Improving Identification of High-Risk Obstructive Sleep Apnea Patients in Primary Care:

An Integrative Review

A Scholarly Project

Submitted to the

Faculty of Liberty University

In Partial Fulfillment of the Requirements of the Degree of

Doctor of Nursing Practice

By

Lauren Ashley Paulson

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Abstract

Obstructive sleep apnea continues to be an area that is underdiagnosed and therefore undertreated. Left untreated, the condition is associated with increased morbidity and mortality as it can amplify the risk of multiple health conditions. Due to the negative impact of obstructive sleep apnea it is necessary for healthcare providers to provide timely detection. Primary care providers are in a position to identify high-risk individuals and refer them for further follow up testing. High-risk identification can be accomplished by integrating validated screening tools into patient assessments. This integrative review provides an overview of current screening tools for use in the primary care setting, barriers to screening adoption, and successful practices.

Keywords: obstructive sleep apnea, primary care, screening tools

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Introduction

Sleep disorders are common in the United States, yet data supports that primary care providers (PCP) do not routinely ask about sleep health (Grandner & Malhotra, 2015). Obstructive sleep apnea (OSA) is an aspect of sleep health that is grossly under detected (American Sleep Apnea Association , 2019). It is a major concern due to the myriad of health risks associated with the disorder. A review of current literature is timely to identify strategies that can bridge the gap between known under detection and appropriate treatment.

Background

Obstructive Sleep Apnea

Obstructive sleep apnea is a disorder defined by pauses in breathing patterns secondary to muscle relaxation, and soft tissue being able to block portions of the upper airway (Harvard Medical School, 2011). The collapse of tissue in the pharynx slows or even stops inspiration and expiration. A drop in the oxygen level in the blood signals the brain to facilitate a brief interruption to the sleep cycle in order to resume breathing (American Lung Association, 2019; Mayo Clinic, 2019). Apnea can happen frequently during sleeping without an individual being aware (American Lung Association, 2019).

OSA is different from central sleep apnea, as the pharynx is blocked due to a relaxation of muscles in the pharynx rather than a problem originating from a lack of signaling from the brain (NIH, 2018). The main types of sleep apnea consist of OSA, central sleep apnea, and a combination of obstructive and central apnea. The most common form of sleep apnea is OSA (Mayo Clinic, 2019). Symptoms associated with OSA include snoring, daytime sleeping, pauses in breathing, difficulties with memory and concentration, unusual moodiness or irritably, frequently waking up to urinate at night, morning headaches, and dry mouth (American Lung

Association, 2019). There are several identified risk factors associated with OSA. Some of these are preventable and include lifestyle habits and environment, whereas other risk factors based on age, family history, genetics, race, and sex are non-preventable (NIH, 2018).

Obesity is one of the biggest risk factors for OSA, with more than 50% of the diagnoses being linked to overweight individuals. This is attributed to an increased tissue deposit around the neck. Ethnic groups such as African Americans, Hispanics, and Native Americans are disproportionally impacted by the disease, which is likely due to the proportion of obesity in these populations (Dudley & Patel, 2016). Age is another one of the major risk factors. While sleep apnea can occur at any age, there is a strong correlation with sleep apnea and aging individuals. The USPTF and AASM specifically note that those aged 40-70 are considered at increased risk for the OSA (Bibbins-Domingo et al., 2017; Semelka et al., 2016). Furthermore, individuals under the age of 70 with OSA are noted to be at an increased risk of premature death (Franklin & Lindberg, 2015).

Obstructive Sleep Apnea Questionnaires

The increasing prevalence of OSA and the underdiagnosis of the condition support the need for an effective screening method (American Sleep Apnea Association, 2019; El-Sayed, 2012). The Berlin, STOP, STOP-Bang, and Epworth Sleep Study questionnaires are four screening tools that are commonly utilized to identify OSA. They have been tested in various practice settings. These tools utilize questions based on common signs and symptoms associated with OSA (El-Sayed, 2012).

Berlin Questionnaire

The Berlin Questionnaire was developed in 1996 at a primary care conference based in Berlin, Germany by a group of primary and respiratory physicians (Tan et al., 2017). This

questionnaire was developed specifically for identifying OSA in primary care but does have some utility in non-primary care settings (El-Sayed, 2012). It is a questionnaire that stratifies individuals into high-or low-risk groups. The questionnaire asks a total of 10 questions along with information on patient demographics such as age, gender, height, and weight. The questions address common signs and symptoms that can be associated with sleep apnea such as snoring, daytime fatigue, obesity, and hypertension (Tan et al., 2017). Scoring for the questionnaire is based on three categories with high-risk exhibiting positive findings for two or more of the categories (American Sleep Apnea Association, n.d.).

STOP and STOP-Bang Questionnaire

The STOP and STOP-Bang Questionnaires were first developed in 2008 for their utility in screening surgical patients (El-Sayed, 2012). The STOP and STOP-Bang utilize four and eight dichotomous questions respectively and can be completed quickly. While developed for the pre-surgical community they have also be utilized and validated in several other patient populations (Chung et al., 2016). The STOP-Bang utilizes questions from (STOP) snoring, tiredness, observed apnea, and high blood pressure along with demographic information. The Bang portion of the questionnaire includes information regarding body mass index (BMI), age, neck circumference, and gender (Chung et al., 2016).

Epworth

The Epworth Sleepiness Scale was developed in 1991 and is another common tool that can be utilized to screen for sleep apnea since sleepiness is one of the common symptoms associated with OSA. However, this tool only provides a subjective assessment of daytime sleepiness and does not include some of the other symptoms that can be associated with OSA. It

is important to note that not all patients with OSA present with daytime sleepiness (Omobomi & Quan, 2018).

Problem Statement

OSA is a growing concern within the United States as there are an estimated 22 million Americans that suffer from the condition. The national average for the condition is postulated to range between 2-10% of the adult population (Miles et al., 2017). Additionally, data supports that 80% of moderate to severe obstructive sleep apnea remains undiagnosed (American Sleep Apnea Association , 2019). There is a strong correlation of OSA among obese populations, and in western society the prevalence of OSA is speculated to increase (Garvey et al., 2015).

It is important to note that the general public does not routinely recognize symptoms or associated severity with OSA (Frost & Sullivan, 2016). Another identified barrier is that primary care providers do not routinely ask patients questions related to sleep quality or duration (Frost & Sullivan, 2016). Providers may not investigate an early OSA diagnosis if the patient does not present with a complaint of fatigue or classic high body mass index (BMI). This can be further complicated since fatigue can also be credited to existing comorbidities. However, evidence supports that lack of fatigue does not rule out sleep breathing disorders and as much as 50% of individuals with OSA are not obese (Osman et al., 2018).

Economic

The health risks associated with untreated sleep apnea can also have noteworthy economic consequences as the AASM estimates that undiagnosed OSA cost the United States $149.6 billion dollars in 2015 alone (Frost & Sullivan, 2016). The economic strain of the chronic condition impacts not only the nation, but individuals as well. Direct costs of obstructive sleep apnea are associated with co-morbidities, workplace injuries, and car accidents. Meanwhile,

indirect costs associated with OSA may include reduced productivity, quality of life, and strain on relationships (Frost & Sullivan, 2016).

