Doctor of Nursing Practice (DNP) Projects         College of Nursing

2015

# Screening for Sleep Apnea in the Heart Failure Population

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Screening for Sleep Apnea in the Heart Failure Population

A Capstone Scholarly Project Presented By:

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Submitted to the Graduate School of the

University of Massachusetts Amherst College of Nursing

In partial fulfillment of the requirements for the degree of

DOCTOR OF NURSING PRACTICE

Family Nurse Practitioner

May 2015

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Abstract

*Background:* Sleep disordered breathing (SDB) occurs in over half of the estimated 5.1 million

people in the U.S. diagnosed with heart failure (HF). Evidence shows that treatment of SDB in

this population decreases not only morbidity and mortality rates, but the overall cost burden of

the disease as well. The routine use of a sleep apnea screening protocol in the HF population can

help identify patients in need of treatment. *Methods:* A project was conducted at an urban

community heart failure clinic to evaluate provider preference of three evidence-based screening

tools to be included in the implementation of a comprehensive SDB screening protocol. This

project's long-term goal was to design and implement a SDB protocol for heart failure patients

treated at an urban heart failure clinic using the Health Belief Model. *Results:* Providers chose

the Epworth Sleepiness Scale (ESS) as the screening questionnaire to be used in the final

screening protocol. *Conclusion:* Ease of use, sensitivity within patient population, and patient-

friendly format were cited as the deciding factors for provider choice of the ESS as the preferred

screening tool.

Keywords: *sleep apnea, screening, heart failure, protocol, questionnaire*

Screening for Sleep Apnea in the Heart Failure Population

According to the Centers for Disease Control (CDC), approximately 5.1 million people in the United States have a diagnosis of heart failure (HF) and half will die within five years of diagnosis (Centers for Disease Control and Prevention Website, 2013). Heart failure, as a syndrome, is thus characterized by its high mortality as well as frequent hospitalizations and a reduced quality of life. Estimates put total heart failure costs to the nation at a staggering $37 billion each year (Brenner, Angermann, Jany, Ertl, & Stork, 2008; Centers for Disease Control and Prevention Website, 2013). Decreasing such costs, in addition to improving morbidity and mortality, hinges upon identifying those factors that impact not only the treatment but also the progression of the condition. Sleep-disordered breathing, commonly known as sleep apnea, is the most common comorbidity in HF, occurs in 50-80% of patients, and is known to accelerate the progression of the condition thus increasing morbidity and mortality (Kasai & Bradley, 2011; Khayat et al., 2013).  Sleep apnea is defined as a combination of hypopnea (slow, shallow breathing for 10 seconds or more) and apnea (cessation of breathing for 10 seconds or more) that results in a decrease in blood oxygen saturation (Spieker & Motzer, 2003).

Several types of sleep-disordered breathing have been identified in the heart failure population. They include obstructive sleep apnea, central sleep apnea, and complex sleep apnea syndrome, which has characteristics of both the afore-mentioned types. Obstructive sleep apnea affects approximately 35% of HF patients and is caused by partial or complete collapse or obstruction of the upper airway. When obstructive sleep apnea is present in the HF patient, the change in intra-thoracic pressure and an increased sympathetic drive are the pathophysiologic mechanisms that affect the progression of HF. Apneic and hypopneic events in obstructive sleep apnea result in a cascade of neuro-humoral changes such as decreased cardiac output, increased

myocardial oxygen demand, vasoconstriction, hypertension, and activation of the renal renin-angiotensin system (Khayat et al., 2013). Over time, such pathology contributes to ventricular hypertrophy, cardiac remodeling, and failure and significantly adds to the risk of myocardial ischemia, arrhythmias, hypertension, and worsening ventricular dysfunction. Central sleep apnea is more complex and more difficult to treat, as its cause is the temporary withdrawal of the brainstem-driven respiratory drive. A distinct pattern of breathing, termed Cheyne-Stokes respiration, is characterized by central apnea or hypopnea that is then followed by hyperventilation in a cyclic crescendo-decrescendo pattern. The resulting oscillation of increased arterial carbon dioxide and decreased arterial carbon dioxide above and below the apneic threshold is thought to be the cause.

Patients with reduced left ventricular ejection fraction (LVEF) have the greatest incidence of central sleep apnea, 30-50%, whereas those with preserved LVEF present with this type in only 18-30% of cases. Much like the obstructive type, patients with central sleep apnea and HF experience the neuro-humoral and hemodynamic changes that are detrimental to the failing heart. (Khayat et al., 2013). There is accumulating research evidence that nocturnal breathing disorders are important modifiers of disease progression in patients with HF (Brenner et al., 2008). Identification and treatment of sleep apnea in the HF population is critical to improving the outcomes and overall impact of this widely prevalent cardiovascular disorder.

## Literature Review

A comprehensive review of the literature was conducted with the keywords heart failure, sleep apnea, treatment, and screening using CINAHL and PubMed. Results were narrowed to include only work published within the last eight years for CINAHL and the last five years for

PubMed and resulted 92 and 128 items respectively. Only research studies that evaluated apnea

screening and/or treatment were reviewed.

Sixteen studies were selected for inclusion in this review: three meta-analyses, five

randomized control trials (RCTs), two quasi-experimental studies, two prospective observational

study, two post hoc study analyses, one systematic review, and one retrospective chart review.

