USE OF EVIDENCE-BASED INSTRUMENT TO IDENTIFY PATIENTS AT RISK FOR OBSTRUCTIVE SLEEP APNEA: A PRACTICE IMPROVEMENT INITIATIVE

A DNP SCHOLARLY PROJECT

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE

DEGREE OF DOCTOR OF NURSING PRACTICE

IN THE GRADUATE SCHOOL OF THE

TEXAS WOMAN'S UNIVERSITY

COLLEGE OF NURSING

BY

KANMONY MATHEW, ACNP

DNP SCHOLARLY PROJECT

Dr. JAYNE DUNLAP, DNP, APRN, FNP-C, FACULTY LEAD

Dr. MARI TIETZE, PhD, RN-BC, FAAN, CONSULTANT

AUGUST 17, 2021

Abstract

Patients and healthcare professionals often neglect sleep apnea symptoms. The clinical team identified the need for Obstructive Sleep Apnea (OSA) screening in the local cardiology clinic patients. Outpatient clinics provide an opportunity to engage patients in maintaining healthy lifestyles, promoting health and well-being. OSA risk increases in patients with heart disease worsening symptoms of coronary artery disease, potentially leading to myocardial infarctions and strokes. This practice improvement project included implementation of OSA screening, risk education counseling, and referral of high-risk patients for a home or in lab sleep study. Upon confirmation of OSA diagnosis, patients were referred to a pulmonologist for OSA treatment initiation. A quantitative analysis of the practice improvement initiative was used to establish its effectiveness, and SPSS version 26 was used to analyze the data. The project has the potential for greater impact and plans for sustainability are in place to provide ongoing screening and evaluation of outcomes.

Keywords: sleep apnea, screening, diagnosis, home sleep apnea test.

Table of Contents

Implementation of Obstructive Sleep Apnea Screening Practice Improvement Initiative

Section I: Introduction of the Problem

Introduction/Background

Obstructive sleep apnea (OSA) is a sleep disorder affecting 26% of the American adult population. Among this population, 10% have moderate to severe sleep apnea (Patil et al., 2019). According to the American Academy of Sleep Medicine (2016), sleep apnea is defined as the transient cessation of breathing for more than 10 seconds during sleep. Three types of sleep apnea are identified: central, obstructive, and mixed sleep apnea. Central sleep apnea is due to the absence of airflow or inspiratory effort. OSA is the result of airflow cessation from upper airway blockage. Mixed sleep apnea is the combination of central and obstructive sleep apnea (Tietjens et al., 2019). OSA is the most common among the three types. Signs and symptoms of sleep apnea include insomnia, early morning headache, and increased sleepiness during the daytime, snoring, difficulty concentrating, memory impairment, and mood changes (Punjabi et al., 2013).

Some of the biological risk factors for sleep apnea are obesity, increased neck circumference, and narrowed airway. The socio-demographic risk factors include male gender, advanced age, family history of sleep apnea, use of alcohol or sedatives, and smoking. The medical conditions that increase the risk for sleep apnea are heart failure, hypertension, Type II Diabetes, Parkinson's disease, or chronic lung disease (Mayo Clinic, 2021). Sleep apnea, over time, increases the risk for cardiovascular comorbidities. There are several screening tools used to identify patients at risk for sleep apnea, and the STOP-BANG questionnaire is one of them (Miller et al., 2018). Research and evidence-based projects validate the efficacy of employing the STOP-BANG questionnaire to identify

sleep apnea risk. STOP-BANG is the preferred self-report screening instrument of OSA compared to other screening tools due to the high level of sensitivity (Miller et al., 2018).

Sleep apnea is diagnosed with either polysomnography (PSG) in a sleep lab or a Home Sleep Apnea Test (HSAT) (Kuna et al., 2011). A sleep study provides the classification of the severity of sleep apnea using the Apnea-Hypopnea Index (AHI) (Khattak et al., 2018). Pulmonologists can determine, diagnose and treat OSA. Treatment of OSA improves the quality of life and health (Hall et al., 2020). Early diagnosis and treatment of sleep apnea can prevent motor vehicle accidents, improve quality of life, and prevent cardiovascular sequelae. Behavioral, medical, dental, and surgical options are available for sleep apnea treatment, and out of these options, Positive Airway Pressure (PAP) is the first line of treatment for sleep apnea (Tietjens et al., 2019).

The clinic in which the project was initiated (local cardiology clinic) is one of the largest cardiology clinics located in southeastern Texas. The local cardiology clinic provides services to patients with heart failure, coronary artery disease, arrhythmia, hypertension, stroke, and structural heart diseases. The patient population is at high risk for sleep apnea and development of cardiovascular diseases such as Transient Ischemic Attacks (TIA), stroke, coronary artery disease, heart failure, hypertension, and arrhythmias such as atrial fibrillation (Laratta et al., 2017). Moreover, sleep apnea increases the risk for cardiovascular comorbidities such as hypertension, obesity, and congestive heart failure (Mayo Clinic, 2021). Approximately, 60 - 70% of patients with stroke and TIA have OSA (Leino et al., 2020). Besides, studies reveal that bariatric surgery patients have a 70-80% prevalence of sleep apnea (Kapur, 2017).

Obstructive sleep apnea is a life-threatening sleep disorder linked to a significant gap in timely diagnosis and treatment (Hartley et al., 2011). Approximately 5.9 million Americans are diagnosed with sleep apnea, whereas 23.5 million have undiagnosed sleep

apnea (American Academy of Sleep Medicine, 2016). Approximately, 82% of men and 92% of women with moderate to severe sleep apnea are undiagnosed (Wickramasinghe, 2020). According to Costa et al. (2015), lack of awareness about sleep apnea and under-appreciation of its seriousness are major causes of under-diagnosis and under-treatment. Most people tend to neglect sleep apnea symptoms compared to other disease symptoms due to the perceived austerity of the condition (Marshall et al., 2014). On the other hand, patients may not be aware of the apnea that happens in their sleep. Underdiagnosis and under-treatment of sleep apnea can lead to chronic cardiovascular or pulmonary diseases and results in a financial burden from chronic disease development (Punjabi et al., 2013).

The prevalence of sleep apnea in the general population is 24% in men and 9% in women (Obstructive Sleep Apnea, 2012). A pre-project pilot study was conducted in the local cardiology clinic, and the findings of the project are discussed here. Men are at higher risk for sleep apnea, with men comprising 50- 60% of patients at the local cardiology clinic. Anecdotally 50% of the local cardiology clinic patients are overweight or obese. Consequently, 30-40% of the patients complain of sleep issues per medical record review. Approximately 50 - 75% of clinic patients have hypertension. Several of the clinic patients complain of sleep issues at night, increased daytime sleepiness, and fatigue. Sleep apnea may be one of the root causes of cardiovascular disease. However, there are no screening guidelines in place to determine the level of risk to begin the referral, diagnosis, and treatment process of the local cardiology clinic patients. It is important to diagnose and treat the underlying cause of cardiovascular diseases in the local cardiology clinic population to ensure health promotion and further illness prevention.

A meta-analysis confirmed the high performance of the STOP-BANG questionnaire in screening OSA in the surgical population and patients of sleep clinics (Nagappa et al, 2015). Miller et al.(2018) compared the OSA screening tools STOP-BANG questionnaire,

Berlin, and ESS and found that STOP-BANG had the highest level of sensitivity in identifying OSA risk compared to other screening tools. STOP-BANG score of 4 has a high sensitivity of 88% in identifying severe sleep apnea, and a score of 6 has high predictability in diagnosing severe OSA (Chung et al, 2013). A small test of change for OSA screening at the local cardiology clinic using the STOP-BANG questionnaire identified 40- 50% of the patients with intermediate or high risk for OSA. An OSA diagnosis is confirmed by either polysomnography (PSG) in a sleep lab or a HSAT (Kuna et al., 2011).

The mission of our hospital system is its dedication to improving health. The vision of the hospital system is "to create healthier communities now and for generations to come" (MHHS, 2020). Keeping in line with the mission and strategic initiatives of the overall health system and the clinic specifically, it was decided to implement an OSA screening practice improvement initiative in the clinic to help promote cardiovascular health. Detecting and diagnosing OSA will allow opportunities for subsequent treatment and eventual life quality improvements for the clinic patients. Providing an objective risk score for OSA and risk counseling encourages patients to understand the need for further measures to diagnose and treat OSA(Williams et al., 2012). Screening for OSA, promoting a healthier lifestyle for the clinic patients at high risk for OSA, diagnosis, and treatment interventions can improve sleep disorders and better health and heart outcomes (Aiello et al., 2016). The clinic team is passionate about providing patient-centered care and ensuring comprehensive health care to every clinic patient.

Program Description

The project implementation of OSA screening practice improvement initiative was done as part of the curriculum requirement for the Doctor Program of Nursing Practice (DNP) of Texas Woman's University. The hospital system Institution Review Board (IRB)

panel reviewed the project and approved it as a quality improvement project. Implementation of the OSA practice improvement project as it is a new initiative in the clinic using an evidence-based instrument to identify patients at risk for OSA. There were no OSA screening strategies in the clinic before project implementation. The needs assessment and research evidence support the need for OSA screening to prevent cardiovascular complications. IRB approval letter is attached in Appendix A.

Organization

The local cardiology clinic is one of the largest cardiology clinics located in southeastern Texas. It is a satellite clinic of one of the best and well-known cardiology and heart failure services in America. The clinic provides services that manage cardiovascular diseases such as cardiac rehabilitation programs, vascular testing, and consultancy for cardiac and neurological care, on-call heart and stroke specialist services, and recovery care for heart attacks. In addition, the clinic provides treatment for surgical interventions such as trans-catheter valve replacement and management of severe aortic stenosis. The clinic is, therefore, able to detect cardiovascular disease development at the initial stages and provide suitable care interventions.

PICOT Question

The project PICOT question: Population: All patients of a local cardiology clinic older than 18 years visited the clinic between 02/22/2021 and 03/24/2021 for an ongoing cardiovascular diagnosis. Intervention: Screening for Obstructive Sleep Apnea (OSA) with the STOP-BANG instrument combined with clinical practice judgment for the identification of at-risk and possible diagnosis of patients. Comparison: Screening for OSA by expert clinician judgment with a possible diagnosis. Outcomes: Number of patients 1). identified at risk 2). underwent sleep study 3). diagnosed and followed up for treatment of OSA. Time: Over 10 weeks.

The project Inquiry Question: Does implementing an obstructive sleep apnea screening practice improvement project improve the identification and diagnosis of patients with OSA at the local cardiology clinic?

Purpose/Aim/Objectives

By March 2021, through screening and clinician judgment 100% of clinic patients who are at high risk for OSA will be identified and placed on a diagnostic pathway. The specific project aims are to improve the number of patients that are identified using the STOP-BANG screening instrument plus clinician judgment as 1) high risk for OSA and 2) lead to the opportunity for diagnosis via diagnostic testing with the HSAT or the in-lab sleep study so that treatment is offered to those that have OSA. Ultimately, it is hoped that this will reduce the burden of cardiovascular complications, improve health, and decrease cost.

Needs Assessment and Problem

The needs assessment of the project was completed using a Strength, Weakness, Opportunities, and Threat (SWOT) analysis. As noted, the local cardiology clinic patients have cardiovascular diseases, and the project implementation of OSA screening practice improvement initiative is appropriate for the clinic. The clinic project team and hospital administrators understood the need for OSA screening in the clinic and were supportive of the project.

We identified many strengths which support the aptness of the project in the local cardiology clinic. The local cardiology clinic provides quality care for the population with various cardiovascular issues. As sleep apnea is seen in patients with different cardiovascular diseases the local cardiology clinic is ideal for the project site. The staff in the local cardiology clinic are dedicated, enthusiastic, and passionate about their role in advancing the cardiovascular health of the community, the sleep apnea screening project

will provide an opportunity for the staff to serve for the betterment of the people. The experienced APRN who knows the impact of sleep apnea in cardiovascular health can educate and motivate patients to take necessary steps to promote cardiovascular health by identifying and getting treatment of OSA. The APRN is excited about the implementation of the project as she will get an opportunity to influence patients' lives. The local cardiology clinic functions with inter-professional collaboration that is very apt for any new endeavor. The sleep apnea practice improvement project needs inter-professional collaboration for proper implementation.

Even though the local cardiology clinic is one of the suitable places for the implementation of the sleep apnea practice improvement project many weaknesses can impede the overall process. At present, there is no existing sleep apnea screening practice in the local cardiology clinic. Implementing a new process requires significant effort, proper planning, team coordination, and the overall process will be time-consuming. Some patients stated reluctance to undergo OSA diagnostic tests especially in-lab sleep studies with the fear of contracting COVID-19 infection. In many cases, patients tend to address acute illnesses first before getting help for chronic health problems. Staff shortage and high staff turnover will force the clinic to provide repeat education and training for the staff to maintain the project. The staff shortage can overall impede the smooth running of the project and delay the project time. High clinic patient volumes and limited provider time can reduce the effectiveness of risk education counseling to patients. Although OSA is a common health issue, many patients lack understanding of the health consequences of OSA.

The local cardiology clinic provides an opportunity to implement OSA screening due to the high-risk nature of the clinic population. Implementation of sleep apnea screening provides an opportunity to improve the cardiovascular health of clinic patients

by treating OSA, one of the causes of health care burden in America. The project will also allow improvement in the pulmonologist referral pipeline.

The project has high potential in the improvement of transitional care for patients diagnosed with OSA. The local cardiology clinic has a multidisciplinary team and inter-professional collaboration with the pulmonary team makes the transition of care of patients diagnosed with OSA easier. The local cardiology clinic has resources and opportunities like periodic educational sessions available to meet the continued need for staff education for the project's success.

The project may encounter many threats during its course. One of the possible threats can be the lack of financial support. Patients who do not have insurance will not be able to afford the expense of sleep study. Another instance of high insurance co-pays for the sleep study can be the cause of a patient's financial issues. Language and educational barriers can be a hindrance in convincing the patient about the need for a sleep study and further management. Patients with language and educational barriers may need multiple educational sessions to ensure awareness about OSA. The same language and educational barriers can limit the ability to effectively communicate the risk of OSA to patients. The complexity of the system for follow-up can cause fall out patients in the overall process of the project. A proper tracking system will aid in the completion of sleep studies and pulmonary referral for treatment.

Theoretical/Conceptual Framework

Pender's health promotion model guided the project although Pender’s model is not directly related to the screening and diagnosis of OSA. However, Pender’s model is used for the work of the sleep apnea project as it aims at health promotion. Pender's health promotion model describes a person's multidimensional nature, as they interact within their environment to pursue health. The three concepts of Pender's health promotion

model are individual characteristics and experiences, behavior-specific cognitions and affect, and behavioral outcomes (Pender et al., 2011). The individual characteristics and behaviors of every person affect their health belief models. In the case of sleep apnea, lack of exercise, sleeping position, obesity, and use of alcohol before bedtime increase the risk for sleep apnea. An individual's perception of sleep apnea impacts their health and leads to many cardiovascular complications. Variability of knowledge can influence or motivate desirable behavioral change that is brought by nursing actions. Objective evidence of the OSA screening result and risk education counseling serves to increase patient's awareness about OSA. The goal is to increase awareness of risk thereby motivating patients to change their behaviors.

The initiative of implementing an OSA screening practice improvement project helped to identify and diagnose OSA which may open a future opportunity for health promotion. Eventual change to a health-promoting behavior leads to the desired health outcome. When patients are willing to adopt healthy behaviors to correct OSA, they will significantly reduce cardiovascular complications. Regular exercises, avoiding alcohol before bedtime, sleeping on a side, and weight reduction are desired behaviors, and those behaviors improve the health quality and functional ability of OSA patients (Patil et al., 2019). Besides, the use of CPAP devices and desired behavior changes help to correct sleep apnea. Health-promoting behavior is the action-outcome that is directed to achieve positive health outcomes such as optimal well-being, personal fulfillment, and productive living (Gonzalo, 2019). Pender's health promotion model is attached in Appendix B.

Section II: Presentation of Evidence

Review of Evidence

The evidence synthesis provides the research support for the rigorous implementation of evidence-based interventions. There are processes to search for, find, critically appraise, and synthesize the highest levels and strongest (quality) evidence. The organization of completing an evidence synthesis included a detailed literature search, literature review, critical appraisal of the research, identification of themes, and evidence synthesis. The databases used for the article search were Pub Med, Google Scholar, Medscape, Cochrane, Science Direct, Ovid, CINAHL, Academic Search Complete, and EBSCO. The keywords or terminologies used for the literature review were 'obstructive sleep apnea,' 'sleep apnea screening,' 'STOP-BANG questionnaire,' 'Home Sleep Apnea Test,' 'Level III Sleep Test,' 'sleep apnea burden,' 'sleep apnea and obesity,' and 'sleep apnea education.' Five literature searches were conducted. Articles reviewed were peer-reviewed and published in the English language from 2010 to 2020.

A total of 60 articles were generated from all literature searches. From the 60 articles, 23 articles were selected for the evidence synthesis based on filtering for outcomes, types of research, and relevance to the interventions. Levels of evidence of the articles were assessed with the evidence pyramid (Winona State University, 2021). The 23 articles revealed multiple levels. Specifically, level I (11), level II (4), level III (1), and level IV (7) were selected and critically appraised. The final research articles for the evidence synthesis included a systematic review, systematic review and meta-analysis, and randomized control trials which were appraised at the highest quality. Research articles for cohort studies, case-control studies, and descriptive studies were appraised and found to be at a moderate strength (quality) of evidence. There were 11 high-quality (strong) articles and 12 articles with moderate strong evidence. The research evidence was

critically appraised using the Critical Appraisal Skills Programme (CASP) (Critical Appraisal Skills Program, n.d) and overall determined to have a quality that was moderate to strong. A large sample size, appropriate research methodology, rigorous data analysis, and a clear research statement justified moderate to a high quality of evidence.

