STUDY PROTOCOL

Project title: **Addressing Insufficient Positive Airway Pressure Use Among Older Veterans With Obstructive Sleep Apnea (IIR 20-046)**

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SPECIFIC AIMS

Primary Aim 1: Test the efficacy of a novel program for improving PAP usage, compared to a general sleep education attention control program, among middle-aged and older Veterans with previously diagnosed OSA who have insufficient PAP use.

- Hypothesis 1a: Compared to control, Veterans who receive the intervention will have greater objectively measured PAP use (mean hours of PAP use per night) at 6-months follow-up.
- Hypothesis 1b: Effects will be sustained at 12-months follow-up.

Secondary Aim 2: Test the efficacy of this novel program for improving sleep quality, daytime sleepiness and sleep-related function compared to the control program.

- Hypothesis 2a: Compared to control, Veterans who receive the intervention will report better sleep quality (PSQI), less daytime sleepiness (ESS), and better sleep-related function (FOSQ-10) at 6-months follow-up.
- Hypothesis 2b: Effects will be sustained at 12-months follow-up.

Exploratory Aim 3: Test the efficacy of this novel program for improving health-related quality of life compared to the control program.

- Hypothesis 3a: Compared to control, Veterans who receive the intervention will report better health-related quality of life (PROMIS-29 v2.1 Physical and Mental Health Summary Scores) at 6-months follow-up.
- Hypothesis 3b: Effects will be sustained at 12-months follow-up.

RESEARCH DESIGN AND METHODS

Basic Study Design

This is a 4-year, randomized controlled trial testing a novel intervention for older Veterans (aged ≥ 50 years) with previously diagnosed OSA, who were prescribed PAP therapy but have insufficient PAP use (defined as no use or use that does not meet Medicare standards). The intervention involves a structured, supervised approach (with weekly oversight by telephone with a study psychologist) that can be provided by individuals from various disciplinesto maximize future implementation. The intervention is 6 months in duration, with sessions at weeks 1,2,3,4 and 8, and brief follow-up sessions at 12,16, 20, and 24 weeks. Core components of the intervention include:
1) educational and behavioral approaches to improve both PAP use and poor sleep behaviors, 2) individualized self-management and troubleshooting techniques to address factors that contribute to the participant's insufficient PAP use, and 3) ongoing review of objective evidence of PAP use. The intervention will be compared to an active control condition that aligns with "optimal usual care" and controls for the added social attention in the intervention group. Structured outcome assessments will be collected at baseline, post-treatment (i.e., after completion of the 5th intervention or control session), and at 6- and 12-months. The primary outcome is objectively measured PAP use at 6 months, with testing for maintenance of effects at 12-month follow-up. Secondary measures include sleep quality, daytime sleepiness and sleep-related function; and an exploratory measure of health-related quality of life, at 6- and 12-months. All data will be collected by research personnel and analyses will be intention to treat.

We will also collect measures of the process of the intervention and explore participants' experiences and attitudes related to the intervention which may act as potential facilitators and barriers to future implementation. We will focus on four specific intervention implementation outcomes identified by Proctor et al, including acceptability and appropriateness of the intervention (from the participant point of view), fidelity and implementation cost of the intervention (estimated from staff time to provide the intervention).

Setting

The study site will be VA Greater Los Angeles Healthcare System (GLAHS), which has one of the most diverse Veteran populations in the US. During the ongoing COVID-19 pandemic, all study activities will be conducted virtually via telephone and video.

Sources used to obtain study sample

We will identify the initial study sample from VA administrative databases. We will also ask VAGLAHS providers to provide us with names of patients who meet basic study eligibility criteria. Veterans identified from any of these sources will be mailed a recruitment letter and opt-in/out form as described below.

VA Corporate Data Warehouse (CDW)

We will use VA administrative data to identify a sample of Veterans who meet basic eligibility criteria. Authorized VA project team member(s) will work with VINCI programmers to pull a sample from CDW. Study inclusionary criteria will be applied to select eligible Veterans for recruitment. The sample file will include Veterans aged 50 years and older who have a diagnosis of obstructive sleep apnea and have received care from a VAGLAHS facility. To help capture eligible patients with fresh contact information, this process will be repeated 2-3 time during the study recruitment period. Specific data requested from CDW will include:

- Unique patient identifiers (e.g., SSN, patient ICN, Patient SID, etc.)
- Contact information (e.g., name, residential address, zip code, telephone numbers, etc.)
- Demographic and Veteran characteristics (e.g., dob, gender, race/ethnicity, dod, Veteran status, income, etc.)Treatment and Diagnoses (e.g., clinic stop codes, station codes, encounter dates, ICD9/ICD10 codes,date of diagnosis, etc.)

