

**Factors Associated with Obstructive Sleep Apnea Evaluation in At-Risk Patients Generally
and in the Perianesthesia Setting Specifically**

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University of Pittsburgh, 2023

Background/Purpose: Obstructive sleep apnea (OSA) is a highly prevalent yet underdiagnosed sleep-related breathing disorder. While studies have been conducted to examine factors associated with OSA care-seeking in at-risk individuals, it is unclear which factors are most influential. Further, these factors have not been explored in at-risk patients identified in the perianesthesia setting, in spite of this care specialty's provision of routine OSA screening. We aimed to address these gaps by reviewing current literature on factors associated with OSA evaluation overall, and in patients identified as at-risk for OSA in the perianesthesia setting, examining associations between OSA care-seeking behavior and health related factors overall, and by age, sex, and marital status.

Methods: A mixed methods literature review was performed to examine factors associated with OSA evaluation. Eligible articles addressed patient, provider, or system-level factors impacting completion of an OSA diagnostic evaluation, care-seeking and/or adherence rates. An observational study was also conducted in a sample of at-risk adults who received OSA risk notification and recommendation for follow-up evaluation as part of an outpatient procedure. Logistic regression examined associations between adherence to a provider's recommendation for OSA evaluation and demographic, clinical and health-related factors. Linear regression examined these same factors and associations between OSA care-seeking intention stratified by age, sex, and marital status.

Results/Conclusion: Twenty-six articles including quantitative, qualitative, and mixed methods studies were included in the literature review. Factors found to be most influential to OSA care-seeking and/or evaluation were social support, sex and the influence of gender, OSA-related symptoms and experiences, OSA knowledge and beliefs, healthcare provider involvement, and administrative considerations. In the original research arm of this study, in a sample of 63 patients identified as at-risk for OSA in the perianesthesia setting, 12.7% adhered to a provider's recommendation for follow-up evaluation. Excessive daytime sleepiness was identified as the strongest predictor of follow-up adherence. Functional impairment related to sleepiness and perceived likelihood of having OSA were the strongest predictors of OSA care-seeking intention. Functional impairment was important to OSA care-seeking intention in younger adults and regardless of sex or marital status; perceived likelihood of having OSA was an important predictor in men.

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1.0 Introduction

The following dissertation proposal, *Factors Associated with Obstructive Sleep Apnea Evaluation in At-Risk Patients Generally and in the Perianesthesia Setting Specifically*, describes a dissertation study that partially fulfills the requirements for the Doctor of Philosophy degree from the School of Nursing at the University of Pittsburgh. Obstructive sleep apnea (OSA) is a highly prevalent yet underdiagnosed sleep-related breathing disorder (Benjafield et al., 2019). Undiagnosed and therefore untreated OSA is considered a public health issue (U.S. Department of Health and Human Services: Office of Disease Prevention and Health Promotion, 2021) as it is associated with increased morbidity and mortality (Bibbins-Domingo et al., 2017; Ralls & Cutchen, 2019) and contributes to significant healthcare usage (Walter et al., 2017). Prior research has identified factors associated with care-seeking as well as adherence to a recommendation/referral for OSA evaluation in at-risk individuals such as symptoms, knowledge, and sociodemographic characteristics in various settings (Aalaei, Amini, Rezaeitalab, et al., 2021; Cukor et al., 2018; Dillow et al., 2017; Henry & Rosenthal, 2013; Jean-Louis et al., 2008; Sawyer et al., 2010; Waldman et al., 2020; Ye et al., 2022); however, no one has comprehensively reviewed factors associated with OSA evaluation and it remains unclear which factors may be most impactful for successful completion of an OSA evaluation.

Screening for OSA is a potential entry point into the OSA diagnostic care pathway for at-risk individuals. OSA screening is a standard feature of the perianesthesia care setting as it is used to inform a patient's plan of care (American Society of Anesthesiologists, 2014; Chung et al., 2016). Adherence to a provider's referral or recommendation for OSA evaluation is low among patients screened at-risk in the perioperative setting (Fidan et al., 2006; Guralnick et al., 2012);

however, investigation of factors impacting adherence to OSA evaluation among these patients is unknown. Further, important theoretical constructs such as risk perception and health literacy have yet to be explored in care-seeking behaviors in individuals at-risk for OSA.

The following dissertation proposal aims to address these gaps. In Aim 1, we aim to review current literature on factors associated with OSA evaluation among at-risk individuals. This will be accomplished through a comprehensive mixed methods literature review to synthesize available evidence. In Aim 2, we aim to examine factors influencing at-risk patients' adherence to a recommendation for OSA evaluation after their anesthesia-related procedure. Specifically, we will examine the associations between adherence to a provider's recommendation for OSA evaluation and health-related factors including actual and perceived OSA risk, OSA symptoms, health literacy, and type of OSA risk information received in patients identified as at-risk for OSA in the perianesthesia setting. In Aim 3, we will build on Aim 2 findings by examining sociodemographic differences in health-related factors associated with adherence to a provider's recommendation for OSA evaluation. The proposed study will help to establish a comprehensive evidence base of factors associated with OSA evaluation as well as inform future interventions and assist in the refinement of clinical guidelines directed toward the care of individuals at-risk for OSA in the perianesthesia setting.

1.1 Specific Aims

An estimated 54 million Americans have OSA (Benjafield et al., 2019), which is characterized as complete or partial airway obstruction caused by pharyngeal collapse during sleep (Ralls & Cutchen, 2019). Of these 54 million, 24 million Americans have *moderate to severe* OSA

(Benjafield et al., 2019), with approximately 80% undiagnosed (American Sleep Apnea Association, 2021; Chung et al., 2016; Punjabi, 2008). Undiagnosed and therefore untreated OSA is associated with increased morbidity and mortality and contributes to significant healthcare usage, with untreated individuals using 25% more services than those who are treated (Aalaei, Amini, Rezaeitalab, et al., 2021; Bibbins-Domingo et al., 2017; Ralls & Cutchen, 2019; Walter et al., 2017).

Diagnosis and treatment of at-risk individuals requires action from both patients and providers, including referral and completion of polysomnography (PSG), also known as a sleep study. Patients are unlikely to seek medical evaluation for OSA on their own (U.S. Department of Health and Human Services: Office of Disease Prevention and Health Promotion, 2021) and, even with provider screening and recommendation or referral, adherence rates to an OSA evaluation vary widely (Aalaei, Amini, Rezaeitalab, et al., 2021; Aalaei, Amini, Taghipour, et al., 2021; Dillow et al., 2017; Jean-Louis et al., 2017; Parks et al., 2009; Saglam-Aydinatay et al., 2018; Sert-Kuniyoshi et al., 2011; Talmage et al., 2008). In addition to adherence rates, prior research has identified factors associated with care-seeking as well as adherence to a recommendation/referral for OSA evaluation in at-risk individuals in various settings (Aalaei, Amini, Rezaeitalab, et al., 2021; Cukor et al., 2018; Dillow et al., 2017; Henry & Rosenthal, 2013; Jean-Louis et al., 2008; Sawyer et al., 2010; Waldman et al., 2020; Ye et al., 2022); however, it remains unclear which factors may be most impactful for achieving a clinical diagnosis. A greater understanding of these factors is needed to direct clinical care and develop patient-centered interventions.

The prevalence of OSA is high in the surgical setting (Vasu et al., 2012) with rates approaching 80% in some surgical populations (Chung et al., 2016; Loo et al., 2020; Sareli et al., 2011), thus OSA screening is a routine procedure in perianesthesia care. Screening procedures

may identify patients at-risk for OSA; however, perianesthesia provider guidelines regarding best practices for informing and educating patients identified as at-risk for OSA are insufficient (Chung et al., 2016; Wolfe et al., 2016), and may contribute to a lack of understanding among at-risk patients of the importance of seeking proper OSA evaluation. Even when a referral or recommendation is given for OSA evaluation in the perianesthesia setting, evidence has shown that patients adhere to the referral or recommendation less than half the time (Fidan et al., 2006; Guralnick et al., 2012). These challenges, coupled with large volumes of patients undergoing anesthesia-related procedures in the United States (National Quality Forum, 2020), present a crucial yet underutilized opportunity for counseling and patient-centered actions to facilitate follow-up OSA care.

Although prior research has identified potential links between OSA care-seeking behavior or adherence to recommendation/referral and various factors including symptoms, knowledge, and sociodemographic characteristics like age, sex, and marital status, the available literature is based on studies that have taken place outside of the perianesthesia context (Aalaei, Amini, Rezaeitlab, et al., 2021; Cukor et al., 2018; Dillow et al., 2017; Henry & Rosenthal, 2013; Jean-Louis et al., 2008; Sawyer et al., 2010; Shaw et al., 2012; Waldman et al., 2020; Ye et al., 2022). Further, important theoretical constructs such as risk perception and health literacy have yet to be explored in care-seeking behaviors in individuals at-risk for OSA. To address these gaps, the overall aims of this study are to synthesize available literature regarding factors associated with OSA evaluation in at-risk individuals overall and to specifically examine factors associated with adherence to a provider's recommendation for OSA evaluation in at-risk patients identified in the perianesthesia setting.

In order to synthesize literature regarding factors associated with OSA evaluation in at-risk individuals, a literature review will be conducted to identify barriers and facilitators occurring at the patient, provider, and healthcare system levels. This review will encompass qualitative, quantitative, and mixed methods studies, and no restrictions will be placed on the setting or population. To gain insight into factors impacting adherence to an OSA recommendation in the perianesthesia population, electronic survey data will be collected to quantify the degree to which health-related factors, including actual and perceived OSA risk, symptoms of OSA (daytime sleepiness, insomnia, and functional outcomes sensitive to impaired sleep), type of OSA risk information received, and health literacy, are associated with adherence to a provider's recommendation for OSA evaluation among at-risk individuals. A sample of 64 patients presenting for outpatient procedures requiring anesthesia in the Excelsa Health system who have been screened as at-risk for OSA (STOP-Bang score ≥ 3 ; Chung et al., 2012), will be included in this study. We will measure actual and perceived OSA risk (using the STOP-Bang tool (Chung et al., 2008) and a self-developed scale, respectively), OSA symptoms (Epworth Sleepiness Scale [ESS] (Johns, 1991), Insomnia Severity Index [ISI] (Bastien et al., 2001), and Functional Outcomes of Sleep Questionnaire-10 [FOSQ-10] (Chasens et al., 2009)), health literacy (Health Literacy Questionnaire [HLQ]) (Osborne et al., 2013), type of OSA screening information received, and self-reported action(s) taken for follow-up OSA evaluation. Findings from this innovative proposal will help to inform future studies regarding provider-delivered education and behavior change strategies for patients at-risk for OSA and assist in the refinement of clinical guidelines, benefiting both patients and providers.

Our specific aims are:

Aim 1: Review current literature on factors associated with OSA evaluation among at-risk individuals.

Aim 2: Examine adherence to a provider’s recommendation for OSA evaluation and associations with health-related factors in patients identified as at-risk for OSA in the perianesthesia setting. *Adherence to a healthcare provider’s recommendation for OSA evaluation will be defined as scheduling or completing an evaluation for OSA. Health-related factors include actual and perceived OSA risk, OSA symptoms, health literacy, and type of OSA risk information received.*

Aim 3: Examine sociodemographic differences in health-related factors associated with adherence to a provider’s recommendation for OSA evaluation in at-risk patients identified in the perianesthesia setting. *Sociodemographics will include age, sex, and marital status.*

1.2 Background

The following section contains important background information to the dissertation, “*Factors associated with obstructive sleep apnea evaluation in at-risk patients generally and in the perianesthesia setting specifically.*” This section includes a brief description of the following topics: OSA, care-seeking and adherence to provider referral/recommendation for OSA evaluation, risk perception and health literacy and their role in screening uptake, and OSA and the perianesthesia setting.

1.2.1 Obstructive Sleep Apnea (OSA)

OSA is characterized as complete or partial airway obstruction, caused by repetitive episodes of upper airway collapse during sleep. Obstructive episodes result in hypopneas (a reduction in airflow), and/or apneas (complete cessation of airflow) which can disrupt physiologic processes occurring during normal sleep in the form of frequent arousals and alterations in sympathetic and parasympathetic nervous system activation (May & Mehra, 2014; Ralls & Cutchen, 2019). Common signs and symptoms of OSA include snoring, gasping, snorting, or choking during sleep, interrupted sleep, excessive daytime sleepiness, morning headache, and fatigue (Mannarino et al., 2012; Veasey & Rosen, 2019). Approximately 54 million Americans have OSA, with 24 million of those individuals living with moderate to severe OSA (Benjafield et al., 2019). Up to 80% of individuals are undiagnosed and therefore untreated (Punjabi, 2008; Suen et al., 2020; Young et al., 1997). Risk factors for OSA include male sex (although rates are similar when comparing men to postmenopausal women (Mirer et al., 2017)), overweight or obesity, increased age, soft tissue enlargement of the upper airway, and craniofacial abnormalities (Gottlieb & Punjabi, 2020).

Intermittent hypoxia and apneas associated with obstructive episodes in untreated individuals contribute to an increase in sympathetic tone and contribute to cardiovascular changes, systemic inflammation, metabolic dysregulation, and psychiatric changes (Gaines et al., 2018; May & Mehra, 2014; Park et al., 2011). This places individuals with OSA at an increased risk of a multitude of cardiovascular complications including hypertension, cardiac arrhythmias, heart failure, cardiovascular disease, stroke, and myocardial infarction (Chaiard & Weaver, 2019; Dong et al., 2013; Ralls & Cutchen, 2019). Other effects include pulmonary hypertension, increased insulin resistance and/or type 2 diabetes, gastroesophageal reflux disease, and increased nighttime

urination (Park et al., 2011; Ralls & Cutchen, 2019). Neurocognitive and behavioral consequences, usually attributed to fragmented sleep, include morning headaches, fatigue, mood disturbances and personality changes, anxiety, depression, irritability, and impaired cognition (such as memory loss and decreased concentration) (Park et al., 2011; Ralls & Cutchen, 2019). OSA also impacts social/relational aspects of individuals, including decreases in overall quality of life, social satisfaction or engagement, work performance, and libido (Chaiard & Weaver, 2019; Kielb et al., 2012; Park et al., 2011; Ralls & Cutchen, 2019). Symptoms associated with untreated OSA (e.g., daytime sleepiness, insomnia) have been implicated in workplace accidents and reduced productivity (Guglielmi et al., 2014; Jurado-Gómez et al., 2015; Knauert et al., 2015) as well as motor vehicle accidents (Gottlieb & Punjabi, 2020; Ralls & Cutchen, 2019).

These symptoms and associated comorbidities present a significant burden to patients and healthcare systems, and contribute to increased healthcare expenditures (Aurora et al., 2015; Aurora & Quan, 2016), with estimates ranging from \$1950 to \$3899 per untreated person, per year equating up to \$69 billion annually in the United States (Knauert et al., 2015). Motor vehicle accidents also present a significant economic impact where hundreds of thousands of crashes per year are linked to OSA, costing nearly \$16 billion (Knauert et al., 2015; Sassani et al., 2004). Researchers project that treating individuals with OSA could reduce costs by approximately \$11 billion, accounting for the cost of treatment itself (Sassani et al., 2004).

1.2.1.1 OSA Diagnostic Pathway

In order to receive treatment for OSA, patients must first be diagnosed. This is achieved through a ‘sleep study’ which can include a home sleep apnea study or in-laboratory PSG, the latter of which is considered the gold-standard for diagnosis. During a sleep study, the number of episodes of apnea and/or hypopnea per hour are calculated to determine a person’s apnea-

hypopnea index (AHI), which is used in establishing an OSA diagnosis and associated severity. Per the American Academy of Sleep Medicine (AASM), hypopnea is defined as at least a 30% reduction in airflow from baseline with an oxyhemoglobin desaturation of at least 3%, or an arousal from sleep. OSA severity is classified as mild (AHI of 5 to < 15 events per hour), moderate (AHI of 15 to < 30 events per hour), and severe (≥ 30 events per hour) (Berry et al., 2012).

The pathway between symptom recognition and OSA diagnosis, culminating in a sleep study, contains multiple points and may vary depending on the point at which the patient interacts with the health system. Patients must first have the ability to recognize and report their symptoms to a provider. After recognition of symptoms, patients must then make a decision to seek care and connect with a healthcare provider (Ye et al., 2022). However, symptom recognition alone is often not enough to lead patients to seek care as individuals with OSA may have no or minimal symptoms (Zinchuk & Yaggi, 2020). Further, patients often lack awareness and/or knowledge of OSA which can impact their ability to recognize symptoms as a sign of a significant problem (Arous et al., 2017; Shaw et al., 2012; Sia et al., 2017). Even when symptoms are noted, many patients fail to seek medical treatment. According to 2015-2016 data from the National Health and Nutrition Examination Survey as reported by Healthy People 2030, only 33.1% of adults exhibiting symptoms of OSA seek medical treatment (U.S. Department of Health and Human Services: Office of Disease Prevention and Health Promotion, 2021).

While some patients may seek care for their symptoms and initiate entry into the diagnostic pathway on their own, health care providers also play an integral role in symptom recognition and elucidation, which can be achieved through OSA screening. Screening tools commonly used in the sleep medicine setting, such as the STOP-Bang questionnaire (Chung et al., 2008), Berlin Questionnaire (Netzer et al., 1999), Epworth Sleepiness Scale (Johns, 1991), and Multivariable

Apnea Prediction Index (Maislin et al., 1995), also help identify at-risk patients in other settings such as primary care, perianesthesia care, and dentistry. However, it is important to note that OSA screening can vary depending on the healthcare setting. In the primary care setting, evidence is currently insufficient to support OSA screening in asymptomatic adults, *including individuals with unrecognized symptoms* (which encompasses individuals who do not report symptoms as being a concern or are not aware of their symptoms) (Bibbins-Domingo et al., 2017). In contrast (as described below), screening of all patients for risk of OSA is routine in the perianesthesia setting, where OSA can significantly impact perioperative outcomes (Chung et al., 2016). Thus, depending upon a patient's entry point into the healthcare system, OSA screening and symptom elucidation may greatly differ. In the pathway to clinical diagnosis of OSA, clinicians may be the first to recognize the patient's symptoms and OSA risk, as opposed to the patient first having an awareness or making a decision to seek care specifically for OSA.

Although screening tools may identify highly probable cases of OSA, a sleep study is required for official diagnosis and requires a provider referral. Healthcare providers may order the sleep study themselves or first recommend or refer a patient to a sleep medicine specialist for further evaluation. Once a patient has navigated the OSA diagnostic pathway and reaches the point of completing a sleep study, treatment and follow-up care can commence if needed. OSA treatments may include continuous positive airway pressure (CPAP) therapy, oral appliances, surgical interventions, and lifestyle changes such as weight loss (Veasey & Rosen, 2019).

1.2.2 Care-Seeking and Adherence to a Recommendation/Referral for OSA Evaluation

In the available literature, researchers have discussed factors surrounding a patient's decision to seek care for OSA as well as completion of an OSA evaluation after receiving a

provider recommendation or referral. This may include completion of a sleep study and/or clinical visit specific to OSA assessment and diagnosis. Factors impacting OSA care-seeking have been determined mostly through qualitative interviews with patients to determine what factors led them to ultimately seek care for OSA, without specific mention of how they initially entered the care pathway (e.g., provider screening or presentation to a clinic for evaluation based on their own recognition of potential OSA) (Henry & Rosenthal, 2013; Sawyer et al., 2010; Waldman et al., 2020; Ye et al., 2022; Zarhin, 2018). Other studies have specifically examined *adherence* to a provider recommendation or referral for OSA evaluation, wherein a primary outcome was completion of diagnostic evaluation after being directed to do so by a healthcare provider (Aalaei, Amini, Rezaeitalab, et al., 2021; Aalaei, Amini, Taghipour, et al., 2021; Cukor et al., 2018; Dillow et al., 2017; Jean-Louis et al., 2017; Jean-Louis et al., 2008; Saglam-Aydinatay et al., 2018). Regardless of whether literature may be classified as OSA care-seeking or related to adherence to a referral/recommendation, completion of a sleep study remains a central focus. Patients already diagnosed, whether they initially entered the pathway on their own or by provider recognition, have navigated the pathway to the point of completion. An understanding of the differences between these diagnosed individuals and at-risk individuals who have received a referral/recommendation but have elected to not seek evaluation is critical to addressing the current public health problem of underdiagnosis of OSA. Therefore, literature encompassing both adherence and care-seeking for OSA evaluation will be reviewed below.

1.2.2.1 Factors Associated with Care-Seeking and Adherence to a Recommendation/Referral for OSA Evaluation

Quantitative and qualitative studies, as well as quality improvement projects, examining OSA care-seeking or adherence to an OSA referral or recommendation in at-risk individuals have

been conducted in a variety of settings. Settings include sleep medicine (Aalaei, Amini, Rezaeitalab, et al., 2021; Aalaei, Amini, Taghipour, et al., 2021; Henry & Rosenthal, 2013; Hwang et al., 2018; Jean-Louis et al., 2008; Sawyer et al., 2010), general community or community-based clinics (Cukor et al., 2018; Jean-Louis et al., 2017; Shaw et al., 2012), occupational medicine (Berger et al., 2012; Evans et al., 2017; Mackey, 2022; Parks et al., 2009; Talmage et al., 2008), dentistry (Dillow et al., 2017; Saglam-Aydinatay et al., 2018), perioperative care (Fidan et al., 2006; Guralnick et al., 2012), and other specialty care settings (Lee et al., 2015; Sert-Kuniyoshi et al., 2011). Many of these studies have identified factors associated with adherence to an OSA recommendation/referral and/or care seeking, including OSA-related symptoms, OSA knowledge and awareness, social support, perceptions of diagnosis and treatment, and logistical and other constraints. Sociodemographic and clinical characteristics have also been identified as factors associated with adherence and/or care seeking.

1.2.2.1.1 Symptoms

Quantitative and qualitative studies have reported mixed results regarding OSA-related symptoms as a factor contributing to adherence to a recommendation and/or referral for OSA evaluation in at-risk individuals. In a retrospective chart review of black adults in a sleep clinic setting based in New York, 38% of individuals adhered to a referral for sleep apnea evaluation, with daytime sleepiness independently predicting adherence to sleep apnea evaluation (multivariate-adjusted Odds Ratio [OR] = 6.69, 95% Confidence Interval [CI] [3.86-12.64]) as well as obesity (OR = 6.98, 95% CI [3.86-12.64]) (Jean-Louis et al., 2008). However, other quantitative studies have not demonstrated an association between symptoms and adherence. In a geographically and racially similar sample of OSA at-risk individuals (n=380), Jean-Louis et al. (2017) conducted a randomized controlled trial to assess the effectiveness of a telephone-delivered

intervention of tailored OSA health messages delivered by a health educator compared to standard care on completion of OSA consultation and diagnostic evaluations. The intervention itself, while adjusting for sociodemographic factors, was found to positively predict adherence to an initial consultation (OR = 3.17, 95% CI [1.68-5.99]) wherein 64.9% receiving the intervention attended a consultation compared to 36.7% receiving usual care. Regardless of intervention assignment, researchers did not find daytime sleepiness, nor any sociodemographic variables, to be significant predictors of adherence to an initial consultation.

A cross-sectional study examining adherence to a recommendation for OSA evaluation in high-risk dental patients identified by the STOP questionnaire and/or overnight pulse oximetry monitoring (n=119) found an overall adherence rate of 47.1% in the sample (Dillow et al., 2017). No significant sociodemographic or clinical factors (including sex, age, or excessive daytime sleepiness) were found to be associated with completion of an OSA evaluation. Interestingly, individuals who were deemed as high risk by pulse oximetry monitoring were 2.55 times as likely to seek evaluation (95% CI [1.02-6.37]) compared to low-risk individuals. However, the likelihood of adherence to a recommendation was not significantly increased by a high-risk STOP score.

In a multi-phase study (a randomized controlled trial and semi-structured interviews) of individuals evaluated and referred for testing by a sleep specialist in Iran, symptoms of daytime sleepiness and nocturnal enuresis were examined as predictors of adherence to referral. Aalaei, Amini, Rezaeitalab, et al. (2021) found that receipt of a tailored educational intervention was found to significantly predict adherence (95 % CI [1.19-13.8]; no ORs reported in this study), with 30% of the intervention and 11.1% of the usual care groups adhering to a referral. Daytime sleepiness and nocturnal enuresis (note: among adults, nocturia is often associated with OSA, where enuresis, or bedwetting, is not) were not found to be significant predictors. However, increased age and a

diagnosis of diabetes were found to significantly predict adherence (95% CI [1.01-1.12] and [1.02-84.07], respectively). In the qualitative portion of this study (n=22), one of the most frequently cited reasons for non-adherence was improvement in condition (11/22), suggesting that symptoms may play a role in adherence, yet daytime sleepiness was not found to be a significant predictor in quantitative analysis.

In a separate sample derived from the same sites as the above study and referred for OSA evaluation, Aalaei, Amini, Taghipour, et al. (2021) completed a multi-phasic study and compared sociodemographic variables and symptoms such as morning headache, libido, snoring, and excessive daytime sleepiness between individuals who were adherent and non-adherent to referral for OSA evaluation and found no significant differences between the groups. In the qualitative phase of the study, symptoms were noted to both positively and negatively impact adherence to prescribed overnight sleep study. Adequate knowledge and tangible experience of the consequences of OSA were considered facilitating factors, while the perception of OSA symptoms as a natural phenomenon was considered a barrier to sleep study completion, which may be more indicative of a knowledge deficit.

While OSA-related symptoms, particularly daytime sleepiness, have largely not been found to be associated with adherence to referral/recommendation for OSA evaluation in quantitative studies, many qualitative and mixed methods studies have consistently identified the role of symptoms in OSA diagnostic care-seeking behavior and adherence to a recommendation/referral (Henry & Rosenthal, 2013; Waldman et al., 2020; Ye et al., 2022; Zarhin, 2018). In a secondary analysis of semi-structured qualitative interviews of patients with OSA and their partners, patients reported that symptoms or alerting events (e.g., daytime sleepiness, nodding off while driving) were facilitators to diagnosis (Ye et al., 2022). Similarly, in a focus group study

of individuals diagnosed with OSA and experiencing excessive daytime sleepiness (n=42) (Waldman et al., 2020), factors considered to facilitate OSA care-seeking included a concern for symptoms (23%) and falling asleep while driving (17%). Further, over half of interviewees indicated they experienced OSA symptoms for many years before seeking care (mean 11.4 years). In a mixed methods study of patients with OSA and their partners (n=24), Henry and Rosenthal (2013) also noted the role of symptoms on care-seeking, with 50% of patients reporting daytime effects (decreased energy, alertness, work problems) as a factor motivating them to seek treatment. Interestingly, in addition to its role as a facilitator, some patients noted the effects of a lack of energy as a barrier to seeking help, such as scheduling an appointment to be evaluated.

Like Aalaei, Amini, Taghipour, et al. (2021), inuring of symptoms was also noted in both Waldman et al. (2020) and Ye et al. (2022), where participants reported that considering symptoms to be normal rather than serious was a barrier to seeking care. These findings signal a possible knowledge deficit as well as a potential lack of perceived risk.

1.2.2.1.2 OSA Knowledge

Overall, patients' awareness and/or knowledge of OSA is low (Arous et al., 2017; Shaw et al., 2012; Sia et al., 2017). Knowledge has been identified as a key factor impacting adherence to an OSA referral/recommendation and OSA care-seeking in many of the aforementioned qualitative studies, as well as implicated in misperceptions impacting symptom recognition and attribution (Aalaei, Amini, Taghipour, et al., 2021; Waldman et al., 2020). However, mixed results have been found in quantitative studies regarding the association between OSA knowledge and referral/recommendation adherence (Cukor et al., 2018; Jean-Louis et al., 2017).

In a sample of at-risk dental patients referred for OSA evaluation, (n=224), Saglam-Aydinatay et al. (2018) found that in the 18.3% who adhered to a referral, increased awareness

about OSA was a frequently noted facilitator (65%). Among non-adherent individuals, 37.7% reported misconceptions about OSA as a barrier. In a sample of patients referred for OSA evaluation, Hwang et al. (2018) conducted a randomized controlled trial to evaluate telemedicine-delivered OSA education and treatment telemonitoring on treatment adherence. When comparing the education portion of the protocol, patients receiving the intervention (OSA education) were more likely to adhere to a referral for an evaluation than those who did not receive education (68.7% vs. 62.7%, $p=0.002$).

Ye et al. (2022) also noted the role of knowledge in diagnosis, as interviewees reported that knowledge, in the form of education and awareness from providers regarding OSA risk, was a facilitator to diagnosis. Similarly, in a mixed methods study of sleep clinic patients diagnosed with OSA and initiating CPAP treatment ($n=16$), Sawyer et al. (2010) found knowledge of health risks and benefits of health behaviors to be a key contributor to OSA diagnosis. Inaccurate knowledge and misperceptions provided a barrier to seeking care for OSA diagnosis in interviewees, specifically misattribution of snoring as the primary issue of OSA as opposed to apnea and other associated health effects.

A lack of intention to be treated for OSA, which may be tied to a knowledge deficit in the form of a treatment misperception, was also noted as a potential barrier for completion of an OSA diagnostic evaluation. Through qualitative interviews, both Sawyer et al. (2010) and Shaw et al. (2012) found that individuals had unfavorable attitudes toward getting tested for OSA because they did not want to have to use CPAP if diagnosed, which may signal that these individuals were unaware of other treatment possibilities.

1.2.2.1.3 Social and Relational Support

Social support has also been associated with completion of an OSA evaluation. Waldman et al. (2020) found that a majority of individuals who sought OSA diagnostic care reported social support, specifically support from family, friends, or a spouse, as a significant facilitator. Sawyer et al. (2010) also noted social support as a facilitator, particularly highlighting the role of friends and coworkers among unmarried/unpartnered individuals, and spouses, partners, and family members among married/partnered individuals.

The impact of OSA extends beyond the person with the disorder, often affecting bed-sharing partners/spouses and beyond (Stålkranz et al., 2012). Spouses/partners often hold an integral role in OSA care-seeking of at-risk or symptomatic individuals (Sawyer et al., 2010; Waldman et al., 2020; Ye et al., 2022). Ye et al. (2022) found social influences and partners pushing patients to seek care as facilitators to OSA evaluation. Specifically, partners were instrumental in making patients aware of OSA symptoms (e.g., snoring). In a cross-sectional, exploratory mixed methods study of patients with OSA and their partners (n=24; 12 dyads) (Henry & Rosenthal, 2013), spouses and/or family were strong motivators for patients to seek help for their OSA symptoms. The majority of participants (83%) did not have firsthand experience with their behavioral symptoms, rather these were reported by partners and/or family members.

1.2.2.1.4 Sex

Henry and Rosenthal (2013) also noted trends in care-seeking behavior by sex. On average, men delayed seeking care for their symptoms longer than women (5.5 ± 8.7 and 4.0 ± 3.4 years, respectively). All men in the study reported seeking care only after repeated spousal insistence or spousal intervention, whereas 60% of women required family or spousal encouragement. Communication, expectations surrounding “proper” sleep, as well as social and cultural norms

were also identified factors influencing OSA care-seeking. For men, this included difficulty and embarrassment in talking about symptoms of snoring as snoring is often portrayed as comical in popular culture. For women, this included viewing snoring as more of a ‘man’s problem’ or not ‘lady-like’.

Quantitative studies of screened at-risk individuals have generally not found an association between sex and adherence to a referral/recommendation for OSA evaluation (Cukor et al., 2018; Dillow et al., 2017; Fidan et al., 2006; Jean-Louis et al., 2017; Jean-Louis et al., 2008; Saglam-Aydinatay et al., 2018). However, qualitative studies have found sex-related nuances in OSA care-seeking behavior, specifically related to impact of symptom disturbance on one’s self or others (Henry & Rosenthal, 2013; Zarhin, 2018). Like Henry and Rosenthal (2013), Zarhin (2018) also found sex-related nuances in OSA care-seeking behavior. Specifically, in semi-structured interviews with Jewish-Israeli patients who received an OSA diagnosis within the previous 18 months, Zarhin (2018) found that sex played a role in care-seeking based on the impact of symptom disturbance on one’s self or others. Women reported monitoring their husbands’ health while focusing less on their own health, but were more willing to seek care when perceiving their symptoms to disturb others. Men mostly sought care based on disturbance to self. Like other studies, most participants believed their symptoms were a normal part of life, and even when experiencing significant symptoms, delayed seeking care.

1.2.2.1.5 Logistical and Other Constraints

Throughout the aforementioned studies, researchers have also identified provider or system-level factors associated with adherence to referral/recommendation and OSA-care seeking. Limitations related to care access were also commonly identified factors, including time constraints (Aalaei, Amini, Rezaeitalab, et al., 2021; Aalaei, Amini, Taghipour, et al., 2021), work

responsibilities (Saglam-Aydinatay et al., 2018), cost (Aalaei, Amini, Rezaeitalab, et al., 2021; Aalaei, Amini, Taghipour, et al., 2021; Ye et al., 2022), and distance required for travel (Aalaei, Amini, Taghipour, et al., 2021). These findings are in alignment with two studies which elucidated perspectives in OSA management. In a mixed methods study conducted via surveys of Canadian primary care providers (n=119) and primary care and sleep provider workshop attendees (n=36), and interviews of patients living with OSA (n=28), Pendharkar et al. (2021) found barriers to optimal management of OSA in the primary care setting to include limited specialist access, lack of provider knowledge and role clarity for OSA management, as well as unacceptable wait times for patients. Natsky et al. (2022) elucidated perspectives of Australians diagnosed with OSA (n=421) and those at high risk for OSA but undiagnosed (n=1033) to determine values and preferences regarding OSA care pathway features. Patients at high-risk for OSA preferred management, including initial assessment, sleep testing, and ongoing care, to be handled through the primary care setting. Low diagnostic costs, minimization of wait times for sleep study results and treatment recommendations, and fewer follow-up visits were preferred by both groups of patients.