Evidence Synthesis

A selected review of the research was informative and synthesized to identify themes related to the project, as follows:

The study by Ononye et al. (2019) concluded that the implementation of obstructive sleep apnea screening in outpatient or primary care settings is effective in identifying OSA. OSA screening increased from 3% to 43%, and referrals increased from 0% to 39% post-implementation of the STOP-BANG questionnaire per the study done by Ononye et al. (2019). Showalter & O'Keefe (2019) conducted obstructive sleep apnea screening in a primary care clinic, 40% of the study participants were identified as at high risk for OSA. Among those, 33% were referred for PSG, and all of them were diagnosed with sleep apnea. Those studies support the need for obstructive sleep apnea screening in outpatient clinics.

According to Miller & Berger (2015), the STOP-BANG questionnaire has high sensitivity in identifying sleep apnea. The STOP-BANG questionnaire has high sensitivity and high negative predictive value (Nagappa et al., 2015). AHI of more than 5 has 90 % sensitivity for sleep apnea, AHI more than 15 has 94% sensitivity, and AHI more than 30 is 96 % sensitive for sleep apnea. The risk for OSA increases, according to Karimi et al. (2018), with higher odds in postoperative atrial fibrillation. Modified STOP-BANG questionnaire STOP-BAG-O is a valid tool in identifying OSA in patients with post-stroke or TIA (Boulos et al., 2019). There is a significant gap in OSA assessment in older Americans per Braley et al. (2018). The study by Devaraj et al. (2017) did not support the

effectiveness of the STOP-BANG questionnaire. The study concluded that the STOP-BANG questionnaire showed low performance in identifying sleep apnea in the South Indian population. STOP-BANG questionnaire is validated in obese and morbidly obese surgical patients. Chung et al. (2013) concluded that a STOP-BANG score of 4 has high sensitivity (88%) in identifying severe sleep apnea, and a score of 6 has high predictivity in diagnosing severe OSA. The study emphasized the sensitivity of the STOP-BANG questionnaire in identifying sleep apnea risk.

A study by Braley et al. (2018) concluded that 56% of participants who completed the sleep module estimated high risk for sleep apnea, but only 8% of high-risk individuals were tested. Ninety-four percent of tested individuals were diagnosed, and 82% were treated with positive airway pressure. Men were at high risk for developing sleep apnea. Another study done by Showalter & O'Keefe (2019) showed that all the men in the study were in the category of moderate or high risk for sleep apnea.

Donovan et al. (2017) found that many diabetic patients without symptoms of sleep apnea were at high risk for sleep apnea per the STOP-BANG questionnaire, and among those who agreed to a sleep study, the prevalence of sleep apnea was high. The study supported a high prevalence of sleep apnea in diabetic patients. The study by Donovan et al. (2017) concluded that Positive Airway Pressure (PAP) significantly reduces sleep-related symptoms but failed to achieve glycemic control and minimize hospitalization rates. Studies by Patil et al. (2019), Hall et al. (2020), Aiello et al. (2016), Barbe et al. (2012), Martinez - Garcia et Al. (2013), and Durán-Cantolla et al. (2010) supported that sleep apnea treatment improves the quality of life of patients.

According to Rosenberg et al. (2019), the use of the HSAT increased greatly compared to PSG. HSAT was used to diagnose OSA in patients with high daytime sleepiness due to its lower cost, lesser technical complexity, and greater convenience. The

HSAT monitors oro-nasal airflow (using a thermistor and nasal cannula), thoracic and abdominal effort, oxyhemoglobin saturation, electrocardiogram, and determination of the body position (Saletu et al., 2018) to diagnose OSA. In 2007, the US Centers for Medicare and Medicaid Services approved the use of portable OSA monitoring to increase the diagnosis of the disorder and to shorten the initiation of PAP therapy (Punjabi et al., 2013). The American Academy of Sleep Medicine's (AASM) current consensus recommends portable monitors over PSG (Cooksey & Balachandran, 2016). The laboratory PSG testing is beneficial for patients with severe cardiovascular, pulmonary, neuro-muscular disorders, or concomitant sleep disorders over home testing (Kundel & Shah, 2017). Home-based diagnostic testing and management are less expensive than the laboratory testing and management of OSA (Kim et al., 2015). Educational, behavioral, telemonitoring, and troubleshooting measures ensure adherence to sleep apnea therapy (Patil et al., 2019).

Themes

Selected literature review and evidence synthesis helped develop themes to support the DNP project. The themes developed are as follows: Screening for sleep apnea in outpatient settings was likely to reduce the number of undiagnosed sleep apnea cases (Ononye et al., 2019; Showalter & O'Keefe, 2019). The STOP-BANG questionnaire was found to be a sensitive and valid tool to diagnose sleep apnea (Miller et al., 2015, 2018; Chung et al., 2013; Orbea et al., 2020; Nagappa et al., 2015). Sleep apnea appeared to be more prevalent in males than in premenopausal females (Showalter & O'Keefe, 2019).

HSAT is more convenient, less expensive, and faster than the laboratory PSG test (Saletu et al., 2018; Labarca et al., 2018; Kim et al., 2015). There appeared to be a significant correlation between the treatment of sleep apnea with quality of life of patients and cardiovascular complications (Patil et al., 2019; Hall et al., 2020; Aiello et al., 2016;

Barbe et al., 2012; Martinez - Garcia et Al., 2013; Durán-Cantolla et al., 2010). Evidence synthesis supports the need for sleep apnea screening in the local cardiology clinic. The evidence table is attached in Appendix C for review.

Section III: Methodological Framework

Implementation of the OSA screening practice improvement initiative included screening for obstructive sleep apnea risk using STOP-BANG questionnaire, risk education counseling for patients screened for OSA, referral for a Home Sleep Apnea Test (HSAT) to determine OSA, and a referral to a pulmonologist for diagnosing and treatment of sleep apnea patients.

Restate Inquiry Question (Problem Statement)

Does implementing an obstructive sleep apnea screening practice improvement project improve the identification and diagnosis of patients with obstructive sleep apnea (OSA) at the local cardiology clinic?

Describe Type of Project (QI, EBP, PE, Policy)

Implementation of OSA screening is a practice improvement initiative using an evidence-based instrument. The University of Iowa model was the framework used for this evidence-based practice project. Appendix D includes the Iowa model, and Appendix E includes permission to use the model for the DNP project. The need for obstructive sleep apnea screening in the local cardiology clinic can be evidenced by the significant increase in the identification and diagnosis of OSA with the implementation of the OSA screening practice improvement initiative. Screening, diagnosis and eventual treatment of OSA is a patient outcome expected to improve quality of life by preventing comorbidities.

Implementation Framework

The Iowa Model (University of Iowa Hospitals and Clinics, 2021), which is an evidence-based practice model, was selected as the most appropriate implementation framework to support this project. Evidence-Based Practice (EBP) models are used for the effective dissemination of research findings into the clinic settings. The Iowa model considers the entire health care system to implement or change the practices based on the

best research evidence (University of Iowa Hospitals and Clinics, 2021). The Iowa model has seven steps. The first step in the process is to identify the type of trigger for the project. The trigger can be either knowledge-focused or problem-focused (Connect, 2020). The OSA screening tool implementation includes both problem-and knowledge-focused triggers. The diagnosis and effective management of OSA reduce the health risk for cardiovascular complications of patients. The second step in the model is to identify if the study topic is a priority for the organization.

The OSA screening implementation was identified as a priority for the organization. It aligns with the vision of the organization to ensure the health promotion of the community by preventing cardiovascular morbidities. The third step in the framework is to form a project team. This team consisted of physicians, medical assistants, the clinic manager, the clinic coordinator, administrative staff, and the nurse practitioner (NP). The roles and responsibilities of each team member were clearly defined and provided in appendix F. For example, medical assistants and clinic administrative staff were educated about OSA and the STOP-BANG questionnaire. The fourth step is the literature search which involves gathering external evidence (data) supporting the need for OSA screening in the clinic.

The research evidence was extracted, critically appraised, and synthesized for common patterns and themes in the literature. The PICOT question was revised based on the evidence. The fifth step determined if enough research evidence existed to support the project. The data supported the need for early diagnosis and treatment of OSA to prevent cardiovascular complications. Ononye et al. (2019) noted sleep apnea screening in a primary health care setting increased sleep apnea risk identification from 3% to 43%, and referral for sleep apnea diagnosis increased from 0% to 39%. The sixth step in the framework is the trial of the project, that is setting up a pre-project pilot.

The pilot project identified the outcome and evaluated the process so that necessary modifications could be made to the project. The next step was to determine if the change (screening practice improvement initiative) was appropriate for adoption in practice. The change would be assessed to determine if the continuation of the OSA screening practice improvement initiative was necessary for the health promotion of high-risk clinic patients and if a value was added. The clinic will continue to evaluate the project quality. The next step will be to monitor and analyze the structure, process, and outcome of the data. The last step is to disseminate the results of the project to the health care setting if appropriate.

Obstructive sleep apnea risk education counseling was initiated to increase patient's awareness about OSA. The sample risk education material is provided in Appendix G. The outcomes of the sleep apnea screening project were evaluated by measuring the following data: the number of patients screened for OSA, the number of patients who received risk education counseling, the number of patients identified as high risk for OSA, the number of patients who underwent home sleep apnea test, the number of patients diagnosed with OSA, and the number of patients referred to a pulmonologist for treatment.

The roles and responsibilities of the team members were clearly defined prior to the new process implementation. Project-related responsibilities were entrusted to the team members in addition to their routine roles and responsibilities. Specific responsibilities of team members concerning the sleep apnea project were reviewed and discussed. The role of the NP was mainly in the assessment of the patients. The NP served as the lead project manager, responsible for team members' education on OSA, its impacts, the screening tool, and the detailed step-by-step process. A medical assistant introduced the OSA screening tool STOP-BANG questionnaire to the patient. A second

medical assistant obtained the patient's measurements including height, weight, neck circumference, and calculated BMI. Every patient received written educational materials prior to screening.

The NP helped patients to complete the STOP-BANG screening instrument, provided risk education counseling to all the screened patients about OSA, calculated the risk score, and identified the patients who needed a Home Sleep Apnea Test (HSAT) or in lab sleep study based on the screening tool and clinical stability. The NP incorporated her clinical judgment in the decision-making process to determine the suitable diagnostic modality for every patient. The project decision tree is provided in Appendix H for reference. The unstable heart failure (Stage IV heart failure) or stroke patients were offered an in-lab sleep study and all remaining patients were directed for a HSAT. The NP prescribed and explained the purpose of the sleep study to patients identified as high-risk for OSA. The NP assisted patients identified as high risk for OSA and willing to undergo HSAT to complete the screening form for pre-authorization of insurance pre-authorization for submission for approval. The third medical assistant informed the patient about the insurance decision. The physician collaborated with the NP in the referral process.

As the project lead, the NP assumes responsibility for documenting the patient’s risk score and category of OSA screening. The NP conducted risk education counseling, reviewed recommendations, and followed up on the patient’s decision. When indicated and approved, the patient was informed that material for HSAT would be mailed to their home within three days. The sleep lab communicated the results of the testing to the clinic. The NP notified the patient about the test results. Patients diagnosed with OSA were referred to the pulmonologist and provided with the contact details of the pulmonologist for follow-up.

The administrative staff ensured the patient was referred to the pulmonologist. The NP followed up with the pulmonologist and the patient to validate the status of the referral and treatment. The clinic coordinator and NP had ongoing meetings with the team to ensure continuity of the overall process. Clear and well-defined roles and responsibilities of stakeholders eased the process to achieve the goal of effective OSA screening. Re-education of team members and organizing weekly team meetings, and evaluation of the process with necessary modifications were ongoing.

Data Analysis Plan

Demographic data and clinical demographics were entered on an individual data sheet, and data were transferred to an Excel spreadsheet. The sample individual data sheet is given in Appendix I and the sample excel spreadsheet in Appendix J. The Excel data was imported to SPSS for data processing. A statistical process control run chart (Perla et al., 2011) was used to evaluate the overall process of the project implementation.

Data Collection Approach

All the patients of the local cardiology clinic were screened for OSA using the STOP-BANG questionnaire. The STOP-BANG questionnaire is a self-reportable straightforward tool that takes approximately 1-2 minutes to complete. It has four self-reportable (STOP: snoring, tiredness, observed apnea, and hypertension) and four demographic data (BANG: BMI >35, age >50 years, neck circumference >40cm, and male gender) (Nagappa et al., 2015). Every patient's demographic data and the clinical demographic data were collected and entered manually in a data collection sheet. The STOP-BANG questionnaire provided a total score ranging from 0-8. A score ranging from 0- 2 indicates low risk for sleep apnea, and a score of more than 3 indicates moderate to high risk for sleep apnea (Chung et al., 2016). Pivetta et al. (2021) has conducted a systematic review to evaluate the sensitivity and specificity of the STOP-BANG

questionnaire and concluded the following details. STOP-BANG score of 3 and up has a high sensitivity of more than 90% in identifying the risk for OSA. The negative predictive value for OSA with STOP-BANG score of 3 & 4 is 77%. The negative predictive value for OSA with a score of 5 and up is 91%. The diagnostic accuracy of STOP-BANG score of 3 and up is more than 80%. The systematic review by Pivetta et al. (2021) proved that the STOP-BANG questionnaire is a valid tool in assessing OSA risk in patients. Every patient's demographic data, the clinical demographic data, STOP-BANG questionnaire score, patient's risk nature for OSA, number of patients educated about OSA, patients referred for the HSAT, and information on referral to the pulmonologist were collected for the project. The sample STOP-BANG questionnaire is attached in appendix K for review.

Timeline (Proposed)

The pre-implementation data collection was conducted for 6 weeks before the actual project data collection to assess the OSA risk identification in the clinic population prior to the project implementation. The project was planned for two months from 2/10/2021 to 3/30/2021. Anticipating the initiation of OSA screening practice improvement project on 2/10/2021 with weekly data collection. The project timeline is outlined in the Gantt chart in Appendix L. Patients in the high-risk category for OSA based on the STOP-BANG questionnaire were arranged for HSAT to diagnose OSA. Patients diagnosed with OSA were referred to a pulmonologist for obstructive sleep apnea treatment.

Operational Definitions

The outcome measures for the project were the number of patients identified with high risk for OSA, the number of patients who underwent HSAT, the number of patients diagnosed, and followed up with the pulmonologists for treatment of obstructive sleep apnea. Operational definitions are provided in Appendix M.

Data Evaluation Plan

Demographic data of patients were collected as part of the study and included age, gender, education, race, and living arrangements, and demonstrated using bar graphs. BMI was depicted using a histogram. Statistical process control used a run chart demonstrating the outcome measures of OSA screening.

Section IV: Findings/Results

The project is the implementation of an OSA screening practice improvement initiative using the STOP-BANG questionnaire (Nagappa et al., 2015) and associated evidence-based instruments, in the local cardiology clinic. This implementation was considered a health promotion initiative within the clinic and supported by providers and staff. Pre-implementation data collection was conducted for 6 weeks before the screening and data collection to evaluate the existing process in the clinic. There were no patients screened for OSA risk, identified, or treated for OSA prior to the project implementation. The clinic team was educated about the sleep apnea project and its processes in January 2021 and reinforced before the project initiation in February 2021. See Appendix G for the educational materials used in the January 2021 education session of which one provider and six staff attended. The screening was initiated on February 22, 2021 and ended on March 24, 2021.

The outcome measures for the project were ascertaining the proportion of patients at the local cardiology clinic with OSA diagnosis. Level 1 outcome measure was screening patients using the STOP-BANG instrument to identify the level of risk for OSA. The level 2 outcome measure was conducting an HSAT or in-home sleep study or in-lab sleep study as a diagnostic tool. The level 3 outcome measure was the diagnosis of OSA with subsequent treatment and follow-up. All patients (100%) who visited the clinic during the project period were screened and identified for OSA risk. The STOP-BANG questionnaire was used to screen patients for OSA, which is provided in Appendix H. Patients who scored 5 to 8 with the tool were considered high risk for OSA.

We collected basic demographic, clinical demographic, and project-based information on all patients who qualified for the project. Additionally, a run chart (Institute for Healthcare Improvement (IHI), 2021) was used to evaluate the outcome

measures associated with the project implementation of the OSA practice improvement initiative for patient screening and management. All data collected were initially entered manually in an individual data collection sheet and transferred to an Excel sheet. Data were collected daily and evaluated based on the proportion of patients seen in the clinic that day. The run chart template by IHI was used to evaluate the process over time.

Characteristics of Sample

Basic Demographics

All patients who visited the local cardiology clinic during the project time and not on sleep apnea treatment were screened for OSA. The basic demographics of the 226 patients in the project indicated that they tended to be white, college-educated, and lived with the family (see Figures 1, 2, and 3). The average age was 64.0 (Standard Deviation (SD) 15.0). People above 50 years are more prone to develop OSA. The average age of 64 is significant, and the local cardiology clinic population is at high risk for OSA in terms of their age. Figure 4 illustrates the age distribution. Gender was equally distributed among males and females [approximately 50% each].