VA Sleep clinic Patient Compliance Monitoring System Database

We will also access the Patient Compliance Monitoring System database used by the VA Sleep clinic to monitor patients' PAP use. This monitoring system is called EncoreAnywhere and is a HIPAA compliant system that has been approved nationally by the VA and is used clinically at all VA Medical Centers. The EncoreAnywhere database contains PAP usage data that has been transmitted via modem from Veterans' prescribed PAP devices. We will identify Veterans in this database with insufficient PAP use and merge this list with the CDW list to obtain contact information. Data abstracted from the EncoreAnywhere database will include:

- Unique patient identifiers (last 6 SSN)
- Name
- Date of birth
- Dates of PAP set-up, modem uploads
- Summary PAP usage data

CPRS electronic medical record

The data abstracted from CPRS will include:

- Dates of clinical sleep apnea testing (i.e., home or laboratory tests)
- Results of sleep apnea tests (i.e., AHI, RDI)
- Treatment prescribed (e.g., type of PAP, pressure settings)
- PAP usage data

Provider Referrals

VA GLAHS providers in primary care/PACTs, mental health, and sleep medicine clinics will be emailed a memo explaining the study and inviting providers to send the study team an encrypted email with the name and last four social security numbers of patients who may be eligible for the study. When the research team receives the name of a patient from a provider, the Veteran will be mailed a recruitment letter and opt-in/out form as described below.

PARTICIPANT RECRUITMENT

We are using a stepwise method to recruit subjects. First, we will identify a cohort of Veterans receiving care from VA GLAHS who have been previously diagnosed with sleep apnea and prescribed a PAP device, who have insufficient PAP use. We will use three sources to identify potentially eligible Veterans, including: 1) VA

administrative data from the VA Corporate Data Warehouse (CDW), 2) VA Sleep clinic patient monitoring system database (i.e., EncoreAnywhere), and 3) provider referrals (since some eligible Veterans may not receive the recruitment letter, or we may be unable to contact them, we will also ask providers to refer patients who have insufficient PAP use). We will mail a recruitment letter to potentially eligible Veterans from each of these sources and conduct telephone screening to identify those who have insufficient PAP use. . Using these methods, we are confident that recruitment methods will be equitable.

A recruitment letter will be mailed one time to potentially eligible Veterans who are identified from one of three sources (i.e., VA Corporate Data Warehouse, Sleep clinic PAP use database, or provider referrals). The letter will introduce the study and include an 'opt-in/out' form that Veterans will be asked to return within 7 days to indicate their preference for being contacted by telephone by the research team.

- Veterans who opt-out of further contact will not be telephoned by research staff.
- Veterans who opt-in will receive a telephone call from research staff. Staff will use the telephone script to explain the study and to obtain verbal agreement to administer a brief eligibility questionnaire.
- Veterans who do not return the form within 7 days of the letter mail date will be called by study staff. If the Veteran is contacted, staff will use the same script and screening questionnaire.
- When attempting to contact Veterans, we will leave up to 4 telephone messages. Veterans who do not return our call after the 4 messages will be considered as "not interested" in participating.

A screening questionnaire will be administered to Veterans after verbal consent is obtained during the telephone contact made by study staff. Using a script, study staff will explain the study and verbal consent for screening will be obtained from Veterans who express interest in the study (see Telephone Screening Script). Additional eligibility criteria will be assessed with a structured screening questionnaire (see Telephone Screening Questionnaire). The screening questionnaire will include items to assess the following: 1) current PAP use 2) major health events (e.g., surgery) within the past month (individuals with a recent major event will be re-contacted 3 months later), 4) housing situation (e.g. homelessness), 5) access to transportation to the medical center, 6) patient-perceived physical, emotional or substance use being a barrier to participating in the study sessions.

The same script and telephone screening questionnaire will be used for Veterans who call the study office directly, for example in response to the recruitment flyer or social media announcements.