All studies were critically appraised by type of evidence as well as strength and consistency

using the Jacox Model and were found to be of high quality. Three major treatment modalities

and three screening tools emerged for both types of sleep-disordered breathing and their findings

summarized.

**Continuous Positive Airway Pressure (CPAP)**

Providing continuous airway support in patients with sleep apnea has been found to

improve the AHI in sleep apneic patients in general. Five studies examined the effects of CPAP -

continuous, low-level end-expiratory pressure that helps maintain an open airway - as treatment

for sleep-disordered breathing in the heart failure patient. Sun et al. (2013), a meta-analysis of

ten RCTs and Jacox 1A study, determined that CPAP may improve LVEF by 3.59% in patients

with obstructive sleep apnea. However, CPAP was found to increase LVEF by 5.18% in those

patients with obstructive sleep apnea and documented heart failure. Ferrier et al. (2008), Jacox

IIA, also evaluated the effect of CPAP in HF patients with obstructive sleep apnea over six

months using a 26-patient RCT.

Left ventricular function (LVEF) was again improved with CPAP, as well as other

measures of physiologic improvement such as decreased systolic blood pressure and decreased

left ventricular end-systolic volume. Hall et al. (2014), Jacox IIB, and Kasai et al. (2008), Jacox

IIB, also reported findings that support the use of CPAP in the obstructive sleep apnea/HF

population by improving cardiac efficiency and reducing the risk of hospitalization and death

respectively. One study assessed the use of CPAP in the presences of central sleep apnea. This

post hoc analysis of the Canadian Continuous Positive Airway Pressure Trial by Arzt et al.

(2007) concluded that suppression of central sleep apnea soon after its initiation with CPAP may

not only improve LVEF but also heart transplant-free survival.

**Bi-level Positive Airway Pressure (BiPAP)**

BiPAP adds additional respiratory support to the existing CPAP via a set level of

inspiratory pressure administered with each breath.  One RCT evaluated the use of BiPAP in

SDB. Khayat et al. (2008), Jacox IIC, compared the use of CPAP in treatment of obstructive

sleep apnea to the use of BiPAP in improving LVEF in 24 patients with stable systolic

dysfunction HF and newly diagnosed sleep apnea. The study found BiPAP to be superior to

CPAP in increasing left ventricular function in this HF population, raising LVEF 7.9% more than

CPAP although both methods were effective in reducing the apnea-hypopnea index (AHI).

This was the first study to compare BiPAP vs. CPAP for obstructive sleep apnea in

patients with systolic dysfunction thus it had several limitations. Most notably, limited

measurements such as echocardiogram that precluded a thorough assessment of the impact of

BiPAP on cardiovascular parameters. Larger studies with greater hemodynamic measure would

aide in the stronger conclusion of BiPAP superiority.

**Adaptive Servoventilation (ASV)**

Adaptive servoventilation, also known as dynamic BiPAP, is a method of respiratory

support that adjusts the inspiratory support component according to the needs of the patient.

Although CPAP has been shown to reduce AHI, increase LVEF, and reduce sympathetic activity

in HF patients with SDB, it has been unsuccessful in suppressing CSA in nearly 50% of treated

patients (Sharma et al., 2012). The research supports the use of ASV for the suppression of CSA as well as mixed apneas (CompSAS) in the heart failure patient. Arzt et al. (2008), a quasi-experimental Jacox IIIB study, studied 14 CHF patients with CSR-CSA for three nights – one for a baseline sleep study, one for CPAP or BiPAP support, and one for ASV support. Although CPAP or BiPAP reduced AHI, ASV was found to have the greatest reduction in AHI and thus CSA suppression.

Similarly, Joho et al. (2012), another quasi-experimental Jacox IIIB study, found that ejection fraction and muscle sympathetic nerve activity (MSNA) changed significantly in the ASV group studied vs. the non-ASV group and concluded that ASV decreases MSNA, improves cardiac function, and suppresses central sleep apnea in HF patients. Allam et al. (2007) performed a retrospective chart review of 100 patients who had a sleep study using ASV at Mayo Clinic Sleep Center. Although this is Jacox VB evidence, the authors concluded that the ASV method of ventilator support appeared to be effective in treating both complex sleep apnea syndrome and central sleep apnea syndromes previously resistant to CPAP therapy.

Those findings were reinforced by the RCT study, Jacox IIB evidence, by Randerath et al. (2012) of 70 patients with HF and the coexistence of obstructive and central sleep apnea confirmed ASV improved CSR-CSA more effectively than CPAP as well as BNP over a twelve-month period. Owada et al. (2013) found that ASV also had an effect on cardiorenal function in HF patients with CKD and SDB in their prospective observational study of 80 patients. This Jacox IVB study reinforces the additive benefits of ASV support in the presence of central sleep apnea and its effects on HF.

Lastly, Sharma et al. (2012) published the highest quality evidence in support of ASV for treatment of sleep apnea in heart failure. Their systematic review and meta-analysis, Jacox 1A

evidence, found that ASV for sleep apnea not only reduced AHI, but also improved cardiac function and exercise capacity (a factor that has the ability to change NYHA classification of HF).