Figure 1

Race Distribution

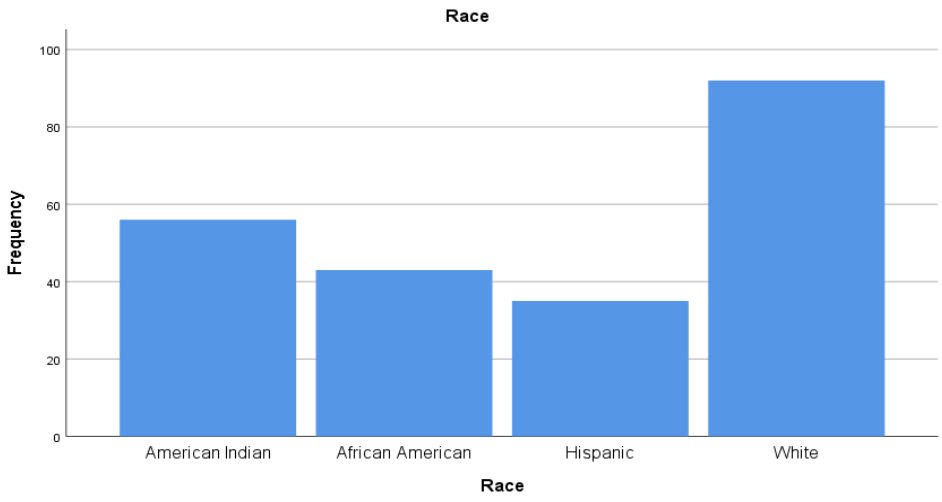


Figure 2

Educational Level

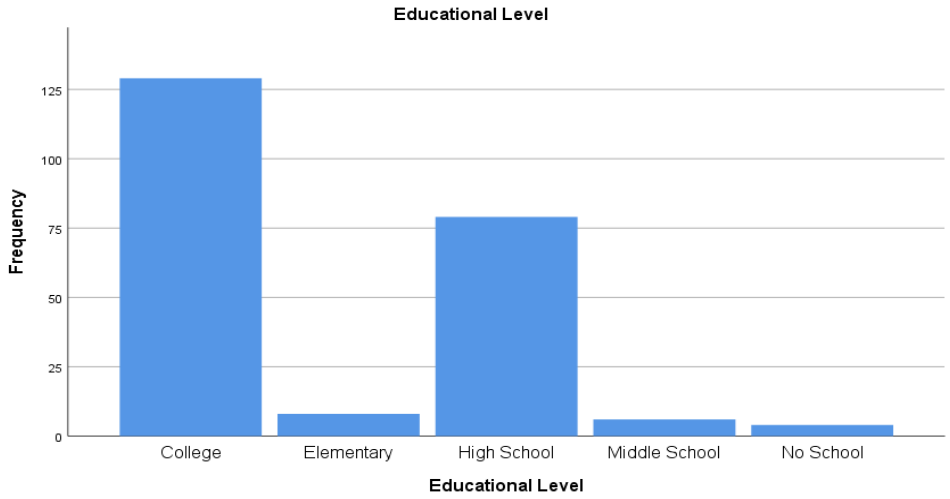


Figure 3

Living Arrangements

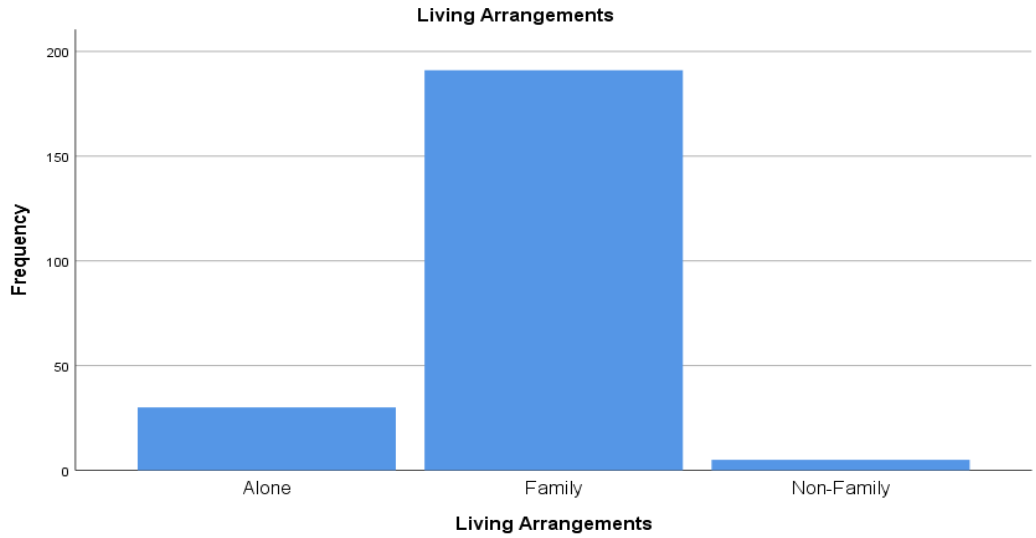
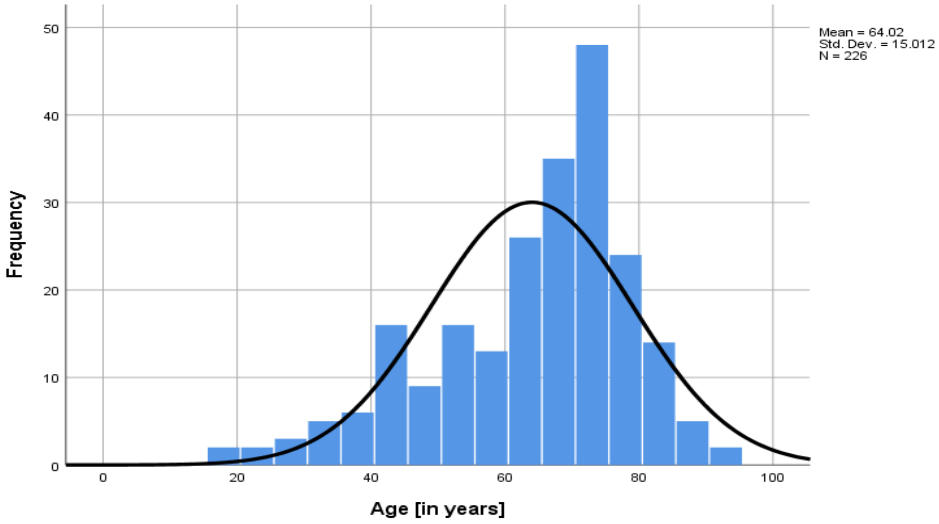


Figure 4

Age Distribution

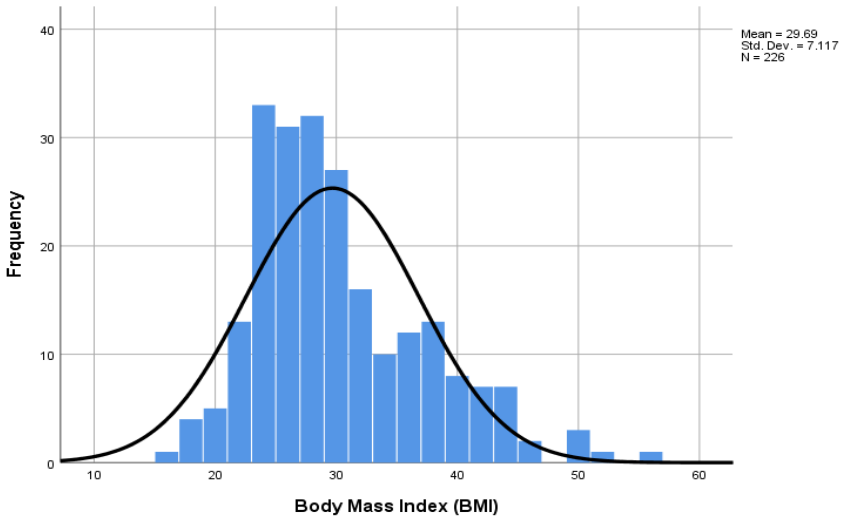


Clinical Demographics

Body Mass Index. Body mass index (BMI) information was collected from the electronic health record. The mean BMI value of 29.69 (Std Dev. 7.12) was found to be the expected norm for a population of this race and age (Romero-Corral et al., 2010) as shown in figure 5 for the project participants' distribution (see Figure 5). Normal BMI is 18.5 to 24.9, overweight is 25 to 29.9, and obesity is BMI >30. Obesity increases the risk for OSA, and the average BMI of the local cardiology clinic throws light into the risk nature of the clinic population for OSA in terms of their BMI.

Figure 5

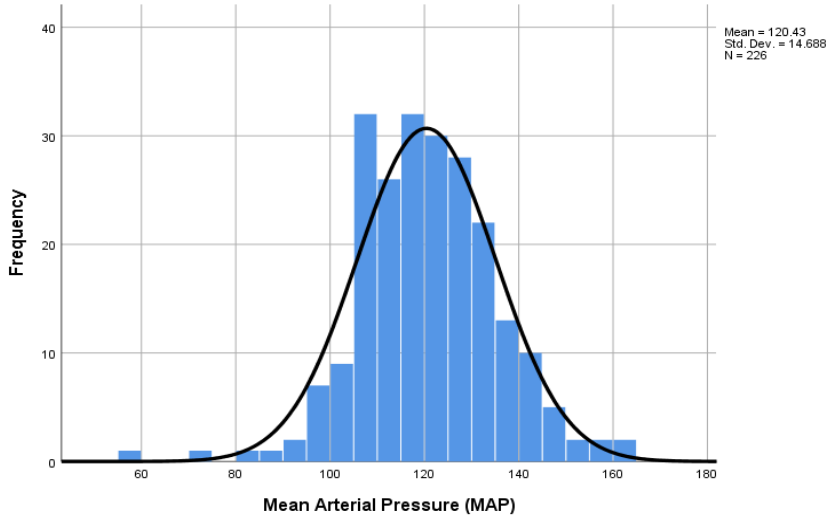
BMI Distribution



Mean Arterial Pressure. *Mean arterial pressure* (MAP) information was collected from the medical record. The mean MAP value of 120.43 (Std Dev. 14.69) was found to be expected norms for a population of this race and age (Showalter & O'Keefe, 2019) as shown in Figure 6 for the project participants' distribution. The normal MAP is 70-100 mm of Hg, the MAP more than 100 mm of Hg is high. Hypertension is commonly seen in patients with OSA. The mean MAP value of the local cardiology clinic of 120.43 shows the importance of OSA screening in the local cardiology clinic.

Figure 6

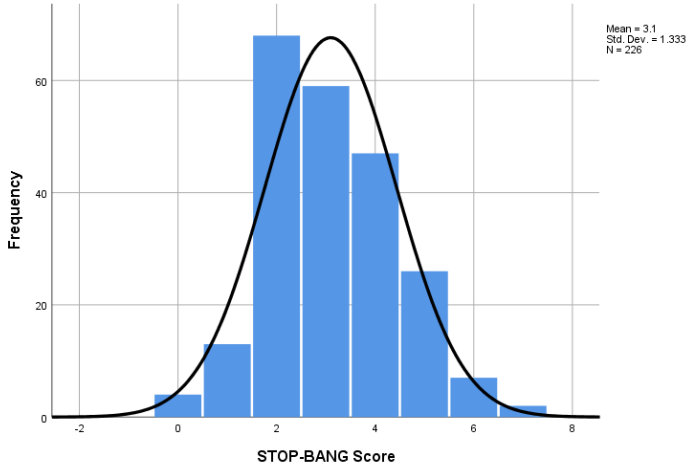
Mean Arterial Pressure Distribution



STOP-BANG Score. The STOP-BANG score information was collected directly from the patient. The mean value of 3.1 (Std Dev. 1.33) was found to be expected norms for a population of this race and age according to the historic use of this instrument (Nagappa et al., 2015) as depicted in Figure 7 for the project participants' distribution. The STOP-BANG score of 3 represents an intermediate risk for OSA. The local cardiology clinic population is at risk for OSA based on the STOP-BANG score.

Figure 7

STOP-BANG Score Distribution



History of Chronic Conditions

Of the screened patients, 16.8% had asthma, and 12.4% had other breathing disorders. 17.7% had anxiety or other mental health issues. No correlation between asthma, lung diseases, or anxiety/depression with OSA was found. 77% of the clinic population were hypertensive, and 60% have cardiac diseases. As per the evidence synthesis, sleep apnea leads to comorbidities like hypertension or cardiac diseases.

Evaluation of Project Outcomes

The sleep apnea practice improvement project specified six actions to be included for the ideal management of patients with OSA. Each one of those outcomes is monitored for a proportion of the time when the action was accomplished [numerator] compared to the number of times when the action should have been accomplished [denominator]. Figure 8 provides an overview of the results of these outcomes which follow by a detailed discussion of each.

Figure 8

Evaluation of Intervention- Related Outcomes

Outcome	Results (n) %
Screened OSA n=226	(226) 100%
Received risk counseling n=226	(226) 100%
Identified high risk n=226	(83) 37%
Initiated Home Sleep Apnea Test (HSAT) n= 83	(51) 61% (9) 11% HF (23) 28% Refused
Completed HSAT n= 51	(12) 24% No HSAT (39) 76%
Diagnosed with OSA n=13	(13)
Referred to pulmonologist for treatment n=13	(13)

1.Screening for Obstructive Sleep Apnea:

We were able to meet our first outcome goal of screening 100% of the local cardiology clinic patients for OSA during the project time. The medical assistants introduced the screening tool to patients, the NP assisted the patients to complete the screening tool and scored the tool. All patients who visited the clinic during the project period were screened using the STOP-BANG questionnaire. We achieved our first

outcome goal through team effort and proper planning. The STOP-BANG score was documented in the clinic note along with the patient's symptoms and risk stratification. It is important to continue screening for OSA until we screen all patients of the local cardiology clinic.

2.Risk Education Counseling About Obstructive Sleep Apnea:

Risk education counseling was also successful. We were able to educate all (100%) screened patients about OSA, and the risk education material was provided to them. Medical assistants handed over the education materials to the patients right after the registration process, and prior to the obstructive sleep apnea screening a short introduction was given on OSA. Patients got to review the education material while waiting for the provider. The NP provided detailed education to the patients after the OSA screening. Patients had the opportunity to ask questions. Education is an important aspect to increase patients' awareness about OSA. The risk education material was scanned into the patients' medical records for future reference. The NP documented the risk education in the clinic visit note. The leadership team should ensure the sustainability of patient education in the clinic by establishing a policy.

3.Identified as High Risk for Obstructive Sleep Apnea:

The STOP-BANG score of 5-8 is considered high risk for OSA. Screening the local cardiology clinic patients for OSA using the STOP-BANG questionnaire identified 83 (37%) patients as high risk for OSA. As discussed earlier, OSA screening was a new initiative in the local cardiology clinic. Compared to the pre-implementation period, identification of high-risk patients was a significant process improvement as the score increased from 0%-37%. Thus, the outcome identification of patients at high risk for OSA was successful during the project period. It is important to continue screening for OSA so that patients can be treated on a timely basis to prevent comorbidities from OSA. It is

evident from the high-risk patient proportion (37%) that obstructive sleep apnea screening practice improvement initiative implementation was required in the local cardiology clinic. The research evidence supports the need for a sleep study for patients in the intermediate (score of 3 and 4) and high-risk (score of 5-8) category (Chung et al. (2013). If we recommend a sleep study for patients with the STOP-BANG score of 3 and up, there would have been an overwhelming number of patients who need to go for a sleep study. The majority of the patients with a STOP-BANG score of 3 did not have symptoms of OSA and it was hard to convince them for sleep study. The above reasons made us recommend a sleep study for patients with a STOP-BANG score of 4 and up. According to Pivetta et al. (2021), the STOP-BANG score of 3 & up has a high sensitivity of more than 90%. This evidence supports a further increase in the number of patients requiring sleep study in the local cardiology clinic.

4.Referred for a Home Sleep Study, Underwent Home Sleep Apnea Test:

Patients identified as at high risk for OSA were referred for either a home sleep apnea test or referred to a pulmonologist for an in-lab sleep study. A sleep study was highly recommended for patients with a STOP-BANG score of 4 and up. An in-lab sleep study was deemed a better option for patients with a neurological disorder or unstable heart failure (Stage D) than a home sleep apnea test. We considered stage D heart failure patients as unstable and recommended an in-lab sleep study. Of the identified high-risk patients, 61.4% (51 patients) were arranged with an HSAT, and 11% (9 patients) referred to a pulmonologist for an in-lab sleep study. American Academy of sleep medicine guideline recommends in-lab sleep studies for patients with significant cardio-respiratory diseases (Kapur et al., 2017). Due to medical complexity, this subgroup of patients did not meet indications for an HSAT study. The remaining 23 patients (28%) were against proceeding with a sleep study even after the risk education due to multiple reasons, and a

few were not convinced about having OSA. Patients were to fill the insurance pre-authorization screening forms and the medical assistant submitted them to insurance for pre-authorization. The sleep study lab informed patients about the insurance decision.

At present, data of the number of patients who completed the sleep study remains in process. Many patients could not afford HSAT due to high copay (around $600). The patients who could not proceed with an HSAT due to high copay are further referred to a pulmonologist for an in-lab sleep study. Some patients changed their decision and decided to proceed with a sleep study after discussion with their families. Sleep study refusal was documented in the patients' medical records to reminded providers to reiterate the need for a sleep study to patients during future clinic visits. The patients' hesitancy with a sleep study warrants consistent motivational interviewing to meet the goal (Hardcastle et al., 2015). Smoking cessation interventions were incorporated into the practice to improve patient education and increase patients' willingness to accept changes in the matter of sleep apnea (Centers for Disease Control and Prevention, 2014) The outcome of the HSAT referral has not yet been met, and the data collection is ongoing.

The project process needs to be modified to incorporate the changes made to the sleep study arrangements, such as the addition of a pulmonologist referral for a sleep study for patients with significant heart failure or neurological disorder. Further exploration is needed to identify exact reasons for the reluctance for a sleep study. The project team can contribute to finding ways to resolve the issue. Addressing the concerns with the insurance companies and explaining the financial burden of untreated OSA can be a new initiative. Conducting a new PDSA cycle to ensure process improvement may be a viable option.