RESEARCH METHODS

Informed Consent Procedures

After the telephone screening, eligible and interested Veterans will be scheduled for a remote consent presentation session, either by VA Video Connect (VVC) or by telephone. Research staff will mail the potential participant two copies of the informed consent form and the HIPAA Authorization (1 to return and 1 to keep), along with a cover sheet and a postage-paid envelope to return the forms to the study office. The potential participant will receive the forms prior to the consent session. When the session is conducted by VVC, research staff will schedule the VVC visit. A Virtual Care Manager Ad Hoc Video Visit invitation is auto-generated by VVC and is sent via the Virtual Care Manager interface to the participant. Research staff will then send participants an email to confirm the appointment and notify them that a VVC email should arrive in their inbox with a link to use to connect to VVC. During the VVC or telephone session, a member of the study team will describe the study procedures in detail, including showing the portable sleep apnea screening device. All sections of the consent and HIPAA forms will be explained and participants will be given a chance to ask questions. Capacity to give informed consent will be evaluated with a brief questionnaire (see Evaluation to Sign a Consent Form for Research), that asks the Veteran to recount major procedures and risks of the study. Veterans who are unable to provide informed consent will be excluded; proxy consent will not be pursued.

Participants who are able to provide informed consent will have the option to provide either a wet-ink hard copy signature or a digital live signature, although in general, we will use the wet-ink hard copy method for in-person

visits and the digital live signature method for VVC visits. The digital live signature will be obtained through the VA-provided DocuSign platform. The DocuSign forms ("envelopes") are provided by the VA's Office of Information and Technology (OIT), Development, Security, and Operations (DevSecOps) Infrastructure Operations (IO). Following the instructions provided to our team by the VA OIT DevSecOps IO, we will send the DocuSign email to the participant's email address and guide the participant through the documents. This digital live signature will replace a wet-ink hard copy signature. A fully executed digital copy of the Informed Consent and HIPAA forms will be available through the Docusign portal, or the study team can mail or e-mail the participant a copy of all signed documents. The site will ask the participant what their preference will be. If the participant does not want the Docusign option, we will provide a paper version to sign.

Participants will be given the option of mailing the signed paper consent form and HIPAA to the study office or meeting a study team member in a Sepulveda or WLA parking lot. If the participant wants to drop off the forms, staff will arrange for a "curb-side" drop off. Staff will meet the participant in the designated parking lot and receive the forms while wearing a mask and maintaining social distancing. When the study office obtains the digital signature or receives the signed paper consent and HIPAA forms, the participant will be considered enrolled in the study and a baseline assessment visit will be scheduled with the participant.

Participants who provide informed consent and are enrolled into the study will undergo the study procedures listed below. Due to the COVID-19 pandemic, we will conduct all study procedures remotely using video platforms approved by the VA (i.e., Veterans Video Connect - VVC). When difficulties with video connections (e.g., bandwidth connectivity issues, software problems, hardware issues) occur, the study visit will be conducted by telephone. When in-person visits are deemed safe for subjects and staff, we will obtain approval from the IRB to hold in-person visits. At that time, participants will be given the option of having in-person visits on the Sepulveda or WLA campuses or virtual visits.

Medical chart review prior to Baseline Visit 1 (conducted after informed consent is returned by mail to the research office)
The following information will be abstracted from the electronic medical record:

1. Medications will be abstracted from the medical record. All medication data will be collected, but we will focus on sedating medications taken at bedtime, including hypnotics, sedating antidepressants, sedating antipsychotics and antihistamines. Sedative medication data will be coded by drug class, and medication variables explored as covariates in analyses
2. Current and past sleep disorders will be recorded, as well as results of diagnostic tests (e.g, AHI) and prescribed treatments (e.g., PAP)
3. The medical record will be reviewed for the presence of exclusion criteria (e.g., severe medical or psychological conditions)

Items mailed to participants prior to Baseline Visit 1

1. 7-day sleep diary to record nightly sleep (e.g., bedtime, nighttime awakenings, wake time). The diary is used to calculate self-reported sleep onset latency (time to fall asleep), sleep efficiency (time asleep over time between bedtime and final awakening) and wake after sleep onset (time spent awake from sleep onset to final awakening) averaged over 7 nights.
2. Disposable paper tape measure so participant can provide hip and waist measurements
3. Home sleep apnea testing device to verify OSA severity, if participant meets any of the following criteria:
    - Severity of sleep apnea (i.e., AHI) cannot be verified from prior diagnostic sleep testing recorded in the medical record
    - Significant time (e.g., > 2 years) has elapsed since prior sleep apnea testing that could alter OSA diagnosis/severity
    - Clinical change (e.g., $\geq$ 10% decrease in body weight) has occurred that could alter OSA diagnosis/severity

