Sleep Quality and the Effect on Functional Outcomes

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Abstract

Introduction: Sleep disorders can go undiagnosed if a provider is not asking the right questions; they can be characterized by loud snoring with apneic episodes that never fully wake the person, difficulty falling asleep or daytime fatigue. Poor sleep can affect activities of daily living, job performance and personal relationships. Poor sleep can be difficult to detect because some may consider it a symptom because of their lifestyle. The purpose of this study is to assess participants sleep quality and functional outcomes of poor sleep.

Methods: Primary care providers have an opportunity to screen for sleep disorders as part of the intake process during an office visit. The Functional Outcomes of Sleep Questionnaire (FOSQ), has been proposed as guide to determine if a sleep disorder is affecting quality of life. This descriptive study randomly recruited 20 participants from a community health center. A 10-question survey was given to individuals over the age of 18 who can write and speak English and either have a body mass index (BMI) over 30, hypertension (HTN) or diabetes type II (DMII). Demographic information evaluated included age, gender, HTN, DMII, BMI>30, marital status, sleeping alone, employment type, race, type of insurance, how many times do they wake up at night, the average number of hours slept per night and does the person work night shift.

Results: The study used a qualitative approach with a descriptive methodology; statistical analysis consisted of proportions, means and standard deviation to describe the study population. Participant age ranged from 33 to 72 years (M=50.1, SD= 11.32). Sixty percent were both female and married/living with partner. Despite being married/living with partner, 50% slept alone. A Mann-Whitney U test showed that there was a significant difference in four of the questions in the FOSQ-10 in which functional outcomes were not affected by being sleepy or tired.

Conclusion: The FOSQ-10 may serve a role in identifying patients who might benefit from a sleep study. The inclusion of a sleep disorder screening tool may increase the specificity and sensitivity of the intervention and the ability to yield data that will objectively measure disordered sleep.

Keywords: sleep apnea, sleep apnea screening, primary care provider, hypertension, diabetes, sleep disorder, impaired quality of life, quality of life screening

Sleep Quality and the Effect on Functional Outcomes

Sleep apnea can be described as a temporary pause in breathing while someone sleeps that lasts from ten to ninety seconds. Symptoms include daytime fatigue, difficulty falling asleep and difficulty staying asleep. Insomnia is characterized by difficulty falling asleep, staying asleep or going back to sleep. Narcolepsy is a described as daytime sleepiness or unable to stay awake during the daytime. What do these conditions all have in common? They are all considered sleep disorders. Treatment for sleep disorders includes medication, positive airway pressure devices, oral appliances, behavioral treatments and/or surgery (Epstein, et al., 2009; Garg, 2018). The benefits of treatment include reduced hemoglobin A1c (HbA1c) in diabetes mellitus type 2 (DMII), a decrease in daytime drowsiness, decrease in hypertension (HTN) and a decrease in disturbed sleep which can result in an improved quality of life. Having untreated sleep disorders increases the chances of developing other conditions that can affect the social, mental and physical health of a person, thereby affecting self-care, personal relationships and employment. Fatigue during the day has been shown to affect employment performance, personal relationships and activities of daily living and mental health (Guglielmi, Magnavita, & Garbarino, 2017; Appleton, et al., 2018). Sleep disorders also contribute to cognitive impairment, loss in work productivity due to injury, and an increase risk of automobile crashes (Hiestand, Britz, Goldman, & Phillips, 2006; Leng, McEvoy, & Allen, 2017).

Background and Significance

Sleep disorders can be considered a life-threatening condition that affects approximately 17% of population in the United States (Goodson, Wung, & Hedger Archbold, 2012). According to the American Academy of Sleep Medicine (2015), undiagnosed sleep disorders cost the U.S. $150 million in 2015. The consequences have been associated with diabetes, hypertension,

obesity and quality of life (Babu, Herdegen, Fogelfeld, & Shott, 2005; Kemple, O'Toole, & O'Toole, 2015; Priou, et al., 2015).

Those who have interrupted sleep are more likely to gain weight and have increased risk of developing obstructive sleep apnea (OSA). Data suggests that the sleep disruption and intermittent hypoxia can decrease insulin sensitivity, worsen glucose tolerance, create insulin resistance and pancreatic β-cell dysfunction increasing risk for diabetes or contributing to diabetic complications (Raju, Swaroopa, Yadati, & Alekhya, 2016; Rajan & Greenberg, 2015). The National Institute of Diabetes and Digestive and Kidney Diseases (2018) reports risk factors that contribute to insulin resistance include large waist size, elevated triglycerides, elevated cholesterol, HTN and fasting blood glucose level of ≥100mg/dl. It can also be noted that sleep disorder patients with insulin resistance are at an increased risk of diabetes mellitus (Malik, Masoodi, & Shoib, 2017; Sahin, et al., 2011).

In a prospective analysis of 1,453 non-diabetic participants, severe OSA was associated with a 71% increased risk of diabetes. This was independent of any other risk factors including BMI and waist circumference (Nagayoshi, 2016; Ford, Cunningham, Giles, & Croft, 2015). Untreated sleep disorders in diabetics are associated with poor glycemic control that results in use of medication that has side effects of weight gain, thereby exacerbating the severity of sleep disorders and increasing cardiovascular risk (Malik, Masoodi, & Shoib, 2017; Reutrakul & Mokhlesi, 2017).

The association between sleep disorders and HTN is just as significant. In 2012 cardiovascular diseases cost the United States an average of $317 billion (CDC, 2016). The constant upper airway obstruction contributes to intermittent hypoxia and hypercapnia which increases blood pressure and stresses the cardiovascular system (Windland-Brown & Porter,

2011). Evidence suggests that the repeated strain on the heart and the circulatory system throughout the night causes a sympathetic nervous system response that can persist during the day. These patients tend to have higher heart rates, higher blood pressure and arterial stiffness (Knauert, Naik, Gillespie, & Kryger, 2015).

In a study by Kasei, Floras and Bradley (2012), it was found that in 65% to 80% of the drug resistant HTN cases, a sleep disorder was present. In general, when there are repeated apnea events the heart and circulatory system are exposed to harmful stimuli that may initiate or contribute to the progression of cardiovascular disorders that include heart failure, arrhythmias and stroke (Kasai, Floras, & Bradley, 2012). In a cohort study by Gami, et al., (2013), 10,701 adults were followed, and the risk of sudden cardiac death after five years was associated with OSA, this was based not only on the frequency of apnea levels but the severity of oxygen desaturation while sleeping.

Sleep disorder studies have been performed in several countries and it has been shown to effect men more than women. The prevalence of sleep disorders in North America, Europe, Australia, and Asia are not significantly different which suggests that this disease is common regardless of the development of the country (Cherasse, 2011; Franklin & Lindberg, 2015; Gottlieb, et al., 2010; Gharibeh & Mehra, 2010).

Currently, there is a family clinic in the Southwestern United States that recently had a change in the organization and no longer has a sleep medicine provider. A challenge that many clinics encounter is that there is no specific screening process in place for sleep disorders. There is not a specific clinical assessment or measurement that can diagnose sleep disorders but identifying those at risk helps the provider seek further evaluation by a sleep medicine provider.

Problem statement

Lack of public awareness and provider education are some of the barriers to diagnosing and treating sleep disorders. The financial and physical consequences of undiagnosed sleep disorders in adult patients led to the clinical PICO question: In adult primary care patients, how does the use of a quality of sleep questionnaire compared to clinical judgement/current standard of care affect sleep disorder referral.

Search Strategy and Methods

To answer the PICOT question, the following databases were searched: Academic Premier (Appendix A), Cumulative Index of Nursing and Allied Health Literature (CINAHL) (Appendix B), and PubMed (Appendix C). Key words used to complete each search included: *sleep disorders, screening, questionnaire, primary care, quality of life, cardiovascular, diabetes, hypertension, obstructive sleep apnea*. The searches were conducted using publications dates from 2012-2018. Setting limits to English languages, regardless of country of origin, and combining terms produced over 535,426 articles.

In total there were 63 articles that met the criteria and were retained for final review. In addition to the search of the databases, the references of the selected articles were also examined for additional studies, however were excluded because they were not published between 2012 – 2018. A search of grey literature was conducted and included position papers, practice guidelines, doctoral theses and dissertations, statistical reports and opinions papers but were excluded due to a low level of evidence.

While reviewing the articles for inclusion, it can be noted that many of them had exclusion criteria that included pregnant subjects, a psychiatric diagnosis, non-English

publications and those that had participants under 18 years old. These exclusions were applied to this search as well to locate studies that demonstrated similar populations. Discarded publications consisted of those that had inconclusive evidence or misleading conclusions. Studies included had settings in a primary care office, specialty clinic or hospital, had a focus on either hypertension or diabetes and had screenings tools implemented or validated. Critical appraisal of 47 articles yielded 10 publications that best addressed the PICOT question. These publications evaluated the relationship between sleep disorders and cardiovascular disease or diabetes. (Appendix E).