Co-Morbidities & Complications

Sleep apnea is a significant problem since untreated sleep apnea can increase risks associated with asthma, some cancers, hypertension, arrhythmias, heart disease, chronic kidney disease, cognitive and behavioral disorders, eye disorders, stroke, diabetes, pregnancy complications, and premature death (Knauert et al., 2015; NIH, 2018).

Asthma

It is noted that patients with asthma have a greater chance of OSA when compared to the general population, with OSA potentially worsening asthma-related outcomes. Evidence supports that asthma patients with OSA have a higher association with poor asthma control, increased nocturnal symptoms, and recurrent exacerbations. While there is a link between asthma and OSA the exact mechanics behind the process remain hypothetical, but OSA has been associated with airway remodeling due to inflammation. Patients with OSA and asthma that are treated with a CPAP seem to have improvement of symptoms as evidenced by peak flow readings and reported quality of life (Dixit, 2018).

Cancer

Obstructive sleep apnea has also been associated with an increased risk of cancer mortality. A Wisconsin sleep cohort study published by Nieto et al. (2012) demonstrated an increase in mortality among cancer patients with severe sleep breathing disorders compared to those without. The association between cancer mortality and sleep breathing disturbances remained high even after accounting for variables such as “age, sex, smoking, BMI, physical activity, diabetes, weight circumference, and sleep duration” (National Sleep Foundation, 2019;

Nieto et al., 2012, p. 192). While there is a correlation, there is not a clear understanding of whether OSA contributes to the formation of cancer or mainly facilitates its growth. However, animal studies demonstrate that intermittent hypoxia promotes angiogenesis and tumor growth (National Sleep Foundation, 2019).

Hypertension

Multiple studies and papers have been dedicated to demonstrating the link of obstructive sleep apnea with resistant hypertension. Resistant hypertension is characterized as elevated blood pressure that elicits a poor response to treatment requiring multiple medications (Yaxley & Thambar, 2015). There are several proposed theories regarding the pathology behind severe OSA and resistant hypertension. Severe OSA has correlated with poor blood pressure control and increased cardiovascular risk. CPAP therapy may provide benefits by reducing blood pressure and overall cardiovascular disease risk (Harding, 2014).

Arrhythmias

Several arrhythmias have been associated with obstructive sleep apnea. Atrial fibrillation is a common arrhythmia encountered in patients with OSA. The exact pathophysiology behind the development of arrhythmias in individuals with OSA remains unclear, but there are a few hypotheses that have been suggested. A hypothesis is that reduced blood oxygen saturation and increased carbon dioxide levels cause complications in both the chemoreflex and baroreflex functions (Patel et al., 2019). This could lead to an activation of the sympathetic system and electrical remodeling within the heart. Another proposed hypothesis is that hypertension that often coincided with OSA, is linked to the development of atrial fibrillation. Evidence supports that hypertension can cause atrial remodeling. Continuous positive airway pressure (CPAP) has

shown to be effective in the treatment of OSA and has the benefit of reducing the incidence of arrhythmia in OSA patients (Patel et al., 2019).

Chronic Kidney Disease

Obstructive sleep apnea has a causal link with chronic kidney disease (CKD) due to the association with chronic hypertension. OSA, through the cycling of sleep fragmentation and arousals, contributes to the progression by increasing sympathetic nerve discharge, renin-angiotensin-aldosterone system (RAAS) activation and increased vascular resistance. Studies on OSA have been associated with glomerular hyperfiltration and glomerular sclerosis (Adeseun & Rosas, 2010). Data suggests that there is a bidirectional relationship between OSA and CKD with OSA contributing to the progression of CKD and CKD worsening the risk associated with OSA (Abuyassin et al., 2015).

Memory and Behavioral Disorders

Several studies have demonstrated that cognitive impairment is a complication associated with OSA. Deficits in executive functioning, memory, and attention are one of the negative consequences of the disorder. Executive function includes the ability to reason, perform tasks, plan, and engage in problem solving. Obstructive sleep apnea is not exclusive to the adult population and can be seen all ages. Furthermore, cognitive disfunction linked with the OSA has been observed in children as well as adults (Krysta et al., 2017). The exact prevalence of cognitive dysfunction associated with OSA is unknown as there is large variation within studies. Variations such as heterogenicity of the sample, premorbid IQ, education level of the subjects, oxygen levels, selection of a comparison group, and even continuity in memory tasks are important to note. Combination studies of neurophysiological and neuroimaging have helped to further support the link of cognitive decline in patients with OSA (Krysta et al., 2017).

Eye Disorders

Obstructive sleep apnea is associated with several ophthalmic conditions. Floppy eye syndrome, glaucoma, and nonarterial anterior ischemic optic neuropathy are some of the conditions that appear to have a link with OSA. Due to the increased risk of eye disorders in patients with OSA it is important that physicians are aware and refer patients to obtain ophthalmic evaluation and any necessary treatment (Skorin & Knutson, 2016).

Stroke

Obstructive sleep apnea is an independent risk factor for stroke patients. Left untreated, OSA in stroke patients could lead to a recurrent stroke. It is also to be noted that OSA has a bidirectional relationship with severity of the stroke manifestations and the degree of recovery after a stroke. CPAP therapy has proven beneficial in improving cognitive and overall function among stroke patients with OSA (Jehan et al., 2018).

Diabetes

The association of OSA and type II diabetes are suggested to be independent of age-related changes or obesity (Muraki et al., 2018). Furthermore, OSA is noted as a co-morbidity of diabetes due to the increased prevalence in the diabetic population and nearly half of type II diabetics suffering with OSA. The association of decreased insulin sensitivity and OSA has been demonstrated through animal studies with intermittent hypoxia. It is believed that the sympathetic pathway is activated by the intermittent hypoxia resulting in oxidative stress and systemic inflammation that subsequently cause changes in hormonal balance (Muraki et al., 2018).

Pregnancy Complications

While sleep apnea is relatively low among women of reproductive age. It is important to note that pregnancy does increase risk of sleep disordered breathing (SDB). While the exact cause is not well understood "the physiological hormonal, mechanical, and cardiovascular changes of pregnancy may place women at risk of developing SDB or exacerbate existing sleep disorders" (Izci, 2015, p. 270). Higher levels of estrogen, progesterone, and other hormones may play a significant role in the anatomical narrowing and resistance due to capillary engorgement, hypertension, and edema (Izci, 2015).

Premature Death

A large sleep study that was conducted for over 18 years indicated that patients with severe sleep apnea have a mortality rate that is approximately three times greater than individuals without apnea (UWHealth, 2016; Young et al., 2008). This study consisted of a randomized sample of men and women (n= 1,522) within the community between the ages of 30 and 60 at the start of the study. Findings of the study indicated a high all-cause mortality risk with severe sleep breathing disorders even when adjusted for age, sex, and BMI. This study highlights the importance of clinical recognition and treatment of SBD (Young et al., 2008). Furthermore, the Wisconsin Sleep Cohort supports that continuous positive air pressure therapy (CPAP) does reduce overall mortality (AASM, 2008).