We will use the WatchPAT ONE (Itamar Medical, Ltd) for the home sleep apnea testing. This disposabledevice has one chest sensor and one finger sensor. The participant downloads a smartphone app on to their phone. The app provides step-by-step instructions on how to apply the sensors and start the recording. At the conclusion of the test, the data are transmitted from the device to the Itamar CloudPAP server. Research staffcan then access the data by logging into the Itamar CloudPAP server using a user name and password. A summary report of the test data will be downloaded and saved into a research study folder on the VA HSR&D CSHIIP server. Copies of Itamar Medical, Ltd confidentiality and privacy policies are attached.

If the participant does not have a smart phone, we will use the WatchPAT 200 device (Itamar Medical, Ltd) that we are currently using in two clinical trials approved by the VA IRB. This non-disposable device also has a chest and a finger sensor. Data are stored in the device, rather than transmitted to an Itamar server. Participants will mail the WatchPAT 200 back to the research office in a FEDEX box that the study will provide. Test data are then downloaded onto a study computer and stored on the VA HSR&D CSHIIP server.

Baseline Visit 1 (30-45 minutes)

1. Research staff administer baseline questionnaires part 1 using VVC
    - Demographic questions
    - Mini-mental State Examination (MMSE)
    - Self-administered comorbidity index
    - Primary Care PTSD Screen
    - Generalized Anxiety Disorder-7
    - Insomnia Severity Index
    - Restless Leg Syndrome Questionnaire
    - Self-efficacy Measure for Sleep Apnea
    - Behavioral Determinants of PAP Adherence questionnaire
2. Research staff explain how to complete the sleep diary
3. Research staff explain how to use the home sleep apnea testing, if necessary

Baseline Visit 2 (30 minutes)

1. Research staff administer baseline questionnaires part 2 using VVC
    - Pittsburgh Sleep Quality Index
    - Epworth Sleepiness Scale
    - Nocturia questions
    - Functional Outcomes of Sleep Questionnaire-10
    - PROMIS-29 questionnaire

Pre-randomization review

Participant's baseline assessment results will be reviewed during a weekly investigators' meeting to determine eligibility for randomization. The meeting will include a study physician (Dr. Alessi and/or Dr. Fung, who are both certified in Internal Medicine, Geriatric Medicine and Sleep Medicine), a psychologist specializing in Behavioral Sleep Medicine (Dr. Martin and/or Dr. Kelly), and a member of the study team who completed baseline assessments. These investigators and study team member will review the baseline assessment and medical record to determine if a participant meets the inclusion criteria for randomization and does not meet any of the exclusionary criteria that would make them ineligible for randomization.

Participants will be excluded if any of the following are present:
- repeat home sleep apnea testing result AHI is < 15
- Mini-Mental State Examination (MMSE) score < 24 the participant has current, significant psychopathology (e.g., active psychosis)
- the participant has severe unstable medical illness

Participants with stable psychiatric/medical conditions, and those using medications for sleep will not be excluded.

Randomization
Participants will be randomized following guidelines of the Consolidated Standards of Reporting Trials (CONSORT). Stratified randomization will be used based on (stratum 1) any PAP use over the prior 12 months, versus (stratum 2) no PAP use over the prior 12 months, since this may predict treatment response. Within each stratum, randomization sequences will be “blocked” using a block size of n=4. The statistician will generate the stratified randomization sequence prior to study onset and it will be transferred to a series of "security envelopes" by another staff member (independent from the study) and stored in a secure location. Once eligibility is determined, another staff person (independent from the study) will open the next envelope in sequence within the appropriate stratum (i.e., for random allocation concealment). Participants will be randomized to the active intervention (i.e., behavioral intervention to improve PAP use) or the general sleep education control condition.