Critical Appraisal and Synthesis

Ten studies have been chosen in this literature review, all studies were evaluated using a rapid critical appraisal and are presented in the evidence table for analysis of data (Appendix D). There was very little evidence to support screening or screening tools for sleep disorders in a primary care provider's office. To overcome this challenge, the literature collected focused on current screening questionnaires that would identify a person who is at risk for a sleep disorder. The final studies for inclusion were comprised of two meta-analysis's (MA), one randomized controlled trial (RCT), one systematic review (level of evidence (LOE) I), one experimental study (LOE III), two cross sectional studies (CSS) (LOE IV) and three cohort studies (CS) (LOE IV) (Appendix D). It should be noted that the LOE I studies were not specific in the type of studies that were analyzed but they did have participants from various countries, solidifying how prevalent sleep disorders are regardless of region. Although level IV evidence is considered moderately strong, two of the studies could identify that sleep disorders increase the risk of DM and HTN complications. Overall there was moderate amount of homogeneity in the population, the majority were men and over the age of 50 years old. This could be considered a weakness,

however epidemiological facts of sleep disorders state that males are more affected than females (Franklin & Lindberg, 2015). The samples size of the studies ranged from 200 to 47,978 participants with an age range of 30-63 years old. There was one study that had an outlier otherwise the average age would have bene closer to 50-63 years old.

Seven of the studies either used or reviewed the screening questionnaires to identify if the severity of sleep disorders can be detected (Appendix D). In all, there were significant implications to indicate a screening tool was reliable in a hospital or surgical setting. Studies chosen were from different countries but all were in English and were published between 2012-2018 (Appendix E). Theoretical frameworks were not listed in any of the studies but the most common theoretical framework that could be applied is Pender's Health Promotion Model (Appendix F) and Lewin's Change Theory (Appendix G).

Most of the settings were surgical centers or hospital. This is also where the participants were recruited from. There were two exceptions, one was an experimental study that took place in a primary care provider's clinic and one cohort study was a longitudinal study that used the participants home for assessment. This could be considered a limitation because it was not generalizable to the other studies, however this study supported the need for the implementation of sleep disorder screening in a PCP setting.

Homogeneity was present in the measurement tools used which consisted of the Berlin Questionnaire (BQ), STOP-Bang questionnaire (SBQ), STOP questionnaire (STOP) and the Epworth Sleepiness Scale (ESS). Sensitivity and specificity in the BQ, SBQ, STOP and ESS were noted in some of the studies. If the instrument used did not have the sensitivity and specificity noted in the article, it used one of the well-known instruments that has specificity and sensitivity published and verified. The evidence presented suggests that the SBQ had the highest

sensitivity and specificity among the screening questionnaire's when the apnea-hypopnea index (AHI) was ≥5. The SBQ is also cost effective and has a simple format (Appendix H).

Four of the studies used quality of life questionnaires before and after sleep disorder treatment. The Functional Outcomes of Sleep Questionnaire (FOSQ) measures the impact of daytime sleepiness on activities of daily living using five subscale that include general productivity (concentrating and remembering), activity level (relationships affected, acting in the morning and evening), vigilance (watching movies, driving long and short distances), social outcomes and intimacy and sexual relationships (Weaver, et al., 1997). The original questionnaire consisted of 30 questions, but in 2009 it was revised to a short 10 question form that still included the subscales of the original questionnaire with an internal consistency of α .87 and would take less than 5 minutes to complete (Chasens, Ratcliffe, & Weaver, 2009).

Purpose and Rationale

The purpose of this evidence-based project is to identify if quality of sleep affects functional outcomes. Primary care providers can identify those who are at risk for sleep disorders based on their body mass index more than 30 (BMI >30) or diagnosis of HTN or DMII. Screening can be completed in the office using a questionnaire. Guidelines that are in place to screen for sleep disorders are recommendations intended for surgical candidates. There is no current recommendation for primary care providers which may prove to be a limitation, however these questionnaires may easily be generalized to a primary care outpatient setting due to the validity and reliability. The research provided can assist in detecting patients who may be at risk for sleep disorders based on a medical diagnosis of DM or HTN and obesity. The treatment of sleep disorders has been shown to reduce the risk of the chronic health consequences of untreated sleep disorders (Kapur, et al., 2017; Peach, Gaultney, & Reeve, 2015). The change in

practice would be to use a screening tool to detect sleep disorders earlier. The benefit would be that an early diagnosis could decrease complications associated with diabetes and hypertension. The increased benefit of this screening program would include how it could potentially affect other aspects of the patient's life.

Conceptual Framework and Evidence Based Practice Model

The Health Promotion Model (HPM) (Appendix F) will guide the proposed change in a primary care office. It is focused on achieving a higher level of wellbeing and self-actualization. Individuals want to actively be involved in their care and continually make decisions based on their environment to improve their health. This model notes that each person has unique personal characteristics and experiences that affect actions and there are modifiable factors that can affect the behavior (Galloway, 2003). Health care providers can influence the commitment and engagement of health promoting behaviors. It is beneficial to provide support and assistance to achieve the desired outcome (Pender, 2011).

The Rosswurm and Larrabee Model (Appendix I) will be used to execute this proposed practice change. This framework uses six steps to implement and support a change in practice. Identifying the need for change (sleep disorder screening, identifying a sleep disorder) would initially include a combination of internal (identifying sleep disorder) and external data (effects of sleep disorder on DM and HTN) and how it would affect stakeholders (provider, staff and patients). This data would be used to identify interventions (sleep disorder screening) and guide the literature search to design the practice change (sleep disorder screening) and define desired outcomes (decrease complications from DM and HTN, improve quality of life). This initial study will be conducted to evaluate the process (screening), identify a need for practice change or process improvement and identify education needs (Rosswurm & Larrabee, 1999).

Project Methods

This initiative was implemented using a qualitative approach with a descriptive methodology at a community health clinic. Patients already scheduled with the provider were used as an opportunity for recruitment. Inclusion criteria were individuals over 18 years old, BMI over 30, HTN or DMII, and write and speak in English. Exclusion criteria were those who are unable to consent and pregnant women. The Functional Outcomes of Sleep Questionnaire (FOSQ-10), was given to every candidate after a signed consent was completed, the questionnaire included demographic information (Appendix J). Demographic information consisted of age, gender, marital status, sleep alone, employment, race, insurance type, how many times does the person wake up at night, average number of hours of sleep and do they work night shift. Due to time limitations, recruitment was conducted over three business days and 20 surveys were obtained. There was not any additional cost to participate in the survey and all candidates were voluntary without compensation.

Project Results

Descriptive statistics were conducted using SPSS to summarize study sample characteristics. Mann-Whitney tests were used to examine whether the total score of FOSQ-10 was significantly different by demographic and health-related variables. The age of participants ranged from 33 to 72 years (M=50.1, SD= 11.32). More than half of the sample was female (60%) and married/living with partner (60%). Despite being married/living with partner, half of the sample slept alone (50%). Half of the sample were white and employed (50%). Less than half of the participants had Medicaid (AHCCCS) (45%). The average numbers of times a person woke up was 2 (M=2.05, SD=1.25). The average number of hours slept per night was 6.6 hours (M=6.63, SD=1.54). Nearly all of the working participants, did not work at night (95%). More

than half of the sample had HTN (55%), most of the participants did not have DMII (80%) and most of the participants had a BMI>30 (85%). Out of the 20 surveys, the total score for questions 1-10 (Q) had a maximum of 20 and minimum of 13.67 (*M* 17.02, *SD* = 1.97) Subscales has a maximum of 4 and minimum of 1.l Subscales for general productivity included concentrating (Q1) and remembering (Q2), with a maximum 4.00 and minimum of 2.00 (*M* = 3.50, *SD* = 0.67). Subscale activity included relationships affected (Q3), activity in the morning (Q4), activity in the evening(Q5), maximum of 4.00 and minimum of 3.00 (*M* = 3.77, *SD* = 0.34). Subscale Vigilance driving short distances (Q6), driving long distances (Q7), watching movies (Q8), maximum 4.00 and minimum of 2.67 (*M* = 3.50, *SD* = 0.41).

The demographic portion of the questionnaire had categories with only one case. Those categories were merged to generate more meaningful data and interpretation of the FOSQ-10 total score and demographics. A Mann-Whitney test on the recoded data showed statistical significance. People being married/significant other had significantly lower total score of FOSQ-10 compared to not being married significant other (*M* = 6.25 vs *M* = 13.3, *U* = 14.0, *p* = .008). In other words, people being married/significant other had less functional disability than individuals not being married/significant other. Sleeping alone had a higher total score compared to those who did not sleep alone (*M* = 13.70 vs. *M* = 7.30, *U*=18.0, *p* = .015), meaning that individuals sleeping alone has less functional disability than those who do not sleep alone.

Questions on the FOSQ-10 also had categories with only one answer, those one answers were recoded to determine if significance was present. Individuals with little to extreme difficulty in concentrating showed a lower total score compared to those with no difficulty in concentrating (*M* = 6.29 vs. *M* = 12.77, *U*=16.0, *p* = .019). Those who had little difficulty remembering had a lower score compared to those with no difficulty remembering (*M* = 6.38 vs.

M = 13.256, *U* = 15.0, *p* = .011). Individuals with a little too extreme difficulty being as active in the morning had a lower score than those who had no difficulty (*M* = 7.30 vs. *M* = 13.90 *U* 16.0, *p* = .009). The category for little to extreme difficulty desire for intimacy had a lower total score than those who had no difficulty (*M* = 6.60 vs. *M* = 14.40, *U* = 11.0, *p* = .003).

Discussion

The increased benefit of a sleep disorder screening would include how it would affect other aspects of the patient's life that include personal relationships, job performance and mental health (Park, Yoo, & Bae, 2013). Literature already presented for sleep disorders identified how it can affect comorbidities; increased HbA1c, uncontrolled HTN, obesity. In addition, health care professionals are part of this change and can provide education and guidance for well informed decisions to be made that could affect HTN and DM outcomes.