**Screening Tools**

Several screening tools have been designed to identify sleep apnea in a variety of populations. A review of the literature with specific emphasis on diagnosing sleep apnea in the heart failure population revealed three tools most commonly used: the Epworth Sleepiness Scale (ESS), the STOP-Bang Equivalent Model, and the Berlin Questionnaire. (Appendices 1-3)

A retrospective chart review by Rosenthal & Dolan (2008) to assess the sensitivity of the ESS in identifying obstructive sleep apnea was conducted on 268 patients screened using this evaluation tool. Patients were screened using the ESS and then underwent a polysomnography (PSG) study to measure the AHI. ESS scores were analyzed in comparison to AHI greater than or equal to five (the diagnostic criteria for sleep apnea). This Jacox V-B study determined that the ESS alone has a fair discriminatory ability as a screener for obstructive sleep apnea when using a cutoff score of ten (66% sensitivity) but sensitivity of the screen improves (76%) when a lower score of eight is used.

Farney et al. (2011) conducted a similar study using the STOP-Bang Equivalent model (SBM) and its ability to predict obstructive sleep apnea in comparison to the PSG and measured AHI in an effort to further classify obstructive sleep apnea into categories ranging from none to severe. A Jacox V-B rated study, the authors used three statistical models to compare the STOP-Bang scores of 1,426 patients who underwent PSG and analyzed the data. Based on the results, stratification of sleep apnea severity based on STOP-Bang scoring was determined. For example, a patient with a SBM score of 6-8 has a high probability of being diagnosed with obstructive

sleep apnea via PSG (53.3%, 74.1%, and 81.9%, respectively) and further evaluation would be

recommended.

The Berlin Questionnaire (BQ), as a sleep apnea screening tool, also underwent testing to

evaluate the sensitivity and specificity of this screen in comparison to the gold standard PSG as a

diagnostic tool. Netzer et al. (1999) was the first to evaluate the use of a screening tool for sleep

apnea in primary care. His Jacox III-B study administered the BQ to 744 respondents, 100 of

whom then underwent an overnight sleep study. The resulting analysis concluded that the BQ, in

this study, had an 86% sensitivity for prediction of sleep apnea (respiratory disturbance index

RDI >5). Ahmadi et al. (2008) conducted a retrospective chart review, Jacox V-B evidence, of

130 sleep-clinic patients to also determine the effectiveness of this widely utilized screening tool

at SDB prediction. All patients in this review completed the BQ as well as underwent two nights

of PSG recording. Statistical analysis resulted in the BQ having moderate specificity and low

sensitivity in correctly diagnosing sleep apnea. The authors noted that their findings differed

from those of Netzer et al. (1999) and that the retrospective nature of the study was indeed a

limitation.

Ramachandran & Josephs (2009) conducted a meta-analysis of multiple screening tests

for obstructive sleep apnea. This study, of the highest Jacox level, found the Berlin

Questionnaire to be one of the most accurate questionnaires, however, a high number of false

negatives were found with all screens, including the BQ, and most clinical prediction models.

The least accurate screen was determined to be the ESS due to the plethora of other causative

factors for daytime sleepiness. The STOP questionnaire, and STOP-Bang model were considered

the simplest to use and score. Lastly, a systematic review of obstructive sleep apnea screening

questionnaires by Abrishami, Khajehdehi & Chung (2010) reviewed 10 studies (n=1,484

patients) aimed at screening for SDB. The researchers concluded that such screening tools are associated with promising but inconsistent results due largely in part to the heterogeneous design of the research.

**Synthesis of the Evidence**

A review of the literature and critical appraisal of the discovered research supports the need for screening, diagnosis, and treatment of sleep-disordered breathing in the heart failure population. Untreated severe SDB has been found to have a statistically significant increased risk of all cause mortality ($p < 0.01$; Young et al., 2008), thus treatment is warranted, especially in patients with a confounding disease such as heart failure. Although using an overnight polysomnography (PSG) study in a sleep lab is considered the gold standard for diagnosis of sleep-disordered breathing (Jureyda & Shucand, 2004), such a study can be time-consuming and costly. Evidence-based screening tools such as The Epworth Sleepiness Scale (ESS) (Appendix 2), which measure subjective daytime sleepiness, or The STOP-Bang Questionnaire (Appendix 3), which assesses risk factors for obstructive sleep apnea, could be used to ferret out those at highest risk for sleep-disordered breathing in the heart failure population.

Despite the research consensus that such screens have noted inconsistencies and a high rate of false-positive results (Ahmadi, Chung, Gibbs, & Shapiro, 2008; Farney, Walker, Farney, Snow, & Walker, 2011; Rosenthal & Dolan, 2008), when used in conjunction with a secondary screen of higher sensitivity and specificity such as overnight oximetry (Chung et al., 2012; Sommermeyer, Zou, Grote, & Hedner, 2012), identification of patients with a true diagnosis of sleep apnea becomes more favorable. Those patients could then be referred for a PSG study to confirm or refute the suggestion of sleep apnea in light of a positive, multi-leveled screen.

Garner & Traverse (2014) implemented such an evidence-based protocol to screen for sleep apnea in a heart failure disease management clinic.

This practice project used a sleep apnea screening questionnaire, the Epworth Sleepiness Scale (ESS), and a less costly overnight pulse oximetry test to screen for sleep apnea in a heart failure clinic. The results were significantly favorable in diagnosing apnea, after confirmation by PSG, in their patient population when compared to using the ESS alone (Garner & Traverse, 2014). Utilizing a screening protocol such as this for all patients diagnosed with heart failure would be not only feasible, but also clinically beneficial and cost effective.