Intervention and control groups
The structure of the intervention and control conditions is identical. Participants in both groups will attend 5 VVC sessions over the course of 8 weeks, plus monthly follow-up telephone contacts for 4 additional months. The content of the two conditions is different and is explained in the tables below. Between session 1 and session 2 of the intervention and control conditions, participants (in both groups) who do not currently have a PAP device, or do not have the current PAP model dispensed by the Sleep Medicine clinic, will receive a new PAP device, alongwith new masks and tubing. To avoid delays in receiving the PAP device from the Sleep Medicine clinic, Dr. Zeidler (Clinic Director) has agreed that one of the research staff (L. Partch) a certified respiratory technician, can dispense the new PAP machine to the research participant. Ms. Partch will set-up the PAP according to the pressure prescription provided by a Sleep Medicine provider and will connect the modem for remote monitoring by Sleep Clinic staff as part of usual care. Dr. Zeidler has also given permission for Dr. Alessi and the interventionists to access the clinic data so summary PAP usage reports can be obtained.
Note: No recalled Philip Respironics PAP devices will be dispensed to study subjects.

Participants in both groups will complete the Credibility/Expectancy Questionnaire (CEQ) after session 1 and session 5. This 6-item questionnaire measures whether subjects think (i.e., cognitively based credibility) and whether they feel (i.e., affectively based expectancy) treatment will help them improve. It will be used to assess for differences in credibility and/or expectancy between the intervention and control groups, to assess participant blinding. All sessions will be digitally recorded. and one of the co-investigators or the project psychologist will listen to the recordings to assess treatment fidelity.

Follow-up Data Collection
Participants will complete three follow-up assessments, including post-treatment (i.e., after session 5) and at 6 and 12 months follow-up. Each assessment will include a repeat of selected baseline questionnaires and a 7-day sleep diary.

In addition, objective cumulative PAP usage data will be accessed at each timepoint.

Post-treatment assessment (45 minutes)

Conducted one week after session 5 (in both groups) to assess initial effects of the intervention and control conditions. Participants will be given a 7-day sleep diary at the end of the session and will be instructed to complete it prior to the post-treatment visit. Research staff (blinded to group status and independent of the interventionists) will administer the following questionnaires:

- Generalized Anxiety Disorder-7
- Insomnia Severity Index
- Self-efficacy Measure for Sleep Apnea
- Behavioral Determinants of PAP Adherence questionnaire

- Pittsburgh Sleep Quality Index
- Epworth Sleepiness Scale
- Functional Outcomes of Sleep Questionnaire-10
- PROMIS-29 questionnaire

Six-month and 12-month follow-up assessments (45 minutes each)

These follow-up assessments will be conducted six months and 12-months from the date of randomization. These assessments will include the same questionnaires that were administered at the post-treatment assessment. Participants will also complete a 7-day sleep diary at each assessment timepoint.

Participant Payments

Participants will receive a $50 gift card after completion of the baseline evaluation and a $50 gift card after each of the three follow-up evaluations, for a possible total of $200 in gift cards. Gift cards will not be provided if a participant does not complete an evaluation, does not return a WatchPat monitoring device, or withdraws from the study. If gift cards are not available, participants will be paid via electronic fund transfer (EFT) to a Direct Express Card.

Study Groups

Active Intervention Group

All participants randomized to the active intervention group will continue to receive usual care for OSA. The structure and content of the behavioral education intervention is described in the table. The intervention was designed to have a high enough intensity/potency for efficacy in OSA patients who have demonstrated prior insufficient PAP use, while limiting the risks of excessive participant burden and excessive costs of implementation into routine care. The intervention is structured and manual-based to be highly translatable to routine care, including primary care settings. Session materials will be mailed to the participant prior to the first session. Core components of the intervention include: 1) educational and behavioral approaches to improve both PAP use and poor sleep behaviors, 2) individualized self-management and troubleshooting techniques to address factors that contribute to the participant's insufficient PAP use, and 3) ongoing review of objective evidence of PAP use. The intervention will be provided in 5 individual (i.e., one-to-one) virtual sessions (see Appendix for Intervention Session 1). The first 4 sessions are provided weekly for 4 weeks, with a 5th session provided at 8 weeks. The interventionist (sleep coach) will consult weekly with a study psychologist by telephone to review active intervention cases to help monitor progress of the participants and trouble-shoot any problems identified. Objective PAP use data (via modem) will be reviewed by the interventionist prior to each session to discuss with the participant during the session, and then monthly, followed by a brief phone call with the participant depending on PAP usage data.