Purpose of the Project

The scholarly project's purpose was to seek improvement in healthcare screening practices for OSA in primary care settings by the identification of best screening tools for the PCP, detection of barriers, and strategies to increase OSA screening. These goals were developed as there continues to be gap between the known under detection and lack of routine questions

regarding sleep health in primary care (Grandner & Malhotra, 2015). This project initiative correlated with the American Academy of Sleep Medicine's suggestion to screen individuals that are considered high-risk based on risk factors (AASM, 2017).

Clinical Question

This review of the literature sought to answer clinical questions to improve detection and standardization of OSA screening in primary care. The clinical questions aimed to promote timely identification of sleep apnea risk for patients that could be used to determine a need for further follow-up testing. Additionally, the review considered best methods to integrate sleep apnea screening into primary care to promote sustainability. Three clinical questions guided the integrative review of the literature and provided a broad scope of the current facilitators and barriers to OSA screening by primary care providers.

Project Goals

1.) What valid and reliable OSA questionnaires, for the adult population, have the best utility in the primary care setting?
2.) What are perceived barriers among health professionals in utilizing OSA screening questionnaires in primary care?
3.) What practices have been successful in increasing OSA screenings for high risk patients?

Methods

Protocol and Framework

Integrative reviews are described as a review of the available research and should uphold a standard in methodology (Whittemore & Knafl, 2005). "The integrative review method can incorporate diverse methodologies in order to capture the context, processes, and subjective

elements of the topic" (Whittemore & Knafl, 2005, p. 552). Robust integrative reviews have the potential to advise further research, policy, and practice initiatives. While this method can provide a holistic view on an issue the combination of different study types can make this process a challenge (Whittemore & Knafl, 2005). Utilization of a framework in the integrative review process facilitates systematic practices and sets a standard for academic excellence. The OSA integrative review utilizes the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) framework as a means to safeguard quality.

The PRISMA framework was developed during 1996 in response to an identified need for improved the reporting quality of meta-analyses (Moher et al., 2009). This framework utilized a 27-point checklist along with a four-phase flow diagram (Moher et al., 2009). The PRISMA checklist was utilized to outline the paper with seven main headings and multiple sub-headings. The four-phase diagram was also utilized to map the systematic approach of collecting scholarly articles for the integrative review. The PRISMA flow diagram methodology is embraced as it guides the reviewer in carefully formulating a question, meticulously identifying articles, screening, and inclusion of literature in the integrative review (Moher et al., 2009; Whittemore & Knafl, 2005). The integrative review method with PRISMA is further characterized by an analysis of studies included with or without statistical scrutiny (Moher et al., 2009). Whittemore and Knafl (2005) supplemented the PRISMA checklist and flow diagram by offering further suggestions in the data analysis stage through data reduction, data display, data comparison, conclusions and verification.

Eligibility Criteria

Inclusion criteria for the integrative review, on the topic of obstructive sleep apnea, included articles that were published in or after 2016 and in the English language. Clinical

questions helped to narrow the search further to those looking at questionnaire use in the primary care setting for the adult population. References were not limited to the United States and included studies conducted around the world. Exclusion criteria for journal articles and reports comprised those published before 2016 as well as those that were published in a foreign language. References with questionnaire use in the hospital, specialty practices, or with children were also excluded from the search.

Information Sources

Liberty University's online library was utilized to search clinical databases for scholarly and relevant sources. Both ProQuest Medline and ProQuest: Nursing and Allied Health Databases were utilized in the integrative review as these databases contain a wealth of scholarly sources focused in health and medicine. Resources within these databases were carefully reviewed for literature that was peer reviewed. DNP dissertations and scholarly projects were also included in the review to increase evaluation on the topic of OSA screening. The PRISMA flow diagram facilitated a systematic approach to obtaining and documenting sources based on the inclusion and exclusion criteria. These databases and the approach guided by PRISMA provided a means to review current literature for questionnaire utility in the primary care setting, perceived provider barriers, and strategies that have proved beneficial in increasing OSA screening.

Search

Since an integrative review is not meant to simply be a list of the current and available literature, there is a process that should be utilized to standardize how literature is obtained and reviewed. An expansive literature search was conducted utilizing ProQuest Medline and ProQuest Nursing and Allied Health. Databases, such as the ones reviewed, are gateways to

rendering a body of evidence (Melnyk & Fineout-Overholt, 2019). A keyword search was conducted in both of these large databases. Key words that were used in the search included sleep apnea, obstructive sleep apnea, primary care, questionnaire, and adult. Literature that met inclusion criteria was saved and then appraised based on Melnyk's hierarchy of evidence (Melnyk & Fineout-Overholt, 2011).

Of the 15 total articles systematically obtained, 13 were primary sources with the remaining coming from secondary sources. Melnyk's hierarch of evidence assessed the strength of the articles included for merit in directing clinical practice. A range of evidence was identified for the articles found that met both the inclusion and exclusion criteria. Two articles included in the integrative review consisted of systematic reviews (level II) which are defined as including at least one randomized control trial. One study included a quasi-experimental approach classified as a level III in terms of evidence. Ten studies included in the review consisted of case control or cohort studies and ranked as a level IV in evidence quality. A qualitative study was also included and provided level VI evidence (University of Michigan, 2020).

Study Selection

The integrative review (IR) of literature was conducted to identify current best practices for OSA screening in the primary care setting. Liberty University Institutional Review Board (IRB) approval for the IR scholarly project was requested and obtained in accordance with university standards. Following the PRISMA flow diagram with inclusion and exclusion criteria provided 15 applicable journal articles. The 15 articles were extracted from the total 893 articles after completing a key word search for articles published after 2015 using the two ProQuest databases.

Data Collection Process

A search for available literature was done by utilizing Liberty's online library. Medical databases were chosen and included both ProQuest Medline and ProQuest: Nursing and Allied Health to discover relevant articles on the topic of OSA screening tools in primary care. There is a significant amount of literature available for OSA and screening tools. However, this particular search was limited to studies with a focus on the primary care role in the discovery and treatment of the OSA disorder utilizing screening tools. Studies were also limited to those that were published within the last five years to provide current evidence.

Data Items

Selection of available articles found through the two ProQuest databases was a rigorous process done to narrow down to the specific data items that addressed the clinical questions. Reduction of the vast number of articles, available through the key word search, was done systematically and the PRISMA model served as a guide for inclusion of relevant articles. Eligible full text articles were read, and data was sifted through based on the subject and setting of the study. Organization of the data items was achieved through the PRISMA flow diagram and synthesis chart of eligible articles.

Risk for Bias in Individual Studies

Integrative and systematic reviews require consistency in the approach of identifying, reviewing, and synthesizing articles to provide current evidence on clinical enquiries. Following the PRISMA checklist and flow diagram helped to reduce bias as the writer documented the approach and included all relevant literature on the topic of interest rather than just selecting articles that supported a particular approach. The organized review of literature can help

healthcare leaders recognize the broad scope on an issue and make well informed decisions that impact services provided (Liberati et al., 2009).