In a study by Lou et al (2015) poor sleep and DMII impacted quality of life and suggested that screening for sleep disorders can influence sleep quality in diabetic patients. Evidence based literature also supports that quality of sleep correlates with body size and composition, cardiovascular health, and poor glycemic control (Bani-issa, Al-Shujairi, & Patrick, 2018; Bruno, et al., 2013; Lou, et al., 2014).

The FOSQ-10 may serve a role in identifying patients who might benefit from a sleep evaluation. Time was a factor to consider, a major strength of the study is the FOSQ-10 was only ten questions and patients were able to complete the questionnaire in less than five minutes. Patients did not have to be recruited from an outside source, they were already at the clinic for another medical reason increasing the chances of capturing data.

A limitation to the study was the lack of a sleep disorder screening tool, for example the SBQ, ESS or a validated tool that is specific to sleep disorders. In this study the SBQ was

removed due to proprietary reasons, the inclusion of a sleep disorder screening tool may increase the specificity and sensitivity of the intervention and the ability to yield data that will objectively measure disordered sleep. The FOSQ-10 could be used before and after treatment if a sleep provider determined a sleep treatment is necessary, thereby measuring how treatment affected quality of sleep and functional outcomes.

Time was also a consideration, as noted by two potential participants who declined to participate, the appointments are for 20 minutes and this includes the time the medical assistant uses for the intake process which can take up to five minutes to complete. Candidates did not like the idea of going to another provider at a different clinic, nor did they want to spend the night at a facility if they were required to complete a sleep study. The cost associated with seeing a specialty provider was not as big of a factor to participate in the questionnaire.

In this sample it is evident that marriage/significant other can influence sleep quality and the functional outcomes. Sleeping alone also affected sleep quality, factors to consider are whether the partner snores or has a movement disorder that disrupts the partners sleep. Individuals that did have lower total FOSQ-10 scores had little to extreme difficulty compared to those who had no difficulty. This is opposite of expectation, but this was also only a small sample of the population and it may warrant more education regarding sleep disorders and how to identify them. To better serve the clinic, a larger sample that more closely relates to the target population would provide a better description of sleep and how it affects functional outcomes.

There is a need for further research to test the complete screening procedure with participants more closely matched with the target population: male, hypertension, diabetes mellitus II, obesity. Interventions for sleep disorders that address cultural and socioeconomic

barriers could also be evaluated that would include education and resources for low income and vulnerable populations.

Conclusion

This qualitative approach with a descriptive methodology evidence-based project used a quality of life questionnaire that contained ten questions to measure the impact of daytime sleepiness on activities of daily living. The FOSQ-10 was brief and simple to complete, most of the participants agreed to complete the questionnaire, but the sample size was also smaller than expected. Although identifying functional limitations cannot predict a sleep disorder, it can help a provider identify a patient that requires further evaluation.

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Appendix A

Academic Premier

Select / deselect all | Search with AND | Search with OR | Delete Searches | Refresh Search Results

Search ID#	Search Terms	Search Options	Actions
S10	sleep disorder AND instrument validation	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (7) | View Details | Edit
S9	sleep disorder AND questionnaire	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (2,635) | View Details | Edit
S8	sleep apnea AND quality of life	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (481) | View Details | Edit
S7	sleep disorder AND quality of life	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (1,203) | View Details | Edit
S6	sleep disorder AND quality of life AND diabetes	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (49) | View Details | Edit
S5	sleep disorder AND quality of life AND hypertension	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (57) | View Details | Edit
S4	insomnia AND quality of life AND hypertension	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (27) | View Details | Edit
S3	insomnia AND quality of life AND diabetes	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (26) | View Details | Edit
S2	insomnia AND quality of life AND diabetes AND primary care	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (2) | View Details | Edit
S1	insomnia AND quality of life AND hypertension AND primary care	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (4) | View Details | Edit

S10	sleep apnea AND primary care AND cardiovascular OR hypertension OR diabetes	**Limiters** - Published Date: 20120101-20181231 **Narrow by Language:** - english **Search modes** - Boolean/Phrase	View Results (185,667) | View Details | Edit
S9	sleep apnea AND primary care AND cardiovascular OR hypertension OR diabetes	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (195,775) | View Details | Edit
S8	sleep apnea AND primary care AND hypertension	**Limiters** - Published Date: 20120101-20181231 **Narrow by Language:** - english **Search modes** - Boolean/Phrase	View Results (23) | View Details | Edit
S7	sleep apnea AND primary care AND hypertension	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (23) | View Details | Edit
S6	sleep apnea AND primary care AND diabetes	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (21) | View Details | Edit
S5	sleep apnea AND primary care AND cardiovascular	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (15) | View Details | Edit
S4	sleep apnea AND instrument validation AND primary care	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (0) | View Details | Edit
S3	sleep apnea AND questionnaire AND primary care	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (31) | View Details | Edit
S2	sleep apnea AND screening OR questionnaire OR instrument validation AND primary care	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (177,431) | View Details | Edit
S1	sleep apnea AND screening	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (543) | View Details | Edit

Appendix B

CINAHL

Search ID#	Search Terms	Search Options	Actions
S10	sleep quality AND primary care OR questionnaire	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (203,657) | View Details | Edit
S9	sleep quality AND hypertension OR diabetes AND questionnaire	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (7,291) | View Details | Edit
S8	sleep quality AND hypertension OR diabetes	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (87,152) | View Details | Edit
S7	sleep quality AND hypertension	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (104) | View Details | Edit
S6	sleep quality AND quality of life	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (1,326) | View Details | Edit
S5	obstructive sleep apnea AND quality of life	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (390) | View Details | Edit
S4	instrument validation AND quality of life	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (1,127) | View Details | Edit
S3	sleep disorder AND quality of life	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (814) | View Details | Edit
S2	sleep disorder AND hypertension OR diabetes	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (87,223) | View Details | Edit
S1	sleep disorders	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (7,071) | View Details | Edit

S9	sleep apnea AND primary care AND cardiovascular OR hypertension OR diabetes AND screening	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (39,310) | View Details | Edit
S8	sleep apnea AND primary care AND cardiovascular OR hypertension OR diabetes	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (98,624) | View Details | Edit
S7	sleep apnea AND primary care AND hypertension	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (24) | View Details | Edit
S6	sleep apnea AND primary care AND cardiovascular	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (10) | View Details | Edit
S5	sleep apnea AND primary care AND diabetes	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (17) | View Details | Edit
S4	sleep apnea AND instrument validation AND primary care	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (0) | View Details | Edit
S3	sleep apnea AND screening OR questionnaire OR instrument validation AND primary care	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (183,759) | View Details | Edit
S2	sleep apnea AND screening	**Limiters** - Published Date: 20120101-20181231 **Search modes** - Boolean/Phrase	View Results (453) | View Details | Edit
S1	sleep apnea AND screening	**Search modes** - Boolean/Phrase	View Results (693) | View Details | Edit

Appendix C

PubMed

#10	Add	Search **(((((sleep apnea) AND primary care) AND cardiovascular) OR hypertension) OR diabetes) AND screening** Filters: **Publication date from 2012/01/01 to 2018/12/31**	72367
#9	Add	Search **((((sleepapnea) AND primary care) AND cardiovascular) OR hypertension) OR diabetes** Filters: **Publication date from 2012/01/01 to 2018/12/31**	306537
#8	Add	Search **((sleep apnea) AND primary care) AND diabetes** Filters: **Publication date from 2012/01/01 to 2018/12/31**	81
#7	Add	Search **((sleep apnea) AND primary care) AND hypertension** Filters: **Publication date from 2012/01/01 to 2018/12/31**	96
#6	Add	Search **((sleep apnea) AND primary care) AND cardiovascular** Filters: **Publication date from 2012/01/01 to 2018/12/31**	87
#5	Add	Search **((sleep apnea) AND instrument validation) AND primary care** Filters: **Publication date from 2012/01/01 to 2018/12/31**	2
#4	Add	Search **((sleep apnea) AND questionnaire) AND primary care** Filters: **Publication date from 2012/01/01 to 2018/12/31**	160
#3	Add	Search **((((sleep apnea) AND screening) OR questionnaire) OR instrument validation) AND primary care** Filters: **Publication date from 2012/01/01 to 2018/12/31**	27592
#2	Add	Search **(sleep apnea) AND screening** Filters: **Publication date from 2012/01/01 to 2018/12/31**	5836
#1	Add	Search **(sleep apnea) AND screening** Filters: **published in the last 5 years**	4742

History

Download history Clear history

Search	Add to builder	Query	Items found	Time
#20	Add	Search **((quality of life) AND primary care) AND sleep** Filters: **published in the last 5 years**	509	18:40:25
#19	Add	Search **((questionnaire) AND sleep) AND primary care** Filters: **published in the last 5 years**	717	18:39:41
#18	Add	Search **(quality of life) AND questionnaire** Filters: **published in the last 5 years**	39549	18:38:46
#16	Add	Search **(quality of life) AND screening** Filters: **published in the last 5 years**	28741	18:38:23
#15	Add	Search **(((sleep) AND quality of life) AND hypertension) OR diabetes** Filters: **published in the last 5 years**	192193	18:34:23
#14	Add	Search **(sleep quality) AND quality of life** Filters: **published in the last 5 years**	6206	18:33:24
#13	Add	Search **sleep quality** Filters: **published in the last 5 years**	12821	18:33:06
#12	Add	Search **quality of life** Filters: **published in the last 5 years**	136745	18:32:51
#11	Add	Search **((sleep) AND instrument validation) AND questionnaire** Filters: **published in the last 5 years**	106	18:32:29