Although time involved in testing and/or wait times for specialists as well as distance required to travel have been identified as barriers to OSA diagnostic evaluation (Aalaei, Amini, Rezaeitalab, et al., 2021; Aalaei, Amini, Taghipour, et al., 2021), Guralnick et al. (2012) found in a sample of at-risk patients originating in the preoperative setting, that even when wait times and other administrative barriers were minimized to facilitate timely sleep testing, adherence rates remained low (49%). Regarding travel distance, Spagnuolo et al. (2019), in a cross-sectional epidemiologic study, found that rural adults who had the largest travel distances to specialist medical care were 1.17 times (95% CI [1.07-1.29]) more likely to report OSA symptoms without

an OSA diagnosis compared to those who had the smallest distance to specialist medical care. However, the proportion of sleep apnea diagnoses remained low among adults who likely required OSA care and were not affected by travel distance.

1.2.3 Perceived Risk and Care-Seeking Behavior

Social Cognitive Theory (Bandura, 2004), a health behavioral theory, identifies the perception of risk as a contributor to health behavior decisions and actions. Multiple studies discussed above have touched on the idea of risk as potentially influencing care-seeking behavior and adherence to a provider's referral/recommendation for OSA evaluation among at-risk individuals (Aalaei, Amini, Rezaeitalab, et al., 2021; Aalaei, Amini, Taghipour, et al., 2021; Jean-Louis et al., 2017; Sawyer et al., 2010). Further, among individuals already diagnosed with OSA, OSA-related risk perceptions have been shown to impact treatment adherence (Olsen et al., 2008; Sawyer et al., 2010). However, the role of risk perception in adherence to a referral/recommendation for OSA evaluation has not been extensively explored.

Perceived risk has been explored as a factor in affecting uptake of screening and diagnostic care in non-OSA at-risk populations including uptake of mammography (Walker et al., 2013), completion of follow-up care for acute coronary syndrome after emergency department recommendation (Sutton et al., 2021), and general health screening (Teo et al., 2016). In a 2013 literature review of studies examining the association between perceived breast cancer risk and adherence to breast screening (including mammography, clinical breast exam, or breast self-exam) among women with a familial history of breast cancer, researchers found weak to moderate associations between higher perceived risk and greater adherence to mammography guidelines (Walker et al., 2013).

The association of perceived risk with follow-up for acute coronary syndrome was evaluated in a sample of patients reporting to the emergency department with chest pain (n=146) (Sutton et al., 2021). This prospective study found that compared to patients with low perceived heart disease risk, patients with higher perceived risk were 2.84 times more likely to follow-up (95% CI [1.25-6.42]; 44% vs. 23%). In a systematic review of 103 studies examining barriers and facilitators to health screening uptake among men, Teo et al. (2016) found low disease risk perception as the second most frequently reported barrier to health screening and perceived risk the most commonly reported facilitator.

1.2.4 Health Literacy and Care-Seeking Behavior

Although it is an emergent concept central to examining health disparities and engagement in healthcare systems, health literacy, like perceived risk, is another factor that has not been adequately explored in OSA-related literature. Health literacy is a central tenet of Healthy People 2030 and is paramount in the elimination of health disparities and achievement of health equity (U.S. Department of Health and Human Services: Office of Disease Prevention and Health Promotion, 2022). Health literacy may also impact a person's decision to act on perceived health risks (Harzheim et al., 2020). Within the context of sleep apnea, a study of ischemic stroke survivors found that application of health literacy concepts applied to an educational pamphlet increased intention to discuss OSA screening with a physician (Donald et al., 2018). A population cohort study of Australian men found that undiagnosed OSA was associated with inadequate functional health literacy (OR = 2.84, 95% CI [1.25-6.45]) (Li et al., 2014). No further known studies have examined health literacy in the context of OSA evaluation in at-risk individuals.

Health literacy has been identified as a factor impacting screening uptake in other settings and populations, including women's health. Women with low health literacy have been shown to be less likely to obtain a mammogram (OR = 0.27, 95% CI [0.19-0.37]) (Komenaka et al., 2015). Researchers have also found that women with higher listening-related health literacy are more likely to be up to date in cervical cancer screening (OR = 2.00, 95% CI [1.09-3.66]) (Mazor et al., 2014). With regards to race, black women with higher health literacy risks (cancer literacy, cancer history, and less than a high school diploma) are less likely to receive clinical breast cancer screening (OR = 0.70, 95% CI [0.53-0.94]) (Roman et al., 2014), whereas Mexican American women with adequate health literacy are more likely to report ever having a mammogram (OR = 2.92, 95% CI 1.62-5.28]) (Pagán et al., 2012).

Health literacy has also been studied in men's health. Nguyen et al. (2021) found men with optimal health literacy have the highest rates of prostate-specific antigen (PSA) screening (42.2%, compared to lowest health literacy group rate of 23.3%) and that optimal health literacy was a significant predictor of PSA screening (OR = 1.214, 95% CI [1.051-1.403]). In a scoping review focused on men's health literacy, Oliffe et al. (2019) summarized that although limitations exist in understanding the concept of health literacy in men, low levels of health literacy contribute to hesitancy in care-seeking. A systematic review of health literacy among individuals at-risk for coronary heart disease noted that compared to patients with higher health literacy, patients with lower health literacy had less engagement with the healthcare system including usage of preventive health services (Peltzer et al., 2020). Patients with higher health literacy were found to have increased knowledge of their disease and were more likely to undertake lifestyle changes, exhibit healthier lifestyle habits, and exhibit more proactive coping behaviors. These findings as they pertain to screening uptake and engagement with health systems suggest that health literacy could

play a critical role in completion of OSA evaluation. Thus, health literacy could be a novel factor impacting adherence to a healthcare provider's recommendation for OSA evaluation.

1.2.5 The Perianesthesia Setting

The perianesthesia setting reflects a continuum of care for patients undergoing anesthesia-related procedures and includes preanesthesia, encompassing preadmission and the day of surgery, intraoperative/intra-procedure, and postanesthesia. In the preadmission setting, procedural planning, assessment, and education take place. The day of surgery/procedure, which is the period immediately prior to the anesthesia-related procedure, focuses on assessment and clinical preparation of the patient for the receipt of anesthesia and their procedure. The intra-procedure or intraoperative phase is where the procedure takes place and anesthesia is delivered. After completion of the procedure, care in the postanesthesia setting focuses on patient stabilization, recovery and preparation for discharge or transfer to another care setting or home. Perianesthesia-related care may be delivered to patients undergoing surgery of any type. It also encompasses other areas where procedural sedation and/or anesthesia is administered without invasive operation, such as the gastrointestinal (GI) laboratory where diagnostic endoscopic procedures occur (American Society of Perianesthesia Nurses, 2020a). For the purposes of this review, the terms perioperative and perianesthesia may be used interchangeably.

The prevalence of OSA is high in the perioperative setting, with rates approaching 80% in select populations (e.g., bariatric surgery) (Chung et al., 2016; Loo et al., 2020; Sareli et al., 2011; Vasu et al., 2012). Similar to the general population, the rate of *undiagnosed* sleep apnea is also high in patients in the perioperative setting, up to 80% (Chung et al., 2008; Finkel et al., 2009; Singh et al., 2013). Patients with OSA are known to have an increased risk of multiple adverse

anesthesia-related outcomes, including pulmonary and airway complications, as well as arrhythmias and other cardiac complications (Chung et al., 2016; Corso et al., 2014; Kheterpal et al., 2013; Memtsoudis et al., 2011; Memtsoudis et al., 2014; Mokhlesi et al., 2013). These and other OSA-related complications often result in increased care requirements including intervention, monitoring, and overall procedure length of stay (Cozowicz et al., 2017; Jules-Elysée et al., 2018; Naqvi et al., 2017).

With the high prevalence of OSA and a heightened risk of complications, identification of patients at-risk for OSA is an integral process in the perianesthesia setting to ensure the safe delivery of anesthesia. OSA screening, supported by national guidelines for anesthesia providers (American Society of Anesthesiologists, 2014; American Society of PeriAnesthesia Nurses, 2020b; Chung et al., 2016), is considered a routine procedure in perianesthesia care. OSA screening, as part of preanesthesia evaluation, assists providers in developing an appropriate management plan which may include additional airway precautions, adjustments to anesthesia approach, enhanced monitoring and discharge disposition, and in some cases, preprocedural diagnosis and treatment optimization (American Society of Anesthesiologists, 2014; Chung et al., 2016). Multiple screening tools exist for OSA risk identification. In the surgical setting, the most commonly used tools are the STOP-Bang questionnaire (Chung et al., 2008), which is the most validated OSA screening tool in the surgical setting (Chung et al., 2016), the Berlin Questionnaire (Netzer et al., 1999), the ASA checklist (American Society of Anesthesiologists, 2006), and P-SAP score (Ramachandran et al., 2010), all of which have demonstrated comparable accuracy (Chung et al., 2016).

While a definitive diagnosis of OSA may seem ideal prior to the receipt of anesthesia, as noted above, in order for OSA diagnosis to occur, patients must undergo a sleep study. In patients

with suspected OSA detected in preanesthesia screening, completion of a sleep study is often not feasible prior to the procedure as screening frequently occurs close to or on the day of the procedure. Provider guidelines recommend against delaying or cancelling surgery for in-depth OSA evaluation except where concern exists for patients with compromised respiratory functioning (Chung et al., 2016). Further, research has shown the majority of patients are not willing to delay surgery to complete an OSA work-up (60%) (Ho et al., 2018), and even when patients are referred for an OSA evaluation preoperatively with administrative barriers minimized (e.g., wait time, cost), less than 50% complete a sleep study (Guralnick et al., 2012). Because of this, providers must rely on screening tools and clinical assessment/judgment to identify patients who likely have OSA, in which case providers are directed to use presumptive management in the delivery of anesthesia, treating the patient as if they have diagnosed OSA (American Society of Anesthesiologists, 2014).

Although OSA diagnosis may not occur prior to a procedure, perianesthesia providers hold a crucial role in facilitating follow-up care for OSA evaluation after the patient completes their procedure. The Society of Anesthesia and Sleep Medicine recommends anesthesia providers advise patients with a high probability for OSA to notify their primary medical provider for referral for further evaluation after their procedure, although this directive is identified as a weak recommendation, based on a low level of evidence (Chung et al., 2016). Challenges inherent to the perianesthesia setting and workflow exist in the form of time limitations and scope of care that is not conducive to long-term follow-up. In spite of this, anesthesia providers remain well-positioned to, at a minimum, initiate follow-up proceedings and promote a patient's entry to the OSA diagnostic pathway particularly given that OSA screening and airway-related assessments

are routine and millions of patients per year (National Quality Forum, 2020) receive this screening while preparing for their surgery.

While anesthesia providers are well-positioned to make an impact on OSA diagnosis, follow-up for at-risk individuals who were recommended or referred for OSA evaluation as part of their perianesthesia procedure is poorly understood. Limited data suggests that less than half (43.9%–49%) of high-risk OSA patients identified in the pre-operative clinic setting adhere to a referral or recommendation for OSA diagnostic evaluation (Fidan et al., 2006; Guralnick et al., 2012). However, no studies have examined factors contributing to adherence to OSA recommendation in this population and setting.

1.2.6 Summary

While multiple factors have been identified that may contribute to OSA evaluation in at-risk individuals, thus far the majority of available studies have taken place in isolated samples and have not been comprehensively examined or synthesized for overall trends and/or themes. Thus, it remains unclear which factors may be most impactful for successful completion of an OSA evaluation. Establishing this knowledge base is an essential piece to addressing the public health issue of OSA underdiagnosis.

Although OSA screening is a standard procedure for the planning and delivery of anesthesia, the impact of sharing of OSA risk status information with patients screened as part of perianesthesia care on completion of OSA evaluation has not been examined in-depth. Further, factors associated with OSA evaluation in this specific population have remained unexplored. With millions of surgical procedures occurring annually wherein OSA screening is a standard feature of

pre-procedure care, realizing the impact of this potential entry point into the OSA diagnostic pathway may be a crucial step in addressing OSA underdiagnosis.

1.3 Significance

National initiatives have recognized OSA underdiagnosis and recognition as a public health issue. Healthy People 2030 has identified a specific objective to *increase the proportion of adults with sleep apnea symptoms who get evaluated by a health care provider* (U.S. Department of Health and Human Services: Office of Disease Prevention and Health Promotion, 2021). However, at the present time, no one has comprehensively reviewed factors associated with adherence to OSA referral/recommendation and it remains unclear which factors may be most impactful for adherence. Further, many of the available studies have been conducted in targeted populations which present considerable limitations in generalizability. A greater understanding of these factors is needed to address this public health problem as well as direct clinical care and develop patient-centered interventions.

The proposed study will identify factors associated with adherence to a provider's recommendation for OSA evaluation among patients screened as at-risk for OSA in the perianesthesia setting. Patients identified as at-risk for OSA in the perianesthesia setting often do not adhere to their provider's recommendation for OSA evaluation (Fidan et al., 2006; Guralnick et al., 2012) and yet, it is unknown what factors contribute to patients' nonadherence. This study will utilize insights from previous work outside of the perianesthesia setting including the key concepts of health literacy and risk perception to identify unique factors influencing at-risk perianesthesia patients' adherence to provider's recommendation for OSA evaluation. Given its

routine OSA screening procedures and significant volume of patients undergoing procedures in the United States (National Quality Forum, 2020), the perianesthesia setting presents a unique opportunity to make a significant impact on the substantial proportion of adults who are currently undiagnosed and therefore untreated. Findings from this study will help to inform the development of perianesthesia provider-delivered education for patients identified as at-risk for OSA in the perianesthesia setting and could encourage refinement of clinical guidelines.

1.4 Innovation

The proposed review would be the first to synthesize available literature of factors associated with OSA evaluation. The proposed study would be the first to examine factors contributing to adherence to a provider's recommendation for OSA evaluation in an at-risk sample originating from the perianesthesia setting, which is a high-volume point of entry into the healthcare system where OSA screening is already routine. Although health literacy has been acknowledged as a critical concept for public health (U.S. Department of Health and Human Services: Office of Disease Prevention and Health Promotion, 2022) and, more specifically, associated with health screening uptake (Komenaka et al., 2015; Mazor et al., 2014; Nguyen et al., 2021; Oliffe et al., 2019; Pagán et al., 2012; Peltzer et al., 2020; Roman et al., 2014), there is a dearth of studies examining this concept in sleep research, in particular in relation to completion of OSA evaluation. The present study is novel in exploring health literacy as a potential factor influencing uptake of OSA evaluation in at-risk individuals. In addition to health literacy, perceived risk of disease has also been shown to influence health screening uptake for various health conditions, not including OSA. The proposed study capitalizes on these previous findings

by examining the potential role of OSA-related risk perception in adherence to a provider's recommendation for OSA evaluation.

1.5 Literature Review Protocol (Aim 1)

1.5.1 Introduction

A narrative review will be conducted to examine factors associated with OSA evaluation among at-risk individuals. A narrative review has been chosen at the present time, since no one has comprehensively reviewed factors at any level (e.g., patient, provider, or system) associated with adherence to OSA referral/recommendation. This style of review serves as the basis of medical literature synthesis (Ferrari, 2015) and thus is an important first step in understanding which factors may be most impactful for adherence. A mixed-methods, convergent segregated design will be used wherein quantitative and qualitative data will be synthesized separately yet simultaneously (Lizarondo et al., 2020).

1.5.2 Eligibility Criteria

English-language articles of quantitative, qualitative, or mixed-methods studies focused on any factors associated with completion of an OSA evaluation (e.g., PSG or OSA-focused physician visit) among adults (age \geq 18 years) will be included in this review. Factors may exist at the individual/patient level, provider level, and system level. All study types will be included with no

restrictions placed on setting or population characteristics. Case studies and opinion pieces will be excluded.

Eligible articles must address patient, provider, or system-level factors impacting completion of an OSA diagnostic evaluation and/or adherence rates. At the individual level, 1) studies must include a sample of patients who are at-risk for OSA or diagnosed with OSA, and 2) participants must have received a recommendation or referral for OSA diagnostic evaluation and/or have completed an OSA evaluation. At the provider or system level, studies must 1) include individuals or organizations involved with OSA screening/diagnosis (e.g., healthcare providers or systems), and 2) identify factors associated with an at-risk individual's completion of an OSA evaluation.

1.5.3 Search Strategy

An initial search of PubMed and CINAHL will be conducted to identify relevant published studies on OSA evaluation, diagnosis, and adherence. Text contained in the titles, abstracts, and index terms (e.g., MeSH terms) associated with relevant articles will be used to establish keywords to be used in the full search strategy, along with consultation with a health sciences research librarian.

1.5.4 Data Management and Extraction

EndNote reference management software (Clarivate Analytics, PA, USA) will be used to keep record of all citations. To identify potentially relevant studies, screening of titles and abstracts will be performed by two independent reviewers using established inclusion criteria. Reference

lists of relevant studies will also be screened for additional studies. Full text versions of potentially relevant studies will be obtained and reviewed for inclusion in the narrative review. Any disagreements between reviewers in initial screening or full-text review processes will be resolved through joint discussion and/or consultation with Dr. Faith Luyster, Dissertation Committee Chair.

Two independent reviewers will extract quantitative and qualitative data from their respective study types. Quantitative data will be retrieved from solely quantitative studies as well as the quantitative component of mixed methods studies. Quantitative study data to be extracted includes study population, methods, interventions, and significant outcomes pertinent to factors associated with OSA evaluation. Qualitative data will be retrieved from solely qualitative studies as well as the qualitative component of mixed methods studies. Qualitative study data to be extracted includes study population (including context and geographical location), methods, and phenomena of interest pertinent to factors associated with OSA evaluation.

1.5.5 Synthesis and Presentation of Findings

Information on included studies will be compiled into a tabular format, summarizing key study characteristics, including authors, study design, sample, outcomes, and results. Each factor or theme identified in the literature review process, specifically recurring phenomena of interest and significant factors, will be presented topically in narrative format in the text, with discussion of relevant findings presented by study design (e.g., qualitative, quantitative, and/or mixed-methods findings), as well as implications described at the patient, provider, and/or system level. A detailed table of factors identified in the literature, grouped by individual, provider, or system-level, describing the types of studies informing each factor as well as an integration of qualitative and quantitative findings, will also be compiled.

1.6 Research Design and Methods (Aims 2 & 3)

Aims 2 and 3 encompass the original research arm of this dissertation. Logistic regression analyses will be performed to examine adherence to a provider's recommendation for OSA evaluation and associations with health-related factors in patients identified as at-risk for OSA in the perianesthesia setting overall (Aim 2) as well as examine differences by sociodemographic variables (Aim 3).

1.6.1 Design

1.6.1.1 Aim 2

Aim 2 will be accomplished using an observational study design to examine adherence to a provider's recommendation for OSA evaluation and associations with health-related factors in patients identified as at-risk for OSA in the perianesthesia setting. Adherence to a healthcare provider's recommendation for OSA evaluation will be defined as scheduling or completing an evaluation for OSA. Health-related factors include actual and perceived OSA risk, OSA symptoms, health literacy, and type of OSA risk information received.

1.6.1.2 Aim 3

Aim 3 will be accomplished using an observational study design to examine sociodemographic differences in health-related factors associated with adherence to a provider's recommendation for OSA evaluation in at-risk patients identified in the perianesthesia setting. Sociodemographics will include age, sex, and marital status.

1.6.2 Setting and Sample

1.6.2.1 Aim 2

We will recruit 64 patients undergoing outpatient procedures requiring anesthesia from the Excelsa Health system’s perioperative and gastrointestinal laboratory units at its 3 hospitals and 2 ambulatory surgery centers. Table 1 illustrates the sequence of eligibility screening and data collection.

Table 1 Study Design

Participant Actions	Week 0 Post-Procedure	Week 1 Post-Procedure	Week 2 Post-Procedure	Week 6 Post-Procedure
Eligibility screening				
Attestation of agreement				
Baseline questionnaires				
Follow-up question				

Patients identified as at-risk for OSA during pre-anesthesia screening related to an outpatient procedure which took place within the previous 2 weeks and who are interested in the study will complete electronic eligibility screening questions. Immediately following determination of eligibility, participants will verify their agreement to participate in the study and will be emailed a link to access baseline questionnaires. Participants will be given up to 14 days to complete baseline questionnaires. Baseline questionnaires include demographics and clinical information, OSA-related symptoms, actual and perceived OSA risk, health literacy, and type of OSA risk information received. At 6 weeks post-procedure, patients will complete a single-item question assessing adherence to a provider’s recommendation for OSA evaluation. Participants will be given up to 14 days to complete this question. All questionnaires will be completed online.

Collection of this data will be performed with consultation from Dr. Faith Luyster, Dissertation Committee Chair, experienced in sleep apnea and behavioral research.

The target sample for this study will be patients presenting for outpatient procedures requiring anesthesia in the perioperative units (including surgery and gastrointestinal laboratory) of the Excelsa Health system (Westmoreland County, PA), which encompasses Westmoreland, Latrobe, and Frick Hospitals and Laurel and Norwin Surgery Centers. This patient population was chosen as at-risk patients (STOP-Bang ≥ 3) in the Excelsa Health system receive a letter notifying them of their potential OSA risk and recommendation for follow-up at discharge and/or in the mail within a few business days (less than 1 week) after their procedure, thus giving patients an impetus to consider taking follow-up action (see Figure 1).

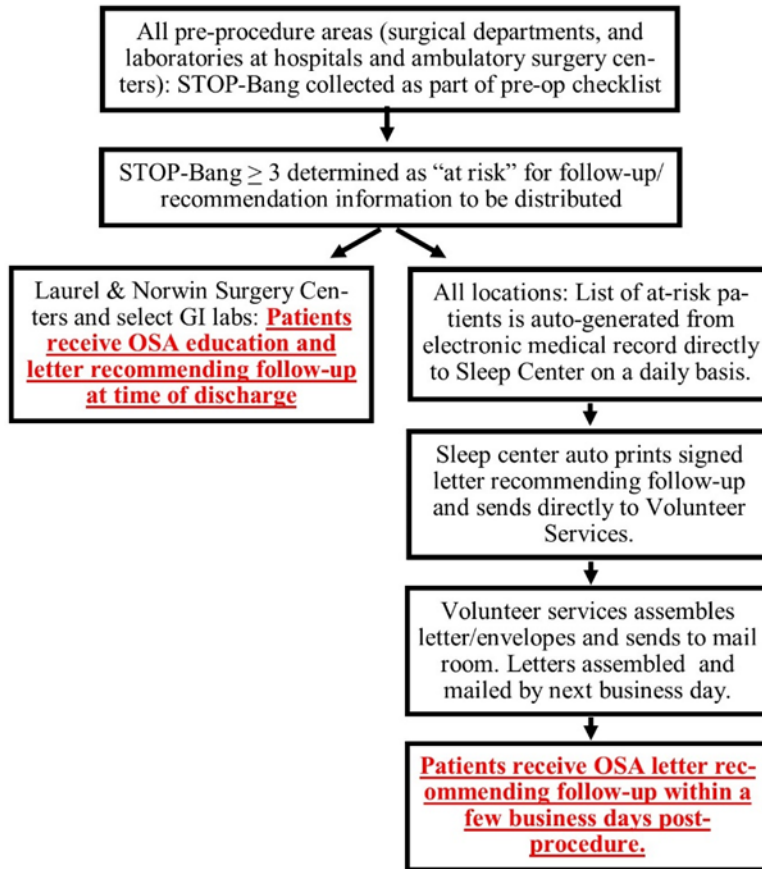


Figure 1 Excelsa Health Perioperative Sleep Apnea Risk Screening and Notification Process

Per business day, approximately 40 patients meet at-risk criteria for receipt of a mailed letter across the Excelsa system, which enhances feasibility in recruitment. Further, utilizing these 5 locations allows for capture of variability in patient demographics and procedure types.

A sample of participants consecutively undergoing outpatient procedures will be included in this study. We plan to enroll a minimum of 64 patients. Eligibility criteria includes: 1) ≥ 18 years old, 2) at-risk for OSA based on STOP-Bang of ≥ 3 (Chung et al., 2008), 3) undergoing an outpatient procedure under anesthesia, 4) cognitively intact with ability to complete written surveys and interviews, 5) English speaking, 6) access to the internet, including an active email address; and 7) access to a telephone. Exclusion criteria is as follows: 1) previous OSA diagnosis

or sleep study and/or completion of a sleep specialist appointment for OSA evaluation prior to procedure completion date, 2) no receipt of OSA risk-related information during the procedural period, and 3) a procedure completion date occurring more than 2 weeks prior to the time of eligibility screening.

Recruitment flyers will be distributed to all patients at Excelsa Health who receive a mailed risk notification letter. Flyers will be placed in the envelope with the patient's risk notification letter by Excelsa Health's Volunteer Services department. The flyer will contain contact information and a Qualtrics® link (web address) for the patient to access study information and eligibility screening questions.

1.6.2.2 Aim 3

See the "Sample and Setting" section in Aim 2 for a detailed description and inclusion/exclusion criteria. Participants eligible for Aim 3 are consistent with those for Aim 2.

1.6.3 Measures

1.6.3.1 Aim 2

In order to examine adherence to a provider's recommendation for OSA evaluation and associations with health-related factors in patients identified as at-risk for OSA in the perianesthesia setting, we will measure actual and perceived OSA risk using the STOP-Bang tool (Chung et al., 2008) and a self-developed scale, respectively, OSA symptoms (Epworth Sleepiness Scale [ESS]; Johns, 1991, Insomnia Severity Index [ISI]; Bastien et al., 2001, and Functional Outcomes of Sleep Questionnaire-10 [FOSQ-10]; Chasens et al., 2009), health literacy (Health

Literacy Questionnaire [HLQ]; Osborne et al., 2013), type of OSA screening information received, and self-reported action(s) taken for follow-up evaluation for official OSA diagnosis.

1.6.3.1.1 Dependent Variable: Adherence to a provider's recommendation for OSA evaluation.

To determine whether an individual adhered or did not adhere to a provider's recommendation for OSA evaluation, a single question will be presented to participants 6 weeks after completion of their procedure to assess follow-up actions taken for OSA evaluation. Participants will be asked, "Since receiving information about your risk status for sleep apnea, which of the following statements best describes actions you have taken for follow-up of potential sleep apnea, if any?" Choices will include, "I have not scheduled or completed an evaluation for sleep apnea," "I have scheduled but not attended/completed an evaluation for sleep apnea," or "I have completed an evaluation for sleep apnea." For the purposes of statistical analyses, responses will be dichotomized into non-adherent (no action taken) or adherent (either scheduled or completed an evaluation).

1.6.3.1.2 Primary Independent Variables.

Actual and Perceived OSA Risk. Actual risk will be measured using the STOP-Bang questionnaire (Chung et al., 2008). The STOP-Bang Questionnaire is an 8-item screening tool for OSA. The STOP-Bang has been validated via PSG across multiple patient populations and was originally validated to screen for OSA in the surgical population. It has high sensitivity for all levels of OSA (Chung et al., 2008). OSA risk is calculated based on 8 dichotomous, yes/no items related to the clinical features of sleep apnea including patient-reported snoring, tiredness, observed apneas, and diagnosis of hypertension as well as BMI ($>35 \text{ kg/m}^2$), age over 50 years, neck circumference (≥ 16 inches or 40 cm), and male sex. Scores of 0-2 indicate low risk for OSA

whereas scores of 5-8 indicate a high probability of moderate-to severe or severe OSA (Chung et al., 2012). STOP-Bang scores of 3-4 indicate a moderate risk for OSA.

Perceived OSA risk will be assessed using 2 Likert-type response questions on the perceived likelihood of having OSA and seriousness of OSA. Respondents will be asked to indicate their level of agreement to the following statement, “Sleep apnea is a serious condition” with 5 response options ranging from ‘strongly disagree’ to ‘strongly agree.’ This question was constructed after a question contained in the Illness Perception Questionnaire-Revised measure (Moss-Morris et al., 2002) focused on consequences of illness. Participants will also be asked the question, “How likely do you think it is that you have sleep apnea?” with 5 response options ranging from ‘very unlikely’ to ‘very likely.’

Health Literacy. Health literacy will be measured using the Health Literacy Questionnaire (HLQ), which is a 44-item questionnaire encompassing 9 aspects of health literacy including understanding/support from healthcare providers, sufficiency of information to manage health, active health management, social support, appraisal of health information, active engagement with healthcare providers, healthcare system navigation, a person’s ability to find good health information, and understanding health information well enough to know what to do. It has high internal consistency ($\alpha = 0.80$) and has been used across a wide range of patient characteristics (Osborne et al., 2013).

OSA Symptoms. OSA symptoms will include measurements of daytime sleepiness, insomnia symptoms, and functional impacts of excessive sleepiness. The Epworth Sleepiness Scale (ESS) measures daytime sleepiness in the context of 8 common situations. Each item is scored on a 0-3 scale, with total scores ranging from 0-24. A score of ≥ 10 is the cutoff score for clinically significant daytime sleepiness. It has high internal consistency ($\alpha = 0.88$) and test-retest

reliability ($r = 0.82$) (Johns, 1991, 1992). The Insomnia Severity Index (ISI) assesses subjective severity of insomnia symptoms, satisfaction with sleep, daytime impairment, and concerns related to sleep difficulties. Each item on this 7-item questionnaire is scored on a 0-4 scale, and total scores determine the severity of insomnia. Clinically significant insomnia is indicated by scores of 15 or greater, with a highest possible score of 28. Internal consistency of the ISI is moderate ($\alpha = 0.74$) (Bastien et al., 2001; Morin et al., 2011). The Functional Outcomes of Sleep Questionnaire-10 (FOSQ-10) measures the impact of excessive sleepiness on a person's functional status. The questionnaire assesses outcomes in 5 domains (general productivity, activity, vigilance, social outcomes, and intimacy and sexual relationships). Each of the 10 items is scored 1-4 with total scores ranging from 5-20. Lower scores indicate greater functional impacts related to sleepiness. Internal consistency of the FOSQ-10 is high ($\alpha = 0.87$) (Chasens et al., 2009).

Type of OSA Information Received. Three questions will be presented to participants to assess the type of OSA-related screening information received within the perianesthesia setting: 1) on the day of the procedure, 2) after discharge, and 3) during a pre-procedure clearance visit, when applicable. Participants will be asked to indicate the type of information received including risk status, risks, symptoms, and/or treatments for OSA, recommendation for follow-up, referral received, and 'other'. For post-procedure information received, participants will be asked about the manner in which the information was provided. Options will include: phone call, letter, email, text, post-procedure follow-up appointment with provider who performed my procedure, and other.

1.6.3.1.3 Secondary Variables.

Sociodemographic and Clinical Information. Sociodemographic and clinical information will be collected in order to describe the sample and as potential covariates in the analysis for Aims

2. Sociodemographic information collected will include age, height and weight, sex, employment status, level of education completed, income, race, ethnicity, marital status, and health insurance. The date, location, and general nature of the participant's procedure (e.g., general surgery, orthopedic, urology, gynecology, ear/nose/throat, vascular, GI – colonoscopy or EGD, and other) will also be collected.

Participants will also complete a brief medical history form asking, "Do you now or did you ever have any of the following medical conditions?" to the following items: heart failure, diabetes (and type), high blood pressure, high cholesterol, kidney disease, stroke, chronic obstructive pulmonary disease, rheumatoid arthritis, coronary artery disease, asthma, peripheral vascular disease, any sleep disorder other than sleep apnea, and any other medical conditions not previously mentioned.

Intention to Seek OSA Care. This study includes a longitudinal component where the dependent variable is not measured until 6 weeks after a person's procedure is completed. Intention to seek OSA care will be collected at the time of the initial survey and used as a proxy variable to adherence to a provider's recommendation if participants become lost to follow-up. Intention to seek OSA care will be assessed using a 1-item, semantic differential scale (0-100), where respondents can indicate the degree to which they do or do not intend to complete an OSA evaluation within the next 6 weeks. Participants will be presented with the statement, "I intend to seek medical care to determine if I have sleep apnea within the next 6 weeks." Participants will be asked to indicate the level of their intention along a continuum between the response options of "definitely no" to "definitely yes." This scale was developed specifically for this study and is based on the theory of planned behavior (Fishbein & Ajzen, 2010; Osgood, 1952).

1.6.3.2 Aim 3

See the “Measures” section in Aim 2 for information on study measures used in Aim 3. Although sociodemographic variables are considered secondary variables in Aim 2, age, sex, and marital status will become main variables of interest and used to explore differences in health-related factors associated with adherence to a provider’s recommendation for OSA evaluation.