Summary Measures

The purpose of the integrative review was to answer the clinical questions of OSA questionnaire utilization in the primary care setting. Finding tools with the best utility, identification of barriers, and recognizing facilitators was accomplished and charted in a literature results matrix. This matrix provides an overview of the applicable articles found by including the focus of the article, level of evidence, background, practice implications and recommendations.

Synthesis of Results

Literature notes a continued lack of OSA diagnosis and treatment which prompted a review of current literature for primary care strategies in addressing the continued under identification and treatment. Several OSA screening tools were identified during the literature review to aid providers in discovery of high-risk signs and symptoms among patients. A few barriers to screening tool adoption along with recommendations for practice were included to improve the process of screening tool utilization in clinical practice.

Results

Study Selection

The review of literature rendered a total of 893 articles using two ProQuest databases with keyword search and limiting articles to those published after 2015. The PRISMA flow diagram was utilized to navigate the selection of applicable articles. The diagram provided a top down approach for mapping the inclusion of articles. Identification, screening, eligibility, and inclusion represented the steps to systematically reviewing scholarly sources. The flow chart first

displayed the total number of articles identified with each database and include ProQuest Medline (641) and ProQuest: Nursing and Allied Health (252). After duplicates from the two databases were removed a total of 461 articles were available for screening. Of these articles, 420 were excluded for not meeting both the inclusion and exclusion criteria. The remining 55 articles were reviewed for eligibility based on relevance to the clinical questions. Based on the clinical question, one qualitative and 14 quantitative articles were included in the integrative review (See Appendix A).

Study Characteristics

A results matrix table was utilized to summarize the findings and appraise the evidence. Including both qualitative and quantitative articles is one of the benefits of conducting an integrative review. The methods of conducting an integrative review allowed for articles with mixed methodologies such as experimental and non-experimental research that provided a robust examination of available evidence (Whittemore & Knafl, 2005). Three clinical questions guided the search for relevant articles to address the validity of screening tools, perceived barriers, or successful practices in increasing screening practices within the primary care. No identifiable bias was noted within or across the articles included in the review.

Synthesis of Results

Whittemore and Knafl (2005) detailed the data analysis process for an integrative review and noted that there are four distinct parts to a detailed synthesis. The analysis advances through data reduction, data display, data comparison, conclusions drawn and verification. This systematic process helps to mitigate formulating premature conclusions (Whittemore & Knafl, 2005).

Data Reduction

The data reduction phase describes the classification and sub-categorization of articles. This process can account for articles based on the chronology, setting, sample characteristics, or other predetermined conceptual classification (Whittemore & Knafl, 2005). Data was reduced using inclusion and exclusion criteria and further dwindled down based on the topics that answered the preformulated clinical questions.

Data Display

The next step to data analysis included displaying the themes from the multiple sources. Whittemore and Knafl (2005) stated that the data may be displayed using various forms such as matrices, graphs, charts, or networks to provide a clear comparison across sources. Displaying data in one or multiple forms helps to improve visualization for further interpretation. The literature matrix table was developed to sort data by providing the level of evidence, background, and conclusions for each article.

Data Comparison

Data comparison was then completed after finalizing the literature matrix table. Articles that corresponded with the clinical questions were sorted and reviewed. The matrix table proved beneficial in the process of comparing and contrasting the themes of reliable OSA questionnaires, perceived barriers, and successful practices.

Conclusions Drawn and Verification

After a careful review of the available articles, conclusions were drawn and identified in the summary of evidence. The review of available screening tools, barriers, and successful practices provided a comprehensive depiction of the evidence. Generalities emerged from the

available articles to provide recommendations for integration into clinical practice through policy changes or suggestions for further study.

Additional Analysis

Valid and Reliable OSA Questionnaires

The review of literature revealed a total of seven different screening tools that have been tested in the primary care setting. The sensitivity and specificity data of the screening tools depended largely upon the population screened as well as the data apnea-hypopnea index (AHI) set point. The AHI notes the severity of sleep apnea and results can be classified as normal (0-5) sleep, mild apnea (5-15), moderate apnea (15-30), or severe apnea (>30) (Miller & Berger, 2016). While some of the studies offered sensitivity and specificity data on all severity cutoffs others offered sensitivity and specificity data only on a single AHI cutoff such as moderate apnea (Miller & Berger, 2016). The STOP-Bang was by far the most utilized tool within the articles reviewed. The Berlin Questionnaire and Epworth Sleepiness Scale both tied for the second most common tools used within the available literature. Literature supports that the Berlin and STOP-Bang currently offer the best measures for the presence of moderate and severe apnea (Miller & Berger, 2016). Use of the Epworth as an initial screening tool for OSA is cautioned due to inconsistency with both sensitivity and specificity (Aurora & Quan, 2016; Miller & Berger, 2016).

STOP and STOP-Bang. The STOP-Bang was identified in nine of the articles included in the review. Some provided data on the utility of this screening tool in the primary care setting, whereas other articles looked at the process of implementing the questionnaire in the clinical practice. The STOP questionnaire is a precursor to the STOP-Bang and was only reviewed in one of the articles (Miller & Berger, 2016). While the STOP and STOP-Bang screening tools were

initially designed for the pre-surgical population, the STOP-Bang was readily used in the articles reviewing the primary care setting due to the high sensitivity data and ease of use (Miller & Berger, 2016).

A study that compared the STOP-Bang against the Berlin Questionnaire within the diabetic population found the STOP-Bang had the highest sensitivity (87.2) for mild apnea but was nonspecific to OSA. The STOP-Bang along with the Berlin has even better sensitivity with moderate and severe apnea. Sensitivity improved but was still poor with moderate and severe sleep apnea for both the STOP-Bang and Berlin (Edmonds et al., 2019). Another study reviewed the utility of the STOP-Bang with patients suspect to have a sleep disorder and referred by their primary care providers for a sleep study. The STOP-Bang used with individuals suspected to have a sleep disorder provided a 98.62% sensitivity and 33.33% specificity (Rebelo-Marques et al., 2018).

Berlin. The Berlin Questionnaire was implemented in four of the journal articles. This questionnaire consistently had lower sensitivity than the STOP-Bang but offered an improvement in specificity (Edmonds et al., 2019; Senaratna, 2019). As previously noted, a literature review looking at Epworth, Berlin, and STOP-Bang screening questionnaires highlighted that the Berlin and STOP-Bang currently offer the best questionnaire for OSA in the primary care setting (Miller & Berger, 2016).

Epworth. Studies recommended against the use of the Epworth Sleepiness Scale (ESS) as an initial screening of OSA due to lack of consistency with sensitivity and specificity data (Aurora & Quan, 2016; Grover et al., 2016; Miller & Berger, 2016). Another study reviewed the ESS in conjunction with the Berlin, STOP-Bang, and OSA-50 to determine how it would impact predictive values. The ESS helped to raise the specificity from 21%-59% to 92-95% when used

with all three tools but also lowered the sensitivity from 65%-86% to 36%-51% (Senaratna, 2019).