Appendix D

Table 1

Evaluation Table

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice/ application to practice
Chiu (2017) Diagnostic accuracy of the Berlin questionnaire, STOP-BANG, STOP, and Epworth sleepiness scale in detecting obstructive sleep apnea: A bivariate meta-analysis **Country**: United States & Taiwan **Funding**: Ministry of	Not stated: Lewin's Change Theory can be applied	**Design**: MA **Purpos**e: Estimate the summary sensitivity, specificity and DOR of BQ, SBQ, STOP and ESS against AHI or RDI (severity of OSA)	**N**: 100 **Demographics**: Avg age BQ - 51.7 y SBQ – 55.5 y STOP – 50.8 y ESS – 52.3 y **Inclusion criteria:** Studies examining sensitivity and specificity of BQ, SBQ, STOP and ESS against AHI or RDI Access to full text in English	**IV**1: BQ **IV2**: SBQ **IV3**: STOP **IV4**: ESS **DV1**: dx of OSA **DV2**: Mild OSA AHI >5 **DV3:** Moderate OSA AHI >15 **DV4**: Severe OSA AHI >30	BQ SBQ STOP ESS Data extraction forms	QUADAS-2 Bivariate statistical analysis. Metaregression and moderator analysis Stata Version 14.0 with midas and metandi user written command and SAS version 9.0.2 with Proc Mixed module Chi squared test	Pooled sensitivity (95% CI) AHI ≥5 BQ (n=32) 0.76 (0.71-0.81) SBQ (n=27) 0.88 (0.83-0.91) STOP (n=10) 0.87 (0.81-0.92) ESS (n=15) 0.54 (0.45-0.63) AHI≥15 BQ (n=34) 0.77 (0.73-0.81) SBQ (n=32) 0.90 (0.86-0.93) STOP (n=12) 0.89 (0.81-0.94) ESS (n=8) 0.47 (0.35-0.59)	**Level**: 1 **Strengths**: Large sample **Weaknesses**: Blinding and test reproducibility were not fully reported, can alter reliability. Heterogeneity among studies. Diagnostic properties of the questionnaires for certain population were unavailable.

Key: **AC –** Accuracy, **AASM –** American Academy of Sleep Medicine, **AHTN** – antihypertensive, **AHI** – apnea-hypopnea index, **AVG** – average, **BMI** – body max index, **BP** – blood pressure, **BQ** – Berlin questionnaire, **CV –** cardiovascular, **CVD –** cardiovascular disease, **CBP –** controlled blood pressure, **CI –** confidence interval, **CAD –** coronary artery disease**, ,** **CS –** cohort study, **CSS –** cross sectional study, **DBP -** diastolic blood pressure, **DOR** – diagnostic odds ratio, **DLP** – dyslipidemia, **DM** – diabetes mellitus, **DV**- dependent variable, **dx** - diagnosis, **EBP** – elevated blood pressure, **EF** – ejection fraction, **EHR** – electron health record, **ESS** – Epworth sleepiness scale, **FOSQ**- Functional Outcomes of Sleep Questionnaire, **HgA1c** – glycated hemoglobin, **HF** – heart failure, **HTN** – hypertension, **IAR** – intensive antihypertensive regimen, **IV**- independent variable, **LR** – literature review, **M** - mean , **MA –** meta-analysis, **MiOSA** – mild obstructive sleep apnea AHI ≥5 but <15, **MOSA** – moderate sleep apnea AHI ≥15 but <30, **MSOSA** – moderate-severe sleep apnea, **NE** – non-experimental**, Nuero** – neurological, **NPV –** negative predictive value, **N**-number of studies; **n**- number of participants, **NYHA –** New York Heart Association, **OR** - odds ratio, **OS –** observational study, **OSA** – obstructive sleep apnea, **ODI –** oxygen desaturation index, **pt** – patient, **PCP** – primary care provider, **PPV** – positive predictive value, **PSG** – polysomnography, **PRISMA** – preferred reporting items for systematic reviews and meta-analysis, **PSQI** – Pittsburgh Sleep Quality Index, **PSY** – psychological, **QOL**- quality of life, **REBP** – resistant elevated blood pressure, **RDI** – respiratory disturbance index, **ROC –** receiver operating characteristic, **RR –** relative risk**, SAQLI –** Calgary Sleep Apnea Quality of Life Index, **SBQ** – STOP-Bang questionnaire, **SD –** standard deviation, **SF-36 –** Short Form of the Medical Outcomes Survey, **SOSA –** severe sleep apnea AHI ≥ 30, **Sn -** Sensitivity, **Sp** – Specificity**, SR –** systematic review, **STOP** – STOP questionnaire, **SBP** – systolic blood pressure, **UEBP** -uncontrolled elevated BP, **WIAR** – with intensive hypertension regimen, **WOIAR** – without intensive hypertension regiment

Science and Technology **Bias**: None			or Chinse published in a peer reviewed journal. Or portable monitoring Full overnight in lab PSG, in home PSG **Exclusion criteria**: Non-English or Chinese text, not published in peer reviewed journal, children, adolescents, pregnant women				AHI ≥30 BQ (n=19) 0.84 (0.79-0.88) SBQ (n=26) 0.93 (0.89 -.95) STOP (n=10) 0.90 (0.84 -0.93) ESS (n= 6) 0.58 (0.48-0.67) Pooled specificity AHI ≥5 (95%CI) BQ (n=32) 0.59 (0.48-0.66) SBQ (n=27) .42 (0.35 -0.50) STOP (n=10) 0.42 (0.29-0.56) ESS (n=15) 0.65 (0.57-0.72) AHI ≥15 BQ BQ (n=34) 0.44 (0.38-0.51) SBQ (n=32) 0.36 (0.29 -0.44) STOP (n=12) 0.32 (0.19-0.48) ESS (n=8) 0.62 (0.56-0.68) AHI ≥30 BQ (n=19) 0.38 (0.31	**Conclusion**: SBQ is superior for detecting mild, moderate, severe OSA. Inexpensive tool when PSG not available

Key: **AC –** Accuracy, **AASM –** American Academy of Sleep Medicine, **AHTN** – antihypertensive, **AHI** – apnea-hypopnea index, **AVG** – average, **BMI** – body max index, **BP** – blood pressure, **BQ** – Berlin questionnaire, **CV –** cardiovascular, **CVD –** cardiovascular disease, **CBP –** controlled blood pressure, **CI –** confidence interval, **CAD –** coronary artery disease**,** , **CS –** cohort study, **CSS –** cross sectional study, **DBP -** diastolic blood pressure, **DOR** – diagnostic odds ratio, **DLP** – dyslipidemia, **DM** – diabetes mellitus, **DV-** dependent variable, **dx** - diagnosis, **EBP** – elevated blood pressure, **EF** – ejection fraction, **EHR** – electron health record, **ESS** – Epworth sleepiness scale, **FOSQ-** Functional Outcomes of Sleep Questionnaire, **HgA1c** – glycated hemoglobin, **HF** – heart failure, **HTN** – hypertension, **IAR** – intensive antihypertensive regimen, **IV-** independent variable, **LR** – literature review, **M -** mean , **MA –** meta-analysis, **MiOSA** – mild obstructive sleep apnea AHI ≥5 but <15, **MOSA** – moderate sleep apnea AHI ≥15 but <30, **MSOSA** – moderate-severe sleep apnea, **NE** – non-experimental**, Nuero** – neurological, **NPV –** negative predictive value, **N-**number of studies; **n-** number of participants, **NYHA –** New York Heart Association, **OR -** odds ratio, **OS –** observational study, **OSA** – obstructive sleep apnea, **ODI –** oxygen desaturation index, **pt** – patient, **PCP** – primary care provider, **PPV** – positive predictive value, **PSG** – polysomnography, **PRISMA** – preferred reporting items for systematic reviews and meta-analysis, **PSQI** – Pittsburgh Sleep Quality Index, **PSY** – psychological, **QOL-** quality of life, **REBP** – resistant elevated blood pressure, **RDI** – respiratory disturbance index, **ROC –** receiver operating characteristic, **RR –** relative risk**, SAQLI –** Calgary Sleep Apnea Quality of Life Index, **SBQ** – STOP-Bang questionnaire, **SD –** standard deviation, **SF-36 –** Short Form of the Medical Outcomes Survey, **SOSA –** severe sleep apnea AHI ≥ 30, **Sn -** Sensitivity, **Sp** – Specificity**, SR –** systematic review, **STOP** – STOP questionnaire, **SBP** – systolic blood pressure, **UEBP** -uncontrolled elevated BP, **WIAR** – with intensive hypertension regimen, **WOIAR** – without intensive hypertension regiment

							-0.56) SBQ (n=26) 0.35 (0.28 -0.44 STOP (n=10) 0.28 (0.18 -0.40) ESS (n= 6) 0.60 (0.53-0.68) Pooled DOR (95% CI) AHI ≥5 (95%CI) BQ (n=32) 4.30 (2.96-6.24) SBQ (n=27) 5.13 (4.25-6.29) STOP (n=10) 4.85 (2.50-9.41) ESS (n=15) 2.18 (1.39-3.40) AHI ≥15 BQ BQ (n=34) 2.68 (2.19-3.29) SBQ (n=32) 5.05 (3.65-7.00) STOP (n=12) 3.71 (2.73-5.06) ESS (n=8) 1.45 (0.94-2.24) AHI ≥30 BQ (n=19) 3.10 (2.57-3.73)	