Table: Intervention visit schedule and summary of components			
Week	Session	Duration	Content
1	1	45 minutes	Identify previous barriers to use, assess current emotion/thoughts about PAP, understanding sleep apnea, health problems related to sleep apnea, PAP therapy, getting started with PAP, what causes poor sleep quality, review of past week's sleep diary, set stable bedtime and get-up time for the week
2	2	30 minutes	Benefits of PAP use you've noticed so far, your challenges with PAP (patient, therapy, equipment-related challenges), my PAP use motivation, healthy sleep patterns, the "sleep bank", stimulus control techniques, relaxation techniques, review of past week's sleep diary, adjust bedtime, review of past week's PAP use (modem data), this week's plan for PAP use
3	3	30 minutes	Benefits of PAP use you've noticed so far, your challenges with PAP (patient, therapy and equipment-related challenges), challenges to sleep plan (bedtime and get up time), additional relaxation techniques, review of past week's sleep diary, adjust bedtime (if needed), review of past week's PAP use (modem data), this week's plan for PAP use
4	4	30 minutes	Benefits of this treatment you've noticed so far, your challenges with PAP (patient, therapy and equipment-related challenges), sleep hygiene (e.g., caffeine, napping, alcohol, exercise), review of past week's sleep diary, adjust bedtime (if needed), review of past week's PAP use (modem data), this week's plan for PAP use
8	5	30 minutes	How has this treatment impacted your life, current status of your sleep apnea, current status of your sleep pattern, sleep apnea self-management, adjusting your sleep schedule, sleep problem self-management, review of past week's sleep diary, review of past month's PAP use (modem data), my PAP planning contract
12, 16, 20, 24	N/A	10 minutes	Monthly review of modem PAP use data by interventionist. Participants will receive a message of congratulations/encouragement for their accomplishments and discussion to troubleshoot and identify new/ongoing barriers to PAP use.

The PAP self-management component of the intervention will involve an OSA disease-specific, self-management intervention modified from our prior work. The PAP adherence program includes information specific to OSA, in addition to concepts in self-management of chronic illnesses. Issues covered include understanding OSA symptoms and consequences, problem-solving difficulties with PAP treatment, managing emotional-cognitive symptoms, and motivational techniques. Each participant's PAP use in the prior week is reviewed by the interventionist with the participant. The intervention takes advantage of this objective PAP usage data to open dialogue with the participant regarding their ongoing experience with PAP, to troubleshoot commonly occurringproblems with PAP, and help understand how their PAP use relates to the management of their OSA.

The sleep quality improvement component of the intervention recognizes that multiple factors and learned behaviors contribute to poor sleep in OSA patients. It is modified from a previously tested, manual-based program we previously developed. Although the current study participants will not necessarily have insomnia, we anticipate high rates of disrupted sleep and poor sleep habits. The intervention involves education and practical training in key aspects of stimulus control (i.e., reducing anxiety about falling asleep), sleep compression (i.e., an individualized, structured process of gradually reducing time in bed to decrease nighttime wakefulness and consolidate sleep), sleep hygiene (i.e., establishing behavioral routines to promote restorative sleep), and cognitive therapy (i.e., addressing maladaptive and inaccurate perceptions and beliefs about sleep).

Active Control Group

We will use an active control condition that controls for the added attention of the intervention condition and

assists with participant blinding. Session materials will be mailed to the participant prior to the first session. The initial control session includes educational material we've successfully used in prior sleep research, including among participants with OSA. The control condition will be administered by research staff (separate from intervention staff) using a manual-based education program that focuses on general sleep education, sleep hygiene and related topics.

Table: Control visit schedule and summary of components			
Week	Session	Duration	Content
1	1	45 minutes	General information about sleep, overview of sleep cycles, normal quantity and quality of sleep, consequences of sleep for health and well-being, importance of sleep for health benefits
2	2	30 minutes	Sleep across the lifespan, sleep stages, circadian rhythms, general health education
3	3	30 minutes	Sleep and health, sleep hygiene (sleep environment considerations)
4	4	30 minutes	Sleep hygiene (diet, exercise, caffeine), daytime relaxation techniques
8	5	30 minutes	Review of content from prior sessions, daytime stress reduction
12, 16, 20, 24	N/A	10 minutes	Brief, non-directed, check-in phone call

Sample Size

Our proposal estimated that we will need to consent (i.e., enroll) 225 individuals to reach the target sample of 90 randomized participants. While enrolled participants will meet basic eligibility criteria, informed consent is required to administer the questionnaires and conduct the medical record review necessary to determine eligibility for randomization. In addition, participants may drop out of the study during the baseline assessment phase or may choose not to proceed with the randomization phase.