5. Diagnosed with Obstructive Sleep Apnea Using HSAT:

The outcome of diagnosing patients with OSA has not been met. The process is ongoing and time-consuming. One of the reasons for the delay in the diagnosis of OSA was due to financial constraints. A number of the patients could not afford the HSAT and had to be referred to the pulmonologist for an in-lab sleep study. In-lab sleep study takes a longer time than the HSAT. Another reason for the delay in OSA diagnosis was the delay in getting the pulmonologist appointments, and the delay for an in-lab sleep study. So far, 12 patients have undergone HSAT, and one patient completed an in-lab sleep study that makes a total of 13 patients. All of the 13 patients (100%) who completed the sleep study were diagnosed with OSA and referred to a pulmonologist for CPAP initiation. However, only 24% (12 patients) of the identified high-risk OSA patients underwent HSAT. Many patients could not undergo HSAT due to high insurance costs. A few patients changed their minds about getting sleep study after discussing with their family members. Some of the patients did not get a call back from the team after submission to the insurance. One of the reasons could be the mistake in faxing the documents to the insurance for pre-authorization. Another reason could be the failure in the sleep lab to process the requests received. Out of the 11 patients referred for an in-lab sleep study, only one patient has completed the process. The remaining ten patients' results are pending. So far, 39 patients (76%) did not undergo sleep study due to the above-mentioned reasons. A collaborative team effort to resolve the issues with delay in diagnosis of OSA and process modification is needed. For example, engagement of social workers and financial advisors earlier in the process is under consideration.

6.Referred to Pulmonologists for Obstructive Sleep Apnea Treatment:

During the project outset, the project team decided to refer only patients who were diagnosed with OSA to the pulmonologist for treatment initiation. The process had to be modified as few patients had a significant neurological disorder or unstable heart failure

requiring an in-lab sleep study. We referred a total of 23 patients (38%) to the pulmonologist for sleep study or OSA treatment. We referred a few patients (9 patients/ 11%) to the pulmonologists for an in-lab sleep study due to their medical condition. Few patients were referred to the pulmonologists for an in-lab sleep study as patients could not afford HSAT. All OSA diagnosed patients require pulmonologists' guidance for obstructive sleep apnea treatment. The 13 OSA diagnosed patients were referred to pulmonologists for CPAP treatment. The process is continuing and pending outcome measurement as in-lab sleep study takes time. It is important to identify ways to resolve the financial constraints in arranging sleep studies. It will be beneficial to follow up on the insurance pre-authorization, sleep lab status, and with the patients to avoid missing cases. We need to increase patients' awareness about OSA through education so that the hesitancy in getting a pulmonary appointment can be minimized. Patient education and motivation may increase patient access to diagnostic and treatment avenues toward an ultimate decrease in health care costs and quality of life gains.

Project-Based Results

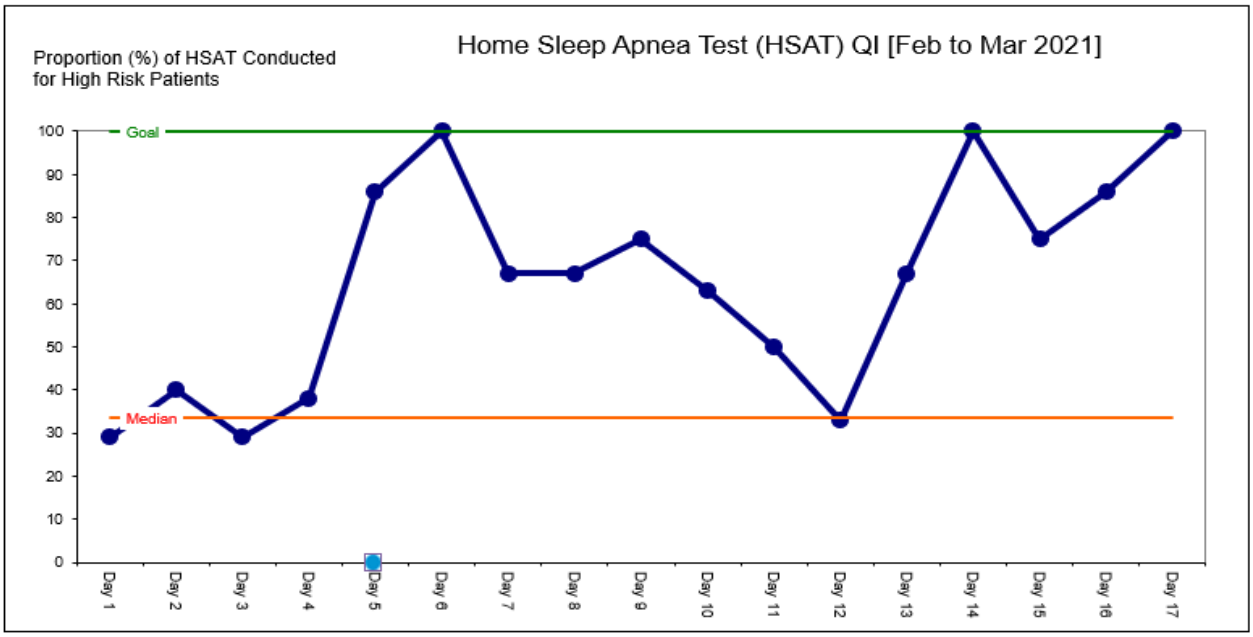
Obstructive Sleep Apnea Screening

The process improvement implementation of the OSA screening (STOP-BANG Score of 3 or more) was tracked daily during project time from February to March 2021. The IHI run chart tool was used to manage the implementation and to evaluate the extent of process improvement that occurred (IHI, 2021). Figure 9 illustrates the daily proportions of patients who were designated as high-risk for OSA per the STOP-BANG tool, that were entered into the HSAT program alone (the in lab sleep study was not measured on the run chart. With a goal of 100% of patients screened as high-risk were entered into the HSAT program, the run chart had a median proportion of 0.335 that was extended through the course of the project. The 17 points of data proportions indicated

that a shift and a run had occurred. With 2 of the 4 rules having been met, this was a positive finding. For example, continuation with the project until the trend rule was achieved would be beneficial.

Figure 9

Run Chart



X-axis: number of days of the project.
Y-axis: Proportion of HSAT- the number of patients referred for HSAT to the patients identified as high risk for OSA on each day of the project.

Patients with severe heart failure are referred to pulmonologists for an in-lab sleep study. Out of the screened patients, 36.7% of patients were identified as high risk for OSA. 61.4% of patients (51) arranged for HSAT and 11% of patients (9) were referred to the pulmonologist for a sleep study. The project findings were compared to the pre-implementation period. There was no screening strategy in the clinic prior to the initiation of the OSA project.

As per the run chart, 2 out of the 17 data points met the goal (11.8%), indicating a minimal process improvement. The reasons for the deficiencies in the process implementation were likely due to financial constraints, poor insurance coverage, patients'

lack of understanding about OSA, and defects in process implementation. The sleep study process can be improved by arranging financial assistance, early identification of insurance denials for a sleep study, and early referrals to a pulmonologist, repeated patient education about OSA, motivational interviews, algorithm modifications for heart failure patients, and conduct a new PDSA cycle for process improvement with a run chart evaluation.

Males and females who participated in the study were of similar proportion however, females were slightly higher than males. As per the data analysis, 59.7% of the clinic patients had heart diseases. The characteristics of the samples and findings are as follows

Discussions

The sleep apnea screening practice improvement project is a new initiative in the local cardiology clinic. A total of 226 patients were screened for OSA, and all 226 patients received risk education about OSA. Only one patient refused to undergo sleep apnea screening as he believed he had a low probability of OSA. We hope that the knowledge gained from the risk education counseling and screening may have helped patients modify their high-risk behaviors and educated their family members who have OSA. It is clinically significant that 13 patients were diagnosed with OSA during the short project duration. Implementation of an OSA screening practice improvement initiative in the local cardiology clinic helped identify patients with OSA, and the project increased the OSA identification from 0% to 36.7%.

The project findings of mean MAP of 120.4 mm of Hg, mean age of 63 years, mean BMI of 29.69, and a mean STOP-BANG score of 3.1 support the evidence of the high-risk nature of the clinic population for OSA. The STOP-BANG screening tool was convenient, easy, and understandable for the patients. We also noted that patients were particularly interested in their STOP-BANG results and engaged providers in discussions

about their scores and what this might mean for their overall health and well-being. The team found this particularly enlightening given this was the first project addressing OSA risk at the local cardiology clinic, and several people were interested in patients' feedback throughout the process.

The NP took a leadership role during the project implementation. The roles and responsibilities of each team member were clearly defined before the project initiation. We conducted weekly team meetings to evaluate the overall process and were required to conduct additional meetings in the first week to discuss each step of the practice improvement initiative to assure a smooth flow. We made changes to the roles and responsibilities to reduce interruption in the regular clinic activities and accommodate staff shortages. Patients were receptive to education about OSA. It can be a depressing event for patients to be screened and unable to be diagnosed with subsequent opportunities for treatment. Financial constraints were another reason for not undergoing a sleep study. In the future it would be helpful to identify financial resources prior to screening.

Patient Challenges - Insurance

Most patients were excited to learn about OSA as they were able to relate their risks to their experiences and share results with their families. However, some patients were reluctant to follow through on the referral process. Few patients denied a sleep study even though they were at high risk for OSA sharing their lack of experience with insomnia or snoring. Financial constraints were another reason for not undergoing a sleep study. A primary reason for denial of a sleep study was the reluctance to use Continuous Positive Airway Pressure (CPAP) therapy in the future. Many patients could not proceed with the sleep study as they had to pay approximately $600 out of pocket for the sleep study.

Patient Reception/Enthusiasm

Patients experiencing insomnia or snoring were generally agreeable to proceed with screening and the subsequent follow-up actions. Overall, there was enthusiasm about the process and future health promotion projects, particularly for initiatives that could make a notable difference in the care and quality of life of the patients. Specifically, the team shared that this project, and others to follow, provided an infrastructure for carrying out other quality improvement initiatives.

Many patients changed their minds to undergo HSAT after discussion with their family members. Family members were not present at the time of OSA education due to the restriction to the family members to be present for the clinic visit due to the COVID pandemic. Few patients changed their decision about sleep study as they thought OSA is not giving them much problem.

Conclusions

Following the screening of 226 patients, 83 patients were identified as high risk for OSA. It was surprising to the inter-professional team that 37% of patients screened were at high risk for OSA. If the group of intermediate-risk patients was to be added to the high risk, there would be an overwhelming number of patients at risk for OSA and subsequent poor cardiovascular outcomes. Out of the 83 high-risk patients identified, only 13 patients were able to undergo a sleep study, and all 13 patients were diagnosed with OSA. Sleep apnea screening and subsequent diagnosis are a critical part of an initial assessment of every patient seen in the local cardiology clinic. However, the process needs to be modified to improve the outcome.

Timeline (Actual)

The data collection was initiated on 02/22/2021 and completed on 03/24/2021 with a total duration of 6 weeks. The actual timeline or Gantt chart is attached in appendix N.

Limitations

Short project duration was a limitation for the process evaluation. The local cardiology clinic was closed for a month during the initial phase of the COVID-19 pandemic that delayed the project initiation. A severe winter storm also caused a one-week delay in the initiation of data collection. The COVID-19 pandemic was a barrier to scheduling appointments with the pulmonologist for evaluation and in-lab sleep studies. It was noted that few patients were not enthusiastic about arranging an appointment with the pulmonologist due to the fear of contracting the COVID-19 infection. The pulmonary clinic was also triaging with COVID-19 patients which caused scheduling delays for the local cardiology clinic patients to complete sleep apnea evaluations.

The team members noticed hesitancy in patients to accept their OSA high-risk status. Many patients had a lack of understanding about the seriousness of OSA, complications of OSA, and the need for diagnosis and treatment. Many patients were not willing to undergo the HSAT as they are not convinced about the possibility of having OSA. Those patients may require multiple educational sessions and motivational sessions.

Financial constraints were observed in patients who did not have insurance, or who had a higher copay for undergoing a sleep study. Few of the patients faced an insurance copay of around $600 for a sleep study. Due to time limitations, it was challenging to complete the entire referral process for the in-lab sleep study due to a longer turnaround time for pulmonary referrals and appointments. The project timeline impeded our ability to do a thorough follow-through of the OSA screening practice improvement initiative. Many patients could not undergo sleep study due to the issues in getting pre-authorization. This may have been caused by failure to fax necessary documents to the insurance companies and the sleep lab. Some patients reported not receiving a call back regarding the status of the insurance verification. A few patients changed their decisions about the sleep study after reaching home.

Project Sustainability:

The OSA screening practice improvement initiative was able to identify an overwhelming number of patients at high risk for OSA. Even though, only 13 patients completed the sleep study, all the 13 patients who completed the sleep study were diagnosed with OSA. This data supports the need to continue OSA screening and risk education in the local cardiology clinic. Periodic telephonic follow-up on the process with the insurance authorization and sleep lab may enhance project sustainability.

The local cardiology clinic had to make a few modifications after the project initiation. In the beginning, one of the medical assistants was responsible to distribute the STOP-BANG questionnaire to the patients along with COVID screening. As COVID screening was eliminated from the clinic, the responsibility was given to one of the clinic administrators and modified the overall process.

The local cardiology clinic will continue to screen all the new patients for OSA using the STOP-BANG questionnaire as we have completed OSA screening for all the established patients. A policy committee should be established to develop an institutionalized policy about OSA screening and management to encourage collegial support and further establish structure. Exploring options for pre-clinic electronic STOP-BANG screening will help to ease the process of OSA screening and alert providers to positive screening results prior to patient arrival. Electronic STOP-BANG screening will save time and eliminate scoring errors. Results should be build into the electronic health record to auto-populate.

It is important to conduct an in-depth assessment of co-pays with insurance companies and take necessary steps to reduce co-pays. The team should consider submitting a white paper to the insurance companies regarding the benefits of OSA screening and management in reducing the financial burden of cardiovascular

complications of undiagnosed OSA. Screening and managing diseases will be a proactive investment for insurance companies. Adding OSA screening and follow up action data to the monthly posted board of institutional quality indicators will promote project engagement. This data may increase the sustainability of OSA screening in the local cardiology clinic.

It is not enough to ensure the continuity of OSA screening in the local cardiology clinic. The findings of the OSA screening practice improvement project need to be communicated to the other cardiology clinics and primary care clinics so that they will be able to take necessary measures in cardiovascular health promotion. Emphasizing to other local clinics a recommendation for digitized pre-clinic STOP-BANG screening is likely to improve broader risk identification. The local cardiology clinic team is planning to arrange general educational campaigns across disciplines and other clinics to educate about the importance of OSA screening and management in primary care settings.

Section V: Recommendations and Implications of Practice

The project implementation of the OSA screening practice improvement initiative was successful in identifying patients at high risk for OSA using the STOP-BANG questionnaire. The team appreciated the impact of this evidence-based practice initiative and learned valuable lessons on the importance and complexity of making changes in the clinical setting. Patients and families shared perceptions of their enthusiasm for health promotion strategies that could improve the quality of their sleep, and potentially reduce risk factors for worsening of heart disease.

Recommendations/Implications for Practice

The project obstructive sleep apnea screening practice improvement initiative was able to identify patients at high risk and diagnose 13 patients with OSA. Chung et al. (2013) proved that a STOP-BANG score of 4 has a high sensitivity of 88 % in identifying severe sleep apnea. We recommend referring patients of the local cardiology clinic for an HSAT with a STOP-BANG score of 4 and up to increase the OSA diagnosis due to the sensitivity of the score in OSA diagnosis. It is important for patients and practitioners to be aware of the financial impact of the sleep study. Moreover, it is important to arrange financial support for patients who do not have insurance coverage for a sleep study. Many patients of the local cardiology clinic agreed to proceed with the sleep study, however, failed to complete the process due to multiple reasons.

Telephonic follow-up calls to patients at scheduled intervals to remind patients about their high-risk OSA status and need for a sleep study may be beneficial. It is important to assign a staff member to follow up on the status of the insurance pre-authorization and follow up with the sleep lab to ensure all required information for the sleep study is received. Fall outs may have been avoided by calling patients and re-

educating them about the need for a sleep study. It is important for the family members to be present for the sleep apnea risk education (pandemic permitting) as they are involved in the decision-making process. Family members who received sleep apnea risk education can motivate the patient to undergo sleep study as they are aware of the health hazards of not treating OSA.

The American Academy of Sleep Medicine (2015) recommends annual OSA screening to evaluate the progression of the OSA so that appropriate measures can be taken in a timely manner. I am planning to evaluate the long-term outcomes of OSA treatment in a future research project, specifically the correlation between sleep apnea treatment and reduction in cardiovascular complications. One of the examples can be a reduction in blood pressure in hypertensive patients after the initiation of OSA management. It is important to conduct future projects to evaluate the quality-of-life improvements with OSA treatment. Having more time to experience all phases of the screening practice improvement initiative and the impact on patients' risk factors could provide valuable information on the process, as well as specific patient outcomes (reduction in Emergency Department visits, reduction in risk factors for OSA, etc.). Lifestyle changes will be further addressed in future projects to include a tailored exercise/movement plan and incorporate sleep hygiene strategies such as a regular bedtime, limiting sedatives before sleep, and limiting alcohol use, particularly before bedtime (Aiello et al., 2016).

Analysis of the clinical variables and demographic data will be important to determining future improvement initiatives aimed at health promotion, illness prevention, and greater emphasis on patient self-management and engagement. The clinic team did appreciate working together on this evidence-based practice improvement initiative and came away with a greater appreciation of the importance of collaboration and teamwork.