Key: **AC –** Accuracy, **AASM –** American Academy of Sleep Medicine, **AHTN** – antihypertensive, **AHI** – apnea-hypopnea index, **AVG** – average, **BMI** – body max index, **BP** – blood pressure, **BQ** – Berlin questionnaire, **CV –** cardiovascular, **CVD –** cardiovascular disease, **CBP –** controlled blood pressure, **CI –** confidence interval, **CAD –** coronary artery disease**,** , **CS –** cohort study, **CSS –** cross sectional study, **DBP -** diastolic blood pressure, **DOR** – diagnostic odds ratio, **DLP** – dyslipidemia, **DM** – diabetes mellitus, **DV**- dependent variable, **dx** - diagnosis, **EBP** – elevated blood pressure, **EF** – ejection fraction, **EHR** – electron health record, **ESS** – Epworth sleepiness scale, **FOSQ**- Functional Outcomes of Sleep Questionnaire, **HgA1c** – glycated hemoglobin, **HF** – heart failure, **HTN** – hypertension, **IAR** – intensive antihypertensive regimen, **IV**- independent variable, **LR** – literature review, **M** - mean , **MA –** meta-analysis, **MiOSA** – mild obstructive sleep apnea AHI ≥5 but <15, **MOSA** – moderate sleep apnea AHI ≥15 but <30, **MSOSA** – moderate-severe sleep apnea, **NE** – non-experimental**, Nuero** – neurological, **NPV –** negative predictive value, **N**-number of studies; **n**- number of participants, **NYHA –** New York Heart Association, **OR** - odds ratio, **OS –** observational study, **OSA** – obstructive sleep apnea, **ODI –** oxygen desaturation index, **pt** – patient, **PCP** – primary care provider, **PPV** – positive predictive value, **PSG** – polysomnography, **PRISMA** – preferred reporting items for systematic reviews and meta-analysis, **PSQI** – Pittsburgh Sleep Quality Index, **PSY** – psychological, **QOL**- quality of life, **REBP** – resistant elevated blood pressure, **RDI** – respiratory disturbance index, **ROC –** receiver operating characteristic, **RR –** relative risk**, SAQLI –** Calgary Sleep Apnea Quality of Life Index, **SBQ** – STOP-Bang questionnaire, **SD –** standard deviation, **SF-36 –** Short Form of the Medical Outcomes Survey, **SOSA –** severe sleep apnea AHI ≥ 30, **Sn -** Sensitivity, **Sp** – Specificity**, SR –** systematic review, **STOP** – STOP questionnaire, **SBP** – systolic blood pressure, **UEBP** -uncontrolled elevated BP, **WIAR** – with intensive hypertension regimen, **WOIAR** – without intensive hypertension regiment

							SBQ (n=26) 6.51 (5.05-8.40) STOP (n=10) 3.37 (2.10-5.39) ESS (n= 6) 2.10 (1.76-2.52)	
Citation	**Theory/ Conceptual Framework**	**Design/ Method**	**Sample/ Setting**	**Major Variables & Definitions**	**Measurement/ Instrumentation**	**Data Analysis (stats used)**	**Findings/ Results**	**Level/Quality of Evidence; Decision for practice/ application to practice**
Coman (2016) Obstructive Sleep Apnea Syndrome and the Quality of Life **Country**: Romania **Funding**: European social Fund through the Sectorial Operational Programme Human Resources	Not stated: Health Promotion Model could be applied	**Design**: CSS **Purpose**: Assess OSA patients QOL before and after therapy.	n: 79 **Setting**: Sleep Laboratory **Inclusion criteria**: Adults with OSA who have CPAP at home and consented. **Exclusion Criteria**: Subjects refused, mental or cognitive disorders	**IV**: SAQLI **DV**: Any participant with an =or> MiOSA	SAQLI 3 months of CPAP treatment ESS was only used to measure daytime sleepiness Somnologia Studio 5.0 as scoring platform Manual of American Academy of Sleep Medicine	MedCalc Statistical Software version 15.8 When applicable: Paired-t test, Wilcoxon test or ANOVA. Between groups student t test, Mann-Whitney test Sig level .05	**IV on DV1**: SAQLI pretreatment 3.11±0.32, mean total post treatment 4.24 ±0.39	**Level**: 4 **Strength**: Patients already diagnosed with CPAP and aware of treatment. Objective data collected regarding compliance using CPAP compliance card.

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Bias: None								**Weakness**: Specific population. Central apnea was not evaluated separately **Conclusion**: QOL is impaired by OSA
Citation	**Theory/ Conceptual Framework**	**Design/ Method**	**Sample/ Setting**	**Major Variables & Definitions**	**Measurement/ Instrumentation**	**Data Analysis (stats used)**	**Findings/ Results**	**Level/Quality of Evidence; Decision for practice/ application to practice**
Silva (2016) Obstructive Sleep Apnea and Quality of Life: Comparison of the SAQLI, FOSQ and SF-36 Questionnaires **Country**: United States **Funding**:	None stated: Pender's Health Promotion Model can be applied	**Design:** Cohort **Purpose:** Compare instruments to each other to assess whether they were able to detect differences in QOL among groups with different severities of OSA and	**n:**884 **Setting**: Sleep Heart Health Study **Population**: Participants from Tucson and Framingham sites of the Sleep Heart health Study that initially	**IV1:** SAQLI **IV2:** FOSQ **IV3:** SF-36 MCS **IV4:** SF-36 PCS **DV:** OSA treatment	Sleep Habits Questionnaire ESS SF-36 (MCS mental component) SF-36 (PCS physical component) FOSQ	Stat SE version 13.0 for windows Fisher's chi-square test ANOVA Pearson's correlations Multivariate linear regression models Spearman's Sig level 0.05	**Total scores** **IV1 on DV:** Total 6.0 (.82). No OSA 6.0 (.78), Mild-moderate OSA 6.0 (.83), SOSA 5.8 (.8) **IV2 on DV**: Total 11.5 (.82), No OSA 53.8 (8.0) Mild-moderate OSA 11.5 (.84), SOSA 11.4 (.91)	**Level:** 4 **Strength**: Cohort was part of longitudinal study resulted in high compliance because they knew importance of compliance **Weakness**: Participants from

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NHLBI grant HL 062373-05A2 **Bias**: None		whether there were differences between genders	completed the QOL instruments **Inclusion criteria**: Participated in original Framingham sites of the Sleep Heart Health Study. Completed QOL questionnaires in original Framingham study, live in Tucson **Exclusion criteria**: did not participate in Framingham study		SAQLI		**IV3 on DV**: Total 54.0 (8.2), No OSA 53.8 (8.0), Mild-moderate OSA 54.4 (8.4), SOSA 55.3 (7.4) **IV4 on DV**: Total 47.1 (10.8), No OSA 48.5 (10.5), Mild-moderate OSA 46.5 (11.0), SOSA 45.1 (10.3)	longitudinal study, may not be representative of US adult population. Those who do not have OSA were also included in QOL questionnaire. QOL questionnaires are specific to different aspects of QOL, hard to compare when they are measuring different areas of life **Conclusion**: QOL poorer in females with SOSA.
Citation	**Theory/ Conceptual Framework**	**Design/ Method**	**Sample/ Setting**	**Major Variables & Definitions**	**Measurement/ Instrumentation**	**Data Analysis (stats used)**	**Findings/ Results**	**Level/Quality of Evidence; Decision for practice/ application to**

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								practice
Miller (2015) Screening and assessment for obstructive sleep apnea in primary care **Country**: United States **Funding**: None **Bias**: None	Not indicated but Lewin's Change Theory	**Design**: NE SR **Purpose**: Evaluate the screening and assessment for OSA in primary care setting	**N**: 17 **Setting**: 14 non-experimental and 3 experimental designs **Inclusion criteria**: English language, primary care setting/internal medicine, OSA screening process, compared screening tools, management of OSA **Exclusion criteria:** Sleep disorders other than OSA, pediatric patients	**IV**: Screening of OSA in PCP office **DV1**: BQ D**V2**: ESS **DV3**: STOP **DV4**: SBQ	SBQ, SB, ESS, STOP AASM clinical guidelines task force	Cronbach's alpha Test-retest reliability	Reliability (95% CI) BQ: Cat 1 α = 0.92 Cat 2 α = 0.63 ESS α = 0.88 STOP k = 0.93 SBQ none reported SBQ Sensitivity/Specificity (95% CI) (AHI _ 15 events/hr) 0.54/0.97 0.79 (0.67, 0.88)/ 0.51 (0.41, 0.62) 0.95 (0.91, 0.98)/ 0.07 (0.01e0.24) PPV/NPV (95% Cl) (AHI _ 15 events/hr) PPV = 0.97 0.51 (0.42, 0.61)/0.78 (0.67, 0.87) 0.87 (0.82, 0.91)/0.20	**Level**:1 **Strengths**: Screening tools identify at risk patients for OSA **Weakness**: Not all screening tools have been reported to be reliable and valid. **Conclusion**: A screening and assessment process in PCP's office is lacking. PCP's aware health effects but do not recognize or refer Need large scale, nationwide studies to assess implementation in PCP settings

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							ESS Sensitivity/Specificity (95% CI) (AHI _ 15 events/hr) 0.39, 0.71 0.76 (0.69e0.82)/0.48 (0.29, 0.68) PPV/NPV (95% Cl) (AHI ≥15 events/hr) 0.91 (0.85, 0.95)/ 0.23 (0.13, 0.36) SQ Sensitivity/Specificity (95% CI) (AHI ≥ 15 events/hr) 0.74 (0.62, 0.84)/0.53 (0.43, 0.63) 0.62/0.56 0.95 (0.89, 0.97)/0.26 (0.11, 0.46) PPV/NPV (95% Cl) (AHI ≥ 15 events/hr) 0.51 (0.41, 0.60)/0.76 (0.64,0.85) 0.89 (0.84, 0.93)/0.41 (0.18, 0.67)	