Phillips. Data on the Phillips questionnaire was limited to a single article that reviewed its function when used with overnight oximetry (Fabius et al., 2019). The study was able to optimize cutoffs for the oximetry data index (ODI) and questionnaire based on results from patients referred for sleep studies. A sensitivity of 99% and specificity of 65% was achieved utilizing a two-step screening method using both the Phillips questionnaire and oximetry. Using the two-step method improved sensitivity results beyond using oximetry data alone (Fabius et al., 2019).

OSA 50. The OSA 50 screening tool was included in an article that cross analyzed the sensitivity and specificity with the STOP-Bang & Berlin alone and in combination with the Epworth Sleepiness Scale for moderate OSA. The OSA 50 provided moderate sensitivity (86%) but low specificity (21%). Specificity (92%) for this tool improved when used with the ESS but sensitivity (51%) data was impacted. The OSA 50, when compared against the other tools provided the highest sensitivity but the lowest specificity (Senaratna, 2019).

SACS tool. The SACS tool was used in only one of the articles reviewed. This tool was provided to a convenient sample of patients within the primary care setting with clinical suspicion of sleep apnea. It is important to note that the study classified OSA as an AHI>10. The SACS provided a sensitivity (44%) and specificity (89%) for moderate sleep apnea (AHI>15). (Grover et al., 2016).

Perceived Barriers

Reviewing perceived screening barriers is important since there is a lack of utilization of OSA questionnaires within the primary care setting (Bakhai et al., 2017; Devaraj, 2020; Khan et

al., 2019). Several articles addressed some of the perceived barriers to OSA screening in the primary care setting. Five main themes emerged with the review of included articles. Studies determined that inconsistency with practice guidelines, lack of awareness regarding available screening tools, current screening test predictive values, time constraints, and electronic medical record (EMR) limitations (Aurora & Quan, 2016; Bakhai et al., 2017; Khan et al., 2019; Kleisiaris et al., 2016; Ononye et al., 2019).

Inconsistency with Guidelines. Screening guidelines vary across professional organizations. The United States Preventative Services Task Force (USPSTF) position does not recommend OSA screening in the general population whereas the American College of Physicians' guideline recommends screening individuals with symptoms such as unexplained fatigue. The American Academy of Sleep Medicine recommends screening all high-risk individuals such as those with atrial fibrillation (AF), obesity, hypertension, heart failure, stroke, diabetes, and pulmonary hypertension (Khan et al., 2019). The lack of consistency across guidelines makes it challenging to know what organizational recommendations to follow.

Time Constraints & Low Reimbursement Rates. Limitations on available time to conduct screening questionnaires in the office was another barrier noted (Bakhai et al., 2017). A quality improvement study performed a root cause study to evaluate patient, physician, and material barriers to adoption of OSA screening. The extra time needed to complete the screening forms was one of the physician barriers listed (Bakhai et al., 2017). Furthermore, low reimbursement rates were an identified barrier that made screening for OSA less of a priority in busy practice settings (Addogoh, 2018).

Lack of Awareness. A review of perceived barriers was done in a quality improvement study and noted that one of the challenges was a lack of awareness of available screening tools as well as education on appropriate sleep screening (Khan et al., 2019). This finding was supported by several other articles (Bakhai et al., 2017; Miller & Berger, 2016). Furthermore, primary care providers need to be educated on what high-risk groups and symptoms require further follow up (Ononye et al., 2019; Kleisiaris et al., 2016).

Screening Test Predictive Values. Lack of assessment may also be linked to screening tests failing to provide a combination of high sensitivity and high specificity (Miller & Berger, 2016). Most OSA screening tools provide high sensitivity but low-to-moderate specificity. However, multiple articles conclude that there needs to be routine screening for OSA in the primary care setting (Aurora & Quan, 2016; Kleisiaris et al., 2016; Miller & Berger, 2016; Showalter & O'Keefe, 2019).

Electronic Medical Record Limitations. An additional shortfall to OSA screening identified in the literature search pointed to limits within the electronic medical records (Bakhai et al., 2017). For practices that have OSA screening tools available in the EMR it is important to note the extra steps of manual calculation and documentation added to a clinical workflow (Bakhai et al., 2017). The absence of an automated algorithm and clinical decision support was recognized as the greatest barrier to a quality improvement process aimed at increasing detection and referral of high risk OSA patients (Bakhai et al., 2017).

Successful Practices

Review of successful practices to increasing OSA screening for high risk patients was another aspect of the literature review. Three main themes emerged in regard to helpful

interventions for primary care practices. These themes include staff education, development of an OSA screening protocol, and EMR improvements.

Staff Education. As noted earlier, lack of education or awareness on available screening tools was one of the perceived barriers to OSA screening. Several studies noted that primary care providers would likely benefit from further training on detection of OSA and impact of untreated OSA (Devaraj, 2020; Khan et al., 2019; Miller & Berger, 2016). However, training should not be limited to practitioners and should also include other key clinical personnel such as medical office assistances, nurses, and clinic administrators. Education on OSA screening includes how to administer as well as the value and potential benefit of routine OSA screening (Aurora & Quan, 2016). Implementing an OSA screening training program has proven successful in improving screening and referral rates for high risk patients within the primary care setting (Addogoh, 2018).

OSA Screening Protocol. Another identified strategy for improving screening within the primary care is to provide a screening protocol within the practice setting (Addogoh, 2018; Ononye et al., 2019; Miller & Berger, 2016; Showalter & O'Keefe, 2019). Several of the screening protocols proved successful in identifying OSA high-risk patients that had not been previously identified. Despite the recommendation to create a screening protocol for OSA there were inconsistencies with what groups were screened and with what screening tool. In line with a screening protocol was a recommendation to provide the screening tool to high-risk patients prior to clinic visits (Aurora & Quan, 2016). Implementing a protocol that allows for completion of the screening tool prior to the clinical visit can help improve workflow and mitigate time restraints (Aurora & Quan, 2016).

Electronic Medical Record. The third main theme for improving success with OSA detection and screening suggests the use of an electronic medical record. Several studies were limited in the extent of being able to utilize the EMR, but suggested built-in alerts and reminders through clinical support tools, integration of the screening tool in the EMR, and hard stops to complete screening tools for at risk patients (Addogoh, 2018; Aurora & Quan, 2016; Grover et al., 2016; Johnson, 2019; Miller & Berger, 2016; Senaratna, 2019; Showalter & O'Keefe, 2019). Integrating the screening tool in the EMR can help to streamline the process by reducing the time healthcare providers are spending to manually entering OSA screening questionnaires (Bakhai et al., 2017). However, use of clinical support tools and alerts should be further explored (Grover et al., 2016).

Discussion

Summary of Evidence

The articles reviewed provided substantial support for adoption and integration of OSA screening tools in the primary care setting. Primary care providers are in an important position to facilitate early screening (Aurora & Quan, 2016). Despite this, lack of sufficient screening continues to be an issue within primary care (Addogoh, 2018; Bakhai et al., 2017; Khan et al., 2019; Ononye et al., 2019). While the benefit of implementing screening is recognized, research is still needed regarding the best strategies for timely identification of patients that have undiagnosed OSA. Prominent guidelines provide different suggestions regarding screening only symptomatic individuals or screening high risk. However, it is important to note that none of the screening guidelines recommend widespread screenings for all primary care patients (Khan et al., 2019.)

