Diagnosis and Medical Management of Obstructive Sleep Apnea Syndrome

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Policy
Blue Cross and Blue Shield of Kansas City (Blue KC) will provide coverage for the diagnosis and medical management of obstructive sleep apnea when it is determined to be medically necessary because the criteria shown below are met.

When Policy Topic is covered
A single unattended (unsupervised) home sleep apnea test with a minimum of 3 recording channels with the following sensors: nasal pressure, chest and abdominal respiratory inductance plethysmography, and oximetry; or else PAT [peripheral arterial tone] with oximetry and actigraphy may be considered medically necessary in adults who are at high risk for obstructive sleep apnea (OSA) and have no evidence by history or physical examination of a health condition that might alter ventilation or require alternative treatment, including central sleep apnea, heart failure, chronic pulmonary disease, obesity hypoventilation syndrome, neuromuscular disorders with sleep-related symptoms, injurious or potentially injurious parasomnias, or narcolepsy. Considerations section defines high pretest probability.

A single unattended (unsupervised) home sleep apnea test with a minimum of recording channels as described above may be considered medically necessary as a screening tool in patients who are scheduled for bariatric surgery and have no evidence by history or physical examination of a health condition that might alter ventilation or require alternative treatment (see Considerations).

Auto-adjusting positive airway pressure (APAP) may be considered medically necessary for the titration of pressure in adult patients with clinically significant OSA defined as those who have:
- An Apnea/Hypopnea Index (AHI), Respiratory Disturbance Index (RDI), or Respiratory Event Index (REI) of at least 15 events per hour, or
• An AHI, RDI or REI of at least 5 events per hour in a patient with excessive daytime sleepiness or unexplained hypertension, cardiovascular heart disease, or stroke; OR.
• If there is a significant change in weight or change in symptoms suggesting that continuous positive airway pressure (CPAP) should be retitrated or possibly discontinued.

Repeated unattended (unsupervised) home sleep apnea test with a minimum of 3 recording channels with the following sensors: nasal pressure, chest and abdominal respiratory inductance plethysmography, and oximetry; or else PAT with oximetry and actigraphy may be considered medically necessary in adults under the following circumstances:
  1. To assess efficacy of surgery or oral appliances or devices; OR
  2. To reevaluate the diagnosis of OSA and need for continuous positive airway pressure (CPAP), eg, if there is a significant change in weight or change in symptoms suggesting that CPAP should be retitrated or possibly discontinued.

Supervised polysomnography (PSG) performed in a sleep laboratory may be considered medically necessary in patients with a moderate or high pretest probability of OSA in the following situations:
  1. Pediatric patients (ie, <18 years of age); OR
  2. When patients do not meet criteria for an unattended home sleep apnea test as described above; OR
  3. A previous home study failed to establish the diagnosis of OSA in a patient with a high pretest probability of OSA; OR
  4. A previous home study was technically inadequate; OR
  5. Failure of resolution of symptoms or recurrence of symptoms during treatment; OR
  6. When testing is done to rule out other sleep disorders such as central sleep apnea, injurious or potentially injurious parasomnias, or narcolepsy (see separate policy); OR
  7. Presence of a comorbidity that might alter ventilation or decrease the accuracy of a home sleep apnea test, including, but not limited to heart failure, neuromuscular disease, chronic pulmonary disease, or obesity hypoventilation syndrome.

A repeated supervised PSG performed in a sleep laboratory may be considered medically necessary in patients who meet criteria for an in-laboratory PSG under the following circumstances:
  1. To initiate and titrate CPAP in adults who have:
    • An AHI or RDI of at least events 15 per hour, OR
    • An AHI or RDI of at least events 5 per hour in a patient with one or more signs or symptoms associated with OSA (eg, excessive daytime sleepiness, hypertension, cardiovascular heart disease, or stroke); OR
Note: A split-night study, in which moderate-to-severe OSA is documented during the first portion of the study using PSG, followed by CPAP during the second portion of the study, can eliminate the need for a second study to titrate CPAP (see Considerations section for criteria to perform a split-night study).

2. To initiate and titrate CPAP in children:
   - In pediatric patients, an AHI or RDI of ≥ 5; OR
   - An AHI or RDI ≥1.5 in a patient with excessive daytime sleepiness, behavioral problems or hyperactivity.

3. To assess efficacy of surgery (including adenotonsillectomy) or oral appliances/devices

CPAP may be considered medically necessary in adult or pediatric patients with clinically significant OSA.

±±Clinically significant OSA in adults is:
   - An AHI, RDI, or REI ≥15, OR
   - An AHI, RDI, or REI ≥5 in a patient with excessive daytime sleepiness, unexplained hypertension, cardiovascular heart disease, or stroke.

In pediatric patients,
   - An AHI or RDI ≥5 OR
   - An AHI or RDI ≥1.5 in a patient with excessive daytime sleepiness, behavioral problems or hyperactivity.

Bilevel positive airway pressure (BiPAP) or APAP may be considered medically necessary in patients with clinically significant OSA AND who have failed a prior trial of CPAP or for whom BiPAP is found to be more effective in the sleep lab.