Before this project, the clinic did not have a standardized screening process and potentially missed patients at high risk for worsening their heart disease and strokes. It is important to note that this project provides a way to introduce an overall improvement methodology for the clinic for future quality initiatives. Reeducation and reiterating the need for a sleep study will increase patients' awareness about OSA. This also led to the team's discussion of the next steps, particularly focused on the patients with strokes, atrial fibrillation, and diabetes and their risk for worsening chronic diseases. It will be beneficial to study the long-term outcome of OSA screening and management. For example, the quality of life of patients increased ability to exercise, increased pulmonary capacity, decreased daytime sleepiness, and decreased snoring (Patil et al. (2019).

DNP Essentials

The OSA screening EBP project integrated several DNP Essentials (American Association of Colleges of Nursing (AACN, 2006). Specifically, Essential II, Organizational and Systems Leadership for Quality Improvement and Systems Thinking, provided the DNP student opportunities for exercising leadership skills and applying these competencies to the practice site. Becoming a positive change agent at the clinic and learning more about organizational policies were also important to the impact and sustainability of this project and future ones. Quality improvement activities are an important responsibility of a DNP leader. Leading change using a structured process through collaboration and engagement is essential to long-term improvement in how the team communicates and embraces innovation.

Creating a culture of scholarly inquiry and evidence-based practice are key leadership responsibilities that can inspire, empower, and involve team members. Coaching and mentoring the team laid the foundation that every member had a role, and their participation was integral to the success of the project. Through this process, the

DNP student reinforced the cultural change of using research and evidence-based practice as inherent in daily care and to recognizing improvement as part of the practice.

Essential III, Clinical Scholarship and Analytical Methods for Evidence-Based Practice, applying evidence-based knowledge and translation of current research information into practice is a key characteristic of a DNP graduate. Sharing with stakeholders, including the patients and their families allowed for open discussions of risk factors, and the impact on quality of life. Essential IV, Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care emphasized the importance of data transfer and interpretation of research studies. The run chart depicts the overall process change over time. Essential VI, Inter-professional Collaboration for Improving Patient and Population Health Outcomes, aligned with the work of the clinic team and the inter-professional collaboration for the OSA screening practice improvement initiative as a health promotion initiative. Leading change through effective team management promotes consistency and stability of the improvement process. The DNP student as the team leader assured that stages of team development (forming, storming, norming, performing, and adjoining) were successfully addressed. This reinforced team members' capabilities, and increased capacity for screening and educating more patients.

The use of communication skills and team-building measures provided an opportunity for the DNP student to assume a transformational leadership role. Essential VII, Clinical Prevention and Population Health for Improving the Nation's Health providing the opportunity for clinical prevention and improved population health with the implementation of OSA screening practice improvement initiative. Lastly, Essential VIII, Advanced Nursing Practice as a strong component of the DNP program, and this requirement afforded transitional nursing through greater application of critical appraisal

and evidence synthesis, its interpretation to improving health outcomes, and creating an infrastructure to support this project and future translational population health initiatives. (AACN, 2006).

Overall Project Summary

The idea for this project evolved from discussion with the clinic team to find ways to promote healthier lifestyles, reduce the worsening of patient's comorbidities, and impact future disease prevention. The team conducted a SWOT (Strength, Weakness, Opportunities, and Threat) analysis as part of the Needs Assessment in the clinic and identified OSA screening as the highest priority for the clinic given the patient population and risk for obstructive sleep apnea (OSA). This priority is aligned with the strategic goals and initiatives of the organization.

Evidence supporting information about OSA and screening which included critical appraisal and evidence synthesis were essential in supporting evidence-based practices in the local cardiology clinic. Specifically, the clinic team wanted to address OSA which increases the risk for significant cardiovascular comorbidities and financial burden. Upon discussion with the faculty leads and practice mentor, a decision was made to proceed with the OSA screening practice improvement initiative project. We formed a team for the project, and responsibilities were discussed and outlined for each team member. The team was highly engaged in the improvement process through the project providing an excellent exemplar for future quality improvement work. A practice improvement outline was created for the smooth running of the project. The STOP-BANG questionnaire was chosen as the OSA screening tool.

Detailed literature search and appraisal supported OSA screening in primary care clinics and utilized evidence-based processes for the project implementation. The team reviewed and analyzed the implementation process and made required modifications. The

initial plan was to refer all high-risk patients to a pulmonologist. We decided to proceed with a home sleep apnea test instead of a referral to the pulmonologist for an in-lab sleep study for qualified patients due to the ongoing COVID pandemic. Risk educational and counseling materials were made available to educate patients about OSA. We outlined and decided to include all materials into the clinical/medical record documentation of patients regarding the OSA screening.

The project organization's IRB panel reviewed the project information and approved the project as an evidence-based practice project. The project plan was presented to the TWU faculty team and peers and received approval for implementation on 02/08/2021. The team members were educated about the project process, including receiving information on the overall screening practice improvement initiative, and follow-up care. We conducted a pre-project medical record review for 6 months before the project implementation to evaluate the local cardiology clinic status about OSA risk identification and management. The OSA screening practice improvement initiative project was conducted in the clinic from 2/22/2021 to 3/24/2021, and a total of 226 patients were screened. Patients with significant neurological disorders or unstable heart failure patients were referred to the pulmonologist for an in-lab sleep study. Patients diagnosed with OSA through HSAT were referred to a pulmonologist for treatment initiation. Data were collected and evaluated weekly. We held weekly team meetings and reviewed the overall progress of the project discussing all aspects of the process flow. Data were analyzed and interpreted.

Next Steps

The OSA screening project was overall a success, and we were able to identify high-risk patients. As the clinic team reviewed results and future recommendations, decisions were made to continue the screening practice improvement initiative and

ongoing evaluation for impact and sustainability. Specifically, in the future our clinic team plans to measure long-term benefits such as reduced risk, healthy lifestyle choices, and future chronic incidences such as cardiovascular events.

This project was a practice improvement project using the Iowa EBP Model. While this framework had great utility for this project, in communicating with the team, the next steps would include moving to a quality improvement initiative focused on the first cycle of a plan-do-study-act (PDSA). We will continue to evaluate outcomes and track our progress through the use of run charts. Using a PDSA, the team plans to make modifications to the practice improvement initiative to further facilitate timely screenings and referrals. We would continue to track all phases of the project, particularly patients requiring a pulmonologist referral, and evaluate the impact on longer-term benefits on quality of sleep, maintaining a healthy weight, and better management of blood pressure using the Pender Health Promotion. It would also be beneficial to include insurance information for each patient to evaluate financial status. Annually, for patients with low to intermediate risk for OSA who are not on PAP, we will repeat HSAT patients initiated on PAP therapy require a repeat sleep study every five years. This valuable information will become part of the patients' electronic health record to continue to track and trend. As the OSA screening project continues, our team will create a policy for further development and adoption of the practice improvement initiative as a standard of practice. Implementation of OSA screening practice improvement initiative is an evidence-based project and is a new initiative in the local cardiology clinic.

Dissemination

Dissemination is an important aspect of every project. The project findings and the process will be presented to all the local cardiology clinic team and hospital system quality improvement team. The hospital system quality improvement team meets every

third Thursday of the month to discuss the projects and research conducted in the hospital system. The project also will be presented to the advanced practice providers of the team during one of the monthly educational days so that it will help to enlighten other providers in the team about OSA screening and its importance. The local cardiology clinic is one of the satellite clinics of the group and educating the other providers will help to extend the OSA screening project to other satellite clinics. The project findings will be presented at the Texas Nurses Association of India and anticipated to publish the project paper in Medscape Cardiology Journal.

References

Aiello, K. D., Caughey, W. G., Nelluri, B., Sharma, A., Mookadam, F., & Mookadam, M. (2016). Effect of exercise training on sleep apnea: A systematic review and meta-analysis. *Respiratory medicine*, *116*, 85–92. https://doi.org/10.1016/j.rmed.2016.05.015

American Academy of Sleep Medicine. 2016. Hidden Health Crisis Costing America Billions. https://aasm.org/resources/pdf/sleep-apnea-economic-crisis.pdf

American Association of College of Nursing. (2006). The Essentials of Doctoral Education for Advanced Nursing Practice. https://www.aacnnursing.org/Portals/42/Publications/DNPEssentials.pdf

Appraisal of Guidelines for Research and Evaluation II (AGREE II). (2017). https://www.agreetrust.org/wp-content/uploads/2017/12/AGREE-II-Users-Manual-and-23-item-Instrument-2009-Update-2017.pdf

Barbé, F., Durán-Cantolla, J., Sánchez-de-la-Torre, M., Martínez-Alonso, M., Carmona, C., Barceló, A., Chiner, E., Masa, J. F., Gonzalez, M., Marín, J. M., Garcia-Rio, F., Diaz de Atauri, J., Terán, J., Mayos, M., de la Peña, M., Monasterio, C., del Campo, F., Montserrat, J. M., & Spanish Sleep and Breathing Network (2012). Effect of continuous positive airway pressure on the incidence of hypertension and cardiovascular events in non- sleeping patients with obstructive sleep apnea: a randomized controlled trial. *JAMA*, *307*(20), 2161–2168. https://doi.org/10.1001/jama.2012.4366

Braley, T. J., Dunietz, G. L., Chervin, R. D., Lisabeth, L. D., Skolarus, L. E., & Burke, J. F. (2018). Recognition and Diagnosis of Obstructive Sleep Apnea in Older Americans. *Journal of the American Geriatrics Society.* 66 (7). 1296–1302. https://doi.org/10.1111/jgs.15372

Boulos, M. I., Colelli, D. R., Vaccarino, S. R., Kamra, M., Murray, B. J., & Swartz, R. H. (2019). Using a modified version of the "STOP-BANG" questionnaire and nocturnal oxygen desaturation to predict obstructive sleep apnea after stroke or TIA. *Sleep medicine*, *56*, 177–183. https://doi.org/10.1016/j.sleep.2018.12.021

Centers for Disease Control and Prevention. (2014). Cessation Interventions. Best Practices for Comprehensive Tobacco Control Programs. https://www.cdc.gov/tobacco/stateandcommunity/best_practices/pdfs/2014/sectionA-III.pdf

Chen, L., Pivetta, B., Nagappa, M., Saripella, A., Islam, S., Englesakis, M., & Chung, F. (2021). Validation of the STOP-Bang questionnaire for screening of obstructive sleep apnea in the general population and commercial drivers: a systematic review and meta-analysis. *Sleep & breathing = Schlaf & Atmung*, 10.1007/s11325-021-02299-y. Advance online publication. https://doi.org/10.1007/s11325-021-02299-y

Chung, F., Abdullah, H. R., Liao, P. 2016. STOP-Bang Questionnaire: A Practical Approach to Screen for Obstructive Sleep Apnea. 149 (3). Pages 631-638. https://doi.org/10.1378/chest.15-0903.

Connect. 2020. Evidence-Based Practice in Nursing. https://connect.springerpub.com/content/book/978-0-8261-2759-4/back-matter/bmatter

Cooksey, J. A., & Balachandran, J. S. (2016). Portable Monitoring for the Diagnosis of OSA. *Chest*, *149*(4), 1074–1081. https://doi.org/10.1378/chest.15-1076

Costa, Lucas E, Uchôa, Carlos Henrique G, Harmon, Rebeca R, Bortolotto, Luiz A, Lorenzi-Filho, Geraldo, & Drager, Luciano F. (2015). Potential underdiagnosis of obstructive sleep apnea in the cardiology outpatient setting. *Heart (British Cardiac Society), 101*(16), 1288-1292.

Critical Appraisal Skills Program. (n.d). https://casp-uk.net/wp-content/uploads/2018/03/CASP-Qualitative-Checklist-2018_fillable_form.pdf

Devaraj U, Rajagopala S, Kumar A, Ramachandran P, Devereux P, J, D'Souza G, A. (2017). Undiagnosed Obstructive Sleep Apnea and Postoperative Outcomes: A Prospective Observational Study. Respiration. 94:18-25. doi: 10.1159/000470914

Donovan, L. M., Rueschman, M., Weng, J., Basu, N., Dudley, K. A., Bakker, J. P., Wang, R., Bertisch, S. M., & Patel, S. R. (2017). The effectiveness of an obstructive sleep apnea screening and treatment program in patients with type 2 diabetes. *Diabetes research and clinical practice*, *134*, 145–152. https://doi.org/10.1016/j.diabres.2017.10.013

Durán-Cantolla, J., Aizpuru, F., Montserrat, J. M., Ballester, E., Terán-Santos, J., Aguirregomoscorta, J. I., Gonzalez, M., Lloberes, P., Masa, J. F., De La Peña, M., Carrizo, S., Mayos, M., Barbé, F., & Spanish Sleep and Breathing Group (2010). Continuous positive airway pressure as treatment for systemic hypertension in people with obstructive sleep apnea: a randomized controlled trial. *BMJ (Clinical research ed.)*, *341*, c5991. https://doi.org/10.1136/bmj.c5991

Gonzalo, A. (2019). NursesLabs. Nola Pender: Health Promotion Model. https://nurseslabs.com/nola-pender-health-promotion-model/

Hall, K.A., Singh, M., Mukherjee, S., Palmer, L.J. (2020). Physical activity is associated with a reduced prevalence of self-reported obstructive sleep apnea in a large, general population cohort study. *Journal of Clinical Sleep Medicine. 16* (7). https://doi.org/10.5664/jcsm.8456

Hardcastle, S. J., Hancox, J., Hattar, A., Maxwell-Smith, C., Thøgersen-Ntoumani, C., & Hagger, M. S. (2015). Motivating the unmotivated: how can health behavior be

changed in those unwilling to change?. *Frontiers in psychology*, *6*, 835. https://doi.org/10.3389/fpsyg.2015.00835

Hartley, S., Vachon, J., & Benainous, O. (2011). Sleep apnea: no laughing matter. *The British journal of general practice: the journal of the Royal College of General Practitioners*, *61*(588), 434–435. https://doi.org/10.3399/bjgp11X583001

Institute for Healthcare Improvement. (2021). *Run chart tool.* IHI. http://www.ihi.org/resources/Pages/Tools/RunChart.aspx

Kapur, V. K., Auckley, D. H., Chowdhuri, S., Kuhlmann, D. C., Mehra, R., Ramar, K., & Harrod, C. G. (2017). Clinical Practice Guideline for Diagnostic Testing for Adult Obstructive Sleep Apnea: An American Academy of Sleep Medicine Clinical Practice Guideline. *Journal of clinical sleep medicine: JCSM: official publication of the American Academy of Sleep Medicine*, *13*(3), 479–504. https://doi.org/10.5664/jcsm.6506

Karimi, N., Kelava, M., Kothari, P., Zimmerman, N. M., Gillinov, A. M., & Duncan, A. E. (2018). Patients at High Risk for Obstructive Sleep apnea Are at Increased Risk for Atrial Fibrillation After Cardiac Surgery: A Cohort Analysis. *Anesthesia and analgesia*, *126*(6), 2025–2031. https://doi.org/10.1213/ANE.0000000000002852

Kim, R. D., Kapur, V. K., Redline-Bruch, J., Rueschman, M., Auckley, D. H., Benca, R. M., Foldvary-Schafer, N. R., Iber, C., Zee, P. C., Rosen, C. L., Redline, S., & Ramsey, S. D. (2015). An Economic Evaluation of Home Versus Laboratory-Based Diagnosis of Obstructive Sleep Apnea. *Sleep*, *38*(7), 1027–1037. https://doi.org/10.5665/sleep.4804

Khattak, H. K., Hayat, F., Pamboukian, S. V., Hahn, H. S., Schwartz, B. P., & Stein, P. K. (2018). Obstructive Sleep Apnea in Heart Failure: Review of Prevalence, Treatment

with Continuous Positive Airway Pressure, and Prognosis. Texas Heart Institute Journal, 45(3), 151–161. https://doi.org/10.14503/THIJ-15-5678

Kline, C. E., Irish, L. A., Krafty, R. T., Sternfeld, B., Kravitz, H. M., Buysse, D. J., Bromberger, J. T., Dugan, S. A., & Hall, M. H. (2013). Consistently high sports/exercise activity is associated with better sleep quality, continuity, and depth in midlife women: the SWAN sleep study. *Sleep*, *36*(9), 1279–1288. https://doi.org/10.5665/sleep.2946

Kundel, V., & Shah, N. (2017). Impact of Portable Sleep Testing. *Sleep medicine clinics*, *12*(1), 137–147. https://doi.org/10.1016/j.jsmc.2016.10.006

Kuna, S., Badr, M.S., Kimoff, R., Kushida, C., Lee-Chiong, T., Lévy, P., McNicholas, W., & Strollo, P. (2011). Research Priorities in Ambulatory Management of Adults with Obstructive Sleep Apnea.