**Theoretical Framework**

The Health Belief Model was chosen due to literature review findings that noted lack of patient compliance or non-adherence to SDB diagnostic testing and/or prescribed treatment as a significant challenge in the treatment of SDB in the HF patient population (Traverse, 2011). This model was originally developed in the 1950's by a group of U.S. Public Health Service social psychologists in response to a lack of societal participation in disease detection and prevention programs (Health Belief Model "HBM," 2013). It is one of the first theories of health behavior and was later expanded to examine a person's response, behavior, and compliance to healthcare-related recommendations. Exploring the relationship between belief and behavior illuminates the path to understanding noncompliance and thus aides in predicting not only health behavior change but also ultimately compliance (Champion & Skinner, 2008; "HBM," 2013).

Six major constructs comprise the foundation of the Health Belief Model: perceived susceptibility, perceived severity, perceived benefits, perceived costs or barriers, motivation or cues to action, and lastly perceived self-efficacy. Other variables, termed modifying factors, include age, gender, ethnicity, personality, socioeconomics, and knowledge (Champion &

Skinner, 2008). Application of this health behavior theory involves the use of goal setting, verbal reinforcement, and demonstration of positive behaviors. Utilization of a theoretical framework such as Health Belief Model will help identify HF patients at greatest risk for non-compliance with testing and/or treatment and allow for provider education as well as individualization of the plan based on identified barrier(s) to help increase adherence and optimize outcomes.

## Project Description, Implementation, and Monitoring

### Setting, Community, and Gap Analysis

The heart failure clinic at an urban medical center in Hartford, CT will be venue for this quality improvement (QI) project. The cardiology center of excellence at this medical center is inclusive of the heart failure clinic at which this project will be conducted. Hartford, the capitol of Connecticut, is a large city with a population of about 125,000. According to the United States Census Bureau for the year 2010, Hispanic or Latino comprised 43.4% of the city's population, Black or African American 38.7%, White 15.8%, and other 2.1%.

The hospital serves not only its home city, but also Hartford County, which has an estimated population of 898,000. Unlike the city of Hartford, Hartford County has a larger White population (64.2%) than Hispanic (16.6%) or Black (15%) (United States Census Bureau website, 2014). The hospital, in regard to its emergency services and inpatient population, reflects a racial and ethnic composition more similar to that of the city, whereas the heart failure clinic more closely reflects that of the county and the intrinsic prevalence of the disease itself.

Population-based estimates of prevalence, incidence, and prognosis of heart failure are lacking due to differences in study definitions of not only the condition, but also methods used to define the presence of the disease. Thus, the magnitude of the problem of HF cannot be

accurately assessed. Regardless of the defining terms used, the prevalence of HF and LV dysfunction increase significantly with age, and the prevalence in African-Americans is stated to be 25% higher than in Whites. This is due, in part, to a higher prevalence of predisposing conditions for HF that are most often diagnosed in the African American population. There has been a shift over the past four decades in regard to the primary causes of HF from hypertension and coronary artery disease (CAD) to that of CAD and diabetes mellitus as seen in the Framingham Study. CAD prevalence as a cause in men increased 41% per calendar decade and 25% in women with diabetes as a contributing cause in both sexes increasing by more than 20% per decade. Racial differences in HF risk factors revealed that among blacks, a greater proportion of HF risk was due to modifiable risk factors such as elevated systolic BP, elevated fasting glucose levels, CAD, LV hypertrophy, and smoking. (Vasan & Wilson, 2013)

Education, not only intrinsic education, but ongoing disease education, plays a large factor in addressing not only the modifiable risk factors for HF as a disease, but also for the ongoing need for diligent disease management and follow-up critical for patients within this population. Census data shows that those with a Bachelor's degree or higher at age 25+ for Hartford County for years 2009-2013 are 34.9% whereas those in Harford, the city, are 15.2% with the state average being 36.5% (United States Census Bureau website, 2014).

Practitioners need to have an understanding of their patient population in regard to not only racial and ethnic make-up but also educational level and need for educational support for proper disease treatment, management, and compliance. The patients that frequent the heart failure clinic at Saint Francis Hospital are representative of city, county, and disease prevalence populations, with perhaps a slightly higher incidence of African American patients than other ethnicities/races.

**Organizational Analysis of Project Site**

The HF clinic team consists of two MDs, ten PA/APRNs, four RNs, and an administrative director. Together, this team provides complete care for both clinic outpatients as well as heart failure patients currently being treated on the CHF inpatient unit. The inpatient unit is staffed by additional RNs employed by the medical center. Provider support is available to these patients, both inpatient and outpatient, around the clock. The clinic reports to the cardiovascular service line dyad, a medical executive who represents the inpatient aspect, as well as an administrative executive representing the outpatient component of the clinic.

**Evidence of Stakeholder Support**

The internal stakeholders of this project include both physicians responsible for the care of the HF patients who seek care for their disease management at this hospital-based clinic. The medical director requested the institution of a sleep apnea screen based on current research evidence for all patients seen at the clinic. All the providers at the clinic support his request for such a screening tool. Currently, sleep apnea screening does not exist for this patient population at either the outpatient or inpatient level. Screening and treatment were only occurring if HF patients had it with other healthcare providers. The DNP candidate met with not only the heart failure team to discuss ideas for implementation of a complete screening protocol. Providers agreed to implement a multi-phased approach for instituting this newly desired protocol at both the outpatient and inpatient levels of care. The project involved assisting the team with phase one of a projected four-phase plan to adopt a routine SDB screening protocol for the heart failure population served at this facility.