Intraoral appliances (tongue-retaining devices or mandibular advancing/positioning devices) may be considered medically necessary in adult patients with clinically significant OSA under the following conditions:

OSA, defined by an AHI RDI, or REI of at least 5 events per hour in a patient with one or more signs or symptoms associated with OSA (e.g., excessive daytime sleepiness, hypertension, cardiovascular heart disease, or stroke), AND
   - A trial with CPAP has failed or is contraindicated, AND
   - The device is prescribed by a treating physician, AND
   - The device is custom-fitted by qualified dental personnel, AND
   - There is absence of temporomandibular dysfunction or periodontal disease.

Note: CPAP has been shown to have greater effectiveness than oral appliances in general. This difference in efficacy is more pronounced for patients with severe OSA, because oral appliances have been shown to be less efficacious in patients with severe OSA than they are in patients with mild-to-moderate OSA. Therefore, it is particularly important that patients with severe OSA have an initial trial of
CPAP and that all reasonable attempts are made to continue treatment with CPAP, prior to the decision to switch to an oral appliance.

**When Policy Topic is not covered**

Unattended (unsupervised) sleep studies are considered *investigational* in pediatric patients (i.e., younger than 18 years of age).

Multiple sleep latency testing (MSLT) is considered *investigational* in the diagnosis of obstructive sleep apnea.

Nasal expiratory positive airway pressure (EPAP) and oral pressure therapy devices are considered *investigational*.

The use of an abbreviated daytime sleep study (PAP-NAP) as a supplement to standard sleep studies is considered *investigational*.

Supervised or unattended home sleep apnea tests that do not meet the above criteria are *not medically necessary*.

Palate and mandible expansion devices are considered *investigational* for the treatment of OSA.

The use of CPAP, bi-level positive airway pressure, APAP, and intraoral appliances that do not meet the above criteria is considered *investigational* for the treatment of OSA.

**Considerations**

**Specialist Training**

Polysomnography or home sleep apnea testing should be performed in appropriately selected patients and the test summary results reviewed by a physician who is trained in sleep medicine.

Medical professionals who interpret a polysomnogram or home sleep apnea test should be trained in sleep medicine and should review the raw data from PSG and home sleep apnea tests to detect artifacts and data loss.

Treatment of patients diagnosed with OSA should be initiated and monitored by a professional trained in sleep medicine. It is important to monitor symptoms and adherence to positive airway pressure (PAP) treatment (eg, review of symptoms and device utilization at 90 days with a minimum of 4 hours per night for at least 5 nights per week).

**Risk Factors for Obstructive Sleep Apnea**

Although not an exclusive list, patients with all of the following symptoms are considered to be at high risk for obstructive sleep apnea (OSA):

- habitual snoring;
• observed apneas;
• excessive daytime sleepiness;
• a body mass index (BMI) greater than 35 kg/m².

If no bed partner is available to report snoring or observed apneas, other signs and symptoms suggestive of OSA (eg, age of the patient, male gender, thick neck, craniofacial or upper airway soft tissue abnormalities, unexplained hypertension) may be considered. Objective clinical prediction rules are being developed; at present, risk assessment is based primarily on clinical judgment.

The STOP-BANG questionnaire, a method developed for nonsleep specialists, assesses the signs and symptoms of OSA (Snore, Tired, Observed apnea, blood Pressure, BMI, Age, Neck, Gender), has been shown to have 97% sensitivity and 96% negative predictive value (specificity, 33%) for the identification of patients with severe OSA (Apnea/Hypopnea Index [AHI] >30 events per hour). Overnight oximetry has been used by some sleep specialists as a component of the risk assessment but is inadequate for the diagnosis of OSA. Therefore, a follow-up polysomnography (PSG) or home sleep study would still be required to confirm or exclude a diagnosis of OSA.

**OSA in Children**
The presentation of OSA in children may differ from that of adults. Children frequently exhibit behavioral problems or hyperactivity rather than daytime sleepiness. Obesity is defined as a BMI greater than the 90th percentile for the weight/height ratio. Although the definition of severe OSA in children is not well established, an AHI or RDI greater than 1.5 events per hour is considered abnormal (an AHI or RDI ≥10 events per hour may be considered severe). In addition, the first-line treatment in children is usually adenotonsillectomy. Continuous positive airway pressure (CPAP) is an option for children who are not candidates for surgery or who have an inadequate response to surgery.

**Bariatric Surgery Patients**
Screening for OSA should be performed routinely in patients scheduled for bariatric surgery, due to the high prevalence of OSA in this population. The optimal screening approach is not certain. An in-laboratory PSG or home sleep study is the most accurate screening method. Some experts recommend a symptom-based screening instrument, followed by PSG in patients who exceed a certain threshold, as an alternative to performing PSG in all patients. It should be noted that there is a high prevalence of obesity hypoventilation syndrome in patients who are candidates for bariatric surgery. Therefore, obesity hypoventilation syndrome should be ruled out prior to home sleep testing in this population.