In addition to the variation in professional guidelines, there remain barriers that need to be overcome in order to improve identification of OSA positive patients. The limitations in the study pointed to the need for improved healthcare education on OSA impact and available screening tools, enhancement of EMR capability, along with financial reimbursement for time spent screening. Furthermore, while the screening tests tend to have high sensitivity, they consistently provide low specificity for OSA requiring a thorough work up and follow up testing to make a diagnosis.

Multiple articles noted that use of sleepiness scales, such as the ESS, are not ideal for identifying high risk OSA patients due to variability in predicting the presence or absence of sleep apnea (Aurora & Quan, 2016). But this tool continues to be used for initial screening (Addogoh, 2018; Johnson, 2019). The STOP-Bang was one of the most widely used tools in the review of literature. The tool is easy to use with eight dichotomous questions in addition to being consistent with the sensitivity and specificity (Miller & Berger, 2016).

Limitations

The integrative review does have some limitations. Limitations noted within the review of literature include articles that were not limited to the United States. Additionally, the articles included in the review predominately consisted of level IV (case control or cohort) studies and look for correlations. While these studies add to the pool of evidence they are not as strong as randomized control trials (University of Michigan, 2020). Barriers to OSA screening identified in the review of literature were predominately noted by interviewing healthcare providers and could impact the strength of the findings (Bakhai et al., 2017). Some of the successful practices were tested in the review of literature but there were limitations in testing the impact of

modifying the capability of the electronic medical record. Most studies noted that improvements within the EMR would likely help but this was not studied in the articles reviewed.

Conclusions

Literature supported the need for increased detection of obstructive sleep apnea. Primary care clinics are an opportune setting to identify high risk OSA individuals. The integrative review utilized mixed method articles to identify current screening tools, barriers, as well as facilitators to increasing OSA screening in the primary care. The screening tools were reviewed for their utility in the primary care setting and revealed most screening tools to have a high sensitivity but low specificity. The perceived barriers and recommended facilitators to improve OSA screening provide suggestions for practice changes and further research. OSA will remain under detected and undertreated unless action is taken to pursue best methods for detection, streamline the screening process, and implement strategies for continued improvement.

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Tables

Table 1

Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Publications from 2016-2020	Publications during or prior to 2015
Adult patient population (>18 yrs.)	Pediatric patient population (<18 yrs.)
Peer-reviewed, gray literature (i.e. unpublished articles, dissertations, frameworks, policy documents, etc.)	Non-research articles (i.e. commentaries, editorials, briefings, fact sheets)
Primary Care	Hospital or Specialty Practice
Full-text articles	Abstract only articles
English language	Publications written in a foreign language

Table 2

Results Matrix Obstructive Sleep Apnea Screening in Primary Care

Focus of Article, Author/year	Level of Evidence/Source	OSA/ Background	Conclusions/ Practice Implications/ Recommendations
Comparing neck grasp and circumference to STOP-Bang and Berlin questionnaires in the primary care population among type 2 diabetics. (Edmonds, Gunasekaran, & Edmonds, 2019).	IV/Primary	▪ Convenient sample of type 2 diabetics from an internal medicine clinic for routine visits between 2015-2016. ▪ 86 participants were screened with 43 meeting inclusion criteria (Type 2 diabetes and no prior OSA dx)	Conclusions: For the diabetic population ▪ For mild OSA (AHI 5-14) the most sensitive screening test was the STOP-Bang (sensitivity 87.2%) ▪ For moderate OSA (AHI 15—29) the most sensitive screening test was the Berlin ▪ Both Berlin and STOP-Bang were most sensitive for severe OSA (AHI >30) ▪ Most specific test was neck circumference with specificity of 70.4%. Practice Implications/ Recommendations: ▪ Relying on neck circumference avoids the subjective questions ▪ A negative neck circumference and ESAP screening does not rule out OSA due to the low sensitivity ▪ Study reinforces the importance of screening OSA in patients with type 2 diabetes
Study aimed to assess OSA risk using the Berlin questionnaire and Epworth Sleepiness Scale. Additionally, the study evaluates multiple morbidities to determine the epidemiological	IV/Primary	• Cross-sectional screening study of 490 elderly adults (65+) utilizing home care services in Greece. ▪ Data collection between January and June 2010	Conclusions: • High pre-test likelihood noted in individuals with history of stroke, diabetes, cardiovascular disease, and mental health disorders compared to others with no history of chronic disease. • Multiple co-morbidities (2+) showed statistically significance with high OSA likelihood. • Both the Berlin and ESS had good internal consistency (Cronbach's alpha coefficient 0.69 (Berlin) and 0.77 (ESS). • One third of the studied population was considered high risk. Practice Implications/ Recommendations:

link for the elderly population in the primary care (Kleisiaris et al., 2016)			• OSA in the older population often occurs along with multiple common chronic diseases • Recommends systematic screening in the primary care.
Study to assess the rate of prior screening among patients prior to being hospitalized for persistent atrial fibrillation (AF) and willingness of patients to have further testing among those identified as moderate or high risk (Khan et al., 2019).	IV/Primary	• Total of 254 persistent AF patients were surveyed regarding prior OSA screening. • STOP-Bang utilized to identify of patients not screened were moderate or high risk. • Prior cardioversions and willingness for further testing was also recorded in the study	Conclusions: • 66% of AF patients were never screened for OSA. • Of the population that was not screened 75% were deemed high risk based on the STOP-Bang. • Individuals with prior hospitalizations or cardioversions were more likely to be screened for OSA. • Among the high-risk group 79% were interested in obtaining a sleep study. Practice Implications/ Recommendations: • Based on the population surveyed the majority of AF patients are not screened for OSA. • Study recommends OSA screening for AF patients be a focus for the primary care.
Quality improvement study aimed at increasing the OSA diagnosis among patients with hypertension in a primary care setting (Bakhai, Nigam, Saeed,	Primary/IV	• Screened HTN patients in the primary care from July 2015-December 2015 using the STOP-Bang questionnaire. • 1000 convenient OSA questionnaires completed at the	Conclusions: • Retrospective review of patients seen at the clinic demonstrated that only 1% of patients with hypertension were screened and diagnosed with OSA. • Goal to increase OSA dx from baseline to 5% among HTN patients. (Goal not met due to multiple barriers) • Physician barriers to acceptance included: 1.) lack of EMR chart alerts 2.) lack of extra time needed to complete screening questionnaire. • Patient barriers to obtaining follow up sleep studies: 1.) fear of sleep study procedure 2.) fear of diagnosis and treatment 3.) cost -due to high co-pay or lack of insurance 4.) lack of