1.6.4 Procedures for Data Collection

1.6.4.1 Aim 2

Patients will access eligibility screening questions through a Qualtrics® link (web address). Patients will be allowed to access the eligibility screening questions at any time, up to 2 weeks post-procedure. Eligibility screening will include completion of the STOP-Bang screening tool, self-reported height and weight for calculation of body mass index (required for STOP-Bang calculation), and attestation that the individual had a procedure under anesthesia within the last 2 weeks, does not have a previous OSA diagnosis, nor has completed a sleep study or specialist visit for suspected OSA prior to procedure completion date. Once eligibility is determined, participants will be directed to attest that they agree to study participation and provide contact information. After completing this information, a link to the survey will immediately be emailed to the participant.

Participants will complete the following baseline measures using an online survey via Qualtrics®: basic demographic and clinical information, the Health Literacy Questionnaire (HLQ) (Osborne et al., 2013,) Epworth Sleepiness Scale (ESS) (Johns, 1991), Insomnia Severity Index (ISI) (Bastien et al., 2001), and Functional Outcomes of Sleep Questionnaire-10 (FOSQ-10) (Chasens et al., 2009). At 6 weeks post-procedure, participants will be emailed a Qualtrics® link

to a survey containing a select-all-that-apply questionnaire assessing which actions, if any, they have taken regarding their provider's recommendation for OSA evaluation. The 6-week timepoint will allow for physical recovery of the recent procedure and give participants time to initiate follow-up action, if desired.

1.6.4.2 Aim 3

See the "Procedures for Data Collection" section in Aim 2 for information on data collection for Aim 3.

1.6.5 Analysis Plan

Binary logistic regression will be the main analysis used in Aims 2 and 3 to explore the prediction of adherence to a provider's recommendation for OSA evaluation from health-related factors as well as by sociodemographic groupings. The sample size ($n = 64$) was chosen to account for 7% attrition yielding a final sample of $n=60$ and based on feasibility for exploratory, pilot research in order to generate effect size estimates for future, powered studies. Dr. Paul Scott will provide oversight and consultation throughout all statistical analysis procedures.

1.6.5.1 Aim 2

Prior to analysis, data screening will be performed. The data will be examined for any inconsistencies including outliers and missingness. Appropriate steps will be taken to remedy any issues (e.g., data transformation, imputations, and usage of nonparametric analysis). Descriptive statistics of scale variables will be calculated, including mean, standard deviations, medians, and inter-quartile ranges and frequencies, and percentages for categorical variables. Baseline

demographic and clinical descriptive statistics will be evaluated to determine characteristics of the sample overall. Comparisons by adherence to a provider's recommendation for OSA evaluation will be examined amongst categorical variables (sex, race, marital status, income, location and nature of procedure, comorbidities, type of OSA screening information received) using Chi-Square Tests of Independence, and amongst continuous variables (ESS, HLQ, ISI, and FOSQ-10) using Independent Samples t-tests. These initial comparisons will be used to select covariates for the logistic regression models on the basis of yielding $p < 0.10$.

Assumption testing will be performed to determine if a linear relationship exists between explanatory variables and the logit of the outcome using a Box-Tidwell test. Other considerations for logistic regression will also be evaluated including outliers and influential cases, and issues of collinearity such as perfect prediction. Assessment of outliers will be performed by examining Pearson standardized residuals with criteria that none exceed +/- 3. Cook's D, leverage, and DfBetas statistics will be generated to evaluate the presence of influential cases. Depending upon the nature of outliers and/or influential cases, data transformations, and/or case deletion will be considered. Variance inflation factor, based on change in standard error from the unadjusted model with only one predictor to the adjusted model containing the other predictors, will be used to evaluate multicollinearity amongst predictor variables in each model. Multicollinearity will be assessed and considered problematic for a reported variance inflation factor value greater than 5 at the individual parameter estimate level. In this case, removal of highly correlated variables will be considered after review of a correlation matrix for the predictors.

Binomial logistic regression will be used to explore the prediction of adherence to a provider's recommendation for OSA evaluation from health-related factors and sociodemographic and clinical covariates. Unadjusted and adjusted regression models, with incorporation of

appropriate covariates, will be fitted for each health-related factor as a predictor of adherence to a provider's recommendation for OSA evaluation. After diagnostics of model fit to data and potential remediation, a full model with all covariates included will be reported. Due to the smaller sample size for logistic regression, predictors with $p < 0.10$ will be considered as trending towards significance and worthy of further analysis. Model fit will be assessed using log-likelihood value, pseudo- R^2 values, and classification adequacy in terms of sensitivity, specificity, and overall correct classification.

1.6.5.2 Aim 3

Following completion of Aim 2 analyses, logistic regression models will be used to explore sociodemographic differences in predictors trending towards significance from logistic regression models in Aim 2. Interaction terms between these predictors and age, sex, and marital status will be created and entered into logistic regression models. To provide focus and avoid problems with sample size, separate models will be fit to consider each important predictor from Aim 2 in conjunction with each of the demographic predictors and their respective interaction terms. Other sociodemographic variables (e.g., education, race) will be considered pending diversity of the final sample.

1.7 Potential Limitations and Alternative Approaches

The purpose of this study is two-fold: 1) to comprehensively examine and synthesize available literature on factors associated with OSA evaluation in at-risk individuals and 2) examine adherence to a provider's recommendation for OSA evaluation and associations with health-

related factors overall, and by sociodemographics, in patients identified as at-risk for OSA in the perianesthesia setting. The proposed narrative literature review will be the first to comprehensively examine and synthesize factors associated with OSA evaluation in at-risk individuals, however there are potential limitations with the chosen approach. Because this is a review of existing literature, the ability to identify multiple levels of factors associated with OSA evaluation will be limited to what prior studies have previously examined. In the event that factors identified are too few to adequately classify by individual, provider, and system-level, alternate classifications will be considered including combining provider and system level or removing any classification and pooling all factors together. The type of eligible studies may also present a limitation. In the event that an overwhelming majority of studies are solely qualitative or solely quantitative, an alternate review approach will be implemented, adjusting methods to reflect the type of literature found (e.g., a traditional qualitative or quantitative review approach).

There are potential limitations to the proposed original research planned for this dissertation. During pre-procedure OSA screening using the STOP-Bang, neck circumference is not consistently measured by staff. Thus, staff must either rely on self-reported neck measurements, if known, and if unknown, neck circumference is not included in a patient's STOP-Bang score calculation. This may underestimate risk of OSA in the recruited sample overall as it may potentially create a 1-point deficit (e.g., a STOP-Bang score of 4 without accounting for neck circumference may actually be 5 when accounting for neck circumference). A similar issue is present in actual OSA risk as an independent variable as self-reported neck circumference will be an optional question for participants to complete during survey procedures. Alternate scoring configurations have been proposed and validated for high risk of OSA that are not solely dependent on a STOP-Bang composite score of 5 or greater. For individuals with composite scores of 3 or

greater (which is the intended sample to be recruited), specific combinations of factors have been shown to indicate high risk for moderate-to-severe OSA at an overall score <5 . These combinations include a STOP score of 2 or greater in addition to either BMI $> 35 \text{ kg/m}^2$ or male sex (Chung et al., 2014). In the absence of measured neck circumference, these combinations will be considered for classifying actual OSA risk as an independent variable.

The design of Aims 2 and 3 requires patient completion of measures outside of a controlled setting (to be completed at home, online). While this method was decided upon to allow time for risk notification letters to arrive as well as to capture a more realistic depiction of the post-procedure timeframe wherein individuals would decide and/or act upon the recommendation for further OSA evaluation, it also may contribute to drop-out or incomplete survey measures. In the event that individuals enroll but do not complete survey measures after 14 days, participants will be contacted via phone to remind them to complete these measures. If individuals are uncomfortable completing measures online, these measures may be adapted to verbal questions administered by study personnel to be completed over the phone.

Loss to follow-up, specifically of the 6-week post-procedure measure assessing follow-up action(s) taken, is also a potential limitation. In the event that participants do not complete their 6-week follow-up questions within 1 week, research personnel will contact participants by phone and attempt to collect this information. If a participant is unable to be reached to complete the final follow-up question, information collected during the initial survey regarding intention to seek OSA care will be used as a proxy response to follow-up action that individual. Responses from 0-50 on the semantic differential scale will be categorized as “no follow-up action(s) taken” and 51-100 as (“follow-up action(s) taken”). If significant loss to follow-up occurs wherein the majority of the sample does not complete the 6-week follow-up question, we will consider using intention as the

dependent variable for all participants. *Intent* is recognized as a proximal goal or antecedent of *behavior* (Bandura, 2004; Fishbein & Ajzen, 2010), and thus for the purposes of this study, we consider it to be an acceptable proxy variable.

1.8 Publications

Articles Submitted for Publication * = Data Based

1. *Baniak, L., **Orbell, S.**, Luyster, F.S., Henker, R., & Strollo, P.J. (2023). Perioperative management of obstructive sleep apnea in lower extremity orthopedic procedures: a review of evidence to inform the development of a clinical pathway. *Sleep medicine reviews*, 67, 101712. <https://doi.org/10.1016/j.smr.2022.101712> (Note: L. Baniak and S. Orbell first co-authors)
2. *Morris, J., **Orbell, S.**, Scott, P.W., Imes, C.C., Jeon, B., Baniak, L., Burke, L.E., Chasens, E. (2022). Risk stratification by sex and menopausal status in the Multivariable Apnea Prediction Index. *Sleep and breathing*. <https://doi.org/10.1007/s11325-022-02766-0>
3. ***Orbell, S.L.**, Scott, P.W., Baniak, L.M., Chasens, E.R., Godzik, C., Jeon, B., Morris, J.L., and Luyster, F.S. (Manuscript under review). Patient-level factors associated with the self-report of trouble sleeping to healthcare providers in adults at high-risk for obstructive sleep apnea. *Sleep health*.
4. *Luyster, F.S., Baniak, L.M., Imes, C., Jeon, B., Morris, J.L., **Orbell, S.L.**, and Scott, P.W. (Manuscript submitted for publication). Association of comorbid obstructive sleep apnea and insomnia with risk of major adverse cardiovascular events.

Selected Presentations

1. **Orbell, S.L.**, Chasens, E.R., Scott, P.W., Luyster, F.S., Morris, J.L. (2022, June). *Validation of the predictive utility of the Multivariable Apnea Prediction Index for obstructive sleep apnea in women*. Oral presentation at the Associated Professional Sleep Societies' 36th Annual Meeting (SLEEP), Charlotte, NC.
2. Chasens, E. R., Jeon, B., **Orbell, S.**, Morris, J. L., Luyster, F. (2022, July) Functional Outcomes and Daytime Sleepiness in Adults with Type 2 Diabetes and Sleep Disorders. [Oral presentation]. Sigma Theta Tau's 33rd International Nursing Research Conference. Edinburgh, Scotland
3. **Orbell, S.L.**, Scott, P.W., Baniak, L.M., Chasens, E.R., Godzik, C., Jeon, B., Morris, J.L., and Luyster, F.S. (2023, June). *Patient-level factors associated with the self-report of trouble sleeping to providers in adults at high-risk for obstructive sleep apnea*. [Poster presentation]. Associated Professional Sleep Societies' 37th Annual Meeting. Indianapolis, Indiana.

1.9 Research Participant Risk and Protection

The proposed study utilizes survey procedures in a sample of adults. The information obtained in this study will be recorded in a de-identified manner, where the identity of participants will not be able to be directly linked through study identifiers. Institutional Review Board approval for survey-related research will be submitted and completed prior to any data collection. As described above, data will be collected utilizing electronic surveys. Recruitment will be open to both men and women as well as all racial and ethnic backgrounds. We will aim to recruit 64 participants for this study and will attempt to recruit an equal ratio of men to women, understanding that at minimum, 15 participants are needed in each category in order to adequately make statistical

comparisons. We will adjust recruitment and screening procedures to attempt to ensure adequate representation of participants by monitoring enrollment on a weekly basis. Once recruitment of 75% of participants is achieved, we will adjust and/or pause recruitment until we achieve a minimum acceptable sample based on sex collected in eligibility screening.

1.9.1 Risks to Human Subjects

There are few potential risks in this study. Potential risks to participants include a risk to privacy in the event of a data breach. Participants may feel uncomfortable answering survey questions regarding their personal lives and anxious reflecting on the possibility of having sleep apnea. Engagement with survey instruments may indirectly lead participants to develop a sense of urgency to seek care for their potential OSA diagnosis. Participants may feel tired or bored when being interviewed for this study.

1.9.2 Adequacy of Protection Against Risks

Attestation of agreement to participate in the study will be collected at the time of eligibility verification, wherein potential participants who meet eligibility criteria (as described previously) will be directed to a separate survey to confirm agreement and provide contact information. Information provided to participants will include a written explanation of the study's purpose, protocol, risks, and benefits as they pertain to survey procedures. Potential participants will be given contact information for the principal investigator (PI) to allow for the opportunity to ask questions verbally via phone or email. Participants will select "I agree" to indicate their willingness to participate in the study. Measures will be taken to minimize risks to participants are as follows:

Data Breach

Survey data will be maintained in a secure, password-protected, and encrypted database and no identifiers other than the participant's unique study identifier will be contained within the database; no linkable information will be included with the database. Linkage of participants' unique identifier to identifying information (e.g., name, birthdate, and contact information for potential payment) will be stored separately from any survey data using Pitt OneDrive, accessible only to the PI.

Feelings of Discomfort or Anxiety Related to Personal Information and/or the Possibility of Having OSA

To minimize potential feelings of participant discomfort related to answering questions about their personal lives or anxiety in reflecting on the possibility of sleep apnea, participants will be free to decline any specific survey question. They will also be allowed to discontinue their participation in any study procedures at any time. Because study procedures will include questions related to follow-up and may increase a person's awareness of sleep apnea which may create a sense of urgency to seek care, research personnel will direct participants to contact their primary care provider and/or a sleep medicine specialist for evaluation.

Feelings of Tiredness or Boredom

Participants will be notified during consenting procedures that the survey instruments should take approximately 30 minutes to complete. Participants will be told they can take a break at any time.

1.9.3 Potential Benefits of the Proposed Research to Research Participants and Others

There is minimal benefit to participants to complete surveys. It is possible that they may develop an increased awareness of their risk for OSA. Benefits to others include increased

understanding of factors that lead individuals to seek care for OSA symptoms. This could lead to more effective interventions designed to target modifiable factors in the future. While risks are present in this study, they are minimal.

1.9.4 Data and Safety Monitoring Plan

Data and safety monitoring will be an ongoing activity that is reviewed during weekly meetings with Dr. Faith Luyster, Dissertation Committee Chair, during which data quality, management and any adverse events arising from the study will be reviewed. A summary of these reviews will be provided to the IRB at the time of the yearly renewal. Any unanticipated adverse events will be reported immediately to the IRB.

2.0 Summary of Study

2.1 Dissertation Study Overview

The purpose of this dissertation study was to understand factors associated with OSA care-seeking in at-risk individuals both in and outside of the perianesthesia setting. This study sought to synthesize available literature regarding factors associated with OSA evaluation in at-risk individuals overall and to specifically examine factors associated with adherence to a provider's recommendation for OSA evaluation in at-risk patients identified in the perianesthesia setting, as well as illuminate factors most influential to certain demographic groupings. The findings of this dissertation study are reported in two separate manuscripts: Manuscript 1 reports the literature review findings of Aim 1 and Manuscript 2 reports the original research findings from Aims 2 and 3. The content of these manuscripts will be submitted for publication after successful defense of this dissertation.

2.2 Changes to Dissertation Proposal Plans

While Aim 1 was carried out as planned, a few modifications were made to the proposed study for Aims 2 and 3. These modifications were approved with consultation from the dissertation committee and, when required, with approval of both the University of Pittsburgh and Excela Health Institutional Review Boards.

Recruitment for the study encompassing Aims 2 and 3 was initially planned to take place solely via flyers included alongside Excelsa Health's standard OSA risk notifications, sent via mail. After approximately 6 weeks of flyer distribution via mail, it became apparent that this strategy was rather ineffective for recruitment. To increase visibility of flyers, a modification to the study protocol was approved to allow for perianesthesia staff to distribute flyers at the bedside to eligible patients who received OSA risk notification on the day of their procedure (patients in ambulatory surgery facilities and GI laboratories). After this approach was introduced, the rate of enrollment increased, but was still relatively low. Another minor modification was added to further increase rate of enrollment that allowed perianesthesia staff to ask patients if they would be willing to be contacted by study personnel regarding study enrollment, and if yes, the principal investigator would contact these patients about the study. No additional OSA risk information was provided to patients by study personnel. This strategy yielded a substantial increase in enrollment and an acceptable sample size was achieved.

When collecting 6-week follow-up responses from participants, it was noted that the rate of adherence to a provider's recommendation for OSA follow-up was rather low. This was not completely unexpected as we recognized the potential for low adherence to a recommendation for OSA evaluation within such a short timeframe of risk notification. Further, when speaking with participants via phone for administrative purposes, the principal investigator noted on multiple occasions that patients reported intention to seek OSA care even after reporting they had not taken any follow-up action at the time of completing their final survey. While we were still able to accomplish Aim 2 analyses using logistic regression, it became clear that accomplishing Aim 3 would be difficult, considering the power required to appropriately conduct logistic regression using interaction terms with such a low rate of adherence. In light of this, it was determined that

linear regression, using OSA care-seeking intention as a proxy variable to adherence to a provider's recommendation for OSA evaluation would be a more suitable strategy to accommodate lower statistical power and still accomplish Aim 3. While health behavior theory positions intention as an immediate antecedent to action, we felt statistical analyses (Kaplan-Meier curve, classification plots, and receiver operating characteristics with area under the curve) were warranted to evaluate its suitability as a proxy measure for adherence (follow-up action taken) in this study. The results of these analyses verified that intention was an acceptable proxy measure (these can be found in Appendix X). No other modifications were made to the original dissertation proposal.

2.3 Strengths and Limitations

There are several limitations which should be considered when evaluating these findings. While comprehensive, the literature review in Aim 1 was not performed as a systematic review and the quality of each included study was not appraised. Thus, findings may include results from lower quality studies. Regarding the original research arm of this dissertation, the small sample size used to accomplish Aims 2 and 3, its predominance of male participants, as well as the lack of a racial or ethnic diversity, makes the generalizability of these findings somewhat limited. The study time frame was also relatively short in order to thoroughly accommodate long-term follow-up of participants in regard to completion of an OSA evaluation. Because of this short time frame, these results, particularly those related to adherence, should be interpreted solely within a 6-week follow-up context.

There are also several strengths to this dissertation study. First, although previous studies have identified factors associated with care-seeking or completion of an OSA evaluation, this is the first to synthesize these factors, encompassing both quantitative and qualitative studies, which provides important information to researchers and clinicians alike in understanding care-seeking behavior in individuals at-risk for OSA. This is also the first study to examine these factors in a sample of patients identified as at-risk for OSA in the perianesthesia setting. To date, while OSA screening is a fixture of pre-anesthesia care, the role of the perianesthesia provider and the subsequent sharing of this screening information to promote OSA care-seeking is poorly understood. By performing this study in this specific patient population, preliminary data surrounding adherence to a provider's recommendation for OSA evaluation, as well as factors associated with OSA care-seeking behavior in these individuals, have now been established. Further, two important concepts that are relatively novel to existing literature surrounding adherence to a provider's recommendation for OSA evaluation, health literacy and risk perception, were explored.

2.4 Future Studies and Implications

Understanding factors associated with OSA care-seeking behavior in at-risk individuals is critical to addressing the issue of underdiagnosis. To date, few intervention studies exist addressing OSA evaluation uptake, and even fewer have incorporated the influential factors identified in Aim 1, particularly social support, OSA knowledge and beliefs, and provider support and accessibility, into the design of these interventions. Research utilizing interventions based on these factors remains crucial.

Until this point, while evidence regarding OSA care-seeking behavior has been established in general and in other specific care settings such as primary care, sleep medicine, and dentistry, limited study has been devoted to OSA care-seeking in context of perianesthesia screening and risk notification. This is unfortunate as OSA screening is a standard feature of pre-anesthesia assessment, provided to a significant volume of patients each year, and thus, may represent a missed opportunity to facilitate OSA evaluation. The findings from Aims 2 and 3 respond to this gap and have established a preliminary understanding of at-risk adults' care-seeking response to perianesthesia risk screening for OSA. Because these findings carry some limitations to generalizability, similar studies, conducted in larger, more diverse samples should be performed to examine these associations in more adequately powered analyses. Through continued research of OSA care-seeking behavior within this patient population, researchers and clinicians may be better equipped to develop targeted, effective strategies surrounding OSA risk screening and notification to facilitate OSA evaluation in vulnerable individuals, and also help to address the greater public health issue of OSA underdiagnosis.

3.0 Aim 1 Manuscript: A Review of Factors Associated with OSA Evaluation Among At-Risk Individuals

3.1.1 Abstract

Purpose: Obstructive sleep apnea (OSA) is a highly prevalent yet widely underdiagnosed sleep-related breathing disorder. While multiple studies have examined care-seeking behavior for OSA diagnosis, it is unclear which factors are the strongest facilitators of successful OSA care-seeking and evaluation. We sought to synthesize available evidence on factors associated with OSA evaluation and care-seeking for diagnosis among at-risk individuals.

Methods: A comprehensive search of PubMed, Academic Search Premier, CINAHL, and WorldCat yielded 26 pertinent quantitative, qualitative, and mixed methods studies that addressed patient, provider, and/or system-level factors associated with OSA diagnostic evaluation and/or adherence rates. Eligible studies included samples of patients at-risk for or diagnosed with OSA who received a recommendation or referral or completed an evaluation and/or individuals or organizations involved with OSA evaluation.

Results: Facilitators of care-seeking for OSA evaluation included strong spousal and other social support, the experience of OSA-related symptoms and associated negative social and relational impacts, and strong healthcare provider involvement, including concerted educational interventions aimed at increasing adherence to a recommendation or referral for evaluation. While men appear to more readily seek OSA care, social constructs surrounding sex and gender may impact OSA care-seeking, in particular beliefs related to masculinity and femininity and caretaking responsibilities. Barriers to care-seeking for OSA evaluation included a lack of knowledge and

misperceptions about OSA, poor coordination among healthcare providers, and administrative barriers including wait times, scheduling issues, and distance and/or travel required.

Conclusions: Multiple factors may influence care-seeking for OSA evaluation including social support, knowledge and beliefs, sex and gender-based social constructs, symptom experiences, provider involvement, and accessibility to services. However, few intervention studies aimed at promoting OSA evaluation in at-risk individuals have addressed these factors. Future interventions and clinical strategies to promote OSA care-seeking and address the continued issue of OSA underdiagnosis should consider these influencing factors.

3.1.2 Introduction

Obstructive sleep apnea (OSA) is a highly prevalent yet underdiagnosed sleep-related breathing disorder (Benjafield et al., 2019). Undiagnosed and, by extension, untreated OSA is a public health issue, with only one-third of persons experiencing OSA-related symptoms being evaluated by a healthcare provider (U.S. Department of Health and Human Services: Office of Disease Prevention and Health Promotion, 2021). Underpinning this public health crisis is the increased mortality and morbidity experienced by persons with undiagnosed or untreated OSA (Bibbins-Domingo et al., 2017; Ralls & Cutchen, 2019) as well as the substantial healthcare services required to care for these persons (Walter et al., 2017). The negative personal and social impacts of undiagnosed and untreated OSA, along with low rates of evaluation, which will be discussed further, illuminate an important opportunity to better understand why individuals at risk for OSA may or may not elect to pursue a diagnostic evaluation. This requires an understanding of factors which may influence a person's successful navigation of a pathway to OSA diagnosis, from recognition of a problem to official diagnostic evaluation.

The pathway to OSA diagnosis requires multiple actions be taken on the part of patients and providers (Ye et al., 2022). A person's entry into the pathway for OSA diagnosis may differ based on how they come to recognize their symptoms and/or are alerted to their risk. However, to be definitively diagnosed, a person must ultimately take a series of actions, including making a decision to seek care and acting on that decision by presenting to a healthcare provider for evaluation. Once a visit with a provider is undertaken, the provider may recognize a person's symptoms as potentially linked to OSA, and subsequently may recommend or refer the patient for further testing, such as a sleep study (Ye et al., 2022). While factors associated with an at-risk adult's completion of an OSA evaluation and care-seeking for diagnosis have been examined throughout various studies, including both qualitative and quantitative literature, it remains unclear which factors, if any, may be most influential to OSA care-seeking and evaluation and how they may intersect at various points in the pathway to diagnosis. Thus, the purpose of this review is to synthesize available evidence on factors associated with OSA evaluation and care-seeking for diagnosis among at-risk individuals.

3.1.3 Search Strategy and Selection Criteria

A comprehensive and systematic search was conducted electronically utilizing PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Academic Search Premier, and WorldCat through November 3, 2022. Reference lists of articles meeting eligibility criteria were examined for additional records. Additional records were also sought by entering titles of eligible articles into the PubMed search feature for similar articles. Keywords and MeSH terms in different combinations were used to conduct each search and included: 'sleep apnea, obstructive', 'evaluation', 'diagnosis', 'polysomnography', 'referral and consultation', 'patient acceptance of

health care’, ‘patient compliance’, ‘facilitators’, and ‘barriers’. Combinations of these search terms yielded between 26 (‘polysomnography’ and ‘sleep apnea, obstructive’ and ‘facilitators’ or ‘barriers’) and 2915 (‘sleep apnea, obstructive’ and ‘evaluation’ and ‘diagnosis’ with explicit exclusion of ‘pediatric’ or ‘children’ or ‘adolescent’) articles considered for review. Initial searching was performed using PubMed, with keywords and MeSH terms modified as necessary for searching in CINAHL, Academic Search Premier, and WorldCat. No restrictions were placed on eligible articles based on date published, setting, or population characteristics. PICO Portal, a web-based systematic review platform, was used to manage records and perform eligibility screening and full-text review.

3.1.4 Inclusion and Exclusion Criteria

Original qualitative, quantitative, and mixed-methods studies of adults aged 18 years or older, focused on any factors associated with completion of an OSA evaluation, defined as polysomnography (PSG) or a sleep study, a visit with a healthcare provider specifically focused on OSA, and/or care-seeking for OSA diagnosis, were eligible for inclusion in this review. Articles without full-text availability, non-English articles, and case studies, opinion pieces, editorials, quality improvement projects, gray literature, and literature or systematic reviews were excluded. Eligible studies had to address patient, provider, or system-level factors impacting completion of an OSA diagnostic evaluation and/or adherence rates. At the individual (patient) level, studies had to include a sample of patients at-risk for or diagnosed with OSA and study participants had to have received a recommendation or referral for OSA diagnostic evaluation and/or have completed an OSA evaluation (it was inferred that participants identified as diagnosed with OSA had completed an OSA evaluation). At the provider or system level, eligible studies had to include

individuals or organizations involved with OSA screening/diagnosis (e.g., health care providers or systems) and had to identify factors associated with an at-risk individual's completion of an OSA evaluation.

3.1.5 Study Selection

After removal of duplicates, 5974 articles were eligible for screening. All records were first screened for eligibility based on title, full-text availability, and availability in English, wherein 5493 articles were removed. Following initial screening, abstract and title review of 481 articles was performed by two independent reviewers. Potential disagreements were resolved through joint discussions and/or consultation with a third reviewer. A total of 52 articles were eligible for full text review, with an additional 17 records identified in references lists of relevant articles and/or PubMed searching of similar citations (n=69). Full-text review, which was performed with discussion between two reviewers, yielded a total of 26 articles for inclusion in the current review, including 10 quantitative, 9 qualitative, and 7 mixed methods studies. Characteristics of studies included in this review and their associated findings can be found in Table 2.

Pertinent data for quantitative (study population, methods, interventions, and significant outcomes) and qualitative studies (study population, methods, and phenomena of interest pertinent to factors associated with OSA evaluation) was extracted and entered into a single table (see Table 1). For ease of interpretation of findings, as each article was reviewed, all factors noted were compiled into a master spreadsheet by factor. Quantitative findings were recorded significant or not significant, with notation for the relationship between the factor and OSA evaluation completion. Findings in qualitative literature were extracted by categories and grouped together first by using factors identified in quantitative studies, with additional categories and adjustments

as necessary. Qualitative findings were flagged in this spreadsheet as barriers or facilitators. This approach allowed the primary reviewer to align factors represented across both types of literature and to establish broad categories for the presentation of findings. Broad categories identified include patient-level factors of demographics, OSA risk factors, OSA symptoms, medical history and comorbidities, and psychosocial factors, and provider and system-level factors of provider attributes, educational interventions, health system encounters and interactions, and administrative issues. Each of these categories will be discussed in the following section.

3.1.6 Review of Findings

3.1.6.1 Overall Adherence Rates to OSA Evaluation

Studies in a variety of populations identified gross adherence rates to OSA evaluation after referral/recommendation and/or a specific method of screening. These rates range from 18.3% to 76.5% in cross-sectional studies, and in intervention studies, range from 22.7% to 74.7% in adults receiving an intervention and 4% to 66.7% in control groups. Available adherence rate data of studies included in this review can be found in Table 2. While the majority of these results were not presented in the context of an intervention compared to a control, other aspects of these rates, including the settings in which they took place, the person recommending OSA evaluation, and/or the method of screening used to inform the decision to recommend further evaluation, may shed light on evaluation adherence behavior overall as well as future considerations for targeted interventions (Aalaei, Amini, Taghipour, et al., 2021; Dillow et al., 2017; Fidan et al., 2006; Gordon et al., 2018; Jean-Louis et al., 2008; Marzolini et al., 2016; Munks et al., 2019; Saglam-Aydinatay et al., 2018; Vlachantoni et al., 2015).

Table 2 Characteristics of Included Studies

#	Author(s)	Country	Study Design	Participants (n, age, % male)	Intervention/ Study focus	Factor Categories Examined	Outcomes (Quantitative associations and/or predictors; Qualitative barriers and facilitators to OSA diagnosis)
1	Aalaei, Amini, Rezaeitalab et al. (2021)	Iran	Mixed methods; Multi-center randomized controlled trial with qualitative interviews	Patients with suspected OSA per American Academy of Sleep Medicine guidelines and physician examination referred for PSG (quantitative n=102; mean age 46.8 years, 65.4% male); Patients referred but did not complete PSG (qualitative n=22)	The use of tailored educational booklets, developed through qualitative interviews with patients vs. standard care on adherence to a physician referral for sleep study; Post intervention, patients were interviewed regarding reasons for not completing a sleep study	<u>Patient:</u> age, employment, income, BMI, EDS, other symptoms, CVD, diabetes, mood disturbance <u>Provider/System:</u> provider type, educational interventions, scheduling issues, distance/travel/ geographic proximity	The group receiving the educational booklet intervention was significantly more adherent to a referral for a sleep study (30% vs. 11.1%; p=0.042). <u>Quantitative (predictors of adherence to referral for a sleep study):</u> Increased age (OR=1.05, 95% CI [1.01, 1.12] p=0.011), diabetes diagnosis (OR=9.08, 95% CI [1.02, 84.07] p=0.047), and receiving educational booklet (OR=3.41, 95% CI [1.19, 13.8] p=0.025). No significant associations were found between adherence to a referral and family history of sleep problems, anxiety, nocturnal enuresis, coronary disease, ESS score, or BMI. <u>Qualitative:</u> <ul style="list-style-type: none"> Barriers (frequencies): time limitations (68%), condition improved (50%), cost of test (23%), travel (18%), referral to another physician (18%).
2	Aalaei, Amini, Taghipour et al. (2021)	Iran	Mixed methods; Retrospective cross-sectional study & semi-structured in-depth interviews	Patients at high risk for OSA determined by American Academy of Sleep Medicine guidelines, referred for sleep testing (quantitative n=311, mean age 47.6 years, 70.4% male); qualitative n=20, mean age 46.8	Rate of adherence to PSG referral and factors associated with conducting PSG	<u>Patient:</u> age, sex, education level, income, BMI, OSA screening tools, snoring, EDS, symptom experience and impact, other symptoms, HTN, CVD, diabetes, mood disturbance, OSA knowledge and awareness, social consequences	31% of patients were adherent to PSG referral. <u>Quantitative (adherence to a PSG referral):</u> No significant differences were found in adherent vs. non-adherent individuals by age, BMI, gender, education, diabetes, stroke, heart disease, mood disorders, depression, or ESS score, STOP-Bang, stress, history of car accident, enuresis, morning headache, decreased focus, libido, irritability, or snoring, with the exception of a diagnosis of HTN (30.5% vs. 19.4%, 0=0.032). <u>Qualitative:</u> <ul style="list-style-type: none"> Barriers: inadequate knowledge related to the disease, its symptoms, treatment, and testing, psychological factors including personal traits, fear or discomfort with the test equipment or

				years, 70% male)		<u>Provider/System:</u> scheduling issues, distance/travel/ geographic proximity	environment, testing costs, and service system issues including time involved in making an appointment and completing the test and distance to facility. <ul style="list-style-type: none"> Facilitators: adequate knowledge of the disease including a willingness to get better, experience with disease consequences in oneself and others, social consequences, and perceived risk.
3	Cukor et al. (2018)	United States	Randomized controlled trial	Community sample of Black individuals living in Brooklyn, NY at increased risk for OSA determined by an ARES score ≥ 6 (n=365, mean age 49.46 years, 29.6% men)	Culturally-tailored, motivational/cognitive-behavioral interviewing via telephone vs. an education control of physician referral and informational pamphlets on adherence to assessment of OSA	<u>Patient:</u> age, sex, education level, income, neck/waist size, OSA screening tools, HTN, CVD, diabetes, respiratory disease, mood disturbance, other or unspecified comorbidities, OSA knowledge and awareness, readiness to change/intention <u>Provider/System:</u> educational interventions	The intervention group was significantly more likely to attend a sleep assessment (29.2% vs. 4%; p<0.001). <u>Quantitative (on the prediction of sleep assessment attendance):</u> Lower baseline OSA knowledge (OR=0.225, p=0.011), increased total household income (OR=0.617, p=0.048), older age (OR=1.06, p=0.006), and higher education (OR=1.42, p=0.04) were significant predictors in unadjusted models only. Gender, education, citizenship, CVD, diabetes, respiratory disease, ambulation difficulty, cancer, arthritis, depression treatment, ARES risk score, neck size, readiness to change, depression risk score, apnea beliefs, and SF-36 physical or mental scales did not predict evaluation attendance.
4	Dillow et al. (2017)	United States	Cross-sectional	Community dentistry patients (n=119, 63.9% age ≥ 45 years, 47.9% male)	Patient response to a recommendation for OSA evaluation after OSA screening in a dental practice using pulse oximetry and STOP questionnaire	<u>Patient:</u> age, sex, BMI, neck/waist size, OSA screening tools, EDS <u>Provider/System:</u> N/A	Of patients found at high-risk for OSA, 47.1% sought physician evaluation after recommendation for further evaluation. <u>Quantitative (on the prediction of seeking physician evaluation for OSA):</u> Screening high-risk by pulse oximetry (reference: low risk on pulse oximetry or STOP (OR=2.55, 95% CI [1.02, 6.37])) was a significant predictor. Male sex, older age, obesity, increased neck circumference, and daytime sleepiness were not associated with seeking physician evaluation.