During the study, we used data collected from the study to re-run power analysis to inform whether a larger target for total number of randomized participants should be considered. Since PAP usage is based on telemonitoring, we have usage for all participants (0% attrition). For other outcomes we assumed a worse-case scenario of 20% attrition. For the PSQI, ESS and PROMIS questionnaires, we used the published Minimal Clinically Important Difference (MCID) to inform the detectable difference for each questionnaire. For the FOSQ, we could not find an MCID and calculated the detectable difference in terms of Cohen's *d*. The new analysis found a sample size of 106 achieved at least 80% power for each outcome (see Table below). Based on this new (larger) randomized sample size estimate, we continued enrollment until we achieved a sample of 106 randomized participants.

Primary Outcomes	Detectable difference	Power (% Attrition)	Revised required sample size
PAP usage (nightly)	≥1.7 hours/night	0.999 (0%)	n=90
Pittsburgh Sleep Quality Index (PSQI)	≥ 2.5 points	0.803 (20%)	n=106
Epworth Sleepiness Scale (ESS)	≥ 2.9 points	0.906 (20%)	n=106
Functional Outcomes of Sleep Questionnaire (FOSQ)	≥ d=0.64	0.806 (20%)	n=106
Exploratory Outcomes			
PROMIS- Physical	≥ 4.6 points	0.935 (20%)	n=106
PROMIS-Mental Health	≥ 4.6 points	0.963 (20%)	n=106

Data Analysis

Primary Aim 1

Objective PAP use was collected from adherence reports downloaded from the PAP manufacturer's cloud-based data management system (i.e., Care Orchestrator for Philips Respironics devices and Airview for Resmed devices). Beginning with the first night after randomization, each block of 30 nights was considered a "month" (e.g., nights 1 to 30 were month 1, nights 31 to 60 were month 2, etc.). Data extracted from the adherence reports included the average hours of PAP usage per night. These variables were extracted using a customized program written in "R" software to create a dataset containing monthly PAP use data for each randomized participant. Average nightly PAP usage for the first six-months (nights 1 to 180) was computed by averaging the PAP usage for months 1 to months 6. An independent groups *t*-test was used to compare the average PAP usage between the treatment and control groups.

Aims 2 and 3

Aim 2 focuses on improvements in sleep quality (measured by the Pittsburgh Sleep Quality Index (PSQI), and its three subscales – Sleep efficiency, Perceived sleep quality, and Daily disturbances), daytime sleepiness (measured by the Epworth Sleepiness Scale (ESS), and sleep related function (measured by the Functional Outcomes of Sleep Questionnaire-10 item (FOSQ-10). Exploratory Aim 3 focused on health-related quality of life (measured by the PROMIS29-Mental Health and PROMIS29-Physical Health subscales).

Each of these assessments were observed at four time points: baseline, post-treatment, six-month follow-up, and at twelve-month follow-up. Each outcome, at each of the four timepoints, was analyzed using a two-level mixed-effects analyses, time nested within person, with a fixed intercept. For each outcome, we considered three possible residual covariance matrix structures -- unstructured, autoregressive, and exchangeable. The structure providing the best fit (lowest BIC) was selected. The autoregressive residual structure had the smallest BIC for three outcomes, PSQI Total score, PSQI Factor 1, and Promis29-MH. The exchangeable structure had the lowest BIC for the other five assessment outcomes (PSQI Factor 2, PSQI Factor 3, ESS, FOSQ-10, and Promis29-PH). We modeled each assessment outcome as a function of treatment group (coded 1=treatment, 2=control), time (treated categorically, coded 1=Baseline, 2=Post-Treatment, 3=Six-month follow-up, 4=Twelve-month follow-up), and the treatment by time interaction. For each combination of group by month, we estimated the mean and 95% Confidence interval. The treatment effect at six-month follow-up was assessed via an interaction contrast by applying the contrast coefficients (-1 1) to treatment group and the contrast coefficients (-1 0 1 0) to time, and interacting these contrasts. Similarly, the treatment effect at twelve-month follow-up was assessed by applying the contrast coefficients (-1 0 0 1) to time and interacting that contrast with the contrast on group. All assessment outcomes were double data entered, and all discrepancies were resolved by consulting original data forms and correcting the erroneous data entry. This was iteratively repeated until all discrepancies between the original and "double punched" datasets were eliminated.