**Facilitators, Barriers, and Constraints**

As with any new protocol, both facilitators and barriers to implementation success exist. A strong evidence-base supports the use of PAP as a treatment for sleep apnea in the HF patient and lends to provider credibility when educating patients on the need for treatment compliance. The simplicity of the screening tool(s) for healthcare staff to administer and score as well as the ease of home nocturnal oximetry evaluation for the patient enhances acceptance of the screen by both administrators and patients alike. Out-of-pocket costs to implement sleep apnea screening in the office setting are minimal for both providers and patients. Additionally, healthcare insurance companies are more likely to cover the cost of polysomnography in the presence of an oximetry study indicative of periods of hypoxia.

Barriers to implementation are few, but exist. Obtaining either a clinic-owned home oximetry screening system or finding a corporation to provide this service is the greatest hurdle. This part of the screening protocol is significant to diagnosing those patients with central sleep apnea that will often not screen positive on the various obstructive sleep apnea/ESS screening tools to be evaluated during this project. Patient non-compliance is the largest barrier to protocol evaluation and treatment success.

Garner & Traverse (2013) studied the health behaviors and sleep apnea treatment adherence in the HF patient. They found that non-compliance was highest in the elderly and in women for various reasons such as the prospect of an overnight sleep study outside of the home, being "too old" for evaluation and treatment, complications with other diagnoses, and cost. For those who underwent PSG evaluation but did not comply with the recommended PAP treatment, reasons of mask intolerance, claustrophobia, and drying of the nose were given (Garner & Traverse, 2013).

**Project Design and Methods**

Instituting a complete and reliable SDB screening protocol for a HF program of this size is a large task. Thus, implementation was divided into four phases: choosing a written screening tool, obtaining the ability to provide overnight oximetry studies, implementing the two-part screening protocol on all clinic patients per inclusion/exclusion criteria, and screening inpatients for SDB while hospitalized if not previously documented. This project focused on facilitating phase one of this multi-phased project.

Using a set of screening tools similar to those used by Garner & Traverse (2014), the project goal was to screen adult patients with a diagnosis of heart failure, NYHA class I-IV, not currently diagnosed with or being treated for any form of sleep-disordered breathing. Parameters for determination of a positive screen were outlined in advance, and patients that met or exceeded these values would be referred to a sleep specialist to undergo PSG studies to confirm or refute the suspicion of SDB. For example, an ESS score of 9 or greater and/or a nocturnal desaturation of 89% or less for a total of five minutes or more would qualify for PSG (Garner & Traverse, 2014). Those patients found to have an AHI confirming sleep apnea would then be recommended for positive airway pressure (PAP) treatment for the newly diagnosed condition. Patient education throughout the screening and/or treatment process is key to attaining compliance. Use of the HBM to examine patient perceptions and health beliefs to guide additional teaching points is essential.

Using evidence-based research, three screening tools were determined to be effective in screening for SDB. For phase one of this QI project, five providers, one MDs and three APRNs, and one RN used and evaluated the three tools. The DNP candidate gave five copies of each screening tool to be evaluated to each one of the HF clinic providers. They then used the three

tools to screen 15 patients for sleep apnea following the inclusion criteria of the project. Patients

were qualified to be screened if they were 18 years or older, had a documented diagnosis of heart

failure, NYHA stage II or more, and had not been diagnosed with or treated for sleep apnea in

the past. Once all 75 patients were screened, the DNP student had the providers complete a

written evaluation of the tools used (Appendix 4). The next step involved individual meetings

with the providers privately to discuss the pros and cons of each screening tool trialed.  A group

meeting was also scheduled to discuss the overall results and opinions of phase one as well as to

potentially decide which one or two screening tools will become part of the screening protocol.

Phases two through four will be completed after this project, however, the DNP candidate

will assist with facilitating the progression of these advanced stages and support the providers in

continued refinement and development during the time spent in clinic for phase one. Obtaining

the ability to provide overnight oximetry studies is an integral part of the proposed screen.

|  | Begin | End | Goal(s) |
|---|---|---|---|
| **Phase II**<br><br>**Obtain Oximetry** | April 2015 | June 2015 | Obtain overnight oximetry equipment. |
| **Phase III**<br><br>**Implement Full**<br><br>**Protocol** | June 2015 | June 2016 | Screen all new HF clinic patients.<br><br>Refer high-risk patients for PSG and confirm diagnosis.<br><br>Use HBM as foundation for patient education regarding treatment of sleep apnea. |
| **Phase IV**<br><br>**Inpatient Screening** | December 2015 | June 2016 | Educate unit staff and screen inpatients.<br><br>Refer high-risk |

| | | | patients for PSG and confirm diagnosis. Follow-up in HF clinic post-discharge. |
|---|---|---|---|

**Goals, Objectives, and Expected Outcomes**

Identifying comorbidities that negatively impact the morbidity and mortality of cardiovascular disease, namely heart failure, and mitigating them with evidence-based treatment is essential to providing holistic care to patients at risk. In most settings, HF patients are not routinely screened for SDB (Khayat et al., 2013), so any positive screen that resulted in treatment otherwise not prescribed would be considered effective.

The long-term goal of this project is to design and implement a sleep apnea screening protocol for heart failure patients treated at an urban medical center heart failure clinic. The short-term goal is to select a sleep apnea screening questionnaire(s) for use in the protocol.