5	Fidan et al. (2006)	Turkey	Prospective	Patients undergoing preoperative assessment screened for OSA symptoms (n=433, mean age 50.1 years, 42.9% male); invited to undergo sleep testing if experiencing 2 major or 1 major and 2 minor symptoms (n=41)	Frequency of OSA symptoms and OSA prevalence in a surgical patient population	<u>Patient:</u> age, sex, OSA risk factors <u>Provider/System:</u> N/A	Of patients referred for sleep testing based on symptoms (n=41), 43.9% agreed to a sleep study. <u>Quantitative (acceptance of PSG):</u> No significant differences in age, BMI, or sex were noted.
6	Gibson et al. (2018)	New Zealand	Focus groups	Adults ≥ 65 given CPAP therapy and spouses (n=25; of patients n=16, men age 71 years, 93.7% male)	Experiences regarding OSA diagnosis and treatment services	<u>Patient:</u> Marital status/bedsharing partner, symptom experience and impact, OSA knowledge and awareness, support systems <u>Provider/System:</u> provider involvement and support	Many participants reported experiencing OSA symptoms for an extended period before seeking care. <u>Qualitative:</u> <ul style="list-style-type: none"> • Barriers: lack of knowledge, negative feelings/beliefs toward OSA/CPAP, denial that they could have OSA or denial of having OSA symptoms, lack of provider knowledge related to sleep problems or OSA. • Facilitators: awareness of OSA risk factors and outcomes, family or friends having OSA, symptoms noticed by others, partner/spouse initiating diagnostic process, information and referral from provider.
7	Gordon et al. (2018)	United States	Observational cohort study	Adults preauthorized for sleep testing for suspected OSA or unspecified sleep apnea (n=51749; 57.2% age 45-64)	Reasons for nonadherence to diagnostic sleep testing and PAP treatment initiation among preauthorized patients	<u>Patient:</u> age, sex, education level, income, insurance, BMI, apnea or obstructions, EDS, other symptoms, HTN, CVD, diabetes,	Sleep testing noncompletion was 23.5%. <u>Quantitative (on the prediction of nonadherence to sleep testing)*:</u> Factors associated with a higher likelihood of nonadherence* (barriers) to sleep testing included female sex (OR=1.09, 95% CI [1.04, 1.14]), living in the Northeast, South, or West (reference: Midwest; OR=1.10, 95% CI [1.03, 1.18], OR= 1.14, 95% CI [1.07, 1.21], and OR=

				years, 60.2% male)	respiratory disease, mood disturbance, other or unspecified comorbidities <u>Provider/System:</u> provider type, distance/travel/ geographic proximity	and OR=1.28, 95% CI [1.20, 1.37], respectively), high income>\$60,000 in patients' residential region (reference: low income; OR=1.14, 95% CI [1.05, 1.25]), coronary artery disease (OR=1.12, 95% CI [1.03, 1.22]), diabetes (OR=1.07, 95% CI [1.00, 1.15]), and ≥1 emergency department visits during the 6 month baseline period (OR=1.15, 95% CI [1.08, 1.22]). Age, region, urban-rural area, income, education, season of the year, and specialty provider were significant in univariate analyses only. Factors associated with a lower likelihood of <i>nonadherence*</i> (facilitators): age 45-64 and ≥ 65 years (reference: age 18-44; OR=0.91, 95% CI [0.87, 0.96] and OR=0.87, 95% CI [0.80, 0.94], respectively), resident of a large town (reference: urban center; OR=0.87, 95% CI [0.81, 0.93]), medium or high level of education in patients' residential area (reference: % without a high school degree; OR=0.88, 95% CI [0.83, 0.93] and OR=0.83, 95% CI [0.78, 0.89], respectively), PPO or CDHP insurance (reference: HMO; OR=0.93, 95% CI [0.88, 0.99] and OR=0.90, 95% CI [0.84, 0.97], respectively), prescribed a test in October-December (reference: January-March; OR=0.91, 95% CI [0.85, 0.98]), pulmonologist or sleep specialist as sleep test prescriber (reference: primary care provider; OR=0.72, 95% CI [0.68, 0.76] and OR=0.74, 95% CI [0.68, 0.81], respectively), home sleep testing (reference: laboratory; OR=0.95, 95% CI [0.91, 1.00]), sleepiness (OR=0.86, 95% CI [0.82, 0.91]), snoring/gasping/choking (OR=0.87, 95% CI [0.82, 0.92]), cognitive impairment (OR=0.74, [95% CI 0.67, 0.82]), hyperlipidemia (OR=0.93, 95% CI [0.89, 0.99]), obesity (OR=0.89, 95% CI [0.85, 0.93]), and 3-5 or ≥ 6 doctor's office visits in the previous 6 months (reference: 0-2 office visits; OR=0.85, 95% CI
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							[0.81, 0.89] and OR=0.80, 95% CI [0.76, 0.85], respectively).
8	Henry & Rosenthal (2013)	United States	Exploratory mixed-methods; Cross-sectional study with semi-structured interviews	Patients with OSA and their partners (total n=24; patients n=12, mean age 49.25 years, 58.3% male)	The significance of gender and partner-reporting in lay diagnosis, management, and treatment of OSA	<u>Patient:</u> sex and gender, marital status/bedsharing partner, snoring, symptom experience and impact, OSA knowledge and awareness, social consequences <u>Provider/System:</u> N/A	The majority (83%) of participants with OSA did not self-recognize OSA symptoms. Men delayed an average of 5.5 ± 8.7 years before seeking care; women 4.0 ± 3.4 years. <u>Qualitative:</u> <ul style="list-style-type: none"> Barriers: Denial of cause or severity of symptoms, lack of energy to seek care, embarrassment in talking about snoring due to comical depiction of snoring in popular culture (men) or snoring being unladylike (women). Facilitators: Daytime effects (energy, work problems, alertness) motivated 50% of participants to seek treatment. Spousal support – all men in the study required repeated spousal insistence or intervention; 60% of women required family or spousal encouragement, 40% sought care on their own.
9	Hu et al. (2014)	Taiwan	Grounded theory study using interviews	Adults diagnosed with OSA on CPAP (n=22, aged between 37-68 years, 81.8% male)	A descriptive theoretical framework of the experiences of patients with OSA on CPAP	<u>Patient:</u> support systems <u>Provider/System:</u> provider type, wait times	Participants were asked about their experiences before receiving CPAP therapy and any assistance provided. <u>Qualitative:</u> <ul style="list-style-type: none"> Barriers: long wait times for a sleep study. Facilitators: support from family, friends, or relatives, media reports/internet to promote awareness of OSA, experiencing poor sleep, support from other specialists (in this particular study, one participant mentioned referral from an ENT to a sleep clinic).
10	Jean-Louis et al. (2008)	United States	Retrospective chart review	Black adults in Brooklyn, NY, referred to a sleep clinic for sleep-related breathing difficulties (n=421, mean age 51 years, 43% male)	Adherence rates to referrals for sleep apnea evaluation and baseline characteristics that may influence adherence rates.	<u>Patient:</u> age, sex, BMI, snoring, EDS, other symptoms, HTN <u>Provider/System:</u> N/A	38% of patients adhered to a recommendation for a sleep consultation. <u>Quantitative (on the prediction of adherence to a recommendation for a sleep consultation):</u> Daytime sleepiness (OR=6.98, 95% CI [3.86, 12.64], $p<0.001$), and obesity (OR=2.69, 95% CI [1.54, 4.71], $p<0.001$) significantly predicted adherence to a recommendation for a sleep consultation. No significant differences in sex, age, HTN, snoring, or sleep difficulty were found

							between those who completed versus did not complete a sleep consultation.
11	Jean-Louis et al. (2017)	United States	Randomized controlled trial	Black adult patients at risk for OSA determined by ARES questionnaire (n=380, mean age 59.05 years, 28.75% male)	Culturally and linguistically telephone-delivered tailored treatment intervention vs. standard care (referral for OSA evaluation and standard OSA literature) to increase adherence to physician-recommended evaluation and treatment of OSA	<u>Patient:</u> age, sex, education level, income, BMI, EDS, HTN, CVD, diabetes, respiratory disease, smoking status, mood disturbance, other or unspecified comorbidities, OSA knowledge and awareness, risk perception, readiness to change/intention, self-efficacy <u>Provider/System:</u> educational interventions	Compared to a standard care group, patients in the intervention group were more likely to attend an initial consultation with a sleep specialist (69.4% vs. 35.7%) and complete a diagnostic OSA evaluation (74.7% vs. 66.7%). <u>Quantitative (on the prediction of adherence to OSA evaluation):</u> Dyslipidemia (OR=0.43, 95% CI [0.23, 0.81], p=0.009), telephone intervention (OR=3.17, 95% CI [1.68, 5.99], p=0.001), history of respiratory illness (OR=2.27, 95% CI [1.19, 4.57], p=0.021), and treatment self-efficacy (OR=1.11, 95% CI [1.03, 1.20], p=0.007) predicted adherence to OSA evaluation. No significant differences were found between adherers and non-adherers related to age, gender, income, education, place of birth, smoking history, alcohol history, BMI, ESS score, HTN, diabetes, heart problems, arthritis, cancer, anxiety, depression, readiness to change, risk perception, outcome expectancies of CPAP treatment, or apnea knowledge.
12	Khan et al. (2019)	United States	Thematic analysis of semi-structured motivational interviews	Patients newly diagnosed with OSA and their care partners (patients n=28; mean age 58 ± 11.75 years; 43% male)	Preferences, partner experiences, facilitators and barriers to treatment adherence, and understanding of and satisfaction with a multidimensional educational intervention in patients with OSA	<u>Patient:</u> marital status/bedsharing partner <u>Provider/System:</u> provider type, provider involvement and support	<u>Qualitative:</u> <ul style="list-style-type: none"> Facilitators to OSA care-seeking: Partner urging patient to seek care and alerting patient about their symptoms, not believing or agreeing with a physician after being told that no problem was present or no follow-up was needed, and physician whose relationship with the patient was not due to OSA referring for sleep study.
13	Marchildon et al. (2015)	Canada	Qualitative interviews	Respirologists in Saskatchewan, Canada involved in level 1 and 3 diagnostic sleep testing (n=3)	Approaches to OSA care delivery based on national care guidelines of sleep disordered breathing, health benefits	<u>Patient:</u> insurance <u>Provider/System:</u> distance/travel/geographic proximity, wait times	Providers perceived Status Indians to be referred to the sleep lab/sleep specialist at a rate lower than their proportion in the population (i.e., 13% of population, but estimating them to comprise 5-6% of patients presenting to the clinic). <u>Qualitative:</u>

					coverage and program differences determined by health policy between status Indians and other Canadians		<ul style="list-style-type: none"> Barriers (identified by providers): government coverage of specific type of sleep study (only level 1, not level 3 covered) thus limiting options for sleep clinics, geographic location and travel distance to public testing center, and longer wait time for PSG often over a year due to being a Status Indian (related to government coverage)
14	Marzolini et al. (2016)	Canada	Descriptive, questionnaire-based	Patients enrolled in cardiac rehabilitation or diabetes, exercise, and health lifestyle program at high risk for OSA on STOP-Bang and/or ESS (n=295, mean age 61.2 years, 65.4% male)	Identification and communication of OSA risk on proportion of patients screened and diagnosed with OSA and resumption of CPAP treatment in patients diagnosed with OSA but not adherent to treatment	<u>Patient:</u> OSA knowledge and awareness <u>Provider/System:</u> provider involvement and support	<p>After receiving a letter notifying them of their at-risk status for OSA, among patients returning the questionnaire, 49.5% (n=51) had a conversation with their physician about OSA screening results, with 49% of those patients completing PSG.</p> <p><u>Qualitative:</u></p> <ul style="list-style-type: none"> Barriers related to not contacting a physician regarding screening results: physician factors including changing physicians, lack of recollection or receipt of screening results; patient factors including not necessary, knowledge related to sleep apnea, self-treatment Barriers related to not completing a sleep study after physician contact: physician factors (doctor did not care, prescribed medication, doctor decided to forego testing), patient factors (unnecessary, symptoms attributed to bladder/prostate, less sleepy related to retirement)
15	Munks et al. (2019)	Australia	Follow-up survey	Adults at high-risk of OSA who completed a screening in-home sleep study (overall n=339, mean age 66.5 years, 64.9% male; among survey responders, n=192, mean age	In-home OSA screening on care-seeking or lifestyle modification behavior	<u>Patient:</u> age, sex, marital status/bedsharing partner, employment, insurance, BMI, neck/waist size, OSA screening tools, snoring, apneas or obstructions, EDS, symptom	<p>53.6% of respondents took action and/or made lifestyle changes in response to the results of an in-home OSA screening sleep study. Among respondents, 20% went on to have a confirmatory sleep study. 40% of participants who sought advice from a primary care provider, and 25% who sought advice from a pharmacist had a follow-up confirmatory sleep study.</p> <p><u>Quantitative:</u> <u>On the prediction of discussing screening results with a primary care provider:</u> Breathing pauses of 1-2 times per week or less or at least 3-4 times</p>

			67.1 years, 65.6% male)	experience and impact, other symptoms, HTN, CVD, respiratory disease, smoking status, risk perception, support systems <u>Provider/System:</u> provider type, provider involvement and support, distance/travel geographic proximity	per week (reference: never or almost never; OR=2.99, p=0.029 and OR=3.54, p=0.009, respectively) were significant predictors. Univariate analyses only: waist circumference (p=0.007) and moderate or severe OSA by AHI (p=0.039). No associations were found based on snoring loudness or frequency of daytime tiredness. <u>On the prediction of undergoing a confirmatory sleep study:</u> Snoring louder than talking or unknown snoring loudness (reference: snoring as loud as talking or softer; OR=3.4, p=0.009 and OR=3.88, p=0.032, respectively), snoring bothering other (reference: no snoring bothering other people; OR=3.0, p=0.040) were significant predictors. Univariate analyses only: moderate or severe OSA by AHI (p=0.035) and frequency of daytime tiredness (p=0.045). No associations were found between discussing screening results with a primary care provider or completing a confirmatory sleep study related to method of notification of results, age, time since the original survey, sex, marital status, bed partner, study cohort years, employment, health insurance, BMI, blood pressure, cholesterol or triglycerides, falling asleep while driving, feeling tired after sleeping, smoking status, respiratory functioning (neither forced vital capacity nor forced expiratory volume), or ESS score. Response frequencies of barriers to undergoing a confirmatory sleep study included waiting list length (21%), distance to the sleep clinic (12%), feeling that the study's screening sleep study results were adequate thus no need to undergo further testing (44.9%), and primary care or other provider felt screening study results were adequate (34.8%). Facilitators included concern about the health consequences of OSA (60.6%), recommendation from a healthcare provider
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							(48.5%), desire to address snoring problem (42.4%), and desire to reduce sleepiness (20.6%).
16	Parks et al., 2009	United States	Retrospective chart review	Commercial drivers undergoing occupational medical examinations (n=456; age range 18–73 years; 96.5% male)	Evaluation of consensus criteria for OSA screening in commercial drivers	<u>Patient:</u> age, sex, BMI, neck/waist circumference, EDS, HTN <u>Provider/System:</u> N/A	Of the 53 drivers referred for PSG, 13 underwent PSG and 7 admitted to having a previous OSA diagnosis. The remaining 33 individuals referred for PSG were lost to follow-up (62.3%). <u>Quantitative (univariate comparisons of individuals who completed PSG or were previously diagnosed to those referred for PSG but lost to follow-up):</u> No significant differences were found on the basis of sex, age, BMI, neck circumference, systolic or diastolic blood pressure, or mean ESS Scores.
17	Perraudin et al. (2015)	France	Cohort study	Adults at risk of OSA determined by use of antihypertensives, overweight BMI, and snoring almost every night (n=782, mean age 62.6 years, 60.8% male)	Effectiveness of a community pharmacist educational intervention (communication of risk of untreated OSA and recommendation for follow-up with a primary care provider and letter sent to primary care provider) versus control on use of diagnostic tests	<u>Patient:</u> age, sex, education level, employment, BMI, EDS <u>Provider/System:</u> educational interventions	The proportion of participants who completed an OSA diagnostic test was significantly higher in the intervention group than the control group (22.7% vs. 11.4%, p=0.003). <u>Quantitative (on the prediction of completion of a diagnostic test):</u> Female sex (OR=0.55, 95% CI [0.34, 0.90], p<0.05), increased BMI (OR=1.10, 95% CI [1.05, 1.15], p<0.01), and receiving educational intervention from a pharmacist (OR=2.24, 95% CI [1.25, 4.01], p<0.01) were significant predictors of completing a diagnostic test. No significant associations were found for age, education, daytime sleepiness, or employment.
18	Rodgers (2014)	International; Participants primarily based in United States	Grounded theory study using face-to-face, telephone, and/or email interviews	Adults spanning pre-OSA diagnosis to 21 years post OSA diagnosis (n=82, mean age=52 years, 65% male)	Experiences of individuals living with OSA	<u>Patient:</u> marital status/bedsharing partner, income, OSA knowledge and awareness, readiness to change/intention, social consequences <u>Provider/System:</u> provider involvement and support	The majority of participants reported experiencing symptoms long before receiving an OSA diagnosis. <u>Qualitative:</u> <ul style="list-style-type: none"> Barriers to OSA diagnosis completing evaluation for OSA diagnosis: provider misdiagnoses or ignoring patients' complaints, overall lack of knowledge of OSA, lack of communication to a healthcare provider regarding potential OSA-related complaints due to lack of patient knowledge of OSA, a lack of willingness to seek treatment related to not recognizing symptoms as a sign of a

							serious condition and/or being in denial that they may have a serious condition, lack of financial resources to afford a sleep study, skepticism about OSA as a legitimate diagnosis, and concern for bed partner's reaction to an OSA diagnosis
19	Saglam-Aydinatay et al. (2018)	Turkey	Mixed methods; Descriptive study with qualitative interviews	Dental patients at risk for OSA determined by STOP-Bang (n=224, mean age 49.8 years, 60.3% male)	Adherence rate to a dentist's referral for sleep apnea evaluation and facilitators and barriers to referral adherence	<u>Patient:</u> age, sex, education level, employment, BMI, neck/waist size, OSA screening tools, HTN, CVD, diabetes, other or unspecified comorbidities, OSA knowledge and awareness, support systems, social consequences <u>Provider/System:</u> provider type, provider involvement and support, encounters and interactions with the health system, scheduling issues, distance/travel/geographic proximity, wait times	18.3% adhered to a referral for OSA evaluation. <u>Quantitative (on adherence to a referral for OSA evaluation):</u> No significant differences were found based on age, STOP-Bang score, neck circumference, BMI, age, education, sex, HTN, diabetes, heart disease, or stroke. <u>Qualitative:</u> <ul style="list-style-type: none"> • Barriers (frequencies): Misconceptions about OSA (37.7%), work responsibilities interfering with scheduling (24%), negative view of health services/system (9.3%), financial limitations (8.2%), transportation issues including vehicle access or travel distance (7.1%), family responsibilities, particularly for care takers (6%), lack of family support and attitudes toward the disease (5.5%), difficulty making an appointment related to the presence of other illnesses (4.9%), and anxiety about PSG (2.7%). • Facilitators (frequencies): increased OSA awareness related to the receipt of OSA-related information (65%), dentist or 'expert' recommendation (34.1%), positive view of health services/providers such as ease in scheduling and low wait times (17.1%), and family support (14.6%).
20	Sawyer et al. (2010)	United States	Longitudinal mixed methods; concurrent nested design including	Veterans recruited from a sleep clinic diagnosed with moderate or severe OSA	Beliefs and perceptions of OSA diagnosis and CPAP treatment before and after the first week of treatment to determine	<u>Patient:</u> marital status/bedsharing partner, OSA knowledge and awareness, support systems,	<u>Qualitative:</u> <ul style="list-style-type: none"> • Barriers: Differences between patients and providers in perceived urgency of treatment, inaccurate knowledge and negative impression or misperceptions of the disease and its treatments (such as the thought of having to

			semi-structured interviews	(n=16, mean age 53.9 years, 87% male)	differences between patients adherent and non-adherent to CPAP.	encounters and interactions with the health system <u>Provider/System:</u>	wear a CPAP mask), and symptom misattribution. <ul style="list-style-type: none"> Facilitators: Adequate knowledge including the impact of symptoms on daily life, perceived health effects, correctly attributing functional limitations and health risks to OSA, social networks in both married (spouse, partner, or family member) and unmarried participants (friends and coworkers) are sources of health information and impact health beliefs about sleep, and delivery of healthcare services can shape how individuals value their health and their relationship with providers.
21	Stansbury et al. (2022)	United States	Mixed methods; focus groups, cross-sectional surveys, and descriptive analysis	Primary care clinicians (physicians and advanced practice providers) of Federally Qualified Health Centers in West Virginia (n=14, mean age 53.0 years, 21.4% male)	Barriers and facilitators to OSA care in rural areas as identified by primary care providers at Federally Qualified Health Centers in southern West Virginia	<u>Patient:</u> sex and gender, education level, income, insurance, OSA knowledge and awareness <u>Provider/System:</u> provider type, provider involvement and support, scheduling issues, distance/travel/geographic proximity	Healthcare providers discussed factors patients face in OSA care-seeking. <u>Qualitative (from a provider's perspective):</u> <ul style="list-style-type: none"> Barriers: Cost or lack of transportation, reluctance to stay overnight for a sleep study, lacking trust/relationship with a non-primary care provider, poverty, low educational attainment, low health literacy, sleep study cost and variable insurance coverage regarding testing and/or referral to a sleep specialist, lack of awareness on OSA and impaired sleep's relationship to poor health, and social/cultural norms particularly around masculinity and admitting a problem is present. Facilitators: OSA knowledge/awareness and discussion with provider on OSA testing and treatment.

22	Vlachantoni et al. (2015)	Greece	Mixed methods, including individual qualitative interviews	Male taxi drivers at high risk for OSA determined by Berlin Questionnaire and invited for sleep clinic evaluation (quantitative n=194, mean age 45.9 years; qualitative n=10)	Prevalence of OSA and excessive morning and daytime sleepiness in taxi drivers and factors associated with uptake of screening	<u>Patient:</u> age, employment, income, BMI, snoring, apneas or obstructions, EDS, other symptoms, smoking status, readiness to change/intention <u>Provider/System:</u> encounters and interactions with the health system, scheduling issues, distance/travel/geographic proximity, wait times	76.8% invited for evaluation at a sleep clinic did not complete an appointment. <u>Quantitative (on successful completion of a sleep clinic appointment; univariate analyses only):</u> decreased snoring volume (p=0.0001) and non- or former smokers (p=0.01) were associated with completion of sleep clinic appointment. No significant differences were noted in age, BMI, work hours, sleep duration, days of work, work shift, number of apneas, morning sleepiness, or daytime sleepiness. <u>Qualitative:</u> <ul style="list-style-type: none"> • Barriers: Personal health a low priority, job-related time constraints/commitments, difficulty in adopting health prevention behaviors related to organization of the health system, lack of motivation, and fear of results of examination. • Facilitators (suggested by non-completers in qualitative interviews): Adequate income to cover costs, closer proximity of medical care to work areas, monetary incentives, and no/low wait times.
23	Waldman et al. (2020)	United States	Focus group with semi-structured interviews	Adults experiencing EDS and symptoms associated with an OSA diagnosis (n=42, mean age 51.4 years, 52% male; participants discussing reasons for seeking care n=30)	Reasons and timing for care-seeking of OSA symptoms and EDS and the impact of EDS on health-related quality of life	<u>Patient:</u> marital status/bedsharing partner, symptom experience and impact, other or unspecified comorbidities, OSA knowledge and awareness, support systems, social consequences <u>Provider/System:</u> N/A	52% of participants reported experiencing OSA symptoms for many years before seeking care (mean 11.4 years). <u>Qualitative (frequencies):</u> <ul style="list-style-type: none"> • Barriers to seeking care: Lack of knowledge and perceived risk related to acceptance of symptoms as normal (32%). • Facilitators to seeking care: Social support from a partner, family, or friend (67%), individual concern about symptoms (23%), falling asleep while driving (17%), having a comorbidity (7%), falling asleep in the workplace (7%), motor vehicle accident caused by EDS (3%), employer requirements (3%), and response to an advertisement for a sleep study (3%).

24	Ye et al. (2022)	United States	Secondary analysis of semi-structured interviews	Patients seeking OSA evaluation and their partners (n=40 [20 couples], mean age 50 years, 70% male [of patients with OSA])	Barriers and facilitators to OSA diagnosis as described by dyads of individuals with OSA and their partners	<u>Patient:</u> marital status/bedsharing partner, income, snoring, symptom experience and impact, OSA knowledge and awareness, social consequences <u>Provider/System:</u> provider type, provider involvement and support, encounters and interactions with the health system	<u>Qualitative:</u> <ul style="list-style-type: none"> Barriers: Lack of serious attention to symptoms by normalization of symptoms and/or lack of awareness of their symptoms as a potential indication of a sleep disorder, poor/lack of coordination of health care services including coordination between providers, insurance, and communication/education from their care team, and negative perceptions of OSA diagnosis and treatment including stigma of an OSA diagnosis, costs, the sleep study experience, and cumbersome nature of CPAP treatment. Facilitators: Partners supporting/pushing the patient to seek care (this was the most important facilitating factor identified in this study), partners alerting patient to symptoms, the negative impact of symptoms on daily life/alerting events, and discussions with and education provided by care providers on OSA risk.
25	Zarhin (2018)	Israel	Semi-structured interviews	Jewish-Israeli adults diagnosed with OSA within the past 18 months (n=65, 84.6% age 50-66 years, 52% male)	Reasons for delaying and care-seeking for OSA	<u>Patient:</u> sex and gender, marital status/bedsharing partner, employment, snoring, symptom experience and impact, OSA knowledge and awareness, support systems, social consequences <u>Provider/System:</u> scheduling issues	Differences related to gender and relationship status exist in OSA care-seeking behavior. The majority of participants noted significant delay in seeking care for OSA after onset of symptoms. <u>Qualitative:</u> <ul style="list-style-type: none"> Barriers: Lack of knowledge/normalization of OSA-related symptoms, neglecting health due to masculinity (men) and/or prioritizing the needs of their families (men and women), and work obligations. Facilitators: Disturbing effects/symptoms of OSA on oneself (men, unmarried women), disturbing effects of OSA on others, particularly snoring (married women), spouse promoting and coordinating OSA care-seeking (men), and family members.
26	Zhang et al. (2022)	China	Cross-sectional	Adults diagnosed with	Patient and provider delays in OSA care	<u>Patient:</u> age, sex, marital	70.2% of the sample was diagnosed with OSA within 3 months of their initial visit to a provider;

				OSA (n=309, median age 47 years, 84.8% male)	and related factors (patient delay = time from first notice of symptoms to seeking care for the first time; provider delay = time from the patient's first visit to diagnosis and treatment)	status/bedsharing partner, education level, employment, income, BMI, snoring, apneas or obstructions, smoking status, other or unspecified comorbidities, readiness to change/intention, self-efficacy <u>Provider/System:</u> geographic proximity	10.4% reported more than 12 months between their first visit and OSA diagnosis. <u>Quantitative (on the prediction of a prolonged delay in care-seeking):</u> 6 or more or 10 or more years of snoring (reference: <3 years, OR=3.38, 95% CI [1.18, 9.7], p=0.024 and OR=3.56, 95% CI [1.35, 9.42], p=0.011, respectively), mid and high per capita monthly income (OR (OR=0.17, 95% CI [0.05, 0.57], p=0.004, and OR=0.23, 95% CI [0.06, 0.95], p=0.042, respectively), residence in city or town (reference: rural, OR=0.48, 95% CI [0.25, 0.95], p=0.034), self-recognition of the disease (OR=0.79, 95% CI [0.65, 0.97], p=0.026), objective support (OR=0.83, 95% CI [0.74, 0.95], p=0.001), and self-efficacy of patients (OR=0.67, 95% CI [0.53, 0.87], p=0.002) were significant predictors of a prolonged delay in care-seeking. No significant associations were found related to age, BMI, sex, smoking, emotional experience, employment, educational attainment, alcohol consumption, impact of COVID-19, the presence of one or more chronic diseases, regular physical exam, marital status, pulse oximetry, help-seeking intention, and subjective support.
<p>Abbreviations: CPAP=continuous positive airway pressure; CVD=cardiovascular disease; EDS=excessive daytime sleepiness; ESS=Epworth Sleepiness Scale; HTN=hypertension; OSA=obstructive sleep apnea</p> <p>*Note: For ease of interpretation in relation to other studies included in this review, odds ratio and 95% confidence interval values presented in this table are discussed inversely in the text body.</p>							

3.1.6.2 Patient-Level Factors

3.1.6.2.1 Demographics

Associations between demographic-related factors such as age, sex, marital status, education, and other socioeconomic indicators and OSA evaluation and/or care seeking have been examined throughout quantitative and qualitative literature, with mixed findings. The association between a person's age and completion of an OSA evaluation has been examined in a total of 14 quantitative studies, with the majority of studies finding no significant associations (Aalaei, Amini, Taghipour, et al., 2021; Cukor et al., 2018; Dillow et al., 2017; Fidan et al., 2006; Jean-Louis et al., 2017; Jean-Louis et al., 2008; Munks et al., 2019; Parks et al., 2009; Perraudin et al., 2015; Saglam-Aydinatay et al., 2018; Vlachantoni et al., 2015; Zhang et al., 2022). Of significant findings, 2 studies found increased age to increase the likelihood of OSA evaluation. In a study of Iranian patients suspected to have OSA, increased age positively predicted OSA evaluation completion (OR = 1.05, 95% CI [1.01, 1.12]; (Aalaei, Amini, Rezaeitalab, et al., 2021). Similarly, in the United States, adults ages 45 to 64 years and 65 years or older preauthorized for sleep testing were, respectively, 1.1 and 1.15 times more likely to complete an OSA evaluation when compared to those 44 years or younger (Gordon et al., 2018). Although only two studies have directly measured the relationship of age on OSA evaluation, both found similar, significant results, suggesting age may be associated with OSA evaluation.

Completion of OSA evaluation by biological sex has been quantitatively examined in a total of 12 studies. Evidence found in cohort studies conducted in both the United States (Gordon et al., 2018) and France (Perraudin et al., 2015) has shown that compared to men, women are significantly less likely to complete an evaluation, with a decreased likelihood ranging from 8%

(Gordon et al., 2018) to 45% (Perraudin et al., 2015). In the remaining 10 studies, no significant associations were found related to sex (Aalaei, Amini, Taghipour, et al., 2021; Cukor et al., 2018; Dillow et al., 2017; Fidan et al., 2006; Jean-Louis et al., 2017; Jean-Louis et al., 2008; Munks et al., 2019; Parks et al., 2009; Saglam-Aydinatay et al., 2018; Zhang et al., 2022). In the quantitative arm of a mixed methods study of patients with OSA and their partners, men were found to delay seeking care for OSA longer than women, with men delaying an average of 5.5 ± 8.7 years before seeking care and women delaying for 4.0 ± 3.4 years (Henry & Rosenthal, 2013). In that same study, women were more likely to seek care on their own compared to men (40% vs. 0%).

Complementing the literature related to the relationship of biological sex on OSA evaluation, the impact of gender as it intersects with other factors has been cited throughout qualitative literature examining OSA care-seeking. Masculinity was discussed as a barrier to OSA care-seeking in two studies, particularly contributing to neglecting one's health (Zarhin, 2018) and unwillingness to admit having a problem (Stansbury et al., 2022). Other gender-based influences were noted on a variety of factors impacting OSA care-seeking, such as marital status, snoring, and the role of spouses/partners. These will be discussed in subsequent sections. Overall, findings suggest that women may be less likely than men to engage in care-seeking for OSA evaluation.