Krishnan, & Reynolds, 2017).		internal medicine clinic among HTN patients. • 318/1000 patients screened high risk using the STOP-Bang • Of the 255 patients with OSA (score between 3-5) 50% agreed to a sleep study referral.	transportation to sleep study 5.) lack of knowledge regarding OSA Practice Implications/ Recommendations: • Integrate screening tool into the EMR • Provide OSA brochures for patients.
A review of literature to determine if appropriate assessment of OSA at the PCP is being conducted (Aurora & Quan, 2016).	II/Secondary	A total of 364 articles were reviewed that addressed sleep apnea, screening, and common comorbidities.	Conclusion/Practice Implications/ Recommendations: • After a review of cost-benefit of universal vs high risk patient population it was determined that screening should be limited to high risk groups. • Sleepiness scales are not recommended for identification of OSA as they are not as specific. • High risk groups include: "obesity (BMI $\geq$ 30 kg/m^2), congestive heart failure, atrial fibrillation, treatment resistant hypertension (blood pressure above goal despite adherence to antihypertensive regimen of 3 medications, or hypertension controlled by at least 4 medications), impaired glucose tolerance or type 2 diabetes, nocturnal dysrhythmias, stroke, pulmonary hypertension, preoperative for bariatric surgery, coronary artery disease" (Aurora & Quan, 2016).
Determine the value of STOP-Bang OSA screening among hypertensive patients in the primary care setting	IV/Primary	A convenient sample of 32 adult patients with hypertension taken over a three-month period. Two of the patients were then excluded due to already having an OSA dx.	Results/Conclusions: • Small sample size (N=30) • 40% (n=12) screened high risk. • Only three patients that screened high risk obtained a sleep study. • However, all three that obtained the sleep study were diagnosed with OSA. Practice Implications/

(Showalter & O'Keefe, 2019).			Recommendations: • Despite the small sample size, the study recommends a written protocol at the primary care clinic for screening OSA patients among patients with hypertension based on the conclusions in the study and prior literature. • Recommends providing alerts in the EMR for patients that quality for screening.
Quality improvement study of implementing a protocol for OSA screening in the primary care setting using the STOP-Bang questionnaire (Ononye, Nguyen, & Brewer, 2019).	III/Primary	Convenient sample of 187 patients participated in the study. Female patients 99 (53%) male patients 88 (47%).	Conclusions: • Randomized chart audit (60 charts) noted that only 3% (n=2) of patients were routinely screened for OSA during visits pre-protocol. • Randomized chart audit (60 charts) post-protocol implementation had an increase to 43% (n=26) • Referral rates increased after implementing the protocol pre-protocol (0%) compared to post-protocol 39% (n=24). • Primary care physicians do not routinely screen for OSA. Potential barriers could be: uncertainty with identification diagnosis, best sleep monitors for OSA diagnosis, and how to manage patients once diagnosed. Practice Implications/ Recommendations • Recommends utilizing a protocol in the primary care setting to improve detection and referral of patients at high risk for OSA. • States that the STOP-Bang has good utility in the primary care.
Review the current screening an assessment of OSA in primary care as well as the validity of OSA questionnaires in the primary care	II/Secondary	• A review of articles published between 1991 and 2014. A total of 17 articles met the inclusion and exclusion criteria. Non-experimental (N=14) and	Conclusions: • Consensus that there needs to be a screening tool for OSA in primary care. • Data limited on reliability of STOP-bang in the primary care. • Berlin questionnaire has psychometric properties for the primary care. • Epworth sleepiness scale has inconsistent sensitivity/ specificity for OSA. Practice Implications/

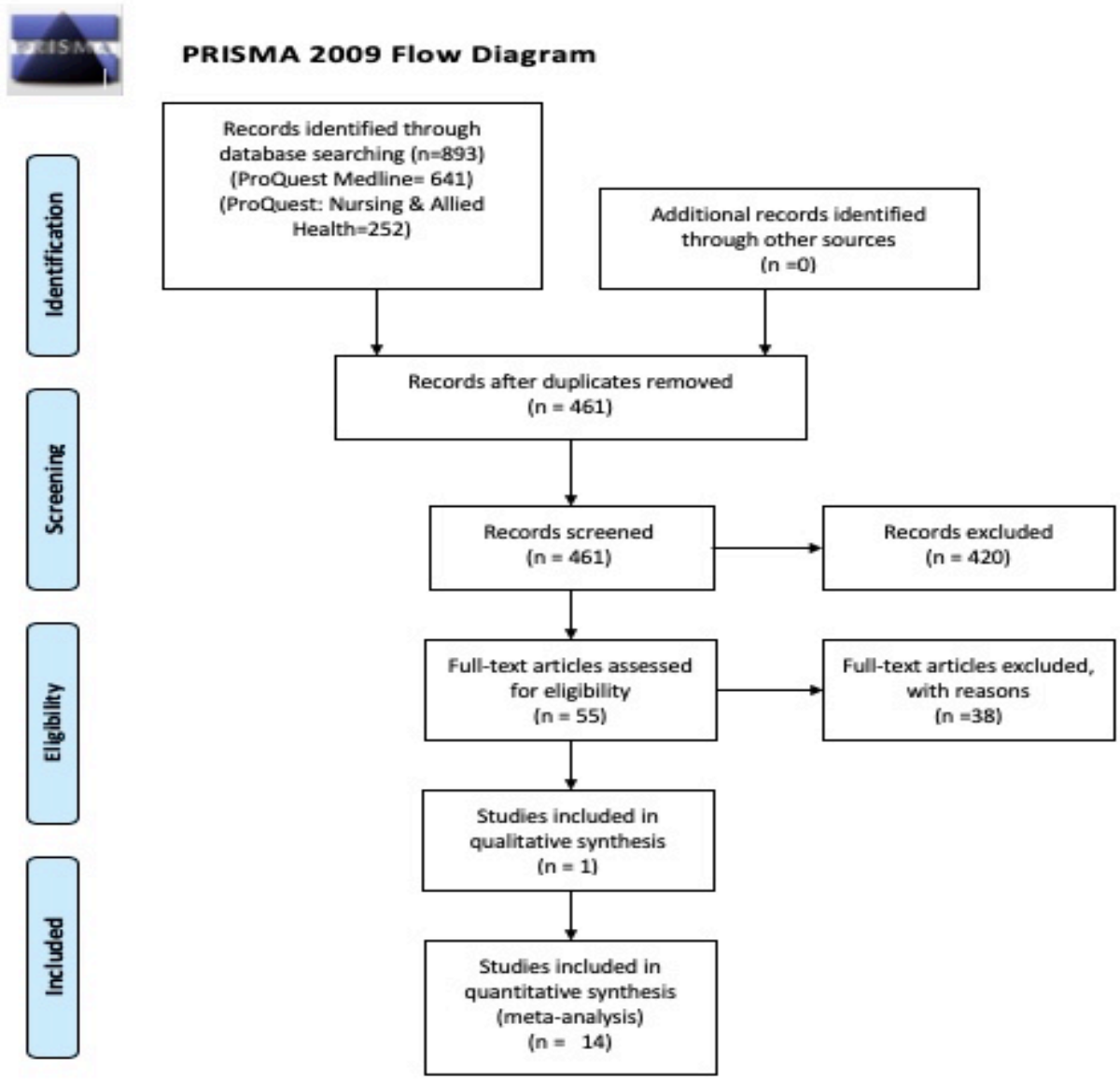
setting (Miller & Berger, 2016).		experimental (N=3) • Review was limited to the STOP, STOP-Bang, Epworth sleepiness scale, and Berlin questionnaire.	Recommendations • Supports the need for a standardized screening tool. • Suggests that the Berlin questionnaire may prove more beneficial in the primary care, but more studies are needed.
The reliability of STOP-Bang questionnaire (Portuguese version) for the screening of OSA within the primary care in Portugal (Rebelo-Marques,Vicente, Valentim, & Agostinho, 2018).	IV/Primary	A convenient sample over 8 months of two hundred fifty-nine patients (aged 18 and older) that completed the STOP-Bang at a single primary care	Conclusions: • Suggests that the STOP-Bang is a beneficial tool in other populations outside of the U.S given the high sensitivity. Practice Implications/ Recommendations • Other tests should be used to confirm due to the low specificity.
The value of using oximetry alone or in combination with the Phillips questionnaire in predicting OSA within the primary care (Fabius, Benistant, Pleijhuis, Van, & Eijsvogel, 2019).	IV/Primary	A total of 140 subjects with suspected OSA were include in the study from 54 primary care practices.	Conclusions: • OSA was diagnosed in 71% of the subjects. The oxygen desaturation index (ODI) (greater or equal to 5) had a sensitivity of 99% and specificity of 50%. When combined with the questionnaire sensitivity was 100% with specificity of 35%. Practice Implications/ Recommendations • Supports that the oximetry alone or in combination is helpful to exclude OSA diagnosis due to high sensitivity.

