure**?

Yes No

Body Mass Index more than 35 kg/m²?

Yes No

Age older than 50 year old?

Neck size large? (Measured around Adams apple)

For male, is your shirt collar 17 inches/43 cm or larger?

Yes No
For female, is your shirt collar 16 inches/41 cm or larger?

Yes No

Gender = Male?

SCORE _____

Low risk of OSA: Yes to 0-2 questions

Intermediate risk of OSA: Yes to 3-4 questions

High risk of OSA: Yes to 5-8

Tables

Table 1. Patient Demographics (N=59)

	Pre-STOP-Bang Questionnaire Mean (SD) or n (%)	Post-STOP- Bang Questionnaire Mean (SD) or n (%)	<i>p</i>
Age	61.5 (9.2%)	64.5 (10.5%)	.25
Gender			
Male	22 (73.3%)	19 (65.5%)	.71
Female	8 (26.7%)	10 (34.5%)	
Comorbid Conditions			
Hypertension	25 (83.3%)	26 (89.7%)	.74
Obesity	20 (66.7%)	23 (79.3%)	.42
Diabetes	10 (33.3%)	6 (20.7%)	.42
Atrial Fibrillation	6 (20%)	4 (13.8%)	.77
Stroke	1 (3.3%)	3 (10.3%)	.58
Chronic Lung Disease	1 (3.3%)	2 (6.9%)	.98

Table 2. Elective Procedure (N=59)

	Pre-STOP-Bang Questionnaire n (%)	Post-STOP-Bang Questionnaire n (%)	<i>p</i>
Procedure			
Hip Arthroplasty	12 (40%)	7 (24.1%)	.44
Knee Arthroplasty	9 (30%)	7 (24.1%)	
Shoulder Arthroplasty	4 (13.3%)	5 (17.2%)	
Ankle Arthroplasty	2 (6.7%)	1 (3.4%)	
Carotid Stent/Endarterectomy	2 (6.7%)	2 (6.9%)	
Deep Brain Stimulator	1 (3.3%)	0	
Spinal Fusion/ Decompression	0	3 (10.3%)	
Abdominal Hernia Repair	0	1 (3.4%)	
Laparoscopic Bowel Resection	0	1 (3.4%)	
Cranioplasty	0	1 (3.4%)	
Transsphenoidal Hypophysectomy	0	1 (3.4%)	

Table 3. STOP-Bang Score (N=59)

	Pre-STOP-Bang Questionnaire Mean (SD)	Post-STOP-Bang Questionnaire Mean (SD)	<i>p</i>
STOP-Bang Score	5.23 (.50)	5.52 (.87)	.13

Table 4. Length of Hospital Stay (N=59)

	Pre-STOP-Bang Questionnaire Range, Median	Post-STOP- Bang Questionnaire Range, Median	p
Length of Hospital Stay	1-3, 1	1-16, 1	.005

Running head: EFFECT OF OBSTRUCTIVE SLEEP APNEA SCREENING ON OUTCOMES OF ADULT SURGICAL PATIENTS

Table 5. Postoperative Outcomes (N=59)

	Pre-STOP-Bang Questionnaire n (%)	Post-STOP-Bang Questionnaire n (%)	<i>p</i>
Extubated After Surgery			
Yes	30 (100%)	28 (96.6%)	.99
No	0	1 (3.4%)	
Non-Invasive Ventilation after PACU			
Yes	0	0	>.99
No	30 (100%)	29 (100%)	
Oxygen after PACU			
Yes	2 (6.7%)	2 (6.9%)	>.99
No	28 (93.3)	27 (93.1%)	
Re-intubated after Extubation			
Yes	0	0	>.99
No	30 (100%)	29 (100%)	
Cardiac Arrest			
Yes	0	0	>.99
No	30 (100%)	29 (100%)	
Outpatient Referral for Polysomnography			
Yes	1 (3.3%)	1 (3.4%)	>.99
No	29 (96.7%)	28 (96.6%)	

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Running head: EFFECT OF OBSTRUCTIVE SLEEP APNEA SCREENING ON OUTCOMES OF ADULT SURGICAL PATIENTS

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