Although quantitative evidence is lacking regarding presence of a bedsharing partner or marital status as a factor in OSA evaluation (Munks et al., 2019; Zhang et al., 2022), qualitative findings strongly indicate spousal and/or bedsharing partner involvement as a facilitator to OSA diagnosis. Qualitative findings of 8 studies reported the role of a spouse/partner as a facilitator to OSA diagnosis. Specifically, spousal/partner actions facilitating OSA diagnosis included alerting the patient to their symptoms, initiating the diagnostic process, and pushing and/or promoting the partner toward OSA care-seeking (Gibson et al., 2018; Henry & Rosenthal, 2013; Khan et al.,

2019; Munks et al., 2019; Sawyer et al., 2010; Waldman et al., 2020; Ye et al., 2022; Zarhin, 2018). Relating to gender differences, married men have been shown to rely more on spousal involvement to seek OSA care. In a study of patients with OSA and their partners, 100% of married men and 60% of married women required spousal involvement to seek OSA care. Further, men have also specifically identified their spouse as a facilitator to diagnosis (Zarhin, 2018).

Of eight studies referencing educational level in OSA evaluation and/or care seeking, two studies found associations between level of education and OSA evaluation. A large cohort study found that adults residing in a location with a medium or high average level of education were, respectively, 1.13 and 1.2 times more likely to complete an OSA evaluation compared to individuals from locations having an average of less than a high school diploma (Gordon et al., 2018). Bolstering these findings, a qualitative study of healthcare providers noted that low educational attainment of patients, and relatedly, low health literacy, may act as a patient barrier to follow-up after referral for an OSA evaluation (Stansbury et al., 2022). However, findings in 6 other studies did not identify significant associations between education and OSA evaluation (Aalaei, Amini, Taghipour, et al., 2021; Cukor et al., 2018; Jean-Louis et al., 2017; Perraudin et al., 2015; Saglam-Aydinatay et al., 2018; Zhang et al., 2022).

Employment status, work hours, and work responsibilities have been evaluated as factors influencing OSA care-seeking and/or evaluation. To date, no significant associations have been found in quantitative literature related to these variables (Aalaei, Amini, Rezaeitalab, et al., 2021; Munks et al., 2019; Perraudin et al., 2015; Vlachantoni et al., 2015; Zhang et al., 2022). However, qualitative literature has identified work constraints as an impediment to OSA care-seeking, with three studies mentioning work responsibilities, work obligations, and/or job-related time constraints barriers (Saglam-Aydinatay et al., 2018; Vlachantoni et al., 2015; Zarhin, 2018). While

these obligations are based on an individual's responsibilities, a person's work-related constraints may intersect with provider and/or health system availability, which may result in other issues such as scheduling constraints.

Financial status and/or cost has been examined in both quantitative and qualitative literature. Gordon and colleagues (2018) found that compared to those residing in a low-income region, individuals from high income residential areas were 12 percent less likely to complete an OSA evaluation. However, two additional studies did not find any significant associations between financial status and completing an OSA evaluation (Cukor et al., 2018; Jean-Louis et al., 2017). Qualitatively, cost has been identified as a barrier to OSA care-seeking and/or diagnosis, with 5 studies reporting cost, income, or financial resources as barriers (Aalaei, Amini, Rezaeitalab, et al., 2021; Aalaei, Amini, Taghipour, et al., 2021; Rodgers, 2014; Stansbury et al., 2022; Ye et al., 2022), and adequate income to cover study costs (Stansbury et al., 2022) and monetary incentives or vouchers (Vlachantoni et al., 2015) as facilitators of OSA care-seeking and/or evaluation. A person's financial means may also contribute to delays in OSA care-seeking. Zhang and colleagues (2022) found that after noticing symptoms, individuals with lower income were more likely to delay seeking care for OSA by more than 3 months. Taken together, while qualitative literature strongly suggests that limited financial means may serve as a barrier to OSA care-seeking, quantitative findings are inconclusive.

The association between insurance, including plan type, and OSA care-seeking and/or evaluation has been examined in a total of 4 studies. In a large observational study based in the United States, compared to a health maintenance organization, having a preferred provider organization or consumer-directed health plan (high deductible) was associated with a small increase in the likelihood of OSA evaluation completion (1.07 and 1.11 times, respectively;

Gordon et al., 2018). In a follow-up study of Australian adults, insurance was not found to be significantly associated with OSA evaluation (Munks et al., 2019). While these quantitative findings present limited conclusive evidence, 2 qualitative studies of healthcare providers have identified insurance as a limiting factor in a patient's ability to seek OSA care, particularly in underserved populations susceptible to poorer health outcomes. Government insurance coverage of Indigenous people located in Canada was identified as a barrier to obtaining OSA diagnostic testing, as sleep tests covered by the plan were limited to one type of study, and thus by extension, presented a lack of options for sleep clinics to obtain care (Marchildon et al., 2015). Likewise, a study of healthcare providers in rural Appalachia reported variable insurance coverage for testing and/or referral to a specialist as barriers to obtaining OSA diagnostic care (Stansbury et al., 2022).

3.1.6.2.2 OSA Risk Factors

Anthropometric measurements traditionally indicative of OSA risk, including waist or neck circumference and body mass index (BMI), have been examined in quantitative literature, with BMI showing modest associations with OSA evaluation completion in 3 studies. In a sample of at-risk Black adults residing in urban New York, Jean-Louis et al. (2008) found that individuals with obesity were 2.7 times more likely to adhere to a referral for OSA evaluation. Gordon et al. (2018) found that individuals with obesity who were preauthorized for sleep testing in the United States were 1.12 times more likely to complete an OSA evaluation. Similarly, French adults at-risk for OSA with an increased BMI were 1.1 times more likely to complete an OSA diagnostic test (Perraudin et al., 2015). In the remaining 10 studies, BMI was not significantly associated with OSA evaluation (Aalaei, Amini, Rezaeitalab, et al., 2021; Aalaei, Amini, Taghipour, et al., 2021; Dillow et al., 2017; Fidan et al., 2006; Jean-Louis et al., 2017; Munks et al., 2019; Parks et al., 2009; Saglam-Aydinatay et al., 2018; Vlachantoni et al., 2015; Zhang et al., 2022).

Neck and waist circumference have also been examined as variables in OSA evaluation, the former in 4 studies, the latter in 1 study. While neck circumference was not found to be associated with OSA evaluation completion in any of the 4 studies in which it was examined (Cukor et al., 2018; Dillow et al., 2017; Parks et al., 2009; Saglam-Aydinatay et al., 2018), in a single study of Australian adults at high-risk for OSA, a waist circumference of 102 centimeters or greater in men and 88 centimeters or greater in women was associated with discussing OSA screening test results with a general practitioner (Munks et al., 2019). However, this association was not evaluated beyond univariate analyses, so it is unclear if this finding was confounded by other factors.

The outcome of OSA risk screening using various instruments, including STOP or STOP-Bang and Apnea Risk Evaluation System Questionnaire, many of which factor in the aforementioned anthropometric measurements, have also been evaluated in relation to OSA evaluation completion, with no significant associations found (Aalaei, Amini, Taghipour, et al., 2021; Cukor et al., 2018; Dillow et al., 2017; Saglam-Aydinatay et al., 2018). Overnight pulse oximetry, an objective measure of desaturation events during sleep, has been examined in 2 studies. In a study of community dentistry patients screened for OSA by overnight pulse oximetry and the STOP questionnaire, Dillow and colleagues (2017) found patients who screened high risk by overnight pulse oximetry were 2.5 times more likely to seek a physician evaluation for OSA, but no significant association with a high-risk STOP score was found. In another study examining delays in OSA care in a sample of Chinese adults diagnosed with OSA, pulse oximetry was not found to be associated with the length of time between a patient first noticing their symptoms and seeking care for OSA for the first time (Zhang et al., 2022).

More in-depth methods of screening may facilitate OSA diagnosis. In a sample of at-risk adults completing OSA screening via an in-home sleep study measuring nasal airflow and oximetry or nasal airflow alone, 49% of participants responding to a follow-up questionnaire reported discussing their screening results with a general practitioner, and 20% of participants went on to have a confirmatory sleep study (Munks et al., 2019). While home sleep testing is emerging as a preferred method of OSA diagnosis in some settings, in situations where its intended purpose is solely screening, patients as well as providers may not feel the need to follow-up with confirmatory testing. Overall, evidence is insufficient to conclude whether a person's measured risk of OSA by screening methods may impact OSA evaluation and/or care-seeking.

3.1.6.2.3 OSA Symptoms

Associations between OSA-related symptoms, including classic symptoms of snoring, obstructive or apneic episodes, and excessive daytime sleepiness, as well as their effects, and OSA evaluation have been explored both quantitatively and qualitatively. While a common OSA symptom, there is a lack of evidence supporting an association between snoring and OSA evaluation completion. Munks and colleagues (2019) found 42% of Australian adults endorsed a desire to address a snoring problem as a facilitator to OSA care-seeking. However, a study of Greek taxi drivers found that increased snoring intensity was associated with a lower likelihood of OSA evaluation (Vlachantoni et al., 2015). Another study in Chinese adults found that increased years of snoring was associated with a prolonged delay in OSA care seeking (Zhang et al., 2022). Three studies found no significant associations between snoring and OSA evaluation (Aalaei, Amini, Taghipour, et al., 2021; Jean-Louis et al., 2008; Munks et al., 2019). In qualitative literature, the intersection of the experience of snoring and gender has been noted as a potential barrier to OSA care-seeking. Henry and Rosenthal (2013) and Ye and colleagues (2022) found

that embarrassment and negative representations of snoring, which may be influenced, in part, by depictions of snoring as comical in popular culture, and the belief that snoring in women is ‘unladylike’, may impede a person’s desire to seek care.

Although evidence associating snoring with OSA evaluation is lacking, modest evidence has shown that symptoms of obstruction during sleep and excessive daytime sleepiness may instigate OSA evaluation. Gasping or choking as well as apneic events were examined in 4 studies. One study found the presence of breathing pauses increased the likelihood of OSA evaluation completion (Munks et al., 2019), and another found an association between snoring, gasping or choking and OSA evaluation completion (Gordon et al., 2018). However, two studies did not find significant associations with apneic events and OSA evaluation, whether on uptake of screening (Vlachantoni et al., 2015) or delays in OSA care-seeking (Zhang et al., 2022).

Excessive daytime sleepiness has been the most extensively explored classic symptom of OSA as it relates to completion of an OSA evaluation. Excessive daytime sleepiness, including measurement via the Epworth Sleepiness Scale, has been examined via quantitative methods in 10 studies, 3 of which found significant associations between excessive daytime sleepiness and OSA evaluation completion. Through multivariable analyses, individuals in a large observational cohort experiencing daytime sleepiness were shown to be 1.16 times more likely to complete an OSA evaluation (Gordon et al., 2018). In a sleep clinic sample of Black adults based in urban New York, the likelihood of completion of an OSA evaluation increased nearly 7 times in those experiencing daytime sleepiness (Jean-Louis et al., 2008). Another study also noted this association, but this relationship was explored in univariate analyses only (Munks et al., 2019). However, the remaining 7 studies found no significant associations related to excessive daytime sleepiness (Aalaei, Amini,

Rezaeitalab, et al., 2021; Aalaei, Amini, Taghipour, et al., 2021; Dillow et al., 2017; Jean-Louis et al., 2017; Parks et al., 2009; Perraudin et al., 2015; Vlachantoni et al., 2015).

An overall desire to address symptoms, particularly when a person develops an awareness of symptoms on their own or through family and friends, has been reported in mixed methods and qualitative literature as facilitating OSA care-seeking (Aalaei, Amini, Taghipour, et al., 2021; Munks et al., 2019; Zarhin, 2018). Individuals with OSA-related symptoms have reported that experiencing negative impacts of symptoms on daily life such as decreased energy, alertness, and work performance (Henry & Rosenthal, 2013; Waldman et al., 2020; Ye et al., 2022), and experiencing alerting or disturbing events, including falling asleep while driving and/or motor vehicle accidents (Waldman et al., 2020; Ye et al., 2022), motivated them to take steps to address their symptoms. Studies have also noted some individuals seek care based on their personal experience with symptoms (Aalaei, Amini, Taghipour, et al., 2021), while others do so when their symptoms are noted by or appear to impact others around them (Gibson et al., 2018; Zarhin, 2018). Zarhin (2018) found this motivation may be influenced by gendered social roles, noting that men and unmarried women reported self-awareness of disturbing effects and/or symptoms of OSA as a facilitator to diagnosis, whereas married women reported the impact of their symptoms on others, particularly snoring, as a facilitator to seeking care.

In addition to classic OSA symptoms, isolated studies (i.e., one or two studies at most) have attempted to examine associations between other symptoms of OSA and evaluation. Symptoms examined in isolation included irritability, libido and morning headache (Aalaei, Amini, Taghipour, et al., 2021), cognitive impairment (Aalaei, Amini, Taghipour, et al., 2021; Gordon et al., 2018), motor vehicle accidents and/or nodding off while driving (Aalaei, Amini, Taghipour, et al., 2021; Munks et al., 2019), nocturia (Aalaei, Amini, Rezaeitalab, et al., 2021;

Aalaei, Amini, Taghipour, et al., 2021), sleep difficulty (Jean-Louis et al., 2008), sleep duration (Vlachantoni et al., 2015), and feeling tired after sleeping (Munks et al., 2019). Aside from a single finding that individuals with cognitive impairment were 1.35 times more likely to complete an OSA evaluation than those without (Gordon et al., 2018), findings in these studies did not demonstrate significant associations between the aforementioned symptoms and OSA evaluation.

3.1.6.2.4 Medical History and Comorbidities

Various comorbidities have been examined as potential predictors of OSA evaluation in quantitative studies, particularly those related to hypertension, cardiovascular disease, diabetes, mood disturbance, respiratory disease, and smoking. Hypertension was examined in 8 studies, 3 of which found a significant association with completion of an OSA evaluation in univariate analyses only (Aalaei, Amini, Taghipour, et al., 2021; Gordon et al., 2018; Jean-Louis et al., 2008). However, the remaining 5 studies did not yield any significant associations (Cukor et al., 2018; Jean-Louis et al., 2017; Munks et al., 2019; Parks et al., 2009; Saglam-Aydinatay et al., 2018).

Multiple studies have examined the association of cardiovascular disease, including hyperlipidemia and/or high cholesterol and coronary artery disease (CAD), and OSA evaluation. The 3 studies examining hyperlipidemia produced mixed results. While one study found people with hyperlipidemia to be 1.07 times more likely to complete a sleep study (Gordon et al., 2018), another found people with hyperlipidemia to be 57% less likely to complete an evaluation (Jean-Louis et al., 2017). The third study found no significant associations between hyperlipidemia and OSA evaluation completion (Munks et al., 2019). Variables of CAD, cardiovascular disease, or heart problems were examined in 6 studies, with only one finding that compared to individuals without CAD, those with CAD were 11% less likely to complete a sleep study (Gordon et al., 2018). No further associations were found for cardiovascular disease and OSA evaluation (Aalaei,

Amini, Rezaeitalab, et al., 2021; Aalaei, Amini, Taghipour, et al., 2021; Cukor et al., 2018; Jean-Louis et al., 2017; Saglam-Aydinatay et al., 2018). Based on these findings, although limited evidence suggests that individuals with hypertension may be more likely to complete an OSA evaluation, hyperlipidemia and/or cardiovascular disease may have little to no bearing on a person's completion of an OSA evaluation.

Diabetes has also been examined as a predictor of OSA evaluation completion. Six studies examined this association, with two studies finding conflicting results. In a modest sample of at-risk Iranian adults, a diagnosis of diabetes was associated with an increased likelihood of OSA evaluation (OR = 9.08, 95% CI [1.02, 84.07] Aalaei, Amini, Rezaeitalab, et al., 2021). However, in a large cohort sample in the United States, a diagnosis of diabetes was shown to decrease the likelihood of a person completing an OSA evaluation by 6% (Gordon et al., 2018). No significant associations related to diabetes were found among the remaining 4 studies (Aalaei, Amini, Taghipour, et al., 2021; Cukor et al., 2018; Jean-Louis et al., 2017; Saglam-Aydinatay et al., 2018).

Respiratory disease and/or function has been examined in 4 studies, with only one finding an increased likelihood of OSA evaluation completion among Black adults with a history of respiratory disease (Jean-Louis et al., 2017). Chronic obstructive pulmonary disease (COPD) and oxygen dependency were shown in a separate study to be associated with OSA testing completion, but those associations were examined in univariate analyses only (Gordon et al., 2018). The two remaining studies showed no significant associations between respiratory functioning/disease and OSA evaluation (Cukor et al., 2018; Munks et al., 2019). The association of smoking status on OSA evaluation has also been examined, with only one (Vlachantoni et al., 2015) of four studies finding an increased likelihood of OSA completion among Greek taxi drivers who were non or former smokers (Jean-Louis et al., 2017; Munks et al., 2019; Zhang et al., 2022). Conclusive

evidence remains scarce regarding the association between respiratory disease and functioning and OSA evaluation.

Mood disturbance, including anxiety and depression, has been examined in 5 studies, the majority of which did not find any significant associations (Aalaei, Amini, Rezaeitalab, et al., 2021; Aalaei, Amini, Taghipour, et al., 2021; Cukor et al., 2018; Jean-Louis et al., 2017). While a single study found a significant association between completion of an OSA evaluation and a diagnosis of depression, this was only examined in univariate analyses (Gordon et al., 2018). Other comorbidities, including alcohol use (Jean-Louis et al., 2017; Zhang et al., 2022), ambulation difficulty (Cukor et al., 2018), arthritis, cancer (Cukor et al., 2018; Gordon et al., 2018; Jean-Louis et al., 2017), and arrhythmia, dementia, gastroesophageal reflux disease, and renal disease (Gordon et al., 2018), have been explored in isolated studies; however, none of these reached significance in adjusted analyses.

Isolated studies have presented comorbidities or the presence of other illnesses as both a barrier and facilitator to OSA evaluation. A study conducted in Turkish adults at-risk for OSA referred for evaluation by a dentist found that the presence of other illnesses interfered with scheduling an OSA evaluation (Saglam-Aydinatay et al., 2018). In another study, a small proportion of a sample of adults at risk for OSA, based in the United States, reported having a comorbidity as a facilitator to OSA care-seeking (Waldman et al., 2020). The number of encounters within a health system, which may serve as a proxy for comorbidities, was evaluated in a single quantitative study. Gordon and colleagues (2018) found that individuals with 3-5 or ≥ 6 doctor's office visits in the previous 6 months had 1.18 and 1.25 times, respectively, increased odds of completing a sleep study. Recent inpatient stay was also evaluated in that study, but was not found to be a significant factor. Overall, aside from modest findings in two studies linking

respiratory disease to completion of an OSA evaluation, evidence remains inconclusive regarding the role of comorbidities in OSA evaluation and/or care-seeking.

3.1.6.2.5 Psychosocial Factors

The psychosocial aspects of OSA diagnosis have been well explored in qualitative literature. Common psychosocial themes found related to OSA care-seeking include the mental and emotional experiences associated with OSA symptoms, knowledge and awareness of OSA, social consequences, and support systems. OSA knowledge and awareness was most frequently discussed in qualitative studies, with 11 studies consistently noting OSA knowledge and awareness as a factor in pursuing an evaluation for OSA. Related to knowledge, themes presented as barriers to OSA care-seeking included a lack of knowledge or awareness related to OSA overall as well as specific symptoms that are concerning or attributable to OSA (Aalaei, Amini, Taghipour, et al., 2021; Gibson et al., 2018; Marzolini et al., 2016; Rodgers, 2014; Sawyer et al., 2010; Stansbury et al., 2022; Waldman et al., 2020; Ye et al., 2022; Zarhin, 2018), denial that a problem was present (Rodgers, 2014; Stansbury et al., 2022), symptom misattribution or the normalization of concerning symptoms (Gibson et al., 2018; Henry & Rosenthal, 2013; Sawyer et al., 2010; Waldman et al., 2020; Ye et al., 2022; Zarhin, 2018), and misperceptions and/or negative beliefs or feelings toward OSA and its treatments (Gibson et al., 2018; Saglam-Aydinatay et al., 2018; Sawyer et al., 2010; Ye et al., 2022). Increased overall knowledge and/or awareness (Aalaei, Amini, Taghipour, et al., 2021; Stansbury et al., 2022), as well as a person's understanding of OSA-related health risks and perceived health effects (Gibson et al., 2018; Sawyer et al., 2010) were both noted as facilitators to OSA-care seeking and/or evaluation.

Isolated analyses have attempted to quantitatively examine associations between OSA knowledge and awareness and OSA evaluation. The impact of measured scales of apnea beliefs

and apnea knowledge on OSA evaluation have been evaluated in limited settings, particularly in black adults located in urban New York (Cukor et al., 2018; Jean-Louis et al., 2017), with low apnea knowledge scores being shown in one study to be associated with a lower likelihood of OSA evaluation (Cukor et al., 2018). Stemming from a person's OSA knowledge, a person's perception of the risks of OSA was examined in 2 studies. While risk perception via a measured scale has not yet been shown to be associated with OSA evaluation (Jean-Louis et al., 2017), concern about the health consequences of OSA was the most frequently cited facilitator (60.6%) to undergoing in-lab PSG in a sample of Australian adults at high risk for OSA (Munks et al., 2019).

Readiness to change or intention to seek care has been examined as a factor in both qualitative and quantitative studies. Qualitatively, a decreased readiness or willingness to change has been discussed as a barrier to OSA care-seeking. Two studies identified unwillingness to seek treatment, a lack of motivation, personal health as a low priority, and a fear of the results of an evaluation as barriers (Rodgers, 2014; Vlachantoni et al., 2015). Though presented as a barrier qualitatively, readiness to change or intention examined by measured instruments has not been associated with OSA evaluation or delays in care-seeking in the literature to date (Cukor et al., 2018; Jean-Louis et al., 2017; Zhang et al., 2022). Increased self-efficacy, or a person's belief in their capacity to succeed in performing tasks, has been shown in isolated studies to be associated with decreased delays in care seeking and OSA evaluation completion. In a sample of Chinese adults diagnosed with OSA, those with higher self-efficacy were 33% more likely to seek care within 3 months after noticing OSA symptoms (Zhang et al., 2022). In a sample of urban-dwelling Black adults, those with increased self-efficacy related to OSA treatment were 1.11 times more likely to complete an OSA evaluation (Jean-Louis et al., 2017).

Support from one's social network has been extensively explored as a factor in OSA evaluation. In addition to a person's marital status, and by extension, the role of a spouse or bedsharing partner as noted in a previous section, other support systems, including family, friends, and coworkers, have been consistently identified in qualitative literature to hold a critical role in OSA care-seeking. Two broad themes noted across 7 qualitative studies were the influence of a person's family and friends on health beliefs (Gibson et al., 2018; Sawyer et al., 2010) and support or urging from family, friends, or relatives to seek care for OSA (Hu et al., 2014; Munks et al., 2019; Saglam-Aydinatay et al., 2018; Waldman et al., 2020; Zarhin, 2018). Sawyer and colleagues (2010) noted that a person's social network was a significant source of health information, shaping a person's health beliefs, including beliefs about sleep. Gibson and colleagues (2018) found individuals within a person's social network living with OSA may serve as a source of knowledge. Conversely, Saglam-Aydinatay and colleagues (2018) found that negative attitudes toward OSA among a person's family may serve as a barrier to care-seeking.

Following the body of literature highlighting the role of a person's social network in promoting OSA care-seeking, a person's ability to function in their social roles has also been well-explored. Facilitating themes identified in qualitative studies include the negative effects of OSA on others in one's social network (particularly in women; Zarhin, 2018), social consequences and the impact of symptoms on daily life (Aalaei, Amini, Taghipour, et al., 2021; Sawyer et al., 2010), and the interference of OSA symptoms on work performance (Henry & Rosenthal, 2013; Waldman et al., 2020). Other nuanced social barriers were identified, some of which have been mentioned previously. These include caretaking or family responsibilities (Saglam-Aydinatay et al., 2018; Zarhin, 2018), concern for a partner's reaction to and social stigma associated with an OSA diagnosis (Rodgers, 2014; Ye et al., 2022), and gender-based social constructs surrounding health

and masculinity (Stansbury et al., 2022; Zarhin, 2018) and snoring (Henry & Rosenthal, 2013; Ye et al., 2022). Overall, evidence is strong suggesting a person's social network is a crucial factor in OSA care-seeking.

3.1.6.3 Provider and System-Level Factors

Factors impacting an at-risk person's entry and progression through the OSA diagnostic pathway extend beyond the individual level as healthcare providers and systems also hold a crucial role in promoting diagnosis. This includes interaction with the patient at the time of presentation, clinician recognition of potential OSA, and recommendation and/or referral for further diagnostic testing (Ye et al., 2022). At the provider and system levels, multiple factors have been identified related to completion of an OSA evaluation and care-seeking in both qualitative and quantitative literature, including the patient's interactions with the health system, accessibility, and the interactions of providers with patients.

3.1.6.3.1 Provider Attributes

Provider-based factors, including provider type, referrals, knowledge, involvement and support, and delivery of OSA-related education to patients have been explored in both quantitative and qualitative literature. The concept of provider type as a factor on completion of OSA evaluation has been explored in numerous studies. Among a sample of Australian adults at-risk for OSA who sought advice from a primary care provider regarding their OSA risk, 40% completed a follow-up confirmatory study. Of those who sought advice from a pharmacist, 25% went on to complete a follow-up sleep study (Munks et al., 2019). Relatedly, the act of referral to another care provider may serve as a barrier to OSA evaluation (Aalaei, Amini, Rezaeitalab, et al., 2021). This

may stem, in part, from a lack of trust in an unfamiliar provider (Stansbury et al., 2022) as well as a lack of coordination between providers (Ye et al., 2022).

Although this limited evidence suggests patients may be more open to a referral or recommendation from a primary care provider, studies have also cited a patient's receipt of a referral or recommendation from practitioners they were seeing for non-sleep related reasons as a facilitator to OSA evaluation, such as dentistry (Saglam-Aydinatay et al., 2018), cardiology, psychiatry (Khan et al., 2019), and ear, nose, and throat (Hu et al., 2014). The role of a sleep specialist or pulmonologist has also been explored. Gordon and colleagues (Gordon et al., 2018) found that compared to referral by a primary care provider, individuals referred for PSG by a sleep specialist or pulmonologist were approximately 1.4 times more likely to complete a sleep test. Given these instances, a patient's entry into the OSA diagnostic pathway may be effectively facilitated by primary care and non-primary care providers alike.

Overall provider involvement and support has been consistently shown to facilitate OSA evaluation. The act of discussing the risks of OSA and/or referring or recommending OSA evaluation to patients was identified as a facilitating theme in 5 studies (Gibson et al., 2018; Munks et al., 2019; Saglam-Aydinatay et al., 2018; Stansbury et al., 2022; Ye et al., 2022). Further, patients reported a provider's lack of adequate OSA knowledge (Gibson et al., 2018; Rodgers, 2014), a lack of recollection in receiving screening results from a provider (Marzolini et al., 2016), or a dismissive approach to their symptoms and/or desire to undergo evaluation as barriers to OSA evaluation (Khan et al., 2019; Marzolini et al., 2016; Rodgers, 2014).

One commonly noted psychological barrier to OSA evaluation identified in qualitative literature is a patient's hesitation in completing the sleep test itself. Studies have identified anxiety about PSG (Saglam-Aydinatay et al., 2018), reluctance to stay overnight for a sleep study

(Stansbury et al., 2022), and the overall sleep study experience (Ye et al., 2022) as barriers to OSA evaluation completion. Knowing patients may commonly experience this hesitation lends even more importance to the role of the provider in providing education and support by not only sharing general OSA information and encouragement to undergo testing, but also to discuss the test itself in more specific detail.

3.1.6.3.2 Educational Interventions

Understanding the impact of concerted educational interventions aiming to increase adherence to OSA evaluation is also an important consideration for providers and health systems. Four studies found that in comparison to a control group, the provision of an educational intervention to at-risk individuals significantly increased the rate of adherence to OSA evaluation. Three interventions, each noted as tailored to a specific population, were discussed. An intervention based on the delivery of an educational booklet on sleep apnea and testing found that 30% of adults receiving the intervention adhered to a provider referral for OSA evaluation, compared to 11.1% of those in a control group ($p=0.042$; Aalaei, Amini, Rezaeitalab, et al., 2021). Two telephone-based interventions using messaging and/or motivational interviewing aimed at increasing adherence to physician-recommended OSA evaluation were also identified, with rates of successful evaluation among participants receiving these interventions ranging from 29.2% (Cukor et al., 2018) to 74.7% (Jean-Louis et al., 2017; control 4% and 66.7%, respectively). In addition, a study conducted in a sample of French adults at risk for OSA found that those who received OSA education, a recommendation for follow-up, and a letter issued to their primary care provider were more likely to complete an OSA diagnostic test than a control group (22.7% vs. 11.4%; $p=0.003$; Perraudin et al., 2015).

3.1.6.3.3 Health System Encounters and Interactions

Interactions with the health system have been identified as a common theme among four qualitative studies, particularly as they apply to care coordination and organization. A positive view of a health system and the delivery of healthcare services as well as relationships with providers have been noted as facilitators to OSA care-seeking (Saglam-Aydinatay et al., 2018; Sawyer et al., 2010). Negative interactions with the healthcare system, particularly poor coordination between providers, the care team, and overall organizational factors, may act as barriers (Saglam-Aydinatay et al., 2018; Vlachantoni et al., 2015; Ye et al., 2022).

3.1.6.3.4 Administrative Issues

There are multiple facets which may impact a patient's perceptions of a healthcare system, particularly administrative ones, that can serve as barriers to OSA evaluation. Scheduling issues, distance or travel, and wait times are all factors which have been identified as barriers to OSA evaluation.

Barriers related to scheduling discussed throughout qualitative literature include a person's time limitations (Aalaei, Amini, Rezaeitalab, et al., 2021; Aalaei, Amini, Taghipour, et al., 2021), work responsibilities (Aalaei, Amini, Rezaeitalab, et al., 2021; Aalaei, Amini, Taghipour, et al., 2021; Saglam-Aydinatay et al., 2018; Vlachantoni et al., 2015; Zarhin, 2018), and/or family or caretaking responsibilities (Saglam-Aydinatay et al., 2018; Zarhin, 2018). While many of these factors may be viewed as patient-based constraints related to scheduling, they may also interact with other factors that are more addressable by providers, particularly accessibility in terms of a patient's travel time and distance, and transportation required to undergo an evaluation for OSA.

Travel constraints, including the length of time and/or distance required, and accessibility in transportation have been frequently noted as potential barriers to OSA care-seeking (Aalaei,

Amini, Rezaeitalab, et al., 2021; Aalaei, Amini, Taghipour, et al., 2021; Marchildon et al., 2015; Munks et al., 2019; Saglam-Aydinatay et al., 2018; Stansbury et al., 2022; Vlachantoni et al., 2015), while minimization of travel requirements through the availability of home sleep studies and/or community-based testing facilities may promote OSA evaluation. In a large cohort study, Gordon and colleagues (2018) found that compared to those ordered a home sleep study, individuals requiring sleep testing in a laboratory were 5% less likely to complete an evaluation.

While it may seem likely that the availability of sleep clinics would correlate with population density, and by extension increase accessibility for OSA evaluation, findings are mixed related to a person's locale and OSA evaluation as well as associated wait times. Gordon and colleagues (2018) found that individuals residing in a large town, compared to an urban center, were 1.15 times more likely to complete an OSA evaluation. However, in that same study, no differences were noted between an isolated rural area and an urban center on OSA evaluation completion. Regarding the role of population density on delays in care-seeking, Zhang and colleagues (2022) found that compared to rural-dwelling persons, those living in a city or town were 2 times more likely to seek care within 3 months of noticing OSA symptoms. Overall, the literature is inconclusive on a person's residence as it relates to population density on OSA care-seeking.

Wait times have been frequently discussed as a factor in OSA care-seeking. Munks and colleagues (2019) found that 21% of a sample of Australian adults reported waiting list length as a barrier to undergoing a confirmatory sleep study. Wait times were also identified in 4 qualitative studies, with increased wait times noted as a barrier (Hu et al., 2014; Marchildon et al., 2015), and conversely, low or no wait times as a facilitator to OSA evaluation (Saglam-Aydinatay et al., 2018; Vlachantoni et al., 2015). These studies highlight wait times as a major factor in OSA care-seeking.

Because of this, a more in-depth examination of factors contributing to wait times, including the role of providers and health systems, may be beneficial to promoting timeliness in OSA care seeking.

3.1.7 Conclusions and Directions for Future Research

Undiagnosed OSA is a public health issue, the effects of which impact not only the person experiencing symptoms, but also their close family and friends, as well as the public. Multiple patient, provider, and health system-level factors have been examined throughout a body of literature attempting to understand what motivates patients to seek care for an OSA evaluation. While evidence is somewhat inconclusive regarding more tangible factors amenable to quantitative measurement (i.e., demographics), qualitative literature has put forth a multitude of barriers and facilitators to OSA evaluation, identified by patients directly as well as providers caring for these patients. The findings of this review highlight that OSA care-seeking may be influenced by sex and gender, OSA knowledge, social support, symptom experiences, healthcare provider involvement, and healthcare accessibility, although further investigation is required for understanding the most impactful factors and how they intersect with one another. Further, educational interventions have been shown to be effective in facilitating OSA evaluation.