The objectives of the project as a whole are as follows:

- Identify HF patients at risk for sleep apnea using screening questionnaires and oximetry studies.

- Refer at-risk patients identified for PSG study to confirm or refute diagnosis of sleep apnea.

- Educate patients and providers on the need for screening and treatment of sleep apnea in the HF population.

- Initiate treatment for patients diagnosed with sleep apnea using PAP as prescribed by a pulmonologist.

- Improve patient wellness by minimizing symptoms associated with sleep apnea and improving cardiac function.

The expected outcome for this project is the successful selection of a screening tool(s) by the clinic providers to be used in the sleep apnea screening protocol.

**Protection of Human Subjects**

Institutional Review Board (IRB) approval was not required for this project as it was a quality improvement project. Assigning numbers to designate each patient protected the confidentiality of all participants during data collection and analysis. Information collected consisted of the data required by the various screening tools, such as age, gender, neck circumference, height, and weight and was not linked with personal identifiers of participants. Although the screening tools were reviewed and re-scored by the DNP student for accuracy of use and frequency of positive screens, patient identification was not necessary and thus no risk to patient confidentiality occurred.

**Implementation and Data Collection**

Providers were educated as to both the short-term goals related to this project, as well as the long-term goal of the institution of a sleep apnea screening protocol for the HF clinic. The three screening tools to be evaluated were distributed to each provider and returned to the DNP candidate for scoring check, patient chart review, and inclusion validation. Providers were expected to screen 15 patients each for a total of 75 patients screened and then complete the provider feedback form (Appendix 4). Data about each screening tool was assessed including number of screens completed, positive screens per tool, gender ratios, and provider feedback. The data was compiled, reviewed, and charted for presentation to the provider group at project end.

## Evaluation

**Results, Findings, and Data Analysis**

Five providers, an MD, three PAs, and an RN, were asked to participate in evaluating the three screening tools, ESS, STOP-BANG questionnaire, and Berlin questionnaire. Each tool was to be used to screen five patients for an anticipated screening database of 75 patients. At project end, 17 out of a targeted 75 patients were screened for 23% of goal. All patients screened, ten males and seven females, met the inclusion criteria set forth by the DNP student as verified by chart audit.

Table I. Completed Screening Tools

| Tool | Anticipated Screens | Actual Screens | Percent Received |
|---|---|---|---|
| ESS | 25 | 7 | 28% |
| STOP-BANG | 25 | 4 | 16% |
| Berlin | 25 | 6 | 24% |
| TOTAL SCREENS | 75 | 17 | 23% |

Of the 17 patients screened, eight patients (47%) scored as being "high risk" for sleep apnea according to the scoring guidelines of each tool. Table II outlines each screen's gender demographics and positive results by tool.

Table II. Positive Apnea Screens by Gender and Tool

|  | ESS | STOP-BANG | Berlin | TOTAL |
|---|---|---|---|---|
| **Male Positive** | 3 | 2 | 0 | 5 |
| **Female Positive** | 0 | 1 | 2 | 3 |
| **Percent Positive** | 43% | 75% | 33% | 47% |

Two of the five providers completed and submitted the Screening Tool Feedback Form.

Each tool was rated using a 1-5 scale (whereas 1 = poor and 5 = superior) in three categories for

a potential score of 3-15.

Table III. Provider Rating of Each Tool

|  | ESS | STOP-BANG | Berlin |
|---|---|---|---|
| Provider 1 | 15/15 | 10/15 | 12/15 |
| Provider 2 | 14/15 | 8/15 | 11/15 |

Both responding providers scored ESS as superior and commented that its ease of use,

sensitivity, and lack of needed "measurements" influenced their opinion.

Despite the small sample size, the results of this preliminary sleep apnea screening trial

closely mirror the findings of not only the CDC but also various research studies that place the

incidence of sleep apnea in heart failure patients at 50-80% (Kasai & Bradley, 2011). The tool of

choice to be used in conjunction with overnight oximetry in the full protocol, Epworth

Sleepiness Scale, meets the criteria for an ideal screening device as described by Pang & Terris

(2006), "…cheap, readily accessible, easily used with minimal instructions, have no risk of side

effects to the patient, and be safe and accurate". Confirmation of suspected diagnosis through

PSG, the gold standard, has proven this screening protocol to be an effective method for

identifying and diagnosing sleep apnea in the heart failure population (Garner & Traverse, 2014).

Once the long-term goal of complete protocol screening has been implemented and

treatment ordered and instituted, long-term compliance with sleep apnea treatment can be

reinforced by noting the patients verbalization of improved symptoms, improved ESS, BQ, or

STOP-Bang scores, or by means of repeat echocardiogram (ECHO) which could possibly show

documented improvement of heart function. Trending the data over time (monthly, quarterly, yearly) to determine compliance rates is necessary so that providers can customize treatment programs and reinforce disease education to increase the self-efficacy construct noted in HBM to overcome these barriers. Follow-up at routine intervals, especially in the first two weeks of PAP treatment, to monitor patient response, tolerance, compliance, and subjective reporting is necessary.  Encouraging the use of support groups is also recommended (Garner & Traverse, 2013).