Identify the benefit of sleep apnea screening questionnaires (STOP-Bang, OSA-50, Berlin) alone and in combination with the Epworth sleepiness scale (ESS) within the primary care setting (Senaratna, 2019).	IV/Primary	• Performed within the Tasmanian Longitudinal Health Study (TAHS), 6th Decade Follow-up • Random sample of 772 participants were invited to participate in the study. • 424 patients participated in the study by completing questionnaires and home-based sleep studies.	Conclusions: • Sensitivity/specificity of STOP-Bang alone (81% and 36% respectively) Sensitivity/specificity of STOP-Bang with ESS (50% and 92%) Practice Implications/ Recommendations • The screening tools together with an ESS >8 are beneficial in ruling in but not ruling out clinically significant OSA. • The Stop-Bang/ESS may be a useful tool in the primary care for referrals.
Determine the ability of the SACS tool to accurately detect OSA in the primary care setting (Grover, Mookadam, Chang, & Parish, 2016).	IV/Primary	• 191 patients were included in the study. After completing the SACS participants completed an overnight oximetry, sleep medicine consultation and polysomnography.	Conclusions: • With OSA defined as AHI≥ 10 a SACS score greater than 15 was 40% sensitive and 90% specific for OSA Practice Implications/ Recommendations • Due to the findings, the study suggest that the SACS screening tool is helpful in determining individuals at risk for OSA in the primary care setting. • Recommends further studies to determine best practices to facilitate use. • Suggests that clinical alerts and clinical decision support tools could prove beneficial in facilitating use and should be explored.
Providing STOP-Bang OSA questionnaire training to primary care	IV/Primary	• Education for STOP-Bang provided to 15 primary care	Conclusions: • Large increase in sleep study referrals for all primary care providers post implementation of the STOP-Bang. Practice Implication/ Recommendations

providers to improve sleep study referrals (Addogoh, 2018).		providers at six different locations. • STOP-Bang questionnaire utilized for three months on patients over the age of 18 being seen during wellness exams.	• Recommends from the study include integrating the STOP-Bang into the EMR and establishing a screening protocol.
Integrating an Epworth Sleepiness Scale clinical advisor into the EMR to improve OSA screening (Johnson, 2019).	III/Primary	• Patients were selected by reviewing the EMR and including every fifth patient during the designated time frame. A total of 50 patients selected from each 6-week period to equal 150. The sample consisted of 150 men and women ages 18-92 at an internal medicine office with two providers. • Chart reviews conducted for pre ESS for 6 weeks, 6 weeks ESS learning phase, and 6 weeks post implementation.	Conclusions: • Imbedding the ESS in the EMR for screening of all internal medicine patients resulted in a 20% detection in high risk OSA patients. Practice Implication/ Recommendations • Integrating the ESS into the EMR can help to identify patients at risk that remain undiagnosed. • Recommends not only placing the ESS in the EMR but also including hard stops that require providers to screen every patient.

Identifying the knowledge and attitudes of primary care providers in Malaysia with regards to obstructive sleep apnea utilizing the OSAKA questionnaire (Devaraj, 2020)	VI/Primary	• A convenient sample of 207 primary care physicians, employed at a clinic in Kuala Lumpur Malaysia, were surveyed utilizing the OSAKA questionnaire. • Cross sectional study was completed over a 3-month period during 2017. • Knowledge domain of the questionnaire asks 18 questions. • Attitude domain asks 5 Likert scale questions.	Conclusions: • Mean score for knowledge was 11.6 The OSAKA has a total maximum score of 18 for the knowledge domain. (mean score =65%) • More than 55% scored above the mean knowledge score. • The mean score for the attitude domain was 15.9. The OSAKA has a total maximum score of 24 for the attitude domain. • There was no single item that was answered correctly or incorrectly by all participants. • Findings from the study were consistent with previous studies done in other countries as it demonstrated similar knowledge and attitude scores. • Most of the primary care physicians that were screened do not utilize OSA screening tools. Practice Implication/ Recommendations • Recommends additional education on OSA for the primary care providers to improve overall knowledge and management of the condition.

Appendix A



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement.* PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit www.prisma-statement.org.

Project Leader's PRISMA Flow Diagram

Appendix B

CITI Training Certificate

Completion Date 24-Aug-2019
Expiration Date 23-Aug-2022
Record ID 32902331

This is to certify that:

Lauren Paulson

Has completed the following CITI Program course:

Biomedical Research - Basic/Refresher (Curriculum Group)
Biomedical & Health Science Researchers (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

Liberty University

Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?wc5cb6636-7e04-4118-b749-a4b046258e0d-32902331

Appendix C
Liberty IRB Letter

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

July 7, 2020

Lauren Paulson
Sharon Kopis

Re: IRB Application - IRB-FY19-20-493 Improving Identification of High-Risk Obstructive Sleep Apnea Patients in the Primary Care: An Integrative Review

Dear Lauren Paulson, Sharon Kopis:

The Liberty University Institutional Review Board (IRB) has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study does not classify as human subjects research. This means you may begin your research with the data safeguarding methods mentioned in your IRB application.

Decision: No Human Subjects Research

Explanation: Your study does not classify as human subjects research because:

(1) it will not involve the collection of identifiable, private information.

Please note that this decision only applies to your current research application, and any modifications to your protocol must be reported to the Liberty University IRB for verification of continued non-human subjects research status. You may report these changes by completing a modification submission through your Cayuse IRB account.

If you have any questions about this determination or need assistance in determining whether possible modifications to your protocol would change your application's status, please email us at irb@liberty.edu.