Many studies in this review mentioned that the recognition of symptoms, including alarming events and the impact of symptoms on daily life facilitated OSA care-seeking. Because entry into the pathway for OSA diagnosis often begins with symptom recognition, it is important to understand which symptoms may be most impactful for influencing a person's desire to seek care. This review found that care-seeking based on classic OSA symptoms can vary. Snoring was not identified as a strong motivating factor to seek care, in fact, it may be a barrier due to influences

from gender-based social constructs. However, experiencing symptoms of breathing interruptions during sleep and/or excessive daytime sleepiness may promote care-seeking. Two studies examining the presence of breathing interruptions during sleep, and 3 studies examining excessive daytime sleepiness, found significant associations with completion of an OSA evaluation. This is not surprising as a previous population-level study has showed that snoring in adults at high risk for OSA was not associated with the likelihood of reporting trouble sleeping to a healthcare provider. However, people experiencing excessive daytime sleepiness and breathing interruptions during sleep were 1.5 and 2.7 times, respectively, more likely to talk with a healthcare provider about trouble sleeping than those not experiencing these symptoms (Orbell et al., Under Review). Another study showed that people who experience daytime sleepiness and/or breathing interruptions during sleep report these symptoms to a primary care provider far more frequently than those who snore (Bailes et al., 2009).

A lack of OSA knowledge may negatively impact OSA care-seeking as it pertains to reporting symptoms. While symptoms like snoring are non-specific to OSA and thus people may not readily associate it with the condition, other symptoms like obstructive episodes during sleep are more specific to the disease. However, this review highlights that people may lack the knowledge to be able to identify concerning and/or reportable symptoms and may also misattribute or attempt to normalize their symptoms. If a patient is unable to recognize or properly attribute their symptoms as possibly linked to OSA, they have little reason to seek care in the first place. These instances are especially concerning as providers may heavily rely on a patient's report of symptoms instead of more objective risk factors when deciding whether to refer them for further assessment (Arsic et al., 2022). Further, current guidelines do not currently support routine OSA

screening in the primary care setting for adults who are unaware of or do not report their symptoms as being a concern (Mangione et al., 2022).

In addition to self-reported OSA symptoms of apneic episodes and excessive daytime sleepiness, increased BMI, increased age, and male sex were found in this review to have modest significant associations with OSA evaluation completion in adjusted analyses presented in quantitative literature. This is not surprising as these are established risk factors for OSA (Yeghiazarians et al., 2021). Of these factors, increased BMI showed the strongest association as it was found in 3 studies to predict completion of an OSA evaluation. This is again not surprising as obesity is a major risk factor for OSA, wherein a person's risk is heightened in direct correlation with increasing obesity (Yeghiazarians et al., 2021). Though the findings of this review suggest that these risk factors may be associated with OSA evaluation, because findings are modest and limited to a handful of studies each showing significant associations, further research is warranted to determine the role these objective risk factors have in OSA evaluation.

The finding that women may be less likely to seek care for OSA is somewhat expected as they may be more prone to underdiagnosis and delays in care-seeking (Basoglu & Tasbakan, 2018; Geer & Hilbert, 2021; Ye et al., 2009). A great deal of work remains in determining effective strategies to promote OSA care-seeking in women, with particular focus on how women may differ from men in their manifestation of symptoms and the influence of gender-based social norms. Differences in the manifestation of OSA symptoms by sex have been established, in particular women are prone to experiencing more generalized, atypical symptoms such as insomnia and nightmares (Geer & Hilbert, 2021). It has also been hypothesized that women's complaints of sleepiness as well as their threshold for feeling sleepy may differ from men (Wimms et al., 2016). These different presentations may contribute to delays in OSA evaluation in women, especially

given that general knowledge and awareness of OSA among the public is lacking (Arous et al., 2017; Shaw et al., 2012; Sia et al., 2017).

OSA screening instruments, which can serve as clinical decision-making tools for providers to refer for further testing, have been shown to skew toward men (Geer & Hilbert, 2021). Instruments often place greater scoring weights on men regardless of life stage, in spite of the fact that the prevalence of OSA is nearly equal between men and postmenopausal women (Wimms et al., 2016). Further, screening tools often only account for classic symptoms that are more common in men, such as snoring, daytime sleepiness, and breathing interruptions during sleep. It is also recognized that knowledge of OSA among healthcare providers continues to warrant improvement (Cherrez Ojeda et al., 2013; Hayes et al., 2012). Without the knowledge of the limitations of screening tools, as well as awareness of atypical symptoms more commonly experienced in women, providers may not recognize that a problem may be present, and thus present a barrier by not providing support or a referral for further evaluation. A concerted effort should be made to increase knowledge and awareness of OSA overall in both the public and healthcare providers, incorporating messages which highlight these important sex differences.

The intersection of sex and gendered social roles may also impact OSA care-seeking. Studies in this review noted that women who snore may be hesitant to discuss this symptom with their partner, due to embarrassment in the social perception of snoring as unladylike (Henry & Rosenthal, 2013; Ye et al., 2022). Further, men may downplay or even hesitate to approach the subject of their female partner's snoring to avoid making their partner feel embarrassed or uncomfortable (Henry & Rosenthal, 2013). Family and caretaking responsibilities may also influence a person's ability or desire to seek care for OSA. While anyone may be subject to such responsibilities, these caregiving roles often fall to women. Zarhin (2018) summarized this in a

study of Jewish-Israeli patients with sleep apnea, finding that women reported a need to protect the health of their loved ones in addition to themselves, and thus may defer seeking care for their own health issues. However, Zarhin (2018) also found that even though women may delay seeking care for their symptoms, they may be more motivated to do so when they notice their symptoms impacting others, especially bedsharing partners. This begins to illuminate the influence of a person's relationships as an important factor in OSA care-seeking.

A person's social network, in particular spouses or bedsharing partners, holds great influence in OSA care-seeking. In this review, partners were found to support OSA care-seeking and evaluation by notifying patients of their symptoms, helping patients initiate the diagnostic process, such as through scheduling appointments, and urging their loved ones to get evaluated. Beyond spouses/partners, family and friends were found to shape health beliefs related to OSA and sleep and were also a source of support for OSA care-seeking. Conversely, negative social stigma surrounding OSA and its symptoms, including gender-based influences, was identified as a barrier.

These findings surrounding interpersonal relationships are not surprising as the influence of a person's social network on health-related decision making and behavior has been well established in multiple theoretical models, such as the Health Belief Model (Rosenstock, 1966), Theory of Planned Behavior (Fishbein & Ajzen, 2010), and Social Cognitive Theory (Bandura, 2004). These theories highlight that a person's close relationships provide social cues and pressures that influence a person to take action and impact a person's perceptions of their susceptibility to and severity of the consequences of an illness (Rosenstock, 1966). Relationships also regulate health behavior in part by providing approval or disapproval and thus influencing a person's expected outcomes of their actions (Bandura, 2004), and influence subjective norms

rooted in a person's belief of how those in their close social network think they should engage in the desired behavior (Fishbein & Ajzen, 2010). These themes are mirrored throughout the findings identified in this review surrounding interpersonal relationships. A finding in Rodgers (2014) exemplifies this social influence, wherein nearly half of participants, ranging through pre OSA diagnosis through treatment, reported concern about a bedsharing partner's reaction toward an OSA diagnosis as a reason for delaying care-seeking efforts.

While interpersonal relationships hold a significant influence in OSA care-seeking, a paucity of evidence exists regarding interventions that incorporate the role of close relationships into efforts to promote OSA evaluation. In this review, only 1 of 4 OSA education intervention studies was found to incorporate social influences into its design. In addition to perceived benefits of OSA evaluation and treatment, Jean-Louis and colleagues (2017) designed their telephone-based educational intervention to address social factors that may encourage or discourage OSA evaluation in Black adults at-risk for OSA, such as engaging the person's social network to promote behavior change. Interestingly, of the 4 interventional studies found in this review, this approach yielded the highest rate of completed OSA evaluation, with 75% of the intervention arm successfully completing an evaluation. This finding and approach provides an excellent point from which to build further interventions aimed at promoting OSA evaluation by incorporating social influences.

Although interventions incorporating social support for OSA evaluation are few, a wealth of evidence has identified the role of social support, in particular bedsharing partners, in OSA treatment adherence (Rosa et al., 2022). Partners have been shown to provide support and ease anxieties when initiating treatment, and in addition to other family members, provide motivation for treatment adherence of persons diagnosed with OSA. Given its strong theoretical basis and

that social support appears to impact the entire continuum of OSA care from recognition of symptoms through long-term treatment, it is crucial that clinicians work to engage a person's support network as early as possible, ideally beginning at the time of entry into the pathway to diagnosis, to work to address social factors that may influence a person's decision to seek OSA diagnosis and treatment.

Extending beyond a person's close social network is the role of healthcare providers in promoting OSA care-seeking. This review found that a provider's recommendation for OSA evaluation, as well as the act of discussing OSA risks, testing, and treatment options with patients facilitated OSA evaluation. A lack of provider knowledge as perceived by a patient, or a provider's dismissal of a patient's symptoms or desire to seek further evaluation for OSA both were identified as barriers. These factors, like others already mentioned, are rooted in the adequacy of a provider's OSA knowledge, their ability to communicate with patients, and their understanding of the options available to patients related to OSA evaluation. The identification of these factors in this review is not unexpected as multiple studies outside of the scope of this review have cited a lack of provider knowledge, particularly that among primary care providers, as a barrier to OSA referral and evaluation (Hayes et al., 2012; Mold et al., 2011; Papp et al., 2002; Pendharkar et al., 2021).

One specific barrier related to provider knowledge is uncertainty in their roles and responsibilities in referral, including which patients should be referred to a sleep specialist, circumstances in which a referral is indicated, and to whom patients should be referred (Hayes et al., 2012). This uncertainty may negatively influence a patient's experience with the healthcare system, and act as a barrier to OSA evaluation, due in part to poor coordination between providers. Adequate provider knowledge of patients warranting referral and to whom the patient should be referred may help to diminish this barrier.

A provider's knowledge of OSA, and their ability to effectively translate that knowledge to promote action on the part of the patient, may be a significant source of motivation for patients. In clinical practice, this would likely take the form of providing education to the patient. The effectiveness of educational interventions aimed at increasing OSA evaluation was shown in four separate studies identified in this review. Knowing that targeted education can effectively promote a person's progression through the OSA diagnostic pathway, future research should examine the effect of OSA education interventions in promoting care seeking for OSA in individuals less likely to seek care such as women and those with little or no social support.

Administrative barriers to obtaining sleep testing services were also a major theme found in this review, particularly in qualitative literature. These barriers, including wait times, scheduling difficulties, cost, and accessibility may also shape how a patient views the health system. Two potential solutions to these issues have been proposed previously: home-based pathways of care and OSA care provided by non-specialists (Donovan et al., 2020). These solutions align with findings from a study examining patient preferences in OSA care, including preferences for minimal wait times and management, testing, and ongoing care provided via primary care providers (Natsky et al., 2022). Although certain patients may be ineligible for either of these solutions for a variety of reasons, they may also help to reduce the burden on specialist providers, and thus making them more available to the patients who most require their services. Both proposed solutions may also reduce wait times, decrease patient costs, and increase accessibility of services by either bringing them right to the patient's home, or shortening travel required as non-specialists may have a more widespread presence in community settings. One study found in this review alluded to this, wherein home-based sleep testing was associated with an increased likelihood of completing an evaluation (Gordon et al., 2018). Although these results are promising,

more research is warranted regarding the effectiveness of home- and/or primary-care based strategies in OSA assessment and diagnosis. Further, it is imperative that future studies aimed at increasing OSA evaluations also examine strategies to assure adequate knowledge among providers, particularly those in the primary care role, as well as strategies to improve care coordination and accessibility.

Understanding the role of various social determinants of health is paramount in today's healthcare climate. Although studies in this review attempted to examine factors associated with social determinants of health such as income and education, the collective findings are mostly inconclusive regarding their role in OSA care-seeking. Of greatest concern is the lack of attention throughout these studies of two important concepts: the role of health literacy as well as race and ethnicity. Although some studies included in this review were conducted in racially-specific populations, only one single study attempted to understand differences in OSA care-seeking by comparing race among participants. Given our knowledge of racial disparities in OSA diagnosis and treatment (Borker et al., 2021; Thornton et al., 2022), it is imperative that we work to understand how race and ethnicity may impact a person's pathway to achieving a definitive OSA diagnosis.

Health literacy continues to emerge as a prominent topic in examining health disparities and engagement with health systems. Overall, a paucity of evidence exists in OSA-related literature regarding health literacy. Likewise, only a single study in this review suggested health literacy as a potential factor in OSA care-seeking (Stansbury et al., 2022). Like social influences, health literacy may impact a person's decision to act on perceived health risks (Harzheim et al., 2020) and has been shown to increase uptake of screening practices in both men (Nguyen et al., 2021; Oliffe et al., 2019) and women (Komenaka et al., 2015; Mazor et al., 2014). It has also been

shown that patients with lower health literacy exhibit less engagement with health systems and uptake of preventive health services, while those with higher health literacy generally have more knowledge of their disease and exhibit more positive health behaviors (Peltzer et al., 2020). These outside findings suggest that health literacy could play a critical role in facilitating a person's progression through the OSA care pathway. Therefore, examining health literacy across the spectrum of OSA care remains critical.

While the findings of this review highlight some of the factors that may be involved in OSA care-seeking and completion of an OSA evaluation, many factors examined in this review showed mixed and/or weak results that are ultimately inconclusive. This may be due to variability in the strength of study design, limitations in sample size and setting, and measures used. Notably, only 3 randomized controlled trials were identified in this review, each taking place within racially homogenous samples, which makes the findings of these higher-level studies difficult to extrapolate to the general population. Because of these limitations, further research is warranted using larger, longitudinal studies in diverse samples utilizing validated measures to assess outcomes related to OSA care seeking and evaluation completion.

3.1.8 Summary

A considerable amount of work remains in understanding factors facilitating entry into and progression through the OSA diagnostic pathway. While it appears that sex and gender, interpersonal relationships, the experience of symptoms, OSA knowledge and beliefs, healthcare provider involvement, and accessibility are among the most influential factors in a person's pursuit of an OSA diagnosis, minimal evidence exists regarding how these factors may be addressed in interventions to promote care uptake. Further, to date, important concepts known to influence

health including race and ethnicity and health literacy have largely been omitted from literature surrounding the pathway to diagnosis. It is imperative that researchers work to address these topics, through targeted study, with an overall goal to address the public health crisis of OSA underdiagnosis.

3.2 Aim 2 and 3 Manuscript: Adherence to a Provider's Recommendation for OSA Evaluation and Associations with Health-Related Factors Overall and by Age, Sex, and Marital Status in Patients Identified as At-Risk for OSA in the Perianesthesia Setting

3.2.1 Abstract

Purpose: Research is limited regarding factors associated with care-seeking behavior for obstructive sleep apnea (OSA) in at-risk individuals positively screened in the perianesthesia setting. This study examined associations between adherence to a provider's recommendation for OSA evaluation and health-related factors in a sample of patients identified as at-risk for OSA in the perianesthesia setting.

Methods: This observational study was conducted in a sample of patients at-risk for OSA (STOP-Bang ≥ 3) who underwent an outpatient procedure under anesthesia and received in-person and/or mailed OSA risk notification and recommendation for follow-up. Measurements included demographic and clinical information, actual and perceived OSA risk (STOP-Bang and a self-developed scale, respectively), OSA symptoms (Epworth Sleepiness Scale, Insomnia Severity Index, and Functional Outcomes of Sleep Questionnaire-10), health literacy (Health Literacy Questionnaire), type of OSA screening information received, baseline OSA care-seeking intention

and, at 6 weeks, self-reported action(s) taken for follow-up OSA evaluation. Logistic regression assessed the prediction of adherence to a provider's recommendation for OSA evaluation and linear regression assessed OSA care-seeking intention, a proxy for adherence, stratified by age, sex, and marital status.

Results: Adherence to a provider's recommendation for OSA follow-up was 12.7%. Daytime sleepiness was identified as the strongest predictor of adherence overall. Functional impairment and perceived likelihood of having OSA were identified as the strongest predictors of OSA care-seeking intention overall, with significant associations noted between OSA care-seeking intention and: 1) functional impairment in younger adults, both sexes, and partnered and unpartnered individuals; and 2) between perceived likelihood of having OSA and OSA care-seeking intention in men.

Conclusions: Daytime sleepiness and its impact on daily function, as well as perceived likelihood of having OSA strongly predict OSA care-seeking behavior in individuals identified as at-risk for OSA in the perianesthesia setting. Functional impairment related to sleepiness appears to hold greater importance to younger people and perceived likelihood of having OSA appears to hold greater importance to men in OSA care-seeking intention. Noting these facilitators and differences in OSA care-seeking behavior can help perianesthesia providers better facilitate OSA follow-up care after positive screening.

3.2.2 Introduction

Obstructive sleep apnea (OSA) is a highly prevalent yet underdiagnosed sleep-related breathing disorder (Benjafield et al., 2019). Undiagnosed and therefore untreated OSA is considered a public health issue (U.S. Department of Health and Human Services: Office of

Disease Prevention and Health Promotion, 2021) that is associated with increased morbidity and mortality (Drager et al., 2017), contributes to significant healthcare usage, and has negative impacts on the workplace (Knauert et al., 2015). In the perianesthesia setting, the prevalence of OSA in adults presenting for procedures is high (Vasu et al., 2012); however, like the general population, the majority of these adults with OSA are undiagnosed (Finkel et al., 2009; Singh et al., 2013). OSA, in particular which is undiagnosed and/or untreated, is a significant concern in the perianesthesia setting as patients with OSA are known to have an increased risk of multiple adverse anesthesia-related outcomes, including pulmonary and airway complications, as well as arrhythmias and other cardiac complications (Aintree et al., 2021; Chung et al., 2016; Fernandez-Bustamante et al., 2017). These and other OSA-related complications often result in increased care requirements including intervention, monitoring, and overall procedure length of stay (Cozowicz et al., 2017; Fernandez-Bustamante et al., 2017; Jules-Elysée et al., 2018; Naqvi et al., 2017).

Due to the high prevalence of OSA coupled with a patient's heightened risk of complications, identification of patients at-risk for OSA is an integral process in the perianesthesia setting to ensure the safe delivery of anesthesia (American Society of Anesthesiologists, 2014; American Society of PeriAnesthesia Nurses, 2022; Chung et al., 2016). While identification of OSA by a definitive diagnosis (i.e., a sleep study) would be ideal prior to the receipt of any anesthesia, completion of a sleep study is often not feasible prior to the receipt of anesthesia as screening frequently occurs close to or on the day of the procedure. Moreover, provider guidelines do not support delaying or cancelling surgery for in-depth OSA evaluation except where concern exists for patients with compromised respiratory functioning (Chung et al., 2016). In these instances, presumptive management is recommended for individuals with suspected but not yet diagnosed OSA (American Society of Anesthesiologists, 2014).

Although a pre-procedural OSA diagnostic evaluation is often not feasible, information obtained in pre-anesthesia OSA screening, as well as observation of potential OSA-related events during a person's course of anesthesia, may be used to inform recommendations or actions for follow-up care for OSA evaluation after a patient's initial procedure is completed. Additionally, national anesthesia provider guidelines recommend that anesthesia providers advise patients with a high probability for OSA to notify their primary medical provider for referral for further evaluation of OSA after their procedure (Chung et al., 2016). Despite the availability of this valuable OSA risk information and a directive to providers to encourage follow-up OSA care, evidence is lacking regarding effective strategies to inform patients of their risk and facilitate OSA follow-up in the perianesthesia setting. Further, care-seeking behavior among individuals who are identified as at-risk for OSA in the perianesthesia setting and are given a recommendation or referral for OSA evaluation to be completed after their procedural episode remains poorly understood.

Aside from limited evidence on adherence rates suggesting less than half of patients identified as high-risk for OSA in the pre-operative clinic setting adhere to a referral or recommendation for OSA diagnostic evaluation (Fidan et al., 2006; Guralnick et al., 2012), as well as limited non-significant findings based on age, sex, and BMI (Fidan et al., 2006), to date, no known studies have conducted an in-depth examination of factors contributing to adherence to a provider's recommendation for OSA follow-up in the perianesthesia population and setting. However, studies have examined adherence to a provider's recommendation for OSA follow-up and/or OSA care-seeking in the general population and other select care areas (see review of this data in Aim 1 manuscript). Some of the factors associated with OSA care-seeking and evaluation identified throughout these studies include age, sex and gender roles, and social support,

particularly through spouses or bedsharing partners. While several factors have been explored related to OSA care-seeking and evaluation, other important factors that are recognized as important to health care-seeking overall have not yet been extensively explored in the OSA care-seeking realm. These include risk perception, based on health behavior theory (Bandura, 2004), and health literacy, which is recognized as a major contributing factor to the elimination of health disparities and assurance of health equity (U.S. Department of Health and Human Services: Office of Disease Prevention and Health Promotion, 2022).

While evidence exists on OSA care-seeking and/or adherence to a recommendation or referral for OSA evaluation outside of the perianesthesia context, a critical need remains to understand care-seeking behavior and associated factors of patients identified as at-risk for OSA through a perianesthesia encounter. Thus, the primary purpose of this study was to examine associations between adherence to a provider's recommendation for OSA evaluation and health-related factors in a sample of patients identified as at-risk for OSA in the perianesthesia setting. We also aimed to explore sociodemographic differences in health-related factors associated with adherence to a provider's recommendation for OSA evaluation.

3.2.3 Methods

3.2.3.1 Design and Sample

This observational study was conducted in a sample of patients at risk for OSA who underwent outpatient procedures under anesthesia in the Excelsa Health System, located in Westmoreland County, Pennsylvania from November 2022 to May 2023. This study was approved by the institutional review boards of both the University of Pittsburgh and the Excelsa Health System. At the time of the study, as part of standard pre-anesthesia screening procedures in the

Excelsa Health system, all patients were assessed for risk of OSA using the STOP-Bang questionnaire (Chung et al., 2008), which is a well-validated, 8-item screening tool for OSA. OSA risk is calculated based on 8 dichotomous, yes/no items related to the clinical features of sleep apnea including patient-reported snoring, tiredness, observed apneas, and diagnosis of hypertension as well as BMI ($>35 \text{ kg/m}^2$), age over 50 years, neck circumference (≥ 16 inches or 40 cm), and male sex. Scores of 0-2 indicate low risk, 3-4 moderate, and 5 or greater high risk for OSA (Chung et al., 2012).

Patients in the Excelsa Health System with a STOP-Bang value of 3 or greater were identified by perianesthesia providers as at-risk for OSA and received a mailed letter after their procedure notifying them of their risk with a recommendation to follow-up with a primary care provider or sleep specialist. In addition, patients in select care areas also received the same printed letter and basic OSA education at the time of screening or during distribution of discharge instructions (See Figure 2). A study recruitment flyer was sent to individuals alongside their mailed risk letters and given to eligible patients who received a letter and education at the time of screening and/or discharge.

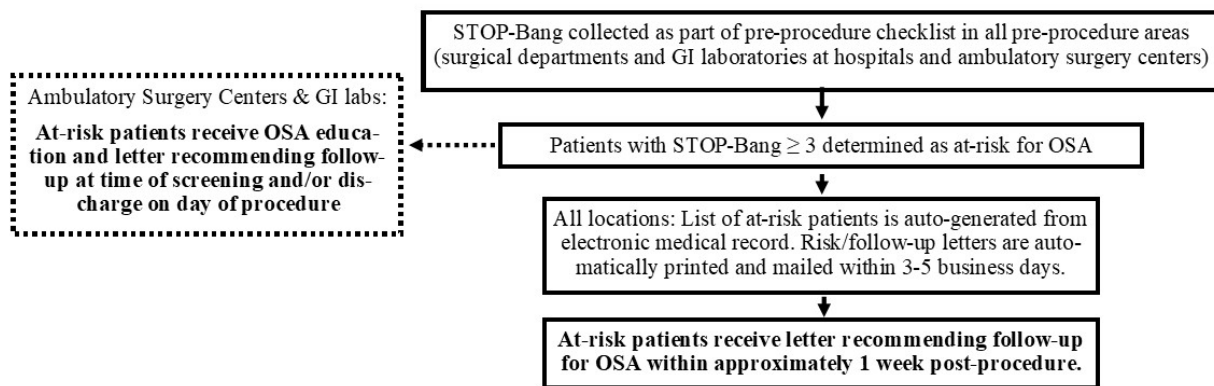


Figure 2 OSA Risk Notification Process

Prospective participants were instructed to access study eligibility screening using a link or QR code provided in the recruitment flyer which directed them to a web-based survey (Qualtrics®; Provo, UT). After verifying their at-risk status for OSA by completion of the STOP-Bang (≥ 3), participants completed initial eligibility screening. Adults at risk for OSA were eligible to participate in this study if they were age 18 or older, underwent an outpatient procedure within the previous 2 weeks, and were cognitively intact, English speaking, and had access to the internet, email, and telephone. Individuals were excluded if they reported a previous OSA diagnosis or sleep study and/or completion of a sleep specialist appointment for OSA evaluation prior to their outpatient procedure. After verification of eligibility, participants were directed to a separate, secure link to provide contact information and attest their agreement to participate in the study. A Qualtrics® survey link was then emailed to participants where they completed baseline measures, including their intention to seek care for OSA. At 6 weeks post-procedure, participants were emailed a second survey link containing a single select-all-that-apply questionnaire assessing which actions, if any, they took after being notified of their risk and receiving a recommendation for OSA evaluation.

3.2.3.2 Measures

Demographic and Clinical Information

Demographic information collected included age, sex, race and ethnicity, marital status (unmarried/unpartnered and not living with someone or married/partnered and living with someone), employment (unemployed or homemaker, employed full- or part-time, or retired), education (some college or less or college graduate or more), income (less than \$50,000 or \$50,000 or more annually by household), and insurance (insured through self or employer or government insurance, Medicare, or Medicaid). Clinical information collected included comorbidities (0-1 or

2 or more of the following: heart failure, peripheral vascular disease, hypertension, high cholesterol, kidney disease, stroke, COPD, rheumatoid arthritis, coronary artery disease, asthma, and/or diabetes), body mass index (BMI; kg/m²) from reported height and weight, and diagnosis of any other sleep disorders. Procedure facility type (ambulatory or hospital-based), type of procedure (gastrointestinal [GI] procedure [i.e., colonoscopy or esophagogastroduodenoscopy] or other), and information received on the day of the procedure (no information received, given information about OSA and/or notified of at-risk status only, given a recommendation or referral for follow-up only, or given both information about OSA and/or notified of at-risk status and given a recommendation or referral for follow-up) were also collected. In addition, participants were also asked if they attended a pre-procedure clearance visit with a primary care provider prior to the day of their procedure, and if yes, what type of information related to OSA, if any, they received during that visit. Responses were dichotomized into no clearance information received and yes clearance information received (yes to any of the following: given information about OSA, notified of at-risk status, or given a referral to a sleep specialist).

OSA Risk

All participants in this study were of moderate or high risk for OSA as part of eligibility requirements (STOP-Bang ≥ 3). Because we recognized that participants may not readily know their neck circumference, a response option for “don’t know” was included for this question and treated as missing in score calculation. For the purposes of statistical analysis, and in light of the possibility for missing responses related to neck circumference, standard and alternate scoring configurations of the STOP-Bang were applied to classify participants by moderate or high risk. A STOP-Bang of 5 or greater by conventional criteria (Chung et al., 2008) or a STOP score of 2 or greater in addition to either BMI > 35 kg/m² or male sex by alternative criteria (Chung et al.,

2014) was considered high risk. All other participants not meeting either conventional or alternative high risk criteria were considered at moderate OSA risk.

Perceived Seriousness and Likelihood of Having OSA

Participants were presented with two Likert-type questions to assess their perception of the seriousness and personal likelihood of having OSA. Participants were asked to indicate their level of agreement to the following statement, “Sleep apnea is a serious condition” with 5 response options ranging from “strongly disagree” to “strongly agree.” This question was constructed after a question contained in the Illness Perception Questionnaire-Revised measure (Moss-Morris et al., 2002) focused on consequences of illness. Participants were also asked, “How likely do you think it is that you have sleep apnea?” with 5 response options ranging from “very unlikely” to “very likely.” The format of this question is similar to that used by Skolarus and colleagues (2012), who assessed perceived OSA risk in a sample of stroke survivors.

Health Literacy

Health literacy was measured using the Health Literacy Questionnaire (HLQ), which is a 44-item self-report questionnaire encompassing 9 aspects of health literacy (Osborne et al., 2013). The HLQ is a two-part Likert-based scale, encompassing 9 subscales assessing various aspects of health literacy. Part 1 subscales assess feeling understood and supported by healthcare providers, having sufficient information to manage health, actively managing health, social support for health, and appraisal of health information. Part 2 subscales assess ability to actively engage with healthcare providers, navigating the healthcare system, ability to find good health information, and understand health information well enough to know what to do. Response options range from 1 = strongly disagree to 4 = strongly agree in part 1 and from 1 = cannot do or always difficult to 5 = always easy in part 2. No overall composite score is calculated for this questionnaire, rather mean

values for each subscale (range 1-4 for subscales in part 1 and 1-5 for subscales in part 2) are computed separately. Lower mean subscale scores indicate areas of weakness and higher scores indicate strengths related to health literacy. It has high reliability across its subscales ($\alpha = 0.77-0.90$) and has been used across a wide range of patient characteristics (Osborne et al., 2013).

Functional Impairment

Functional impairment related to sleepiness was evaluated using the Functional Outcomes of Sleep Questionnaire-10 (FOSQ-10; Chasens et al., 2009), an abbreviated measure of the 30-item FOSQ (Weaver et al., 1997). This is a self-report measure that assesses functional outcomes in 5 domains: general productivity, activity, vigilance, social outcomes, and intimacy and sexual relationships. Each of the 10 items is scored using a Likert scale ranging from 1 = yes, extreme difficulty to 4 = no difficulty, with select items also including an option for 0 = I don't do this activity for other reasons, which is coded as a missing response. Total scores range from 5-20. A score of < 17.9 indicates impairment in daily functioning due to sleepiness (Colvin et al., 2023). Internal consistency of the FOSQ-10 is high ($\alpha = 0.87$; Chasens et al., 2009).

Daytime Sleepiness

Daytime sleepiness was measured using the Epworth Sleepiness Scale (ESS; Johns, 1991), where participants are asked to self-report the likelihood of falling asleep in the context of 8 common situations of daily living. Individual items are scored using a 4-point Likert scale with 0 = never dozing to 3 = high chance of dozing. Scores from each item are totaled with a score range of 0-24. A score of ≥ 10 is indicative of clinically significant daytime sleepiness. It has good internal consistency ($\alpha = 0.88$) and test-retest reliability ($r = 0.82$), and has been validated to discriminate between normal sleepers and those with OSA (Johns, 1991, 1992).

Insomnia Severity

Insomnia was measured using the Insomnia Severity Index (ISI), which assesses subjective severity of insomnia symptoms, satisfaction with sleep, daytime impairment, and concerns related to sleep difficulties (Bastien et al., 2001). Each item in this 7-item questionnaire is scored 0 = no problem to 4 = very severe problem. Scores range from 0 to 28, with scores of 15 or greater indicating clinically significant (moderate) insomnia. Internal consistency of the ISI is excellent for community ($\alpha = 0.90$) and clinical ($\alpha = 0.91$) samples (Bastien et al., 2001; Morin et al., 2011).

Intention to Seek OSA Care

Intention to seek OSA care was assessed with a 1-item, semantic differential scale (0-100), where respondents indicated the degree to which they did or did not intend to seek OSA care within the next 6 weeks. Participants were presented with the statement, “I intend to seek medical care to determine if I have sleep apnea within the next 6 weeks,” and asked to indicate the level of their intention along a continuum between the response options of “definitely no” (0) to “definitely yes” (100). This item was developed specifically for this study and is based on the theory of planned behavior (Fishbein & Ajzen, 2010; Osgood, 1952).

Adherence to a Provider’s Recommendation for OSA Evaluation

To determine whether an individual adhered to a provider’s recommendation for OSA evaluation, participants were asked the following question 6 weeks after their procedure: “Since receiving information about your risk status for sleep apnea, which of the following statements best describes actions you have taken for follow-up of potential sleep apnea, if any?” Choices included, “I have not scheduled or completed an evaluation for sleep apnea,” “I have scheduled but not attended/completed an evaluation for sleep apnea,” or “I have completed an evaluation for sleep apnea.” Responses were dichotomized into non-adherent (not scheduled or completed an evaluation) or adherent (either scheduled or completed an evaluation).

3.2.3.3 Statistical Analysis

Analyses were conducted using SPSS® Statistics version 28 (IBM®). After assessing the data for outliers and missingness, descriptive statistics were calculated for each scale variable, including mean, standard deviations, medians, and inter-quartile ranges and frequencies, and percentages for categorical variables. Comparisons by adherence to a provider's recommendation for OSA evaluation were examined among categorical variables using chi-square tests of independence (sex, employment, education, income, marital status, insurance, procedure type and location, OSA-related information received, comorbidities, OSA risk status, seriousness of OSA, and perceived likelihood of OSA), and independent samples t-tests for continuous variables (age, BMI, intention to follow-up, ESS, HLQ, ISI, and FOSQ-10).