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							SBQ Sensitivity/Specificity (95% CI) (AHI ≥ 15 events/hr) 0.93 (0.84, 0.98)/0.43 (0.33, 0.53) 0.87, 0.43 0.98 (0.94, 0.99)/0.03 (0.006, 0.19) PPV/NPV (95% Cl) (AHI ≥ 15 events/hr) PPV/NPV (95% Cl) (AHI ≥ 15 events/hr) 0.52 (0.43, 0.61)/0.90 (0.79, 0.97) 0.87 (0.81, 0.91)/0.20 (0.03, 0.71)	
Citation	**Theory/ Conceptual Framework**	**Design/ Method**	**Sample/ Setting**	**Major Variables & Definitions**	**Measurement/ Instrumentation**	**Data Analysis (stats used)**	**Findings/ Results**	**Level/Quality of Evidence; Decision for practice/ application to practice**
Tan (2016) Predicting obstructive sleep apnea	Not stated: Pender's Health Promotion Model can be applied	**Design**: CS **Purpose**: Determine if	**Setting**: Outpatient cardiology clinic - Brigham	**IV**: SBQ **DV1**: MSOSA dx	SBQ PSG type 3	R V.3.2.1. General demographics	**IV on DV1**: Prevalence 28.1% BMI ≥35 BMI ≥30 BMI ≥ 27.5	**Level**:4 **Strengths**: High NPV in

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using the STOP-Bang questionnaire in the general population **Country**: Malaysia **Funding**: FY2014 Health Services Research and Quality Improvement Grant of Ng Teng Fong General Hospital, Jurong Health Service **Bias**: None		untreated severe OSA is associated with elevated ambulatory blood pressure in patients with high cardiovascular risk despite medical management	and Women's Hospital, Case Medical Center, Johns Hopkins Medical Center, Veterans Affairs Boston Healthcare System **Inclusion criteria**: high risk for CV disorders. CAD >3 months prior, >3 CV risk factors (PCP treated HTN SBP >140mmhg or DBP >90mmhg or AHTN meds, DM, BMI, DLP BMI 27.5-30 **Exclusion criteria:** HF with EF <30% or NYHA class >2, BP >170/100 mmHg, HbA1c	**DV2**: SOSA dx **Time frame**: 7 months	2012 AASM respiratory scoring World Health Organization cutoff to define obesity in Asian individuals	Anthropometrics	Sn: 66.2, 73%, 70.1% Sp: 74.7%, 73.0%, 70.1% PPV: 50.6%, 50.0%, 48.0% NPV: 85%, 85.8%, 86% ROC: 0.704, 0.711, 0.704 **IV on D2** Prevalence 10.7% BMI ≥35 BMI ≥30 BMI ≥ 27.5 Sn: 69.2, 73.1%, 73.1% Sp: 67.1%, 65.3%, 62.5% PPV: 20.2%, 20.2%, 19.0% NPV: 94.8%, 95.3%, 95.1% ROC: 0.682, 0.692, 0.678	SBQ **Weakness**: Portable sleep studies used instead of in lab PSG. NPV could be inflated due to underestimation of portable monitors. Oversampled snorers. **Conclusion**: SBQ can be used as a screening tool to prioritize individuals for further testing.

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			>9%, prior stroke with functional impairment, severed uncontrolled medical problems, medications that					
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Walia (2014) Association of severe obstructive sleep apnea and elevated blood pressure despite antihypertensive medication use **Country**: United States **Funding**: None **Bias**: None	Not stated: Pender's Health Promotion Model can be used	**Design**: CS **Purpose**: Determine if untreated severe OSA is associated with elevated ambulatory BP in patients with high CVD risk despite medical management	**n**: 284 **Demographics**: M age: 63.1 + 7.2 CBP=SBP <130 and DBP <80. EBP=SBP>130 or DBP >80 WIAR, WOIAR, REBP WIAR, UEBP WIAR **Setting**: Outpatient	**IV**: OSA **DV1**: CBP WOIAR **DV2**: CBP WIAR **DV3**: EBP REBP WIAR **DV4:** EBP UEBP WOIAR **DV5**: WIAR CBP **DV6**: WIAR REBP **DV7**: WOIAR	AASM 2007 guidelines Spacelabs 90217 Ambulatory Blood Pressure Monitors Measure BP every 20 minutes from 0600-2200 and every 30 between 2200-0600 for 24hr period Resting BP after	Univariate and multivariable logistic regression Kruskal-Wallis test SAS version 9.2	p<0.05 **IV on DV1**: 45.8% **IV on DV2**: 15.8% **IV on DV3**: 9.9% **IV on DV4**: 28.5% **IV on DV5**: 15.8% **IV on DV6**: 9.9% **IV on DV7**: 45.8% **IV on DV8**: 28.5%	**Level**:4 **Strengths**: Multiple clinical settings (makes more general) 24 ambulatory BP monitoring is more reliable than spot office BP measurements **Weakness**: No ability to compare those without sleep

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			cardiology clinic - Brigham and Women's Hospital, Case Medical Center, Johns Hopkins Medical Center, Veterans Affairs Boston Healthcare System **Inclusion criteria**: high risk for CV disorders. CAD >3 months prior, >3 CV risk factors (PCP treated HTN SBP >140mmhg or DBP >90mmhg or AHTN meds, DM, BMI, DLP **Exclusion criteria:** HF with EF <30% or NYHA class >2, BP >170/100 mmHg, HbA1c >9%, prior	CBP **DV8**: WOIAR UEBP	sitting quietly for ≥5 minutes JNC7 guidelines			apnea. Not able to assess if those with MiOSA or MOSA with those without OSA. Medication dosages, compliance info not available. **Conclusion**: There is an association of untreated SOSA and REBP.

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			stroke with functional impairment, severe uncontrolled medical problems, medications that might influence measurements or impair ability to participate					
Citation	**Theory/ Conceptual Framework**	**Design/ Method**	**Sample/ Setting**	**Major Variables & Definitions**	**Measurement/ Instrumentation**	**Data Analysis (stats used)**	**Findings/ Results**	**Level/Quality of Evidence; Decision for practice/ application to practice**
Wang (2013) Obstructive sleep apnoea and the risk of type 2 diabetes: A meta-analysis of prospective cohort studies **Country**: China **Funding:**	None stated: Pender's Health Promotion can be used	**Design**: MA **Purpose**: Assess the association between the severity of OSA and the risk of type 2 diabetes	**N**: 6 **n:** 5953 **Setting:** LR using Meta-analysis of Observational Studies in Epidemiology group **Inclusion criteria**:	**IV**: Risk of DM **DV1**: MOSA **DV2**: MSOSA **Time frame**: follow up period 2.7-16 years		Stata version 11.2 Publication bias: Begg's test and Egger's test. Heterogeneity: Cochrane *Q*-test and I^2 test $P < 0.10$	RR of DM for those with MSOSA 1.63 (95% CI: 1.09-2.45, $P = 0.018$) Pooled risk estimate MiOSA and DM 1.22 (95% CI: 0.91-1.63, $P = 0.193$)	**Level**:1 **Strengths**: All studies used objective measurements. Defined the severity of OSA according to AHI and ODI. **Weakness**: Definitions of

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Shandong Province Natural Science Foundation of China **Bias**: None			prospective cohort studies OSA was assessed with objective measurements. OSA and the outcome of interest was DM **Exclusion criteria**: CSS, LR and studies that used self reported surrogate parameters					OSA were not uniform. Influenced by referral bias (false impression of the significance of association with DM) Methods to dx DM were different for each study **Conclusion**: MSOSA increases the risk of DM, risks increase with severity of OSA
Citation	**Theory/Conceptual Framework**	**Design/Method**	**Sample/Setting**	**Major Variables & Definitions**	**Measurement/ Instrumentation**	**Data Analysis (stats used)**	**Findings/ Results**	**Level/Quality of Evidence: Decision for practice/ application to practice**
Wang (2016) Association of obstructive sleep apnea plus	None stated: Pender's Health Promotion can be applied	**Design**: CSS **Purpose**: To evaluate the	**n**: 1889 **Setting**: Inpatient	**IV:** OSA **DV1**: HTN		Log for statistical analysis	**IV on DV1**: HTN no OSA (OR: 1.808, 95% CI: 1.207-2.707) HTN with MiOSA	**Level**: 4 **Strengths**: Large sample

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hypertension and prevalent cardiovascular disease **Country**: China **Funding**: Not stated **Bias**: None		association of OSA plus HTN	cardiovascular ward **n**=773 Normotension M age 54.7 ± 12.4 Male: 570 **n**=1116 HTN M age 58.7 ± 11.9 Male: 841 **Inclusion criteria**: pt agreed to participate, spouses reported snoring during sleep, no previous OSA dx **Exclusion criteria:** pt did not agree, previous OSA dx			1-way ANOVA Mann-Whitney *U* Chi-square Fisher exact test Logistic regression analysis SPSS 18.0 $P < 0.05$	(OR: 2.003, 95% CI: 1.346-2.980) HTN with MSOSA (OR: 1.834, 95% CI: 1.214-2.770)	size. All participants were from the same ward. Standard and similar BP methods were used on all participants. **Weakness**: HTN patients were older in age. Blood pressure used was at admission, this could have been elevated due to white coat syndrome. **Conclusion**: There may be a synergistic adverse effect of OSA and HTN