Labarca, G., Dreyse, J., Salas, C., Contreras, A., Nazar, G., Gaete, M. I., & Jorquera, J. (2018). Differences between manual and automatic analysis in determining the severity of obstructive sleep apnea using home sleep apnea testing. *Sleep medicine*, *47*, 66–71. https://doi.org/10.1016/j.sleep.2018.03.015

Laratta, C. R., Ayas, N. T., Povitz, M., & Pendharkar, S. R. (2017). Diagnosis and treatment of obstructive sleep apnea in adults. *CMAJ: Canadian Medical Association journal = journal de l'Association medicale canadienne*, *189*(48), E1481–E1488. https://doi.org/10.1503/cmaj.170296

Leino, A., Westeren-Punnonen, S., Töyräs, J., Myllymaa, S., Leppänen, T., Ylä-Herttuala, S., Muraja-Murro, A., Kantanen, A. M., Autere, J., Jäkälä, P., Mervaala, E., & Myllymaa, K. (2020). Acute stroke and TIA patients have specific polygraphic features of obstructive sleep apnea. *Sleep & breathing = Schlaf & Atmung*, *24*(4), 1495–1505. https://doi.org/10.1007/s11325-019-02010-2

Lettau, F., Schwarz, E. I., Stradling, J. R., & Kohler, M. (2017). Blood Pressure Variability in Obstructive Sleep Apnoea: Data from 4 Randomized Controlled CPAP

Withdrawal Trials. *Respiration; international review of thoracic diseases*, *93*(5), 311–318. https://doi.org/10.1159/000465528

Martínez-García, M. A., Capote, F., Campos-Rodríguez, F., Lloberes, P., Díaz de Atauri, M. J., Somoza, M., Masa, J. F., González, M., Sacristán, L., Barbé, F., Durán-Cantolla, J., Aizpuru, F., Mañas, E., Barreiro, B., Mosteiro, M., Cebrián, J. J., de la Peña, M., García-Río, F., Maimó, A., Zapater, J., … Spanish Sleep Network (2013). Effect of CPAP on blood pressure in patients with obstructive sleep apnea and resistant hypertension: the HIPARCO randomized clinical trial. *JAMA*, *310*(22), 2407–2415. https://doi.org/10.1001/jama.2013.281250

Marshall, N.S., Wong, K.K.H., Cullen, S.R.J., Knuiman, M.W. (2014). Sleep Apnea and 20-Year Follow-Up for All-Cause Mortality, Stroke, and Cancer Incidence and Mortality in the Busselton Health Study Cohort. *Journal of Clinical Sleep Medicine. 10* (4). https://doi.org/10.5664/jcsm.3600

Memorial Herman. 2020. About us. http://www.memorialhermann.org/about-us/

Miller, Jennifer N, & Berger, Ann M. (2015). Screening and assessment for obstructive sleep apnea in primary care. *Sleep Medicine Reviews, 29*, 41-51.

Miller, J. N., Kupzyk, K. A., Zimmerman, L., Pozehl, B., Schulz, P., Romberger, D., & Berger, A. M. (2018). Comparisons of measures used to screen for obstructive sleep apnea in patients referred to a sleep clinic. *Sleep medicine*, *51*, 15–21. https://doi.org/10.1016/j.sleep.2018.06.007

Mayo Clinic. (2020). Sleep Apnea. https://www.mayoclinic.org/diseases-conditions/sleep-apnea/symptoms-causes/syc-20377631

Nagappa, M., Liao, P., Wong, J., Auckley, D., Ramachandran, S. K., Memtsoudis, S., Mokhlesi, B., & Chung, F. (2015). Validation of the STOP-Bang Questionnaire as a Screening Tool for Obstructive Sleep Apnea among Different Populations: A

Systematic Review and Meta-Analysis. *PloS one*, *10*(12), e0143697. https://doi.org/10.1371/journal.pone.0143697

Nursing Theory. (2020). Pender's Health Promotion Model. https://nursing-theory.org/theories-and-models/pender-health-promotion-model.php

Obstructive Sleep Apnea. 2012. http://www.stopbang.ca/osa/general.php

Ononye, T., Nguyen, K., Brewer, E. (2019). Implementing guidelines for obstructive sleep apnea screening in the primary care setting. Appl Nurs Res. 46:67-71. doi: 10.1016/j.apnr.2019.02.005. Epub Feb 22. PMID: 30853078.

Orbea, C., Lloyd, R. M., Faubion, S. S., Miller, V. M., Mara, K. C., & Kapoor, E. (2020). Predictive ability and reliability of the STOP-BANG questionnaire in screening for obstructive sleep apnea in midlife women. *Maturitas*, *135*, 1–5. https://doi.org/10.1016/j.maturitas.2020.02.004

Pallant, J. (2020). *SPSS survival manual: A step-by-step guide to data analysis using the IBM SPSS* (7th ed.). McGraw-Hill.

Patil, S. P., Ayappa, I. A., Caples, S. M., Kimoff, R. J., Patel, S. R., & Harrod, C. G. (2019). Treatment of Adult Obstructive Sleep Apnea with Positive Airway Pressure: An American Academy of Sleep Medicine Systematic Review, Meta-Analysis, and GRADE Assessment. *Journal of clinical sleep medicine: JCSM: official publication of the American Academy of Sleep Medicine*, *15*(2), 301–334. https://doi.org/10.5664/jcsm.7638

Patil, S. P., Ayappa, I. A., Caples, S. M., Kimoff, R. J., Patel, S. R., & Harrod, C. G. (2015). Treatment of Adult Obstructive Sleep apnea with Positive Airway Pressure: An American Academy of Sleep Medicine Clinical Practice Guideline. *American Academy of Sleep Medicine.* 15 (2).

Perla, R. J., Provost, L. P., Murray, S. K. (2011). The Run Chart: A Simple Analytical Tool for Learning from Variation in Healthcare Processes. *BMJ Qual Saf. 20.* 46-51. doi:10.1136/bmjqs.2009.037895

Pender, N. J., Murdaugh, C. L., & Parsons, M. A. (2011). Health promotion in nursing practice (6th ed.). Pearson. https://deepblue.lib.umich.edu/bitstream/handle/2027.42/85350/HEALTH_PROMOTION_MANUAL_Rev_5-2011.pdf.

Pivetta, B., Chen, L., Nagappa, M. et al. (2021). Use and Performance of the STOP-Bang Questionnaire for Obstructive Sleep Apnea Screening Across Geographic Regions: A Systematic Review and Meta-Analysis. *JAMA Netw Open.4*(3). doi:10.1001/jamanetworkopen.2021.1009

Punjabi, N. M., Aurora, R. N., & Patil, S. P. (2013). Home sleep testing for obstructive sleep apnea: one night is enough! *Chest*, *143*(2), 291–294. https://doi.org/10.1378/chest.12-2699

Romero-Corral, A., Caples, S. M., Lopez-Jimenez, F., & Somers, V. K. (2010). Interactions between obesity and obstructive sleep apnea: implications for treatment. *Chest*, *137*(3), 711–719. https://doi.org/10.1378/chest.09-0360

Rosenberg, R., Hirshkowitz, M., Rapoport, D. M., & Kryger, M. (2019). The role of home sleep testing for evaluation of patients with excessive daytime sleepiness: focus on obstructive sleep apnea and narcolepsy. *Sleep medicine*, *56*, 80–89. https://doi.org/10.1016/j.sleep.2019.01.014

Saletu, M. T., Kotzian, S. T., Schwarzinger, A., Haider, S., Spatt, J., & Saletu, B. (2018). Home Sleep Apnea Testing is a Feasible and Accurate Method to Diagnose Obstructive Sleep Apnea in Stroke Patients During In-Hospital Rehabilitation. *Journal of clinical sleep medicine: JCSM: official publication of the*

American Academy of Sleep Medicine, *14*(9), 1495–1501. https://doi.org/10.5664/jcsm.7322

Showalter, L., & O'Keefe, C. (2019). Implementation of an obstructive sleep apnea screening tool with hypertensive patients in the primary care clinic. *Journal of the American Association of Nurse Practitioners*, *31*(3), 184–188. https://doi.org/10.1097/JXX.0000000000000124

Tietjens, J. R., Claman, D., Kezirian, E. J., De Marco, T., Mirzayan, A., Sadroonri, B., Goldberg, A.N., Long, C., Gerstenfeld, E. P., & Yeghiazarians, Y. (2019). Obstructive Sleep Apnea in Cardiovascular Disease: A Review of the Literature and Proposed Multidisciplinary Clinical Management Strategy. *Journal of the American Heart Association*, *8*(1). https://doi.org/10.1161/JAHA.118.010440

The Iowa Model. https://www.researchgate.net/figure/The-Iowa-Model-of-Evidence-Based-Practice-to-Promote-Quality-Care-Reprinted-with_fig4_8346940

University of Iowa Hospitals and Clinics. (2021). The Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care. https://uihc.org/iowa-model-revised-evidence-based-practice-promote-excellence-health-care

Williams, S.G., Lettieri, C.J. & Dombrowsky, J.W. (2012). CPAP: enhancing its use. *Curr Respir Care Rep. 1.* 131–138 https://doi.org/10.1007/s13665-012-0015-z

Wickramasinghe, H. (2020). Obstructive Sleep Apnea. https://emedicine.medscape.com/article/295807-overview#a5

Wickwire, E.M., Tom, E.S., Vadlamani, A., Diaz-Abad, M., Cooper, L.M., Johnson, A.M., Scharf, S.M., Albrecht, J.S. (2020). Older adult US Medicare beneficiaries with untreated obstructive sleep apnea are heavier users of health care than matched control patients. *Journal of Clinical Sleep Medicine. 16* (1). https://doi.org/10.5664/jcsm.812

Winona State University. (2021). Evidence-Based Practice Toolkit.

https://libguides.winona.edu/c.php?g=11614&p=61584

Appendix A- IRB Approval Letter

Committee for the Protection of Human Subjects
6410 Fannin Street, Suite 1100
Houston, Texas 77030

TO: Kanmony Mathew
UT-H - MS - ACTAT-Surgery

FROM: Laura K. Lincoln
IRB Coordinator
CPHS Office

DATE: January 26, 2021

RE: HSC-MS-21-0068
Implementation of Sleep Apnoea Screening tool (STOP-BANG questionnaire) in the clinic, risk education counseling to all the screened patients regarding sleep apnoea, administer the Home Sleep Apnoea Test (HSAT) to diagnose patients who are at high risk for sleep apnoea per screening tool and refer diagnosed sleep apnoea patients to the pulmonologists to treat as a health promotion initiative.

Reference Number: 211406

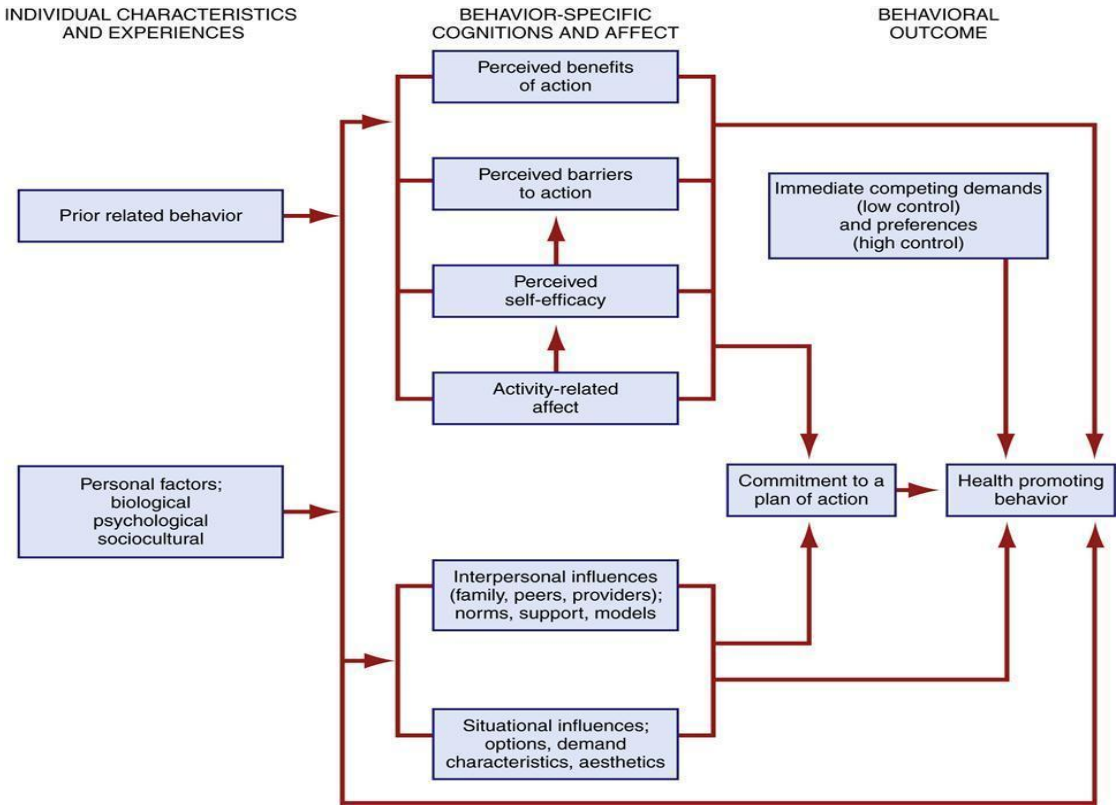
Dear Kanmony Mathew,

This letter is to confirm that the above referenced project is a quality improvement (QI) project and is not research with human subjects. Therefore, no further review by the Committee for the Protection of Human Subjects (CPHS) is required. This submission in iRIS is now closed.

As you have already submitted the project via the QI Registry, you will be receiving outcome notifications via email.

If you have any questions, please contact me at (713) 500-7939.

Appendix B- Pender's Health Promotion Model



Appendix C- Evidence Table and Synthesis Matrix

Study/ Author	Conceptual Framework	Design, Method	Sample, Setting.	Major Variables	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Ononye et al. (2019). Implementing guidelines for obstructive sleep apnea screening in the primary care setting.	No conceptual Framework	Quality improvement method. Descriptive study	Screened 187 participants with STOP-BANG questionnaire between January and April 2018 in 3 primary health care clinics in Houston, Texas.	Age, sex, BMI, neck circumference,	Percentage of patients screened, high risk (score of 3 or more) for sleep apnea, referred for a sleep study and diagnosed with sleep apnea	Descriptive analysis using IBM SPSS statistics 20.0	OSA screening and referral increased from 3 % and 0% respectively to 43% and 39 % post-implementation of STOP-BANG questionnaire.	Level VI. Moderate strength. STOP-BANG questionnaire is effective in diagnosing moderate to severe sleep apnea.
Miller et al. (2015). Screening and assessment for obstructive sleep apnea in primary care.	No conceptual framework	Systematic review	17 Articles in English (includes experimental and non-experimental) published from January 1991 to June 2014	OSA screening measurements	OSA sleep study result is compared with sleep apnea screening results.	Descriptive analysis	STOP-BANG questionnaire and Berlin questionnaire have the highest sensitivity in diagnosing sleep apnea.	Level I. High strength. Early diagnosis and treatment of sleep apnea prevent cardiovascular comorbidities.

Study/ Author	Conceptual Framework	Design, Method	Sample, Setting.	Major Variables	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Miller et al. (2018). Comparisons of measures used to screen for obstructive sleep apnea in patients referred to a sleep clinic.	No conceptual framework	Obser vational cross-sectional study design	170 participants from a Midwestern sleep clinic studied for a 5 months period.	Compare self- screening measures (Epworth, Berlin, & STOP-BANG) to Objective polysomnography (PSG)	The sensitivity, validity, and reliability of each test were assessed.	Correl ational analysis	STOP-BANG had the highest level of sensitivity, and Berlin had the lowest sensitivity. ESS had the highest reliability.	Level VI. Moderate strength. STOP-BANG is the preferred self-report screening of OSA due to the high level of sensitivity.
Showalter & O'Keefe, (2019). Implementation of an obstructive sleep apnea screening tool with hypertensive patients in the primary care clinic.	Kurt Lewin's theory of change	Conv enience sampling method	32 patients from a rural primary care clinic from Iowa screened over 3 months.	Hypertensi ve patients were screened with the STOP-BANG questionnaire for OSA.	Age, sex, BMI, diagnosis of hypertension, height, weight	Descri ptive analysis	All men in the study were intermediate or high risk for OSA. 40 % of study participants were at high risk for sleep apnea and 33 % were referred for PSG and all of them were diagnosed with sleep apnea.	Level VI. Low to moderate strength. Recommended sleep apnea screening for all hypertensive adult patients.
Donovan et al. (2017). The effectiveness of an obstructive sleep apnea screening and treatment program in	None		Diabetic patients who are not on OSA treatment of a primary care Clinics at Boston,	Screened for OSA using STOP-BANG questionnaire. High risk patients	Studied the impact of Positive airway pressure (PAP) on sleep related issues, glycemic	Paired t test, unpaired t test, multi-variable	PAP was associated with reduction in sleep related symptoms but did not affect glycemic control and hospitalization rates.	Level VI. Moderate strength. Lack of standardization in the measurements.

Study/ Author	Conceptual Framework	Design, Method	Sample, Setting.	Major Variables	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
patients with type 2 diabetes.			USA were studied with the STOP-BANG questionnaire telephonically from 2013 to December 2014.	were subjected to sleep study.	control, and hospitalization rates.	linear regression.		
Devaraj et al. (2017). Undiagnosed Obstructive Sleep Apnea and Postoperative Outcomes: A Prospective Observational Study.	None	A Prospective Cohort study	245 adults who is undergoing non cardiac surgeries from July 2011 to February 2013 with >2 risk factors for OSA	Postoperative oxygen saturation, postoperative complications.	Patients were observed for postoperative complications and contacted at 30 days after hospital discharge to collect information regarding postoperative complications.	Logistic regression analysis	STOP-BANG questionnaire did not identify sleep apnea in 17 % of the studies. STOP-BANG questionnaire had low performance in the diagnosis of sleep apnea in the South Indian population.	Level VI. Moderate strength. Unrecognized sleep apnea is common in preoperative patients.
Chung et al. (2013). STOP-Bang Questionnaire: A Practical Approach to Screen for Obstructive Sleep Apnea.	None	Descriptive study	667 elective surgery patients older than 18 years of age not currently getting treatment for sleep apnea of a preoperative clinic in Toronto, Canada from	STOP-BANG questionnaire score is compared with overnight polysomnography findings	The study analyzed sensitivity, specificity, positive and negative predictive value of STOP-BANG questionnaire.	Descriptive statistics, unpaired t test, chi-square test, and Pearson	STOP-BANG questionnaire is validated in obese and morbidly obese patients. STOP-BANG score of 4 has high sensitivity 88 % in identifying severe sleep apnea, and score of 6 has high	Level VI. Moderate to high strength. The study is limited to preoperative patients.