Binomial logistic regression was used to explore the prediction of adherence to a provider's recommendation for OSA evaluation from health-related factors and sociodemographic and clinical covariates. Unadjusted regression models were fit for each health-related factor as a predictor of adherence within 6 weeks post-procedure to a provider's recommendation for OSA evaluation. Factors with $p < 0.10$ in unadjusted, single-predictor models were considered as trending toward significance (age, comorbidities, ISI, ESS, FOSQ-10, social support for health [HLQ scale 4], and perceived likelihood of having OSA) and were first simultaneously entered into a multivariable model, then in a stepwise fashion with $p < 0.1$ for entry. Forward, stepwise selection was chosen due to a small sample size, which created a concern for low power to adequately handle all factors. Model fit was assessed using log-likelihood value, pseudo- R^2 values, and classification adequacy, including sensitivity, specificity, and overall correct classification.

In order to explore sociodemographic differences on the basis of age, sex, and marital status (a proxy for spousal/bedsharing partner support) on adherence to a provider's recommendation for

OSA evaluation, linear regression using intention to seek care for OSA was used. Intention was chosen as a proxy variable for adherence to a provider's recommendation for OSA evaluation in this arm of the analysis due to limitations related to pilot research, including a short timeframe (6 weeks) which may have contributed to relatively few individuals having taken follow-up action. This, in addition to a small sample with fairly limited diversity by age, sex, and marital status, presented a lack of statistical power to adequately support stratified or multi-group analyses using logistic regression. Health behavior theories position intention as a proximal goal or antecedent of behavior taken (Bandura, 2004; Fishbein & Ajzen, 2010), thus supporting its use as a proxy for follow-up action(s) taken, especially in the presence of a potentially inadequate window of time for follow-up. Validity evidence supporting the usage of intention as a proxy to adherence (follow-up action taken) can be found in Appendix E.

Simple linear regression was performed to evaluate the prediction of OSA care-seeking intention from each sociodemographic, clinical, and health-related factor. Factors with $p < 0.10$ were considered as trending towards significance (age, information received on the day of the procedure, ISI, ESS, FOSQ-10, OSA risk status, and perceived likelihood of having OSA). These factors were forward-selected for analysis using the entire sample to determine the most influential factors associated with OSA care-seeking intention. After a final model was identified, it was then stratified based on groupings of age (above or at or below median of 60 years), sex (male or female), and marital status (currently unpartnered/not living with someone or married/partnered and living with someone). Assumptions for linear regression were assessed for each group comparison, including assessments of normality, linearity, homoscedasticity, and multicollinearity. A sensitivity analysis of outliers and influential cases was performed using

regression plots and evaluation of studentized deleted residuals and Cook's D values; no cases warranted removal.

3.2.4 Results

3.2.4.1 Sample Characteristics

A total of 63 adults at risk for OSA were included in the analysis. Characteristics of the sample overall and stratified by adherence to a provider's recommendation for OSA follow-up are presented in Table 3. The sample was comprised of largely middle aged (mean age 57.44 ± 12.72 years) white, non-Hispanic or Latino participants (100%), the majority of whom were men (71.4%). The majority of participants were employed full-or part time (57.1%), married or currently partnered and living with someone (79.4%), and had an annual household income of \$50,000 or more annually (65.1%). All participants had health insurance, 58.7% of whom were insured through themselves or an employer and 41.3% through the government, including Medicare or Medicaid. Approximately half of the sample (50.8%) had a college degree or more. The majority of patients had a GI-related procedure (85.7%), with approximately 60% of patients completing their procedure at an ambulatory surgery center. On average, the sample was overweight or obese, with a mean BMI = 31.99 ± 7.22 kg/m², and more than half reported 2 or more comorbidities (58.7%). Overall, the sample was not considered excessively sleepy (ESS = 8.05 ± 4.62 ; Johns, 1991) and did not endorse clinically significant insomnia (ISI = 9.60 ± 6.02 ; Morin et al., 2011), but reported slight functional impairment related to sleepiness (FOSQ-10 = 17.21 ± 2.68 ; Colvin et al., 2023).

Table 3 Sample Characteristics

	N=63	Did not adhere OSA follow-up recommendation (n=55)	Adhered to OSA follow-up recommendation (n=8)	P value
Age, mean in years (SD)	57.44 (12.72)	58.58 (12.04)	49.63 (15.34)	0.062
Male (%)	45 (71.4%)	38 (69.1%)	7 (87.5%)	0.282
Employment (%)				0.908
Unemployed or homemaker	7 (11.1%)	6 (10.9%)	1 (12.5%)	
Employed full or part time	36 (57.1%)	31 (56.4%)	5 (62.5%)	
Retired	20 (31.7%)	18 (32.7%)	2 (25%)	
Education, college graduate or more (%)	32 (50.8%)	28 (50.9%)	4 (50%)	0.962
Income (annual household, %)				0.211
Less than \$50,000 annually	19 (30.2%)	18 (32.7%)	1 (12.5%)	
\$50,000 or more annually	41 (65.1%)	34 (61.8%)	7 (82.5%)	
Don't know	3 (4.8%)	3 (5.5%)	0 (0%)	
Race, white (%)	63 (100%)	55 (100%)	8 (100%)	
Ethnicity, non-Hispanic or Latino (%)	60 (100%)	55 (100%)	8 (100%)	
Marital status, married or currently partnered and living with someone (%)	50 (79.4%)	43 (78.2%)	7 (87.5%)	0.543
Insurance status (%)				0.317
Insured through self or employer	37 (58.7%)	31 (56.4%)	6 (75%)	
Government insurance, Medicare, or Medicaid	26 (41.3%)	24 (43.6%)	2 (25%)	
Procedure facility type (%)				0.158
Ambulatory	38 (60.3%)	35 (63.6%)	3 (37.5%)	
Hospital-based	25 (39.7%)	20 (36.4%)	5 (62.5%)	
Type of procedure (%)				0.877
GI procedure	54 (85.7%)	47 (85.5%)	7 (87.5%)	
Other procedure	9 (14.3%)	8 (14.5%)	1 (12.5%)	
OSA-related information received on day of procedure (%)				0.143
No information received (mailed letter only)	7 (11.1%)	6 (10.9%)	1 (12.5%)	
Given information about OSA and/or notified of at-risk status only	40 (63.5%)	37 (67.3%)	3 (37.5%)	
Given a recommendation or referral for follow-up only	8 (12.7%)	5 (9.1%)	3 (37.5%)	
Given information about OSA and/or notified of at-risk status and given a recommendation or referral for follow-up	8 (12.7%)	7 (12.7%)	1 (12.5%)	
Attended a pre-procedure clearance visit and received information about OSA prior to the day of procedure	7 (11.1%)	5 (7.9%)	2 (3.2%)	0.127
Comorbidities - 2 or more (%)	37 (58.7%)	35 (63.6%)	2 (25%)	0.065
BMI, kg/m ² , mean (SD)	31.99 (7.22)	31.64 (7.08)	34.42 (8.21)	0.312
Diagnosed with any other sleep disorder (%)	1 (1.6%)	1 (1.8%)	0 (0%)	0.717
Insomnia (ISI), mean (SD)	9.60 (6.02)	8.76 (5.39)	15.38 (7.29)	0.003
Daytime sleepiness (ESS), mean (SD)	8.05 (4.62)	7.25 (4.04)	13.50 (4.90)	<0.001
Functional impairment (FOSQ-10), mean (SD)	17.21 (2.68)	17.66 (2.25)	14.15 (3.48)	<0.001
OSA risk status (%)				0.593
Moderate OSA risk	21 (33.3%)	19 (34.5%)	2 (25%)	
High OSA risk*	42 (66.7%)	36 (65.5%)	6 (75%)	
Health Literacy Questionnaire, mean (SD)				

Healthcare provider support and understanding	3.15 (0.43)	3.15 (0.41)	3.22 (0.57)	0.657
Sufficiency of information to manage health	2.95 (0.44)	2.96 (0.42)	2.88 (0.58)	0.598
Actively managing health	2.87 (0.49)	2.87 (0.50)	2.88 (0.48)	0.959
Social support for health	3.11 (0.47)	3.15 (0.40)	2.80 (0.79)	0.045
Appraisal of health information	2.98 (0.48)	2.97 (0.48)	3.08 (0.49)	0.560
Ability to engage with health care providers	4.02 (0.55)	4.04 (0.55)	3.93 (0.60)	0.600
Navigating the healthcare system	3.40 (0.57)	3.91 (0.58)	3.81 (0.50)	0.657
Ability to find good health information	3.97 (0.58)	3.99 (0.58)	3.83 (0.57)	0.448
Understand health information well enough to know what to do	4.14 (0.50)	4.12 (0.51)	4.23 (0.38)	0.593
Sleep apnea is a serious condition (%)				0.297
Strongly disagree	2 (3.2%)	2 (3.6%)	0 (0%)	
Disagree	0 (0%)	0 (0%)	0 (0%)	
Neutral	16 (25.4%)	16 (29.1%)	0 (0%)	
Agree	29 (46.0%)	24 (43.6%)	5 (62.5%)	
Strongly agree	16 (25.4%)	13 (23.6%)	3 (37.5%)	
Perceived likelihood of having sleep apnea (%)				<0.001
Very unlikely	2 (3.2%)	1 (1.8%)	1 (12.5%)	
Unlikely	12 (19.0%)	12 (21.8%)	0 (0%)	
Neutral	25 (39.7%)	25 (45.5%)	0 (0%)	
Likely	17 (27.0%)	14 (25.5%)	3 (37.5%)	
Very likely	7 (11.1%)	3 (5.5%)	4 (50%)	
Intention of seeking follow-up care for OSA, mean (SD)	32.7 (31.8)	24.87 (25.33)	86.75 (14.34)	<0.001
Abbreviations: BMI=Body Mass Index; ESS=Epworth Sleepiness Scale; ISI=Insomnia Severity Index; FOSQ-10=Functional Outcomes of Sleep Questionnaire-10; GI procedure=colonoscopy or esophagogastroduodenoscopy; HLQ=Health Literacy Questionnaire; OSA=obstructive sleep apnea Notes: *High risk for OSA=overall STOP-Bang ≥ 5 or STOP ≥ 2 + BMI > 35 kg/m ² OR male sex				

Health literacy across the 9 subscales was adequate to strong across the sample. The weakest domain noted in part 1 of the HLQ (scoring range 1-4) was actively managing health (mean 2.87 ± 0.49); the strongest was healthcare provider support and understanding (mean 3.15 ± 0.43). In part 2 of the HLQ (scoring range 1-5), navigating the healthcare system was the overall weakest domain of health literacy (mean 3.40 ± 0.57) and understanding health information well enough to know what to do was the strongest (mean 4.14 ± 0.50).

Two-thirds (66.7%) of the sample was objectively at high-risk for OSA based on the STOP-Bang and 38.1% of the sample reported that they felt they “likely” or “very likely” had OSA. Most of the sample endorsed sleep apnea as a serious condition (71.4% responding “agree” or “strongly agree”). In addition to receiving a mailed letter notifying them of their risk for OSA, on the day of

their procedure, 63.5% received information about OSA and/or were notified of their at-risk status only, 12.7% were given a recommendation or referral for follow-up only, and 12.7% received both information and/or risk notification regarding OSA and a recommendation or referral for follow-up. Average OSA care-seeking intention for the sample was 32.7 ± 31.8 .

3.2.4.2 Characteristics of Participants Taking Action for OSA Follow-Up

Eight (12.7%) participants adhered to a provider's recommendation for OSA follow-up within the 6-week timeframe. Among individuals who were adherent to a recommendation, the average age was 49.63 ± 15.34 years. The majority were male (87.5%), married or partnered (87.5%), and employed full-time (62.5%). The majority of these individuals were at high risk for OSA (75%), had a GI-related procedure (87.5%), and had 0-1 comorbidities (75%). Half of individuals adherent to a provider's recommendation were college graduates. On average, participants who adhered to a provider's recommendation for OSA follow-up had moderate insomnia (ISI = 15.38 ± 7.29 ; Morin et al., 2011), moderate to severe daytime sleepiness (ESS = 13.50 ± 4.90 ; Johns, 1991), and greater than average functional impairment related to sleepiness (FOSQ-10 = 14.00 ± 4.90 ; Colvin et al., 2023). All of these participants agreed or strongly agreed that OSA is a serious condition, and 87.5% felt they likely or very likely had OSA.

3.2.4.3 Prediction of Adherence to a Provider's Recommendation for OSA Follow-Up

Table 4 displays the results of unadjusted logistic regression analyses of each factor on the prediction of adherence to a recommendation for OSA follow-up. In unadjusted models, significant associations ($p < 0.05$) were found between adherence to a recommendation and insomnia, daytime sleepiness, and functional impairment related to sleepiness.

Table 4 Unadjusted Logistic Regression Results on the Prediction of Adherence to a Provider's Recommendation for OSA Follow-Up

Predictor	Odds Ratio	95% CI Lower	95% CI Upper	P value
Demographics				
Age	0.95	0.90	1.01	0.072
Sex (reference: male)	3.13	0.36	27.48	0.303
Marital status (reference: not currently partnered or living with someone)	1.95	0.22	17.47	0.549
Education (reference: some college or less)	0.96	0.22	4.25	0.962
Employment (reference: not currently employed)				
Employed full- or part-time	0.97	0.10	9.83	0.978
Retired	0.67	0.05	8.73	0.757
Income (reference: less than \$50,000 annually)	3.71	0.42	32.52	0.237
Insurance (reference: insured through self or employer)	0.43	0.08	2.33	0.327
BMI	1.05	0.96	1.15	0.313
Comorbidities (reference: <2 comorbidities)	0.22	0.04	1.23	0.084
Information received on day of procedure (reference: no information received)				
Notified of risk and/or given information about OSA only	0.49	0.04	5.48	0.560
Given a recommendation or referral for follow-up only	3.60	0.28	46.36	0.326
Notified of or given information regarding OSA and given a recommendation or referral	0.86	0.04	16.85	0.919
Perceived Risk				
OSA is a serious condition	2.45	0.82	7.37	0.110
Perceived likelihood of having OSA	3.41	1.31	8.89	0.012
OSA Risk and Symptoms				
OSA risk status (reference: moderate risk)	1.58	0.29	8.62	0.595
Insomnia (ISI)	1.21	1.05	1.41	0.009
Daytime sleepiness (ESS)	1.34	1.11	1.63	0.003
Functional impairment (FOSQ-10)	0.64	0.47	0.87	0.005
Health Literacy				
HLQ – Healthcare provider support and understanding	1.48	0.27	8.07	0.652
HLQ – Sufficiency of information to manage health	0.62	0.10	3.64	0.592
HLQ – Actively managing health	1.04	0.23	4.82	0.959
HLQ – Social support for health	0.19	0.04	1.06	0.058
HLQ – Appraisal of health information	1.63	0.33	8.12	0.553
HLQ – Ability to engage with healthcare providers	0.70	0.18	2.64	0.594
HLQ – Navigating the healthcare system	0.74	0.20	2.76	0.651
HLQ – Ability to find good health information	0.61	0.18	2.13	0.442
HLQ – Understand health information well enough to know what to do	1.52	0.34	6.69	0.587
Abbreviations: BMI=Body Mass Index; ESS=Epworth Sleepiness Scale; ISI=Insomnia Severity Index; FOSQ-10=Functional Outcomes of Sleep Questionnaire-10; HLQ=Health Literacy Questionnaire; OSA=obstructive sleep apnea				
Notes: *High risk for OSA = overall STOP-Bang ≥ 5 or STOP ≥ 2 + BMI > 35 kg/m ² OR male sex				

With every unit increase in the ISI and ESS (i.e., worsening insomnia and daytime sleepiness), participants were, respectively, 1.21 and 1.34 times more likely to adhere to a

recommendation (ISI 95% CI [1.05, 1.41], $p = 0.009$; ESS 95% CI [1.11, 1.63], $p = 0.003$). For every unit increase in the FOSQ-10 (i.e., less functional impairment related to sleepiness), participants were 36% less likely to adhere to a recommendation (OR = 0.64, 95% CI [0.47, 0.87], $p = 0.005$). Unadjusted models also showed that with each increase in rank of a person's perceived likelihood of having OSA (e.g., advancing from "neutral" to "agree") the likelihood of adhering to a provider's recommendation increased 3.41 times (95% CI [1.31, 8.89], $p = 0.012$).

Factors identified as trending toward significance ($p < 0.10$) in unadjusted models included age, comorbidities, and social support for health. Using simultaneous entry logistic regression for adjusted analyses (see Table 5), none of the factors identified in unadjusted models as significant or trending toward significance were found to have a significant association with adherence to a provider's recommendation for OSA follow-up. Using forward stepwise logistic regression, the final model indicating best fit included daytime sleepiness (ESS) as a single predictor, with likelihood of adherence to a provider's recommendation for OSA follow-up increasing 1.33 times with every unit increase on the ESS (95% CI [1.09, 1.62], $p = 0.004$).

Table 5 Logistic Regression Results Using Simultaneous and Forward-Stepwise Approaches

Simultaneous Entry					
Model	Predictor	OR	95% CI Lower	95% CI Upper	P value
N/A	Age	0.99	0.92	1.07	0.825
	Comorbidities	1.10	0.09	14.17	0.944
	Perceived likelihood of having OSA	1.97	0.54	7.16	0.304
	ISI	1.02	0.80	1.30	0.894
	ESS	1.16	0.86	1.58	0.347
	FOSQ-10	0.88	0.50	1.56	0.660
	HLQ-4 Social Support for Health	0.38	0.04	3.32	0.380
Forward Stepwise Entry					
Model 1	ESS	1.33	1.09	1.62	0.004
Abbreviations: ESS=Epworth Sleepiness Scale; ISI=Insomnia Severity Index; FOSQ-10=Functional Outcomes of Sleep Questionnaire-10; HLQ=Health Literacy Questionnaire; OSA=obstructive sleep apnea Variables excluded: age, comorbidities, perceived likelihood of having OSA, ISI, FOSQ-10, HLQ-4 Social Support					

3.2.4.4 Examining Differences by Age, Sex, and Marital Status

To examine potential differences based on age, sex, and marital status among factors associated with adherence to a provider’s recommendation for OSA follow-up, forward stepwise linear regression was performed using a person’s OSA care-seeking intention as a proxy for adherence. Using simple linear regression, factors at least trending toward a significant ($p < 0.1$) association with OSA care-seeking intention were considered for entry into stepwise models. These included age ($p = 0.062$), information received on the day of the procedure ($p = 0.074$), perceived likelihood of having OSA ($p < 0.001$), OSA risk status ($p = 0.025$), ISI ($p < 0.001$), ESS ($p < 0.001$), and FOSQ-10 ($p < 0.001$). After entry of these factors into a regression model using a forward stepwise approach, the FOSQ-10 and perceived likelihood of having OSA were identified in model 2 as the most influential factors associated with intention in the sample overall (see Table 6).

Table 6 Forward Stepwise Linear Regression of Predictors Most Influential to OSA Care-Seeking Intention

Model	Predictor	Unstd. B	95% CI Lower	95% CI Upper	P value	R Square	Semi Partial Correlation
Model 1	FOSQ-10	-6.38	-8.94	-3.81	<0.001	0.28	-0.54
Model 2	FOSQ-10	-4.58	-7.50	-1.66	0.003	0.35	-0.33
	Perceived Likelihood of Having OSA	9.18	1.33	17.03	0.023		0.24
Abbreviations: FOSQ-10=Functional Outcomes of Sleep Questionnaire-10; OSA=obstructive sleep apnea Excluded variables: age, ISI, ESS, information received on the day of the procedure, OSA risk status							

The final 2-predictor model showed that for every unit increase in the FOSQ-10, intention of seeking OSA care decreased by 4.58 points (95% CI [-7.50, -1.66], $p = 0.003$), and that with each increase in rank of a person’s perceived likelihood of having OSA, OSA care-seeking intention increased by 9.18 points (95% CI 1.33, 17.03], $p = 0.023$). Table 7 displays the results of the final model, stratified by age, sex, and marital status.

Table 7 Linear Regression of FOSQ-10 and Perceived Likelihood of Having OSA on OSA Care-Seeking Intention, Stratified by Age, Sex, and Marital Status

Factor	Strata	Predictor	Unstd. B	95% CI Lower	95% CI Upper	P value	R Square	Semi Partial Correlation
Age	≤ 60 years	FOSQ-10	-8.00	-13.19	-2.81	0.004	0.49	-0.43
		Perceived Likelihood of Having OSA	7.40	-6.16	20.92	0.272		0.15
	> 60 years	FOSQ-10	-3.03	-6.79	0.72	0.109	0.26	-0.27
		Perceived Likelihood of Having OSA	9.13	-1.38	19.63	0.086		0.28
Sex	Female	FOSQ-10	-6.47	-10.81	-2.12	0.006	0.51	-0.57
		Perceived Likelihood of Having OSA	0.81	-15.23	16.85	0.916		0.02
	Male	FOSQ-10	-4.18	-8.13	-0.22	0.039	0.35	-0.27
		Perceived Likelihood of Having OSA	11.65	1.38	20.93	0.015		0.32
Marital Status	Unmarried/ Unpartnered	FOSQ-10	-10.61	-19.82	-1.40	0.028	0.57	-0.53
		Perceived Likelihood of Having OSA	15.58	-0.15	31.32	0.052		0.46
	Married/ Partnered	FOSQ-10	-4.47	-7.77	-1.17	0.009	0.33	-0.32
		Perceived Likelihood of Having OSA	7.43	-2.01	16.86	0.120		0.19
Abbreviations: FOSQ-10=Functional Outcomes of Sleep Questionnaire-10; OSA=obstructive sleep apnea								

3.2.4.4.1 Age

When stratifying by age using a median split of the sample at age 60 (≤ 60 vs. > 60 year), functional impairment related to sleepiness was only significant for the younger age group. For each unit increase in the FOSQ-10, OSA care-seeking intention decreased by 8 points among individuals 60 years and younger (95% CI [-13.19, -2.81], $p = 0.004$). Perceived likelihood of having OSA was not significant in the younger group ($p = 0.272$), but showed a trending association with intention in individuals older than 60 years ($B = 9.13$, 95% CI [-1.38, 19.63], $p = 0.086$).

3.2.4.4.2 Sex

Among women, only functional impairment related to sleepiness was significantly associated with OSA care-seeking intention, that for each unit increase in the FOSQ-10, intention decreased by 6.47 points (95% CI [-10.81, -2.12], $p = 0.006$). Perceived likelihood of having OSA among women was not significant ($p = 0.916$). Among men, both the FOSQ-10 and perceived likelihood of having OSA were significantly associated with intention. For every unit increase in the FOSQ-10, OSA care-seeking intention among men decreased by 4.18 points (95% CI [-8.13, -0.22], $p = 0.039$), and with each increase in rank of a man's perceived likelihood of having OSA, intention to seek OSA care increased by 11.65 points (95% CI [1.38, 20.93], $p = 0.015$).

3.2.4.4.3 Marital Status

Functional impairment related to sleepiness was significantly associated with OSA care-seeking intention in both unmarried/unpartnered and married/partnered individuals, such that for every unit increase in the FOSQ-10, OSA care-seeking intention decreased by 10.61 and 4.47 points, respectively (95% CI [-19.82, -1.40], $p = 0.028$ and 95% CI [-7.77, -1.17], $p = 0.009$). A trending association between perceived likelihood of having OSA and OSA care-seeking intention was noted among unmarried/unpartnered individuals, but not in married/partnered individuals. Among unmarried/unpartnered individuals, with each increase in rank in their perceived likelihood of having OSA, OSA care-seeking intention increased 15.58 times (95% CI [-0.15, 31.32], $p = 0.052$).

3.2.5 Discussion

To our knowledge, this is the first study examining factors associated with OSA care-seeking in a sample of patients identified as at risk for OSA in the perianesthesia setting who received a recommendation for follow-up evaluation. The findings of this study indicate that despite being notified of their risk for OSA and receiving a recommendation for follow-up evaluation, adherence to a provider's recommendation for OSA evaluation is low (12.7%) in patients screened for OSA as part of an outpatient procedure under anesthesia. Unadjusted analyses in this study identified a heightened perceived risk of having OSA, excessive daytime sleepiness, insomnia, and functional impairment related to sleepiness as associated with adherence to a provider's recommendation for OSA follow-up. Further, associations trending toward significance with adherence to a provider's recommendation for OSA follow-up were younger age, 1 or no comorbidities, and increased social support for health as a facet of health literacy. Of these factors, excessive daytime sleepiness was identified through forward stepwise regression as the strongest factor predicting adherence to a provider's recommendation.

When examining OSA care-seeking intention as a proxy for adherence to a provider's recommendation, functional impairment related to sleepiness and a perceived likelihood of OSA were identified as the strongest predictors, with the FOSQ-10 most consistently predicting intention across groupings by age, sex, and marital status. Perceived likelihood of having OSA was significantly associated with OSA care-seeking intention in men, with trends toward significance noted among unmarried/unpartnered individuals, and those aged 60 years or younger.

We found that adherence to a provider's recommendation for OSA follow-up was low in this sample of patients (12.7%), in spite of the majority receiving some type of information in-person about OSA on the day of the procedure (i.e., given information about OSA, notified of their

at-risk status, and/or given a recommendation or referral for follow-up) in addition to the mailed letter they received notifying them of their risk. The adherence rate noted in our study is considerably lower than what has been reported in other cross-sectional studies occurring outside of the perianesthesia setting, with adherence rates ranging from 18.3% to 76.5% (see data in Aim 1 manuscript). This difference may be attributable, in part, to many of those studies taking place within the context of a patient's longer-term relationship with a healthcare provider, including a recommendation or referral for OSA evaluation originating from primary care and dentistry. This contrasts with the perianesthesia setting, where a patient's relationship with the perianesthesia provider is generally limited to a brief episode of care.

Within the perianesthesia setting, only two known studies exist examining adherence to a recommendation for OSA evaluation in patients identified preoperatively as at risk for OSA. In a sample of Turkish patients identified as at-risk for OSA in a preoperative clinic and referred to a sleep laboratory for OSA diagnosis, 44% of patients completed a sleep study (Fidan et al., 2006). In an observational study of pre-surgical patients screened as high risk for OSA as part of a preoperative clinic workup and referred for in-lab PSG, only half of these patients completed testing prior to their procedure, despite minimal administrative barriers and enhanced availability of sleep laboratory resources (Guralnick et al., 2012).

The higher rates of adherence noted in the aforementioned studies in comparison to the present findings may be attributed to participants in these other studies receiving OSA risk notification and recommendation/referral in a clinic setting, prior to the day of surgery. When receiving OSA risk notification or recommendation/referral prior to the day of surgery, patients may view the impending receipt of anesthesia as an additional motivator to complete an OSA evaluation. It is fairly unlikely that the participants in our study would have experienced this

potential additional motivation for OSA evaluation, as the vast majority did not receive OSA screening information or follow-up recommendation until the day of their procedure and/or after their procedure was finished. Other differences in our sample compared to these two studies, particularly those related to a racially homogenous, predominantly male sample of patients undergoing GI-related procedures, may also contribute to the considerably lower rate of adherence noted in our sample. In addition, advancements in OSA screening practices over time have occurred since these studies were published, which may also contribute to these differences in adherence. However, aside from a lack of significant findings between age, BMI, and sex and completion of a sleep study after provider referral reported by Fidan and colleagues (2006), these studies did not identify other factors associated with adherence to a recommendation/referral for OSA evaluation. Thus, it is difficult to know the extent to which these differences among samples may impact adherence. Further research is warranted to understand the role of perianesthesia OSA screening and risk notification, and other factors associated with OSA care-seeking in this patient population.

We found that excessive daytime sleepiness, as measured by ESS, was the strongest factor to predict adherence to a provider's recommendation for OSA evaluation. This finding aligns with findings in three studies which have explored factors associated with completion of an OSA evaluation outside of the perianesthesia context. In a large cohort study based in the United States, Gordon and colleagues (2018) found that adults experiencing excessive daytime sleepiness were 1.2 times more likely to complete an OSA evaluation than their counterparts who did not experience this symptom. Jean-Louis and colleagues (2008) found that daytime sleepiness independently predicted adherence to a recommendation for OSA evaluation, with those experiencing this symptom being 7 times more likely to complete an OSA evaluation. Munks and

colleagues (2019) found that compared to those with an ESS score of less than 10, individuals who had an ESS score of 10 or greater had a significantly higher rate of making lifestyle changes to address their sleep issues and/or seeking help from a healthcare provider in response to learning they were at risk for OSA determined through in-home sleep monitoring (88.0% vs. 63.5%, $p = 0.020$). However, that association was not evaluated in multivariable models, so it is unclear if other confounding factors may have been present.

The finding that excessive daytime sleepiness is the strongest predictor of adherence to a provider's recommendation for OSA evaluation is similar to the secondary finding that functional impairment related to sleepiness appears to drive OSA care-seeking intention. We found significant associations between functional impairment related to sleepiness and care-seeking intention across groupings by sex and marital status and among younger adults. Although the ESS and FOSQ-10 are separate scales aiming to measure different aspects of daytime sleepiness, considerable overlap remains in their central focus on daytime sleepiness, where the ESS measures the extent to which a person is subjectively experiencing daytime sleepiness and the FOSQ-10 seeks to examine the impact of sleepiness on activities of daily living. This overlap has been noted previously with studies describing significant correlations between the FOSQ and FOSQ-10 and ESS (Chasens et al., 2011; Gooneratne et al., 2003; Weaver et al., 2021).

In spite of the dearth of studies examining functional status via measured scales on completion of an OSA evaluation, multiple qualitative and mixed methods studies have, in other ways, identified functional impairments related to sleepiness as facilitators to OSA care-seeking. These facilitating factors include social consequences and the negative impact of symptoms on daily living (Aalaei, Amini, Taghipour, et al., 2021; Sawyer et al., 2010), negative effects of OSA-related symptoms on individuals within a person's social network (Zarhin, 2018), and the negative

impact of OSA-related symptoms on a person's work performance (Henry & Rosenthal, 2013; Waldman et al., 2020). While these studies suggest that daily functioning plays a role in OSA care-seeking, further research is warranted, using measured scales, to better establish a link between adherence to a provider's recommendation for OSA evaluation and a person's daily functioning as it pertains to sleep.

Functional impairment related to sleepiness was identified in our study as an important predictor of OSA care-seeking intention regardless of sex or marital status. However, when examining this association by age, we found that functional impairment related to sleepiness may only be a factor driving OSA care-seeking intention in younger individuals. Unfortunately, no known studies have examined the extent to which a person's functional status may moderate the association between adherence to a provider's recommendation for OSA evaluation or OSA care-seeking intention, so it is difficult to position this finding in the context of other studies. In our study, 71% of the subsample age 60 and younger was employed full-time while only 25% of their counterparts over the age of 60 were employed full-time. The finding that functional impairment related to sleepiness may drive OSA care-seeking intention in younger adults may be partly due to the effects of sleepiness within the workplace, which has been noted as a substantial burden among individuals dealing with excessive daytime sleepiness (Waldman et al., 2020). It is also plausible that this finding may reflect lesser acceptance of a decreased quality of life and functional impairment among younger adults compared to their older counterparts (Brouwer et al., 2005), thus facilitating OSA care-seeking. Further, the lack of a significant association between FOSQ-10 and OSA care-seeking intention in the older age group may also reflect older adults' beliefs and perceptions of what constitutes normal and, by extension, acceptable age-related changes to sleep (Gooneratne & Vitiello, 2014; Li et al., 2018), as an association has been noted previously

between quality of life and beliefs surrounding sleep (Sella et al., 2022). Continued examination on the role of age in OSA care-seeking, specifically related to its relationship with daily functioning, is recommended.

Though findings examining a moderating effect of age and marital status on the association between perceived likelihood of having OSA and OSA care-seeking intention were unremarkable, we found that perceived likelihood of having OSA is significantly associated with OSA care-seeking in men, but not women. Perceived risk of OSA has only been examined in a single study focused on adherence to a provider's recommendation for OSA evaluation. Jean-Louis and colleagues (2017) did not find perceived OSA risk to be significantly associated with adherence to a provider's recommendation for OSA evaluation in their sample, which, although was racially different from our sample, was largely comprised of women (71%). This lack of association between perceived risk of OSA and follow-up, particularly as it may apply to women, is similar to what we found in our subgroup analyses, that perceived risk of OSA was only significantly associated with OSA care-seeking intention among men, not women. However, this finding must be interpreted with caution, as the sample of women in the present study was quite small.

While little evidence exists regarding an association between OSA risk perception and care-seeking among men, the finding that an increased perceived likelihood of having OSA was significantly associated with OSA care-seeking intention in this group aligns with studies outside of the OSA realm. In a systematic review of barriers and facilitators to health screening in men, Teo and colleagues (2016) reported that a man's perception of being at-risk for a disease was the most frequently identified facilitator of health screening, reported in 31 out of 68 studies. While our findings may align with literature outside of the context of OSA, further research is necessary to understand the role of risk perception on OSA evaluation and care-seeking overall, and what

differences, if any, exist by sex. Additionally, because the associations between perceived likelihood of having OSA and groupings by age and marital status were, at best, trending toward significance, more exploration of these potential differences is warranted.