**Discussion and Conclusion**

This capstone project was designed to be the first phase of a multi-phased sleep apnea screening protocol for a busy urban heart failure clinic. The goal was to evaluate and select an evidence-based sleep apnea screening questionnaire for use in the larger sleep apnea screening protocol. After providers used the selected tools, completed the feedback form, and met as a group for open discussion, the Epworth Sleepiness Scale was chosen as the screening tool to be used in the full screening protocol to be implemented in the near future. Providers stated ease of use, patient autonomy in completion, and screening sensitivity as factors for this choice.

The implementation and use of this tool, in conjunction with overnight pulse oximetry studies for those who are scored as "high risk", will lay the solid foundation for the gold-standard polysomnography study and absolute diagnosis of patients with a sleep disordered breathing condition. Health Belief Model can then be used to guide patient teaching, readiness to learn, barriers to treatment compliance, and self-efficacy for action. HBM allows healthcare providers to predict why individuals engage in behavior change to prevent, detect, or treat a diagnosed condition or disease (Champion & Skinner, 2008). The focus on self-efficacy, the confidence in one's own abilities to engage in a treatment, is important not only as an indicator

of health outcomes but also as a means by which nurse educators can improve patient's quality of life.

Sleep apnea in the heart failure population should be approached as a coexisting chronic disease requiring long-term multidisciplinary management (Khayat et al., 2013). Unfortunately, sleep apnea is not part of the routine evaluation and management of heart failure, so it remains untreated in most patients. Nursing can play an instrumental role in screening and identifying those patients at highest risk for sleep apnea using an evidence-based screening protocol. Once identified and diagnosed, nurse educators can implement the principles and knowledge of HBM to construct an individualized educational plan to increase adherence with recommended therapies, spawn cues to action, and increase patient awareness. The resulting compliance to treatment greatly impacts quality of life, disease progression, and ultimately morbidity and mortality (Kazimierczak, Krzesinski, Krzyzanowski, & Gielerak, 2013).

**Limitations**

The lack of full provider participation and evaluation of selected tools limited the "real-use" input during the round-table discussion regarding tool choice/preference for use in the larger protocol. Additionally, the short timeframe of the project limited implementation to phase one only and disallowed for evaluation of the multi-faceted screening protocol and ability to attain true diagnostic confirmation via gold-standard testing, thus gaining insight as to the sensitivity and specificity of the protocol design.

<div align="center">

**Plan for Post-Project Continuation**

</div>

The heart failure clinic that served as the site for this capstone project will continue with phases two through four of the implantation of a SDB screening protocol for both the inpatient heart failure unit and the affiliated outpatient heart failure clinic. An overnight pulse oximetry

study will be ordered and completed for patients who score as "at risk" on the chosen sleep apnea screening tool. Oxygen desaturation associated with periods of apnea can be rudimentarily detected via this study. The true AHI (apnea-hypopnea index) is then determined by polysomnography, a full overnight sleep study, which can then be ordered for patients exhibiting episodes of hypoxia. Inpatients deemed at risk can also undergo oximetry study during their hospitalization if not previously diagnosed or ruled-out for sleep apnea. The goal for full implementation of such comprehensive sleep-disordered breathing screening protocol is projected for the end of 2015. Ongoing education of all staff not only on newly instituted screening protocols but also HBM theory and patient compliance will aide in project success.

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**Appendix 1**

# The Epworth Sleepiness Scale

The Epworth Sleepiness Scale is widely used in the field of sleep medicine as a subjective measure of a patient's sleepiness.  The test is a list of eight situations in which you rate your tendency to become sleepy on a scale of 0, no chance of dozing, to 3, high chance of dozing.  When you finish the test, add up the values of your responses.  Your total score is based on a scale of 0 to 24.  The scale estimates whether you are experiencing excessive sleepiness that possibly requires medical attention.

## How Sleepy Are You?
How likely are you to doze off or fall asleep in the following situations? You should rate your chances of dozing off, not just feeling tired. Even if you have not done some of these things recently try to determine how they would have affected you. For each situation, decide whether or not you would have:

- No chance of dozing        =0
- Slight chance of dozing      =1
- Moderate chance of dozing    =2
- High chance of dozing       =3

Write down the number corresponding to your choice in the right hand column. Total your score below.

| Situation | Chance of Dozing |
|---|---|
| Sitting and reading | • |
| Watching TV | • |
| Sitting inactive in a public place (e.g., a theater or a meeting) | • |
| As a passenger in a car for an hour without a break | • |
| Lying down to rest in the afternoon when circumstances permit | • |
| Sitting and talking to someone | • |
| Sitting quietly after a lunch without alcohol | • |
| In a car, while stopped for a few minutes in traffic | • |

Total Score =           _____

### Analyze Your Score
**Interpretation:**
- **0-7:** It is unlikely that you are abnormally sleepy.
- **8-9:** You have an average amount of daytime sleepiness.
- **10-15:** You may be excessively sleepy depending on the situation. You may want to consider seeking medical attention.
- **16-24:** You are excessively sleepy and should consider seeking medical attention.

Reference: Johns MW. A new method for measuring daytime sleepiness: The Epworth Sleepiness Scale. *Sleep* 1991; 14(6):540-5.