Study/ Author	Conceptual Framework	Design, Method	Sample, Setting.	Major Variables	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
			2006 to 2009			Correlation analysis	predictability in diagnosing severe OSA.	
Orbea et al. (2020). Predictive ability and reliability of the STOP-BANG questionnaire in screening for obstructive sleep apnea in midlife women.	None	Retrospective Cross-sectional study	Midlife women (ages 40- 65 years) of a Women's Health Clinic at Minnesota who completed the STOP-BANG questionnaire followed by PSG or HSAT between May 1, 2015 and December 31, 2018.	Age, BMI, apnea Hypoxia Index (AHI)	STOP-BANG questionnaire's predictive ability is compared with PSG, and HSAT.	Descriptive statistics, and logistic regression analysis.	STOP-BANG questionnaire is not sensitive for screening OSA in women with mild OSA but useful for prediction of moderate to severe OSA in women.	Level VI Low to moderate strength. Limitations of the study are small sample size and retrospective study.
Saletu et al. (2018). Home Sleep Apnea Testing is a Feasible and Accurate Method to Diagnose Obstructive Sleep Apnea in Stroke Patients During In-Hospital Rehabilitation.	None	Single bind randomized control trial	265 adult stroke patients aged 19- 70 years referred to a rehabilitation unit underwent HSAT	apnea Hypoxia Index of HSAT and PSG	Home Sleep apnea test is compared to Polysomnography test	Descriptive statistical analysis and inferential statistical analysis	The study confirmed good feasibility and sufficient accuracy of HSAT in diagnosing sleep apnea in stroke patients.	Level II. High strength.

Study/ Author	Conceptual Framework	Design, Method	Sample, Setting.	Major Variables	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Labarca, Dreyse, Salas, Contreras, Andrea, Nazar, Gaete, Maria, & Jorquera, (2018). Differences between manual and automatic analysis in determining the severity of obstructive sleep apnea using home sleep apnea testing.	None	Prospective study	198 patients with suspected OSA studied between July 2015 and July 2016	Age, BMI, sex, Neck circumference	Compared AHI of Automatic analysis and Manual analysis of Home Sleep apnea testing	T test	The automatic analysis of HSAT underestimates AHI and provides erroneous severity classification (47%) of OSA.	Level VI. Moderate strength.
Lettau et al. (2017). Blood Pressure Variability in Obstructive Sleep Apnoea: Data from 4 Randomised Controlled CPAP Withdrawal Trials.	None	Randomized control trial	183 participants registered in the sleep database of Switzerland, and the UK, studied between 2010 and 2015.	Home systolic BP, in-office systolic BP readings and CPAP use.	Blood pressure variability with CPAP and without CPAP use are compared	The Kolmogorov-Smirnov test, and the Independent t test,	CPAP withdrawal resulted in mild increase in in-office systolic BP reading.	Level II. High strength. Treatment effects may be blinded by anti-hypertensive treatment.
Kim et al. (2015). An Economic Evaluation of Home Versus Laboratory-Based Diagnosis of Obstructive Sleep Apnea.	None	Multi-center randomized control trial	373 subjects at high risk for moderate to severe OSA from 7 academic sleep centers	Cost per person	Economic analysis of home-based vs laboratory-based diagnosis and management of OSA.	T test	Home based diagnostic testing of OSA is less expensive than the laboratory-based testing.	Level II. High strength. Unable to assess the long-term economic effects of OSA.

Study/ Author	Conceptual Framework	Design, Method	Sample, Setting.	Major Variables	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Kline et al. (2013) Consistently high sports/exercise activity is associated with better sleep quality, continuity, and depth in midlife women: the SWAN sleep study.	None	Multi -center cross-sectional study/ Cohort	370 SWAN sleep study patients, conducted over 6 years	Seep study and physical activity	Relationship between sleep and physical activity	Linear and logistic regression analysis	Consistent high level recreational physical activity is associated with better sleep quality in mid-life women.	Level IV. Moderate to high strength.
Hall et al. (2020). Physical activity is associated with reduced prevalence of self-reported obstructive sleep apnea in a large, general population cohort study.	No	Cross sectional study, Population based cohort study	155,448 adult residents of Ontario, Canada	BMI, levels of physical activity	Association of OSA and physical activity	Logist ic regression model	Vigorous intensity physical activity is associated with decreased prevalence of sleep apnea.	Level IV Moderate to high strength. Physical activity is very important in preventing sleep apnea.
Wickwire et al. (2020). Older adult US Medicare beneficiaries with untreated obstructive sleep apnea are heavier users of health care than	No	Case control study	Random 5 % Medicare claims between 2006 to 2013. Out of total sample of 287,191 Medicare beneficiaries 10,317 are	Health care utilization and cost., age, sex, race, co-morbidities	Health care utilization and cost are compared between patients with OSA and matched patients without sleep	Pearso n Chi square	People with undiagnosed OSA showed higher health care utilization and costs compared to patients on OSA treatment.	Level IV. Moderate strength. Regardless of age, young patients with OSA had a high comorbidity burden compared to non

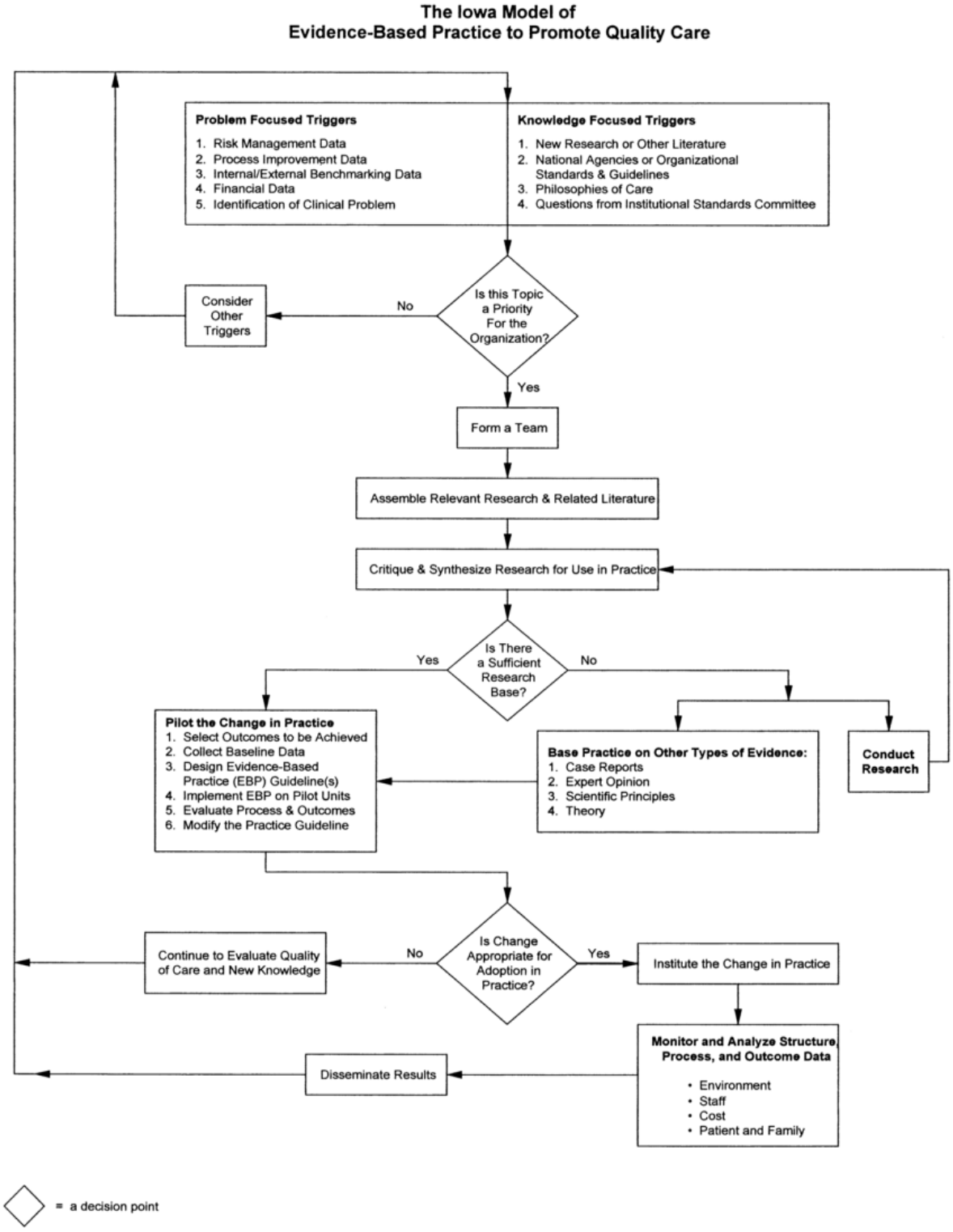
Study/ Author	Conceptual Framework	Design, Method	Sample, Setting.	Major Variables	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
matched control patients.			with OSA and 276,874 control patients		breathing disorder.			OSA patients.
Patil et al. (2019). Treatment of Adult Obstructive Sleep Apnea with Positive Airway Pressure: An American Academy of Sleep Medicine Systematic Review, Meta-Analysis, and GRADE Assessment.	No	Systematic review and meta-analysis	184 articles from Pub Med and Em base databases used for the study.	Types of PAP devices, types of CPAP masks, CPAP humidification,	CPAP adherence, OSA severity, sleepiness, quality of life, BP management, side effects, all-cause mortality, are compared and studied.	Meta-analysis, Standardized mean difference.	PAP treatment compared to no treatment proved significant reduction in the severity of symptoms, and improvement in sleep and quality of life. The study proved that home PAP titration is as effective as in lab PAP titration. The study also proved that educational, behavioral, troubleshooting, and tele-monitoring measures ensure patients adherence to the therapy.	Level I. High strength.
Aiello et al. (2016). Effect of exercise training on sleep apnea: A systematic review and meta-analysis.	No	Systematic review and meta-analysis	8 articles from various databases and 182 patients	BMI, Exercise,	Effect of exercise on apnea/ hypopnea index (AHI)	Meta-analysis, Unstandardized mean differences,	The study proved a decrease in AHI rates in patients who received exercise as treatment.	Level I. High strength. Exercise in OSA patients results in improved outcomes.

Study/ Author	Conceptual Framework	Design, Method	Sample, Setting.	Major Variables	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Barbe et. al, (2012). Effect of continuous positive airway pressure on the incidence of hypertension and cardiovascular events in non-sleepy patients with obstructive sleep apnea: a randomized controlled trial.	No	Multi center parallel group randomized control trials	725 patients with AHI 20 or greater from 14 teaching hospitals in Spain between May 2004 and May 2006. 357 in the CPAP group and 366 in the control group.	Age, sex, BMI, BP,	Outcome measures were systemic hypertension or cardiovascular events	Incidence density rate, Confidence interval	In patients with OSA without daytime sleepiness treatment with CPAP did not prove significant reduction in hypertension or cardiovascular mortality compared to the control group.	Level II High strength.
Martinez - Garcia et Al, (2013). Effect of CPAP on blood pressure in patients with obstructive sleep apnea and resistant hypertension: the HIPARCO randomized clinical trial.	No	Open label Multi center randomized clinical trial	194 patients with resistant hypertension and AHI 15 or greater from 74 teaching hospitals in Spain, and data collected from June 2009 to October 2011. CPAP - 98 patients and no CPAP (control group) 96 patients.	AHI, number of anti-hypertensive drugs	Changes to 24 hours mean blood pressure after 12 weeks of CPAP therapy was compared. Changes to nocturnal BP and other BP values are monitored.	Correlational analysis	Among patients with OSA and resistant hypertension, 12 weeks of CPAP treatment showed significant reduction in mean 24-hour BP, diastolic BP, and nocturnal BP compared to the control group.	Level II High strength.

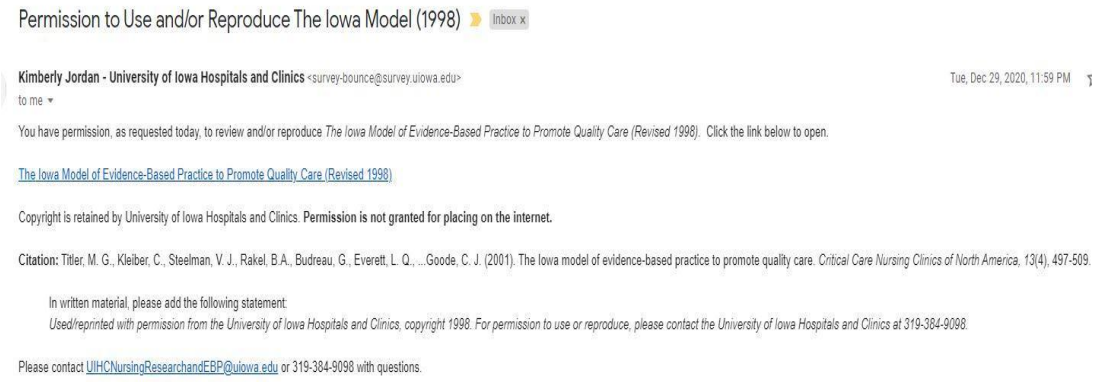
Study/ Author	Conceptual Framework	Design, Method	Sample, Setting.	Major Variables	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Durán-Cantolla et al. (2010). Continuous positive airway pressure as treatment for systemic hypertension in people with obstructive sleep apnea: randomized controlled trial.	No	Multi center double blind randomized placebo control trial	340 patients recently diagnosed with hypertension and AHI greater than 15 from a general hospital in Spain between 2004 and 2007. 169 patients for CPAP therapy and 171 for sham CPAP for three months.	Gender, age, BMI,	Changes in 24-hour ambulatory BP reading after 3 months of optimal CPAP therapy.	Chi square test	Proved statistically significant reduction in BP with 3 months of CPAP therapy in patients with systemic hypertension and sleep apnea.	Level II High strength.
Marshall et al. (2014). Sleep Apnea and 20-Year Follow-Up for All-Cause Mortality, Stroke, and Cancer Incidence and Mortality in the Busselton Health Study Cohort.	No	Community based cohort	397 residents of a Western Australian town. Sleep study was done in 1990 and information about death and hospitalization was obtained in 2010.	Age, gender, height, weight, neck circumference, hip circumference, waist circumference, and abdominal height.	OSA severity is assessed with the Respiratory Disturbance Index (RDI) generated from a home sleep test and death and hospitalization information is collected from medical records in 2010.	Cox regression model	Moderate to severe sleep apnea is a significant risk factor for all- cause mortality, cardiovascular disease, cancer, and stroke.	Level IV Moderate strength.

Study/ Author	Conceptual Framework	Design, Method	Sample, Setting.	Major Variables	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Nagappa et al. (2015). Validation of the STOP-Bang Questionnaire as a Screening Tool for Obstructive Sleep Apnea among Different Populations: A Systematic Review and Meta-Analysis.	No	Systematic review and meta-analysis.	Seventeen studies including 9,206 patients. Articles published from 2008 to 2015.	Age, AHI or Respiratory Distress Index (RDI).	STOP-BANG score is compared to PSG result	Logistic regression analysis	Meta-analysis confirmed high performance of STOP-BANG questionnaire in screening sleep apnea in surgical population and patients of sleep clinic.	Level I High strength. The higher the STOP-BANG score, the greater the probability of moderate to severe sleep apnea.
Chen et al. (2021). Validation of the STOP-Bang questionnaire for screening of obstructive sleep apnea in the general population and commercial drivers: a systematic review and meta-analysis.	No	Systematic review and meta-analysis.	7 studies from 2008 to 2020 with a total of 8770 subjects. Studies evaluated sleep apnea with the STOP-BANG questionnaire: five studies in the general population (n-8585) and 2 studies in truck drivers (n-185).	Age, AHI, RDI	STOP-BANG score is compared to PSG or HSAT result	AUC analysis. chi2 test	STOP-BANG questionnaire is a valid and effective tool in screening OSA.	Level I. High strength.

Appendix D- The Iowa model



Appendix E: Permission for the use of the Model for Improvement



Permission to Use and/or Reproduce The Iowa Model (1998) Inbox x

Kimberly Jordan - University of Iowa Hospitals and Clinics <survey-bounce@survey.uiowa.edu> Tue, Dec 29, 2020, 11:59 PM

to me

You have permission, as requested today, to review and/or reproduce *The Iowa Model of Evidence-Based Practice to Promote Quality Care (Revised 1998).* Click the link below to open.

The Iowa Model of Evidence-Based Practice to Promote Quality Care (Revised 1998)

Copyright is retained by University of Iowa Hospitals and Clinics. **Permission is not granted for placing on the internet.**

Citation: Titler, M. G., Kleiber, C., Steelman, V. J., Rakel, B.A., Budreau, G., Everett, L. Q., ...Goode, C. J. (2001). The Iowa model of evidence-based practice to promote quality care. *Critical Care Nursing Clinics of North America, 13*(4), 497-509.

In written material, please add the following statement:
Used/reprinted with permission from the University of Iowa Hospitals and Clinics, copyright 1998. For permission to use or reproduce, please contact the University of Iowa Hospitals and Clinics at 319-384-9098.

Please contact UIHCNursingResearchandEBP@uiowa.edu or 319-384-9098 with questions.