Given its status as a major factor to the elimination of health disparities and assurance of health equity, we attempted to examine health literacy in this study, particularly considering a lack of measured health literacy in OSA-related literature overall. Only a trending association was found in unadjusted analyses which suggests increased social support as having a negative impact on adherence to a provider's recommendation for OSA evaluation. All other subscales of the HLQ were not significantly associated with adherence to a provider's recommendation for OSA or OSA care-seeking intention. Although a paucity of evidence exists surrounding health literacy in the context of OSA, adequate health literacy has been shown to positively impact uptake of screening practices in men (Nguyen et al., 2021; Oliffe et al., 2019) and women alike (Komenaka et al., 2015; Mazor et al., 2014). In light of this, the lack of significant associations found between health literacy measures and adherence to a provider's recommendation for OSA was rather surprising. This lack of associations may be due, in part, to stronger health literacy of our participants as evidenced by mean subscale scores consistently above all scale midpoints and a potential attenuating effect related to low variability in HLQ responses. Because health literacy remains a somewhat novel concept to OSA care-seeking, a critical need remains to examine this important social determinant of health in future studies focused on OSA care and care-seeking.

There are several limitations to our study, perhaps the most significant being a small sample size which limited our ability to adequately power larger regression models in examining the sample overall as well as by strata. Our sample lacked racial and ethnic diversity as the entirety of our sample was white, non-Hispanic adults, the majority of whom were male. The lack of

representation of women in this study may be due, in part, to using the STOP-Bang as a criterion for study eligibility, as this measure places men at greater risk of having OSA, despite nearly equal prevalence in some age groups (Wimms et al., 2016). Because the proportion of women was substantially smaller than men, results of regression analyses in this group should be interpreted with caution. Likewise, our sample was largely married/partnered, which also warrants caution when interpreting regression results in the unmarried/unpartnered group. This study utilized largely cross-sectional data, the nature of which does not allow for inference of causal relationships. The measures utilized in our study were reliant on participants' self-report, which may be prone to errors in recall.

While this study was intended to assess adherence to a provider's recommendation for OSA evaluation among patients undergoing outpatient procedures of all types in both hospital and ambulatory-based facilities, the majority of our sample was comprised of patients at ambulatory-based facilities. Further, the majority of our sample underwent GI-related procedures (colonoscopy or esophagogastroduodenoscopy), which is of note as the process and extent of recovery may differ from outpatient surgical procedures. Our sample was also made up of individuals with a STOP-Bang score of 3 or greater, which was determined by procedures already established in the organization where this study took place. Although this may be considered a low threshold for risk notification and recommending follow-up evaluation, two-thirds of our sample was considered at high-risk for OSA by conventional and/or alternative STOP-Bang scoring.

It is unknown the degree to which participants were aware of their OSA risk and/or had already intended to seek care before being notified of their risk on the day of their procedure. We attempted to assess this to an extent by asking participants if they had completed a pre-procedure physical examination with a primary care provider prior to the day of their procedure, and if yes,

received any OSA-related information at that time. We found the proportion of individuals having received OSA information prior to their procedure at a clearance visit was small (n=7) and was not significantly different between those who did and did not adhere to a provider's recommendation for an OSA evaluation, thus it was not explored further. However, patients often delay seeking care for OSA symptoms for many years (Henry & Rosenthal, 2013; Ye et al., 2022; Zarhin, 2018), thus it is possible that individuals in our sample were aware of their OSA risk prior to any anesthesia-related proceedings, which could have impacted their OSA care-seeking intention and action. This could explain why information received on the day of the procedure related to OSA risk notification/and or recommendation for follow-up was not significantly associated with adherence to a provider's recommendation for OSA evaluation. However, it is difficult to determine the basis of these lacking associations without performing these group comparisons directly, including, at minimum, participants who received risk notification and recommendation for follow-up by mail only, received information on the day of the procedure in addition to mail, and received information at a pre-procedure clearance visit in addition to mail/and or the day of the procedure.

3.2.6 Conclusion

The findings of this study suggest that experiencing excessive daytime sleepiness and impacts on daily functioning related to this symptom are important drivers of health behavior and intentions related to OSA care-seeking in patients at-risk for OSA identified in the perianesthesia setting. However, functional impairment related to sleepiness may not be as important to OSA care-seeking intention in older adults. Our findings also suggest that depending on a person's sex, perceived likelihood of having OSA may hold a differing level of importance in OSA care-seeking

intention. Perianesthesia providers should consider assessing the degree to which individuals identified as at-risk for OSA experience excessive daytime sleepiness and the impact it has on their daily functioning, as well as their perception of OSA risk. In doing so, perianesthesia providers may be able to enhance their efforts to promote OSA evaluation by identifying those at-risk for OSA who may be more inclined to forego OSA care-seeking and further support efforts to address the greater issue of OSA underdiagnosis.

Appendix A Study Questionnaires for Aims 2 & 3

Demographics Questionnaire

1. What is your age? _____

2. What is your current employment status?

- Employed full time
- Employed part time
- Homemaker, not working outside the home
- Retired
- Unemployed, on disability
- Unemployed, not on disability
- Full-time student
- Other (please specify)

3. Which category best describes the highest grade or educational level that you have achieved?

- 8th grade or less
- Some high school
- High school graduate or GED
- Trade or technical school
- Some college, no degree
- College graduate
- Graduate/professional training (MA, MBA, PhD, MD, JD, etc.)
- Decline to answer
- Don't know

4. To help us characterize the economic status of our study participants, please indicate which category best describes the combined annual income, before taxes, of all members of your household for the last year.

- Less than \$25,000
- \$25,000 - \$49,999
- \$50,000 - \$99,999
- \$100,000 or more
- Don't know

5. In terms, of these ethnic categories, how do you identify yourself?

- Hispanic or Latino
- Not Hispanic or Latino
- Unknown

6. What is your primary racial background?

- White
- Black or African American
- American Indian or Alaska Native
- Asian
- Native Hawaiian
- Other (please specify)
- Unknown

7. What is your marital status? (Check one box only)

- Never married, not living with partner/significant other
- Never married, living with partner/significant other
- Married
- Separated
- Divorced
- Widowed
- Other (please specify)

8. Do you currently have health insurance?

- Yes, I have an individual plan (not paid for by an employer)
- Yes, I have a group plan through my employer
- Yes, I have Medicare or Medicaid
- Yes, I have a US Governmental health plan (Military, CHAMPUS, VA, etc.)
- Yes, I have another type of insurance not listed (please specify)
- No, I am currently uninsured

Please provide information about your recent outpatient procedure under anesthesia/sedation.

9. What was the date of your procedure?

Month, Day, Year

10. Where did your procedure take place?

- Westmoreland Hospital
- Latrobe Hospital
- Frick Hospital
- Norwin Surgery Center
- Laurel Surgery Center

11. What was the general nature of your recent outpatient procedure?

- General or Vascular surgery (examples: gallbladder, hernia, breast, veins)
- Orthopedic surgery – upper extremity (examples: hand or shoulder)
- Orthopedic surgery – lower extremity (examples: knee, foot, or hip)
- Urologic (examples: urinary tract, bladder, kidneys, prostate)
- Gynecologic (examples: d&c, hysterectomy or hysteroscopy, tubal ligation)
- Ear/Nose/Throat (examples: ear tubes, septoplasty, tonsillectomy, thyroid)
- GI lab procedure (examples: colonoscopy or EGD)
- Other (please specify)

Medical History Form

Do you NOW or did you EVER have any of the following medical conditions?

- | | | | | | | |
|--|--------------------------|------|--------------------------|------|--------------------------|------------|
| 1. Heart Failure | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> | Don't know |
| 2. Peripheral vascular disease | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> | Don't know |
| 3. High Blood Pressure | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> | Don't know |
| 4. High Cholesterol | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> | Don't know |
| 5. Kidney Disease | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> | Don't know |
| 6. Stroke | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> | Don't know |
| 7. Chronic Obstructive Pulmonary Disease (COPD) | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> | Don't know |
| 8. Rheumatoid Arthritis | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> | Don't know |
| 9. Coronary Artery Disease | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> | Don't know |
| 10. Asthma | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> | Don't know |
| 11. Diabetes | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> | Don't know |
| <i>If yes, which type of diabetes do/did you have?</i> | <input type="checkbox"/> | Type | <input type="checkbox"/> | Type | <input type="checkbox"/> | Don't know |
| | <input type="checkbox"/> | 1 | <input type="checkbox"/> | 2 | <input type="checkbox"/> | Don't know |
| 12. Have you been diagnosed with any sleep Disorder (other than sleep apnea) | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> | Don't know |
| <i>If YES, please specify:</i> | | | | | | |
| 13. Do you have any other medical conditions not previously mentioned? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No | | |
| <i>If YES, please specify:</i> | | | | | | |

STOP-Bang Questionnaire

Chung, F. (2008)

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 the day?	Yes	No	
Has anyone observed you stop breathing in your sleep?	Yes	No	
Do you have or are you being treated for high blood pressure?	Yes	No	
Are you older than 50 years of age?	Yes, I am age 51 or older	No, I am age 50 or younger	
Is your neck circumference (shirt collar measurement or measurement around your neck at the Adam's apple) 16 inches or larger?	Yes (16 inches or larger)	No (Less than 16 inches)	I don't know
What is your biological sex (sex assigned at birth)?	Male	Female	
What is your height (in inches)?			
What is your weight (in pounds)?			
Based on your height and weight, your body mass index or BMI is:	<i>[Automatically calculated based on height and weight entered above]</i>		
Based on the value above, is your BMI over 35?	Yes, my BMI is 35.01 or more	No, my BMI is 35.00 or less.	

Perceived Seriousness and Likelihood of Having OSA Questionnaire

Based on your knowledge of sleep apnea, please indicate your level of agreement to the following statement:

	Strongly Disagree	Disagree	Neutral (neither agree nor disagree)	Agree	Strongly Agree
Sleep apnea is a serious condition.					

Based on your knowledge of sleep apnea, how likely do you think it is that you have sleep apnea?

		Neutral (equal likelihood of having or not having sleep apnea)		
Very Unlikely	Unlikely		Likely	Very Likely

The Health Literacy Questionnaire (HLQ)

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Feeling understood and supported by healthcare providers				
How strongly do you disagree or agree with the following statements:				
	Strongly disagree	Disagree	Agree	Strongly agree
I have at least one healthcare provider who knows me well				
I have at least one healthcare provider I can discuss my health problems with				
I have the healthcare providers I need to help me work out what I need to do				
I can rely on at least one healthcare provider				
Having sufficient information to manage my health				
How strongly do you disagree or agree with the following statements:				
	Strongly disagree	Disagree	Agree	Strongly agree
I feel I have good information about health				
I have enough information to help me deal with my health problems				
I am sure I have all the information I need to manage my health effectively				
I have all the information I need to look after my health				
Actively managing my health				
How strongly do you disagree or agree with the following statements:				
	Strongly disagree	Disagree	Agree	Strongly agree
I spend quite a lot of time actively managing my health				
I make plans for what I need to do to be healthy				
Despite other things in my life, I make time to be healthy				
I set my own goals about health and fitness				
There are things that I do regularly to make myself more healthy				
Social support for health				
How strongly do you disagree or agree with the following statements:				
	Strongly disagree	Disagree	Agree	Strongly agree
I can get access to several people who understand and support me				
When I feel ill, the people around me really understand what I am going through				
If I need help, I have plenty of people I can rely on				

I have at least one person who can come to medical appointments with me				
I have strong support from family or friends				

Appraisal of health information				
How strongly do you disagree or agree with the following statements:				
	Strongly disagree	Disagree	Agree	Strongly agree
I compare health information from different sources				
When I see new information about health, I check up on whether it is true or not				
I always compare health information from different sources and decide what is best for me				
I know how to find out if the health information I receive is right or not				
I ask healthcare providers about the quality of the health information I find				

Ability to actively engage with healthcare providers					
How easy or difficult are the following tasks for you to do now:					
	Cannot do or Always difficult	Usually difficult	Sometimes difficult	Usually easy	Always easy
Make sure that healthcare providers understand your problems properly					
Feel able to discuss your health concerns with a healthcare provider					
Have good discussions about your health with doctors					
Discuss things with healthcare providers until you understand all you need to					
Ask healthcare providers questions to get the health information you need					
Navigating the healthcare system					
How easy or difficult are the following tasks for you to do now:					
	Cannot do or Always difficult	Usually difficult	Sometimes difficult	Usually easy	Always easy
Find the right health care					
Get to see the healthcare providers you need to					
Decide which healthcare provider you need to see					
Make sure you find the right place to get the health care you need					
Find out which healthcare services you are entitled to					

Work out what the best care is for you					
--	--	--	--	--	--

Ability to find good health information

How easy or difficult are the following tasks for you to do now:

	Cannot do or Always difficult	Usually difficult	Sometimes difficult	Usually easy	Always easy
Find information about health problems					
Find health information from several different places					
Get information about health so you are up to date with the best information					
Get health information in words you understand					
Get health information by yourself					

Understand health information well enough to know what to do

How easy or difficult are the following tasks for you to do now:

	Cannot do or Always difficult	Usually difficult	Sometimes difficult	Usually easy	Always easy
Confidently fill medical forms in the correct way					
Accurately follow the instructions from healthcare providers					
Read and understand written health information					
Read and understand all the information on medication labels					
Understand what healthcare providers are asking you to do					

Epworth Sleepiness Scale (ESS)

Epworth Sleepiness Scale (ESS)

ESS © MW Johns 1990-1997. Used under License.

How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired?

This refers to your usual way of life in recent times.

Even if you haven't done some of these things recently, try to work out how they would have affected you.

Use the following scale to choose the **most appropriate number for each situation**:

0 = would **never** doze

1 = **slight chance** of dozing

2 = **moderate chance** of dozing

3 = **high chance** of dozing

It is important that you answer each question as best you can.

	0 Would never doze	1 Slight chance of dozing	2 Moderate chance of dozing	3 High chance of dozing
Sitting and reading				
Watching TV				
Sitting, inactive in a public place (e.g., a theatre or a meeting)				
As a passenger in a car for an hour without a break				
Lying down to rest in the afternoon when the circumstances permit				
Sitting and talking to someone				
Sitting quietly after a lunch without alcohol				
In a car, while stopped for a few minutes in the traffic				

For any information on the use of the ESS, please contact Mapi Research Trust, Lyon, France.
Internet: <https://eprovide.mapi-trust.org>

Insomnia Severity Index (ISI)

Insomnia Severity Index (ISI)

ISI : © Morin, C.M. (1993 and 1996) ISI-Clinician version: © Morin, C.M. (1993, 1996, 2000, 2006)

For each question, please choose the number that best describes your answer.

Please rate the CURRENT (i.e. LAST 2 WEEKS) SEVERITY of your insomnia problem(s).

Insomnia problem	0 None	1 Mild	2 Moderate	3 Severe	4 Very severe
Difficulty falling asleep					
Difficulty staying asleep					
Problem waking up too early					

How SATISFIED/DISSATISFIED are you with your CURRENT sleep pattern?

Very Satisfied	Satisfied	Moderately Satisfied	Dissatisfied	Very Dissatisfied
0	1	2	3	4

How NOTICEABLE to others do you think your sleep problem is in terms of impairing the quality of your life?

Not at all Noticeable	A Little	Somewhat	Much	Very Much Noticeable
0	1	2	3	4

How WORRIED/DISTRESSED are you about your current sleep problem?

Not at all Worried	A Little	Somewhat	Much	Very Much Worried
0	1	2	3	4

To what extent do you consider your sleep problem to INTERFERE with your daily functioning (e.g. daytime fatigue, mood, ability to function at work/daily chores, concentration, memory, mood, etc.) CURRENTLY?

Not at all Interfering	A Little	Somewhat	Much	Very Much Interfering
0	1	2	3	4

For any information on the use of the ISI, please contact Mapi Research Trust, Lyon, France.
Internet: <https://eprovide.mapi-trust.org>

Functional Outcomes of Sleep Questionnaire-10 (FOSQ-10)

Some people have difficulty performing everyday activities when they feel tired or sleepy. The purpose of this questionnaire is to find out if you generally have difficulty carrying out certain activities because you are too sleepy or tired. In this questionnaire, when the words “sleepy” or “tired” are used, it means the feeling that you can’t keep your eyes open, your head is droopy, that you want to “nod off”, or that you feel the urge to take a nap. These words do not refer to the tired or fatigued feeling you may have after you have exercised.

DIRECTIONS: Please put a check (✓) in the box for your answer to each question. Select only **one** answer for each question. Please try to be as accurate as possible. All information will be kept confidential.

(0) I don't do this activity for other reasons	(4) No difficulty	(3) Yes, a little difficulty	(2) Yes, moderate difficulty	(1) Yes, extreme difficulty
---	-------------------------	---------------------------------------	---------------------------------------	--------------------------------------

- | | | | | |
|--|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. Do you have difficulty concentrating on the things you do because you are sleepy or tired? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Do you generally have difficulty remembering things because you are sleepy or tired? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Do you have difficulty operating a motor vehicle for <u>short</u> distances (less than 100 miles) because you become sleepy or tired? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Do you have difficulty operating a motor vehicle for <u>long</u> distances (greater than 100 miles) because you become sleepy or tired? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Do you have difficulty visiting with your family or friends in <u>their</u> home because you become sleepy or tired? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

(4) No	(3) Yes, a little	(2) Yes, moderately	(1) Yes, extremely
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6. Has your relationship with family, friends or work colleagues been affected because you are sleepy or tired?

(0) I don't do this activity for other reasons	(4) No difficulty	(3) Yes, a little difficulty	(2) Yes, moderate difficulty	(1) Yes, extreme difficulty
--	-------------------------	------------------------------------	---------------------------------------	--------------------------------------

7. Do you have difficulty watching a movie or videotape because you become sleepy or tired?

8. Do you have difficulty being as active as you want to be in the evening because you are sleepy or tired?

9. Do you have difficulty being as active as you want to be in the morning because you are sleepy or tired?

(0) I don't engage in sexual activity for other reasons	(4) No	(3) Yes, a little	(2) Yes, moderately	(1) Yes, extremely
--	-----------	----------------------------	---------------------------	--------------------------

10. Has your desire for intimacy or sex been affected because you are sleepy or tired?

Thank you for completing this questionnaire.

Type of OSA Information Received

The Perianesthesia Encounter: From the time you entered the hospital/facility on the day of your procedure, to the time you were discharged home after your procedure, did your care providers give you any of the following information about the sleep disorder, sleep apnea (*select all that apply*):

- I was told I am at-risk for or might have sleep apnea
- I was given information about the risks, symptoms (snoring, daytime sleepiness, choking or gasping during sleep), and/or treatments of sleep apnea (weight loss, oral appliances, CPAP)
- It was recommended (by a doctor or nurse) that I follow-up with my primary care provider
- I was given a referral to a sleep clinic or specialist for further evaluation to see if I have sleep apnea
- Other (please describe: _____)
- I did not receive any information or education related to sleep apnea on the day of my procedure.

Pre-Procedure (Clearance with Primary Care): Prior to the day of your procedure, did you have to complete an appointment (such as a physical) with a primary care provider in order to be given approval or “clearance” to have your procedure?

- Yes
- No
- Don't know

(If Yes): During your appointment/physical for approval or “clearance” for your procedure, did a primary care provider give you any of the following information about the sleep disorder, sleep apnea (*select all that apply*):

- I was told I am at-risk for or might have sleep apnea
- I was given information about the risks, symptoms (snoring, daytime sleepiness, choking or gasping during sleep), and/or treatments of sleep apnea (weight loss, oral appliances, CPAP)
- I was given a referral to a sleep clinic or specialist for further evaluation to see if I have sleep apnea
- Other (please describe: _____)
- I did not receive any information or education related to sleep apnea prior to the day of my procedure.

Post-Procedure: Aside from the letter you received in the mail about being at risk for sleep apnea, from the time you were discharged from the hospital/facility to the time of completing this survey, have you received any additional information about the sleep disorder, sleep apnea?

- Yes
- No

- Don't Know

(If Yes): How did you receive this information (*select all that apply*)?

- Phone call from a healthcare provider
- Email
- Text
- Post-procedure follow-up appointment with the provider who performed my surgery/procedure (in-person or telemedicine)
- Other

(If yes): What information were you given (*select all that apply*)?

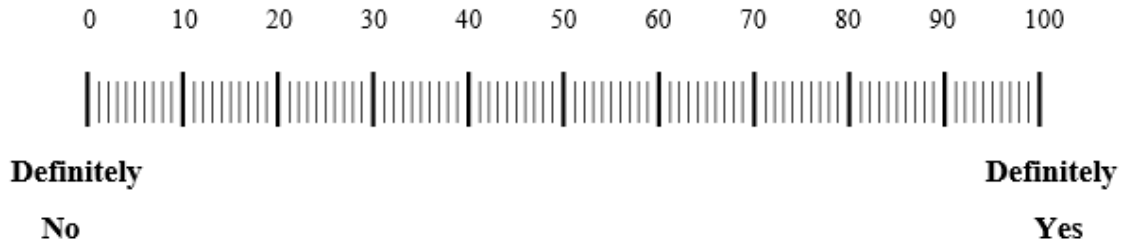
- I was told I am at-risk for or might have sleep apnea
- I was given information about the risks, symptoms (snoring, daytime sleepiness, choking or gasping during sleep), and/or treatments of sleep apnea (weight loss, oral appliances, CPAP)
- It was recommended (by a doctor or nurse) that I follow-up with my primary care provider
- I was given a referral to a sleep clinic or specialist for further evaluation to see if I have sleep apnea
- Other (please describe: _____)
- I did not receive any information or education related to sleep apnea after the day of my procedure.

Intention to Seek OSA Care

Please indicate your level of agreement to the following statement:

I intend to seek medical care to determine if I have sleep apnea within the next 6 weeks.

Place the marker at the point on the line below that best describes your intention.



Adherence to a Provider's Recommendation for OSA Evaluation (Follow-up Action[s] Taken)

Since receiving information about your risk status for sleep apnea, which of the following statements best describes the actions, if any, you have taken for follow-up of potential sleep apnea?

Note: The term "evaluation" below refers to a clinical visit with a healthcare provider to specifically discuss sleep apnea or a sleep study.

- I have not scheduled or completed an evaluation for sleep apnea
- I have scheduled but not yet attended/completed an evaluation for sleep apnea
- I have completed an evaluation for sleep apnea

Appendix B IRB Approval for Aims 2 & 3



EXEMPT DETERMINATION

Date:	September 28, 2022
IRB:	STUDY22080078
PI:	Staci Orbell
Title:	Adherence to Provider Recommendation for Obstructive Sleep Apnea Evaluation in at-risk Perianesthesia Patients
Funding:	Internal Funding

The Institutional Review Board reviewed and determined the above referenced study meets the regulatory requirements for exempt research under 45 CFR 46.104.

Determination Documentation

Determination Date:	9/28/2022
Exempt Category:	(2)(iii) Tests, surveys, interviews, or observation (identifiable); and for which limited IRB review was conducted via expedited review

Determinations:	None
Approved Documents:	<ul style="list-style-type: none"> • Eligibility Screening 3 - Inclusion/Exclusion Criteria, Category: Data Collection; • Contact information, Category: Data Collection; • Eligibility screening 1 - landing script, Category: Data Collection; • Main Survey 2 - Demographics, Category: Data Collection; • Main Survey 3 - Health Literacy Questionnaire, Category: Data Collection; • Main Survey 6 - Epworth Sleepiness Scale, Category: Data Collection; • Main Survey 8 - Functional Outcomes, Category: Data Collection; • Main Survey 10 - Intention to Follow-Up, Category: Data Collection; • Main Survey 3 - Medical History, Category: Data Collection; • Main Survey 4 - Perceived Risk, Category: Data Collection; • Main Survey 7 - Insomnia Severity Index, Category: Data Collection; • Eligibility Screening 2 - STOP-Bang, Category: Data Collection; • Main Survey 1 - Landing script, Category: Data Collection; • Main Survey 9 - Type of OSA Info Received, Category: Data Collection; • Follow Up Survey 1 - Actions taken, Category: Data Collection; • Excelsa Sleep Letter of Support, Category: External Site Permission Letter; • Introductory Script, Category: Recruitment Materials; • OSA Study Exempt Application, Category: IRB Protocol; • Reminder Email & Text message, Category: Other; • Study Flyer, Category: Recruitment Materials;

If you have any questions, please contact the University of Pittsburgh IRB Coordinator, [John Ries](#).

Please take a moment to complete our [Satisfaction Survey](#) as we appreciate your feedback.



Excelsa Health IRB
532 West Pittsburgh Street
Greensburg, PA 15601
724-832-4244

September 29, 2022

Staci Orbell, MSN, RN, CPAN
staciobell@pitt.edu

Dear Ms. Orbell:

**Re: Adherence to Provider Recommendation for Obstructive Sleep Apnea
Evaluation in at-risk Peri anesthesia Patients
IRB # 102 8-28-22**

This memo will serve as official notice that the Excelsa Health Institutional Review Board approved the above mentioned study.

Please sign the attached agreement and return it to the Office of Medical Affairs by fax, scan or mail.

Under FDA regulations, this approval will last only one year. The Expiration Date is: **September 29, 2023**. If the study is expected to last beyond a year, you must request re-approval for the next year at least 6 weeks prior to the expiration date noted above. **If the annual review report is not provided, the study will be suspended until such time as the report is provided.**

The FDA requires you to notify the IRB of any new advertisements or recruiting materials, change of investigator or site location, serious adverse events, amendments or changes in the protocol, significant protocol deviations, patient death or termination of the study. Please note that you must submit all protocol amendments and/or advertisements to the IRB for review, and await a response from the IRB, prior to implementing the amendments and/or advertisements

Sincerely,

Michael Sekhon, PharmD
Chairman Excelsa Health IRB

Appendix C Study Recruitment Flyer for Aims 2 & 3

Are you at risk for



Sleep Apnea?

The **C**are-Seeking for Potential Sleep **A**pnea after Anesthesia **R**isk **E**valuation (**CARE**) research study is examining health-related decision-making in people at-risk for sleep apnea who recently had a procedure under anesthesia.

This research study does not involve evaluation for potential sleep apnea. If you are seeking evaluation for sleep apnea, please refer to your sleep apnea risk notification letter from Excelsior Health enclosed with this flyer.

You may be eligible to participate if you:

- Are age 18 or older
- Had an outpatient procedure with anesthesia in the past 2 weeks
- Have an email address with reliable internet access
- Have never been diagnosed with or evaluated for sleep apnea

What is involved in this study?

Participants will complete questionnaires online after their procedure. These should take approximately 20 minutes. Participants will also be asked to answer a single question 6 weeks after their procedure.

Participants will be compensated up to \$40 for completion of the questionnaires.

To see if you qualify for the study, and for more information, visit:

pi.tt/carestudy

Or scan this code on your mobile phone to access eligibility screening



Principal Investigator:

Staci Orbell MSN, RN, CPAN
staciorbell@pitt.edu

Co-Investigator:

Faith Luyster PhD
FSL3@pitt.edu



University of
Pittsburgh®

Appendix D Study Information and Attestation of Agreement for Aims 2 & 3

Informational Script for CARE Study

You are eligible to participate in this study.



The Care-Seeking for Potential Sleep Apnea after Anesthesia Risk Evaluation (**CARE**) research study is for people who are at risk for sleep apnea who have recently had a procedure under anesthesia. The purpose of this study is to learn about health-related decision-making in individuals who have been identified as at-risk for sleep apnea during a recent outpatient procedure under anesthesia.

Our research study will include 64 individuals at-risk for sleep apnea who have completed an outpatient procedure under anesthesia within the last 2 weeks. If you choose to participate, you will be asked to complete online questionnaires within 14 days of enrolling in the study. The questionnaires will ask about your sleep and health-related decision-making. These questionnaires should take approximately 30 minutes to complete. You will also be asked to answer a single online question about health-related decision-making 6 weeks after discharge from your procedure. This question should take less than 1 minute to answer. Questionnaires can be completed on any computer or mobile phone.

You will receive a total of \$40 for your time. You will receive \$20 after completion of the first set of questionnaires completed after your procedure. You will receive the remaining \$20 after completion of the final follow-up question at 6 weeks.

There is a risk of possible breach of confidentiality with participation in this research study which is rare (occurring in less than 1% of people). All records related to this research study will be stored in a secure password protected database or in a locked file cabinet. Your identity on all records will be

indicated by a case number (unique identifier) rather than by name, and the information linking these case numbers with your identity will be kept separate from the research records. If you opt to receive survey reminders by text message, it is possible the text messages could be intercepted and used by others not associated with this study because they are not encrypted or secure during their transmission.

You will likely receive no direct benefit from taking part in this research study; however, it is possible that you may develop an increased awareness of your risk of sleep apnea by participating in this study.

Your participation is voluntary, and you may withdraw from the study at any time. If you choose not to participate, or if you do not complete the study, this will have no effect on your relationship with the University of Pittsburgh or Excelsa Health.

This study is being conducted by Staci Orbell, who can be reached at [omitted]if you have any questions.

If you agree to participate, please select, "I agree to participate in this study" below.

- I agree to participate in this study.
- I do not agree to participate in this study.

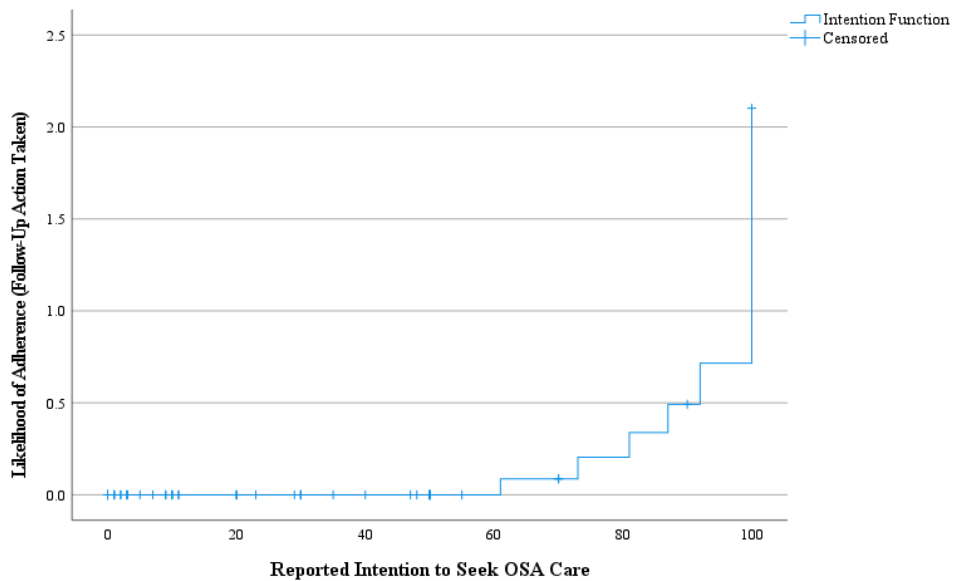
A copy of the study information and a unique link to the CARE Study questionnaires will be emailed to you. Please enter your name and email address below.

1. Participant Name _____
Last First M.I.

2. Email Address: _____

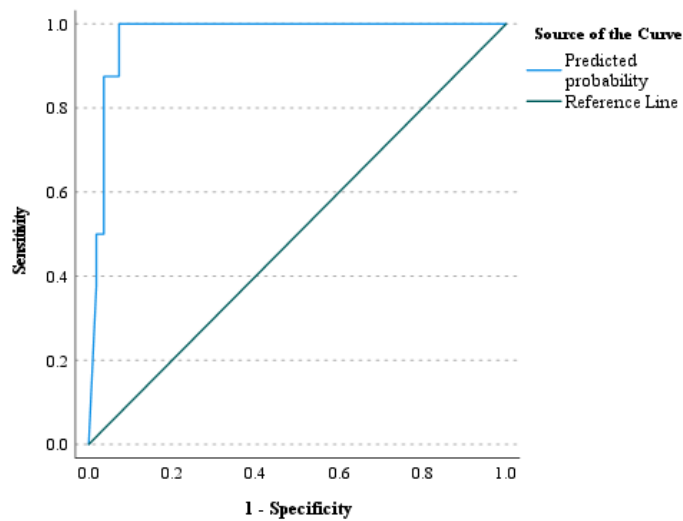
Appendix E Validity Evidence for OSA Care-Seeking Intention as a Proxy for Adherence to a Provider’s Recommendation for OSA Follow-Up (Follow-Up Action Taken)

To assess the acceptability of OSA care-seeking intention as a proxy for adherence to a provider’s recommendation for OSA follow-up, we generated a Kaplan-Meier curve to evaluate the relationship between OSA care-seeking intention and adherence to a provider’s recommendation for follow-up. We found that individuals reporting an intention level of 70 and above (out of 100) had an increased likelihood of adherence to a provider’s recommendation for OSA follow-up within the 6-week time frame (see Figure 3).



Appendix E Figure 3 Likelihood of Adherence to a Provider's Recommendation for OSA Follow-Up as a Function of Intention to Seek OSA Care

A contingency table was generated with OSA care-seeking intention and adherence to a provider's recommendation for OSA follow-up to provide measures of sensitivity and specificity, which were 75.0% and 96.4%, respectively, and had an overall correct classification of 93.7%. Receiver operating characteristic (ROC) analyses (see Figure 4) and area under the curve (AUC) were then conducted to assess the accuracy of OSA care-seeking intention in predicting adherence to a provider's recommendation. We found that OSA care-seeking intention had high discrimination, $AUC = 0.972$, 95% CI [0.93, 1.01], $p < 0.001$. Given the results of these analyses, we felt OSA care-seeking intention was an acceptable proxy dependent variable.



Appendix E Figure 4 ROC Curve on the Prediction of Adherence to a Provider's Recommendation

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