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Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice/ application to practice
Weaver (2012) Continuous positive airway pressure treatment of sleepy patients with milder obstructive sleep apnea: Results of the CPAP apnea trial north American program (CATNAP) randomized clinical trial **Country**: U.S. **Funding**: National Institutes for Health, National heart, Lung and Blood Institute, Sleep Medicine Education and	None stated: Can use Pender's Health Promotion Model	**Design**: RCT **Purpose**: Evaluate efficacy of CPAP to improve functional status in sleep patients with MiOSA and MOSA	**n**:223 **Setting**: Active or Sham CPAP for home use randomized to 8 weeks of study at home **Inclusion**: New diagnosis of MiOSA, no previous CPAP use, stable medically for 4 months, no history of sleep disorders, pregnancy, substance use, sleepiness related driving accident or sleepiness sensitive occupation	**IV**: OSA **DV1**: Sham CPAP **DV2**: Active CPAP	ESS to measure sleepiness SF-36 Psychomotor Vigilance task Total Mood Disturbance Scale on the Profile of Moods States, Mean 48 hour ambulatory blood pressure FOSQ	Last Observation Carried Forward Paired t tests Effect size 0.36 Sig 0.05	**Baseline** **IV on DV1**: FOSQ total score 13.91 ± 3.02 **IV on DV2**: FOSQ total score 14.43 ± 2.78 (*P*=0.18) **Final treatment mean change** **IV on DV1**: FOSQ -0.**06** **IV on DV2**: FOSQ 0.89 (*p* = .0006) Adjusted difference in mean changes (SE) 0.95 (0.34) Lower and upper 95% CI 0.27, 1.62	**Level**:1 **Strength**: Large sample size. Low dropout rate **Weakness**: mean daily CPAP use was 4 hours and 3 hours per day, desired 6 hours of use. Multisite double blind RCT that is first of its kind. **Conclusion**: CPAP therapy for sleep patient with milder OSA can have significant health benefits

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Research Foundation, Respironics Sleep and Respiratory Research Foundation, Cepahlon, Inc **Bias:** Equipment provided but does not say if compensation or if was given in the form of a grant			**Exclusion**: Those that did not meet inclusion criteria					
Citation	**Theory/ Conceptual Framework**	**Design/ Method**	**Sample/ Setting**	**Major Variables & Definitions**	**Measurement/ Instrumentation**	**Data Analysis (stats used)**	**Findings/ Results**	**Level/Quality of Evidence; Decision for practice/ application to practice**
Williams (2017) Implementation of an obstructive sleep apnea screening program at an overseas military hospital	Not stated: Lewin's Change Theory can be applied	**Design**: experimental **Purpose:** Determine whether educating nurses on OSA and	**n**: 200 **Setting**: U.S. Naval Hospital in Okinawa, Japan **Inclusion criteria:** All	**IV:** Education regarding OSA screening using SBQ **DV1**: increase	Education OSA (PowerPoint presentation)	Descriptive statistics χ^2 test	*P* = .05 **IV on DV1**: 1.18 ± 1.02 vs 0.91 ± 0.68 (*P* = .03) **IV on DV2**: 5% to 26 % (*P* = .0001)	**Level**:3 **Strengths**: Findings significant to identify those at risk for OSA, decrease perioperative

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Country: United States **Funding**; Not stated **Bias**: disclaimer study was independent of US Naval Department		incorporating SBQ into the preoperative screening process was associated with an increase in Identification of pt with suspected OSA and increase in nurse generated anesthesia consults for OSA	charts regardless of OSA dx **Exclusion criteria:** cesarean deliveries, younger than 18 years, emergency surgery	identification of suspected OSA **DV2**: Increase frequency of nurse generated anesthesia consults for OSA **Time frame**: 1 month				complications. **Weakness**: Older version of preop forms were used Inconsistent recording of apnea. symptoms. Type of surgery not listed. No PSG available for those who scored 3 or higher on SBQ Small sample Short timeframe **Conclusion**: Using the SBQ increased the identification of patients at high risk for OSA. Improve patient safety.

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Appendix E
Synthesis Table

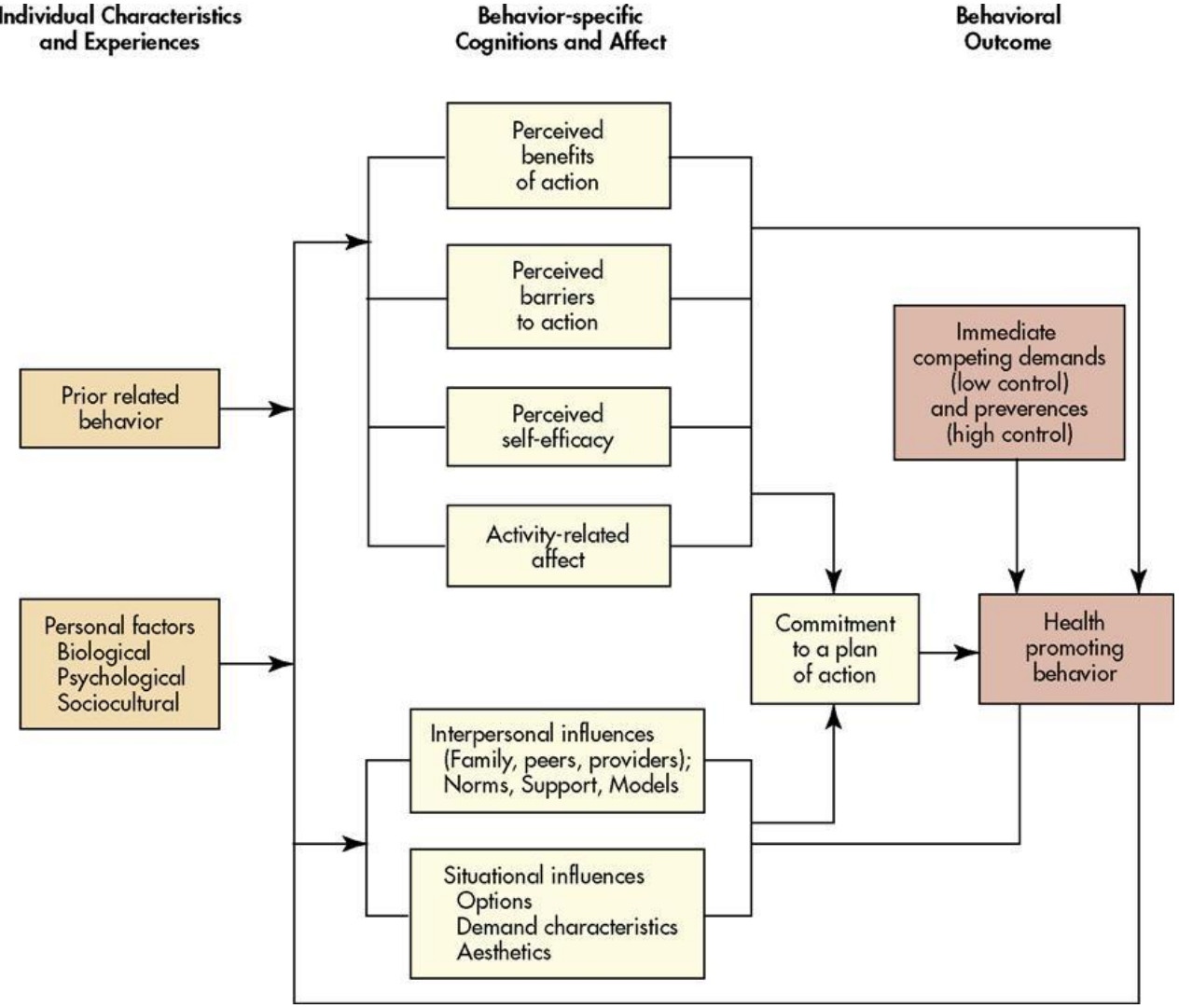
Author	Chiu	Coman	Miller	Silva	Tan	Walia	Wang	Wang	Weaver	Williams
Year	2016	2015	2015	2016	2016	2014	2013	2016	2012	2017
Study Design/Level of Evidence	MA LOE: 1	CSS LOE: 4	SR LOE: 1	CS LOE: 4	CS LOE: 4	CS LOE: 4	MA LOE: 1	CSS LOE: 4	RCT LOE: 2	Experimental LOE: 3
Setting	U.S./China	Romania	U.S.	U.S.	Malaysia	U.S.	China	China	U.S.	U.S.
PCP Office	x					x				
Hospital/Surgery Center	x		x				x	x		x
Sleep Clinic	x	x	x		x				x	
Home				x						
Sample Size										
N		79	17	884			6			
n	47978				242	284	5953		121/118	200
Gender										
Male		59		421	122	207		1411	55%/63%	
Female		20		463	120	77		478		
Average Age in Years										
	52.5	54.13		61.6	48.3	63.1	30-69	54.7	49.5/51.7	
Screening Questionnaires										
SBQ	x		x		x					x
ESS	x	x	x	x	x				x	
SQ	x		x							
BQ	x		x							
Detection of OSA										
MiOSA	+	+	+	+				+	+	+
MSOSA	+	+	+	+	+	+	+	+	+	+
SOSA	+	+	+	+	+	+	+	+		+
Presence of										
HTN	x		x		x	x		x		
DM	x		x		x	x	x	x		
QOL Questionnaire		x		x	x				x	