Appendix F - Team Roles and Responsibilities

Team Member	Roles and Responsibilities
Clinic Coordinator:	Staff coordination Addresses issues or concerns
Nurse Practitioner:	Overall project coordination and follow up on the process Education of team members about OSA. Assist the patient to complete STOP-BANG questionnaire Score patient's STOP-BANG questionnaire Identify patients who need HSAT and recommend sleep apnea test Risk education counseling to all screened patients Assist the patient to complete insurance pre-authorization document Document about OSA screening in clinic note. Notify patient about sleep study report Recommend referral to pulmonologists Data collection and analysis
Physicians:	Collaborating with the NP in the referral process
Medical Assistants:	Introduce STOP-BANG questionnaire to patients Measure patient's height, weight, neck circumference, and BMI Submit documents to the insurance for HSAT insurance pre-authorization Fax necessary documents to the sleep lab to arrange HSAT Scan documents to the patient's medical record Carry out the referral process to a pulmonologist. Documentation
Administrative staff:	Check the insurance privileges of the pulmonologist prior to referral. Assist the medical assistants with the referral process to pulmonologists.
Pulmonary team:	Arrange sleep study Fax the sleep study report to the local cardiology clinic
Pulmonologist:	Interpret sleep study and diagnose sleep apnea Recommend treatment for sleep apnea

Appendix G- Risk Education Counseling on Sleep apnea

Sleep Apnoea -risk education

What Are Snoring and Obstructive Sleep Apnoea?

If you've ever had a stuffed-up nose, you know the feeling of trying to breathe through a very narrow passageway. This is what happens in your throat when you snore. While you sleep, structures in your throat partly block your air passage. This makes the passage narrow and hard to breathe through. In some cases, the entire passage may become blocked so you can't breathe at all. This is called obstructive sleep apnoea.

Obstructive sleep apnoea

If the structures partly or completely block the throat, air can't flow to the lungs at all. This is called hypo-apnoea (decreased breathing) or apnoea (meaning "no breathing"). The lungs aren't getting fresh air. So the brain tells the body to wake up just enough to tighten the muscles and unblock the air passage. With a loud gasp, breathing starts again. This process may be repeated over and over again during the night. This can make your sleep fragmented with lighter stages of sleep. You may not remember waking up many times during the night however due to lighter sleep you will most likely feel tired the next day. The lack of sleep and fresh air can also strain your lungs, heart, and other organs. This may lead to problems such as high blood pressure, diabetes, behavioral disorders, heart attack, or stroke.

Sleep apnoea and snoring

In some cases, snoring is not physically harmful. But it can be linked to a more serious condition called sleep apnoea. Some common symptoms of sleep apnoea include:

- Loud, frequent snoring
- Heavy daytime drowsiness
- Trouble breathing during sleep
- Headaches when you wake up

If you are concerned that you might have sleep apnoea, talk with your healthcare provider about your symptoms. Ask about tests and treatments that may help.

Risk factors for sleep apnoea include:

- Being overweight
- Being a man, or a woman in menopause
- Smoking
- Using alcohol or sedating medicines
- Having enlarged structures in the nose or throat such as enlarged tonsils or adenoids, or extra tissue in the airway

When to seek medical advice

See your healthcare provider if you have daytime symptoms of sleep apnoea. These include:

- Waking up tired after a full night's sleep
- Waking up with a headache
- Feeling very sleepy or falling asleep during the day
- Having problems with memory or concentration

Also talk with your provider if your partner tells you that you snore, gasp for air, or stop breathing while you sleep.

Who needs a sleep study?

If you have sleep problems that last longer than a few weeks, you may need a sleep study. It's important to get tested for sleep disorders. Untreated sleep disorders raise your risk for heart failure, high blood pressure, stroke, diabetes, and depression. Talk with your healthcare provider. Be prepared to answer questions about your health history. Try to keep a daily sleep diary for a week or 2. Write down the time you go to bed, the time you wake up, and anything that seems to affect your sleep. Then your healthcare provider can refer you to a sleep specialist and recommend a sleep study.

Monitoring your sleep

Your sleep can be monitored at a sleep clinic or at your home. In either case, your healthcare provider will discuss the results with you at a future visit:

- **At a sleep clinic.** Most sleep studies are done at a sleep clinic or a sleep lab. In most cases, you will need to stay overnight. You will sleep in a private room, much like a hotel or hospital room. A family member or a friend can come along. But he or she can't stay overnight. Most people don't have trouble sleeping during the study. In the morning you can go home. Sometimes you may be asked to stay at the lab the next day for a daytime nap study.
- **At home.** At times, a sleep study can be done at home. A home sleep study provides most of the same information as a study done at a clinic. A special computer is loaned to you by a sleep clinic or a medical supplier. You will be given instructions on how to use it. Before bedtime, the computer is turned on to monitor your sleep all night. In the morning, you return the computer.

Home care

Lifestyle changes that can help treat snoring and sleep apnoea include the following:

- If you are overweight, lose weight. Talk with your healthcare provider about a weight-loss plan for you.
- Don't drink alcohol for 3 to 4 hours before bedtime. Don't take sedating medicines. Ask your healthcare provider about the medicines you take.
- If you smoke, talk to your healthcare provider about ways to quit. It's important to stay away from secondhand smoke. don't use e-cigarettes because of their harmful side effects.
- Sleep on your side. This can help prevent gravity from pulling relaxed throat tissues into your breathing passages.
- If you have allergies or sinus problems that block your nose, ask your healthcare provider for help.
- Use positive airway pressure (PAP): Discuss with your healthcare provider the benefits of using PAP at home and the type of PAP that is best for you.

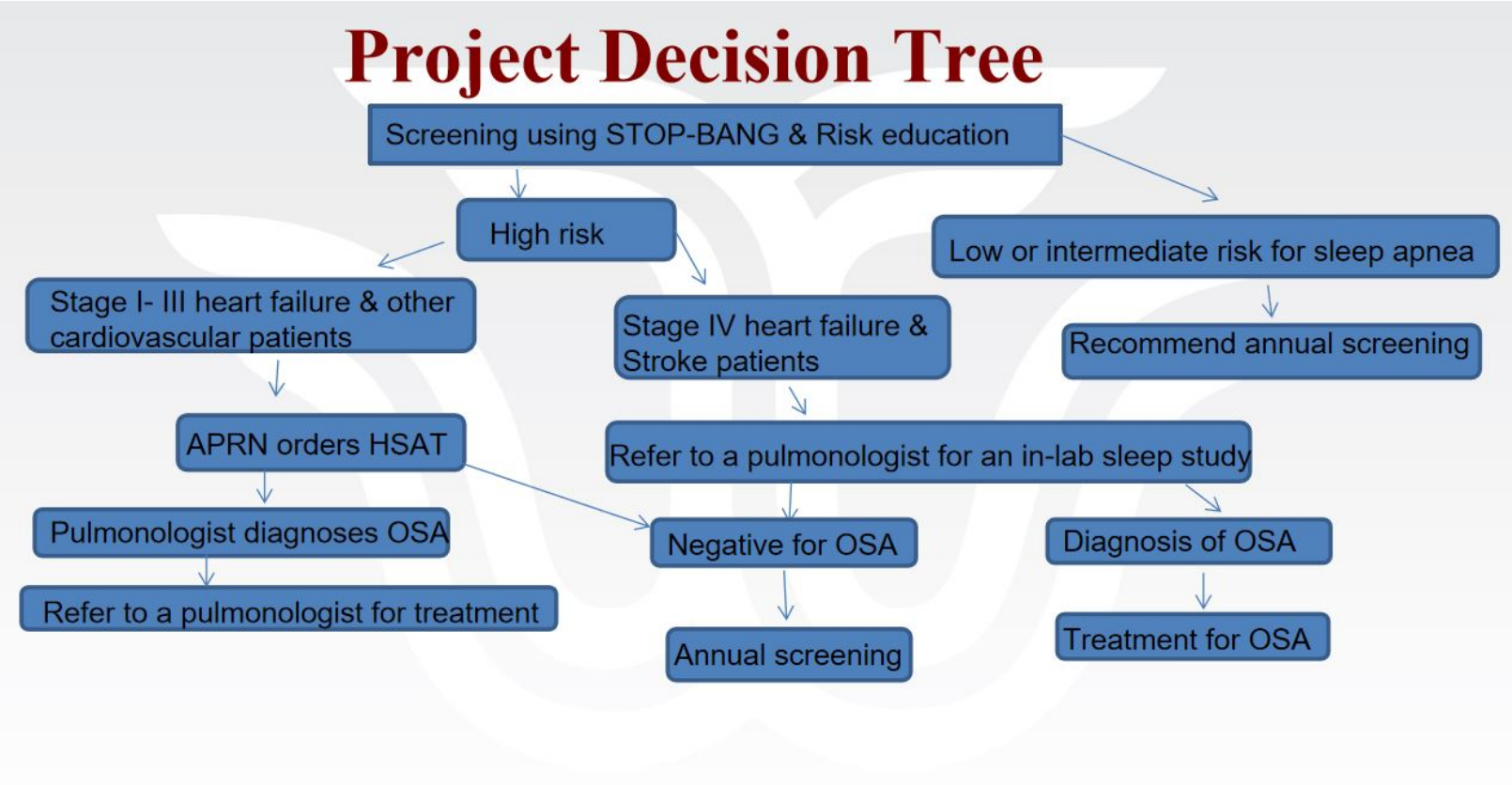
Follow-up care

Follow up with your healthcare provider, or as advised.

What to expect?

Patients are screened for sleep apnea in the clinic using the STOP-BANG questionnaire to identify patients at high risk for sleep apnea. Identified high-risk sleep apnea patients will undergo a home sleep apnea test to diagnose sleep apnea after insurance pre-authorization. Patients will get an update on the status of the pre-authorization and co-pay. The materials for the home sleep study will be mailed to the patient's home. The materials after the home study need to be mailed back for interpretation. Patients can anticipate a callback from the provider's office regarding the home sleep study findings within 2-3 weeks after returning the materials. Patients who are diagnosed with sleep apnea will be referred to a pulmonologist for treatment initiation.

Appendix H- The Project Decision Tree



Appendix I- The STOP-BANG Questionnaire

Name _____
Height _____ Weight _____
Age _____ Male / Female _____

STOP-BANG Sleep Apnea Questionnaire

STOP		
Do you SNORE loudly (louder than talking or loud enough to be heard through closed doors)?	Yes	No
Do you often feel TIRED, fatigued, or sleepy during daytime?	Yes	No
Has anyone OBSERVED you stop breathing during your sleep?	Yes	No
Do you have or are you being treated for high blood PRESSURE?	Yes	No

BANG		
BMI more than 35kg/m2?	Yes	No
AGE over 50 years old?	Yes	No
NECK circumference > 16 inches (40cm)?	Yes	No
GENDER: Male?	Yes	No

TOTAL SCORE		

High risk of OSA: Yes 5 - 8

Intermediate risk of OSA: Yes 3 - 4

Low risk of OSA: Yes 0 - 2

Appendix J- Sample Individual Data Sheet

TEXAS WOMAN'S UNIVERSITY

DNP Program

Scholarly Project Data Collection Form [1 form per project participant]

Demographic Data [Basic]

Data Collector Name: _____

Participant Name: _____

Participant Number: _____

Participant Gender: _____

Participant Race: _____

Participant Age: _____

Participant Marital Status: _____

Participant Educational Level: _____

Participant Living Arrangement: _____

Demographic Data [Historic]

Variable	Value 1	Date 1	Value 2	Date 2	Value 3	Data 3	Other
Hypertension [Yes/No]							
Heart Disease [Yes/No]							
Asthma [Yes/No]							
Other Breathing Disorder [Yes/No]							
Insomnia [Yes/No]							
Anxiety or other Mental Health Problems [Yes/No]							

Clinical Data [Clinic-Specific]

Variable	Value 1	Date 1	Value 2	Date 2	Value 3	Data 3	Other
STOP-BANG Score							
Blood Pressure							
High-Risk for Sleep Apnea [Yes/No]							
Risk Counseling [Yes/No]							
HSAT[1] arranged [Yes/No]							
Diagnosed with Sleep Apnea [Yes/No]							
Referred to Pulmonologist [Yes/No]							

Other Data

Other Comments:

_____

_____

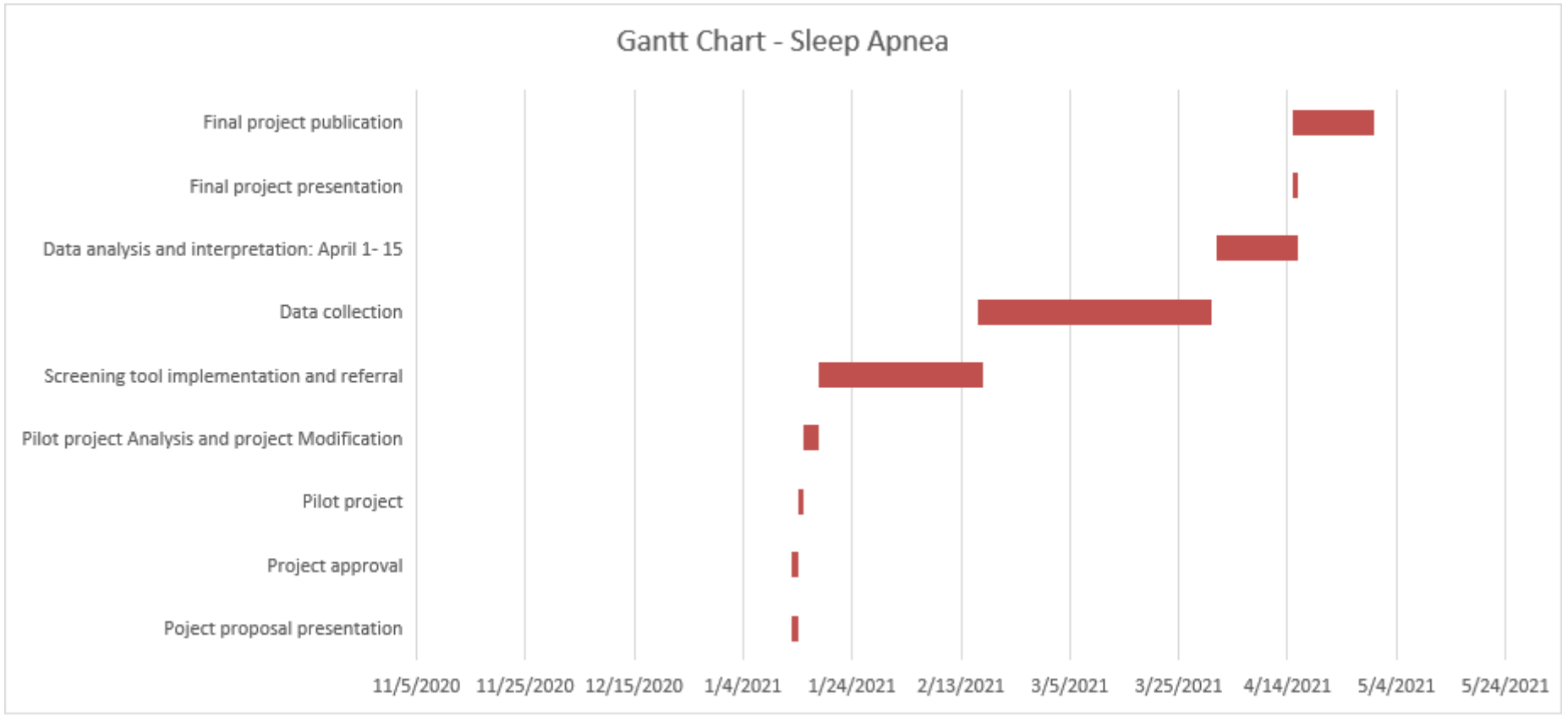
_____

[1] Home Sleep Apnea Test (HSAT)

Appendix K- Sample Excel Data Sheet

Date of visit [mm/dd/yy]	Participant Initials [First, Last]	Participant Number [nn]	Gender[M/F/U]	Race [AI/A/AA/H/NH/W]	Age [in years]	Marital status [M/S/D/W]	Educational Level [E]lem, [M]iddle, [H]igh, [C]ollege, [U]nknown	Living Arrangements [A]lone, [F]amily, [NF]non-family]	Hypertension [Y/N]	BP_SystolicValue1	BP_DiastolicValue1	Mean Arterial Pressure	HTN Value Date1 [mm/dd/yy]	Heart Disease [Y/N]	Asthma [Y/N]	Other Breathing Disorder_OBD [Y/N]	Insmonia [Y/N]	Anxiety or Mental Health Issues [Y/N]	BMI	STOP-BANG Score	High risk for sleep apnea [Y/N]	Risk Counseling [Y/N]	HSAT [Y/N]	Diagnosed with Sleep Apnea [Y/N]	Pulmonologist Referral [Y/N]	Completed Sleep Study [Y/N]	Comments
												0															
												0															
												0															
												0															

Appendix L -Timeline (Proposed)- Gantt Chart



Appendix M- Operational Definitions

Variables	Operational Definition
Population (P)- Patients of the local cardiology clinic	All patients of a local cardiology clinic older than 18 years that visited the clinic between 02/22/2021 and 03/24/2021 for an ongoing cardiovascular diagnosis.
Intervention (I)- Screening patients for sleep apnea using STOP-BANG questionnaire, risk education counseling of patients about sleep apnea, and identify high risk patients for sleep apnea, arrange home sleep apnea test to diagnose sleep apnea, and refer to pulmonologist for treatment of sleep apnea to reduce cardiovascular complications.	Screening for OSA with the STOP-BANG instrument combined with clinical practice judgement for the identification of at risk and possible diagnosis of patients.
Comparison (C)-	Screening for OSA by expert clinician judgement with possible diagnosis
Outcomes (O)-	Number of patients 1). identified at risk 2). underwent sleep study 3). diagnosed and followed up for treatment of OSA.
Time (T)	a 10 week period.

Appendix N- Timeline (Actual) - Gantt Chart