**Appendix 2**

## STOP BANG Questionnaire

Height _____ inches/cm Weight _____ lb/kg
Age _____
Male/Female
BMI _____
Collar size of shirt: S, M, L, XL, or _____ inches/cm
Neck circumference* _____ cm

1. *S*noring
Do you *s*nore loudly (louder than talking or loud enough to be heard
through closed doors)?
Yes             No

2. *T*ired
Do you often feel *t*ired, fatigued, or sleepy during daytime?
Yes             No

3. *O*bserved
Has anyone *o*bserved you stop breathing during your sleep?
Yes             No

4. Blood *p*ressure
Do you have or are you being treated for high blood *p*ressure?
Yes             No

5. *B*MI
*B*MI more than 35 kg/m$^2$?
Yes             No

6. *A*ge
*A*ge over 50 yr old?
Yes             No

7. *N*eck circumference
*N*eck circumference greater than 40 cm?
Yes             No

8. *G*ender
*G*ender male?
Yes             No

\* Neck circumference is measured by staff

*High risk of OSA:* answering yes to three or more items
*Low risk of OSA:* answering yes to less than three items

Adapted from:
**STOP Questionnaire**
*A Tool to Screen Patients for Obstructive Sleep Apnea*

**Appendix 3**

## BERLIN QUESTIONNAIRE

Height (m) _____ Weight (kg)_____ Age_____ Male / Female
Please choose the correct response to each question.

**CATEGORY 1**

**1. Do you snore?**
_ a. Yes
_ b. No
_ c. Don't know

*If you snore:*
**2. Your snoring is:**
_ a. Slightly louder than breathing
_ b. As loud as talking
_ c. Louder than talking
_ d. Very loud – can be heard in adjacent rooms

**3. How often do you snore**
_ a. Nearly every day
_ b. 3-4 times a week
_ c. 1-2 times a week
_ d. 1-2 times a month
_ e. Never or nearly never

**4. Has your snoring ever bothered other people?**
_ a. Yes
_ b. No
_ c. Don't Know

**5. Has anyone noticed that you quit breathing during your sleep?**

_ a. Nearly every day
_ b. 3-4 times a week
_ c. 1-2 times a week
_ d. 1-2 times a month
_ e. Never or nearly never

**CATEGORY 2**

**6. How often do you feel tired or fatigued after your sleep?**
_ a. Nearly every day
_ b. 3-4 times a week
_ c. 1-2 times a week
_ d. 1-2 times a month
_ e. Never or nearly never

**7. During your waking time, do you feel tired, fatigued or not up to par?**
_ a. Nearly every day
_ b. 3-4 times a week
_ c. 1-2 times a week
_ d. 1-2 times a month
_ e. Never or nearly never

**8. Have you ever nodded off or fallen asleep while driving a vehicle?**
_ a. Yes
_ b. No

*If yes:*
**9. How often does this occur?**
_ a. Nearly every day
_ b. 3-4 times a week
_ c. 1-2 times a week
_ d. 1-2 times a month
_ e. Never or nearly never

**CATEGORY 3**
**10. Do you have high blood pressure?**
_ Yes
_ No
_ Don't know

## Berlin Questionnaire (for sleep apnea)

Scoring Berlin questionnaire

Adapted from: Table 2 from Netzer, et al., 1999. (Netzer NC, Stoohs RA, Netzer CM, Clark K, Strohl KP.
Using the Berlin Questionnaire to identify patients at risk for the sleep apnea syndrome.
Ann Intern Med. 1999 Oct 5;131(7):485-91).

The questionnaire consists of 3 categories related to the risk of having sleep apnea.

Patients can be classified into High Risk or Low Risk based on their responses to the individual items and their overall scores in the symptom categories.

## Categories and scoring:

Category 1: items 1, 2, 3, 4, 5.
Item 1: if '**Yes**', assign **1 point**
Item 2: if '**c**' or '**d**' is the response, assign **1 point**
Item 3: if '**a**' or '**b**' is the response, assign **1 point**
Item 4: if '**a**' is the response, assign **1 point**
Item 5: if '**a**' or '**b**' is the response, assign **2 points**

**Add points. Category 1 is positive if the total score is 2 or more points**
Category 2: items 6, 7, 8 (item 9 should be noted separately).
Item 6: if '**a**' or '**b**' is the response, assign **1 point**
Item 7: if '**a**' or '**b**' is the response, assign **1 point**
Item 8: if '**a**' is the response, assign **1 point**

**Add points. Category 2 is positive if the total score is 2 or more points**
**Category 3 is positive if the answer to item 10 is 'Yes' OR if the BMI of the patient is greater than 30kg/m2.**
(BMI must be calculated. BMI is defined as weight (kg) divided by height (m) squared, i.e., kg/m2).

**High Risk:** if there are 2 or more Categories where the score is positive
**Low Risk:** if there is only 1 or no Categories where the score is positive

Additional question: item 9 should be noted separately.

**Appendix 4**

# Screening Tool Feedback Form

**Please rate using 1-5 scale whereas 1 = poor; 5 = superior**

**Epworth Sleepiness Scale:**

1) Patient friendly: _____

2) Provider friendly: _____

3) Ease of use/scoring: _____

4) Pros/cons: _____

**Stop-BANG Questionnaire:**

1) Patient friendly: _____

2) Provider friendly: _____

3) Ease of use/scoring: _____

4) Pros/cons: _____

**Berlin Questionnaire**

1) Patient friendly: _____

2) Provider friendly: _____

3) Ease of use/scoring: _____

4) Pros/cons: _____

**What tool or tools do you think would BEST be suited to aide in screening your**

**patients for sleep-disordered breathing and why?**_____

_____

_____

_____