***Blank boxes indicate it was not applicable**

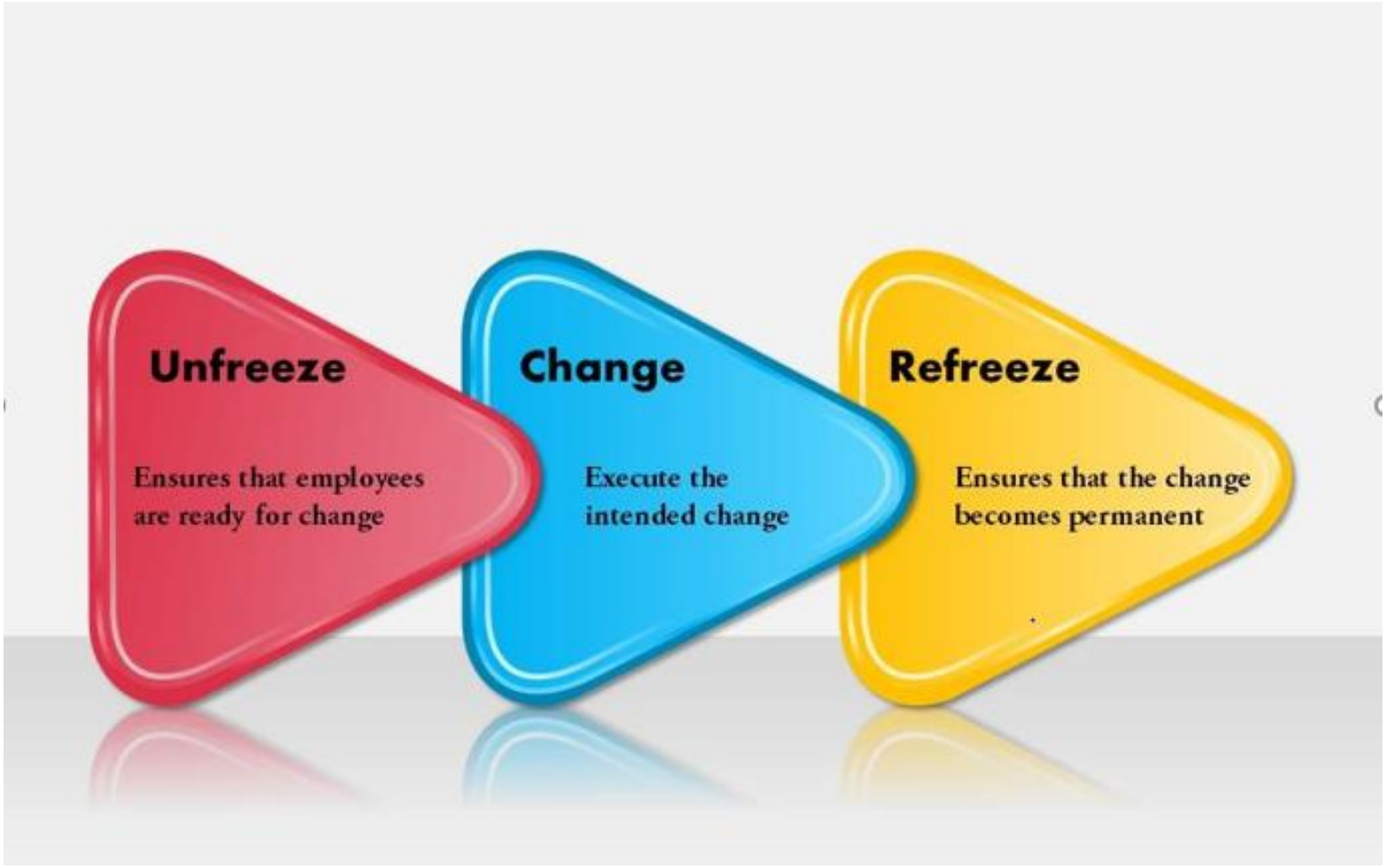
Key: **BQ** – Berlin questionnaire, **CS –** cohort study, **CSS –** cross sectional study, **DM** – diabetes mellitus, , **ESS** – Epworth sleepiness scale, **HTN** – hypertension, **LOE** – level of evidence, **MA –** meta-analysis, **MiOSA** – mild obstructive sleep apnea AHI ≥5 but <15, **MOSA** – moderate sleep apnea AHI ≥15 but <30, **MSOSA** – moderate-severe sleep apnea, **NE** – non-experimental, **N**-number of studies; **n**- number of participants, **OS –** observational study, **OSA** – obstructive sleep apnea, **PCP** – primary care provider, **SBQ** – STOP-Bang questionnaire, **SOSA –** severe sleep apnea AHI ≥ 30, **SR –** systematic review, **STOP** – STOP questionnaire, **+** diagnosed.

Appendix F

Pender's Health Promotion Model



Appendix G
Lewin's Change Theory



Appendix H

STOP-BANG Sleep Apnea Questionnaire

Chung F et al Anesthesiology 2008 and BJA 2012

STOP		
Do you **S**NORE loudly (louder than talking or loud enough to be heard through closed doors)?	Yes	No
Do you often feel **T**IRED, fatigued, or sleepy during daytime?	Yes	No
Has anyone **O**BSERVED you stop breathing during your sleep?	Yes	No
Do you have or are you being treated for high blood **P**RESSURE?	Yes	No

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

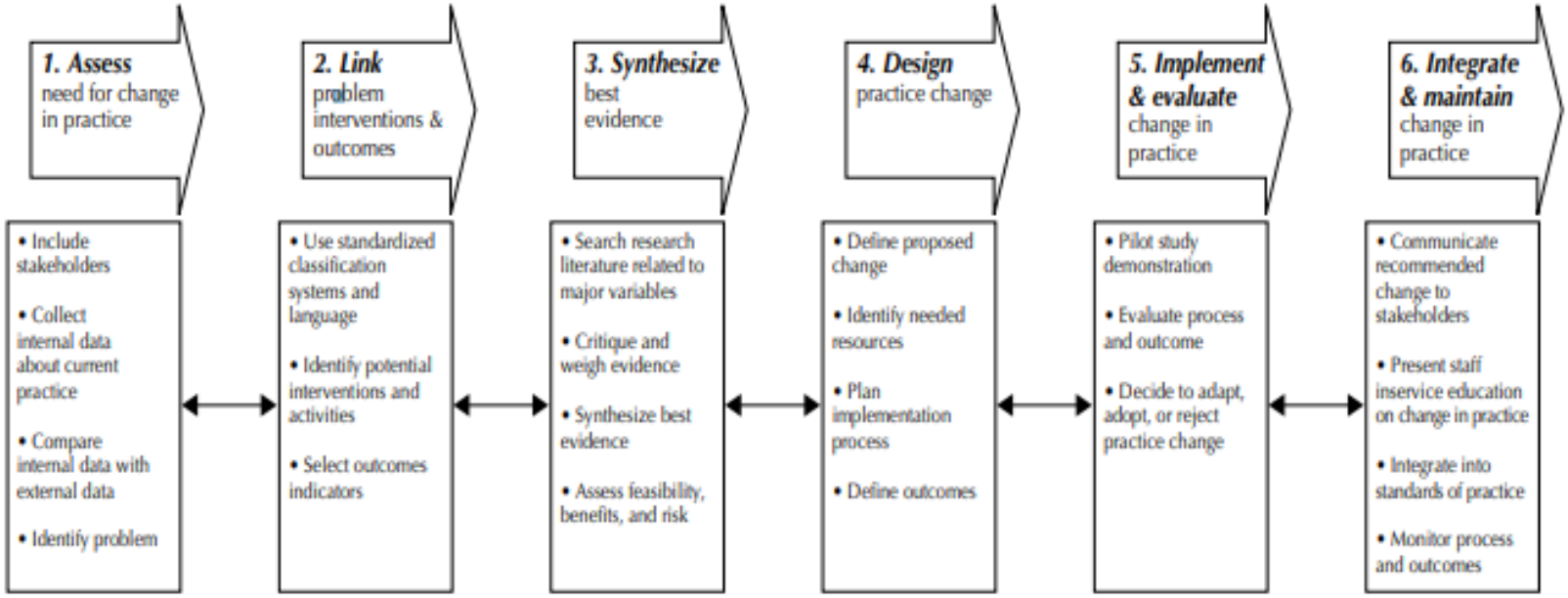
TOTAL SCORE		

High risk of OSA: Yes 5 - 8

Intermediate risk of OSA: Yes 3 - 4

Low risk of OSA: Yes 0 - 2

Appendix I
Rosswurm and Larrabee's Model



Appendix J

Demographics
Please answer each question in the space provided

1. Age: _____

2. Gender
   _____ Male _____ Female

3. Marital Status
   _____ Single
   _____ Married/Living with Partner
   _____ Divorced
   _____ Widowed

4. Do you sleep alone?
   _____ Yes _____ No

5. Are you
   _____ Employed
   _____ Retired
   _____ Disabled
   _____ Student

6. Race
   _____ White
   _____ Black or African American
   _____ Hispanic or Latino
   _____ American Indian or Alaska Native
   _____ Asian
   _____ Native Hawaiian or other Pacific Islander
   _____ Other

7. Insurance
   Medicare _____
   Medicaid (AHCCCS) _____
   Private Insurance _____
   No Insurance _____

8. On average, how many times do you wake up at night? _____

9. What is the average number of hours you sleep per night? _____

10. Do you work night shift? _____ Yes _____ No

FUNCTIONAL OUTCOMES OF SLEEP QUESTIONNAIRE (FOSQ)

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 Mark** 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?					
2. Do you generally have difficulty remembering things, 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
3. Do you have difficulty operating a motor vehicle for **short** distances (less than 100 miles) because you become sleepy or tired?					
4. Do you have difficulty operating a motor vehicle for **long** distance (greater than 100 miles) because you become sleepy or tired?					
5. Do you have difficulty visiting with your family or friends in **their** home because you become sleepy or tired?					
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?					