**Significant Weight change**
There is no established threshold for significant change in weight. Studies have reported improvements in OSA with an average weight loss of 20 kg or 20% of body weight.
Multiple Sleep Latency Test
The multiple sleep latency test (MSLT) is an objective measure of the tendency to fall asleep in the absence of alerting factors, while the maintenance of wakefulness test is an objective measure of the ability to stay awake under soporific conditions (used to assess occupational safety). The MSLT and maintenance of wakefulness test are not routinely indicated in the evaluation and diagnosis of OSA or in the assessment of change following treatment with CPAP. The MSLT may be indicated in the evaluation of patients with suspected narcolepsy to confirm the diagnosis (often characterized by cataplexy, sleep paralysis, and hypnagogic/hypnopompic hallucinations) or to differentiate between suspected idiopathic hypersomnia and narcolepsy. Narcolepsy and OSA can co-occur. Because it is not possible to differentiate between the excessive sleepiness caused by OSA and by narcolepsy, OSA should be treated before confirming a diagnosis of narcolepsy with the MSLT.

Split-Night Studies
American Academy of Sleep Medicine practice parameters (2005) have indicated that a split-night study (initial diagnostic PSG followed by CPAP titration during PSG on the same night) is an alternative to 1 full night of diagnostic PSG followed by a second night of titration if the following 4 criteria are met:

a. An AHI of at least 40 events per hour is documented during a minimum of 2 hours of diagnostic PSG. Split-night studies may sometimes be considered at an AHI between 20 and 40 events per hour, based on clinical judgment (eg, if there are also repetitive long obstructions and major desaturations). However, at AHI values below 40, determination of CPAP-level requirements, based on split-night studies, may be less accurate than in full-night calibrations.

b. CPAP titration is carried out for more than 3 hours (because respiratory events can worsen as the night progresses).

c. PSG documents that CPAP eliminates or nearly eliminates the respiratory events during rapid eye movement (REM) and non-REM sleep, including REM sleep with the patient in the supine position.

d. A second full night of PSG for CPAP titration is performed if the diagnosis of a sleep-related breathing disorder is confirmed, but criteria b and c are not met.

Categorization of PSG and Portable Monitoring
Full correspondence does not exist between CPT codes and the most current categorization scheme for the different types of studies. The 2005 practice parameters from the American Academy of Sleep Medicine list 4 types of monitoring procedures: type 1, standard attended in-lab comprehensive PSG; type 2, comprehensive portable PSG; type 3, modified portable sleep apnea testing (also referred to as cardiorespiratory sleep studies), consisting of 4 or more channels of monitoring; and type 4, continuous single or dual bioparameters, consisting of 1 or 2 channels, typically oxygen saturation, or airflow. Types 1 and 2 would be considered polysomnographic studies, and types 3 and 4 would be considered polygraphic sleep studies. The terms sleep studies and PSG are often used interchangeably. CPT coding distinguishes between sleep studies that do not
include electroencephalographic (EEG) monitoring, and PSG, which includes EEG monitoring. PSG is usually conducted in a sleep laboratory and attended by a technologist, but may also be conducted with type 2 portable monitoring. The type of study is further characterized as attended (supervised) or unattended by a technologist. Home or portable monitoring implies unattended sleep studies, typically conducted in the patient’s home. There are no specific codes for remotely monitored home sleep studies. They would likely be reported with the CPT code for the sleep study with the GT modifier (“via interactive audio and video telecommunications systems”) appended. There is no CPT code for “unattended” PSG.

Cardiorespiratory sleep studies without EEG may be called polygraphic studies and can be attended or unattended by a technologist. CPT codes 95807 and 95806 distinguish polygraphic sleep studies that are attended or unattended, but there are no codes that distinguish between type 3 and type 4 sleep studies. A wide variety of portable monitors and proprietary automated scoring systems are being tested and marketed, but the optimum combination of sensors and scoring algorithms is currently unknown. Current recommendations are that the portable monitoring device have 4 channels (oxygen saturation, respiratory effort, respiratory airflow, heart rate) and permit review of the raw data. Type 4 monitors with fewer than 3 channels are not recommended due to reduced diagnostic accuracy and higher failure rates. As with attended PSG, it is important that the raw data from home sleep studies be reviewed by a professional trained in sleep medicine to detect artifacts and data loss.

**Coding**

**CPT: Attended Studies**

Code 95807 Sleep study, simultaneous recording of ventilation, respiratory effort, electrocardiogram (ECG) or heart rate, and oxygen saturation, attended by a technologist

Code 95808 Polysomnography; any age, sleep staging with 1-3 additional parameters of sleep, attended by a technologist

Code 95810 Polysomnography; age 6 years or older, sleep staging with 4 or more additional parameters of sleep, attended by a technologist

Code 95811 Polysomnography; age 6 years or older, sleep staging with 4 or more additional parameters of sleep, with initiation of continuous positive airway pressure therapy or bilevel ventilation, attended by a technologist

Code 95782 Polysomnography; younger than 6 years, sleep staging with 4 or more additional parameters of sleep, attended by a technologist

Code 95783 Polysomnography; younger than 6 years, sleep staging with 4 or more additional parameters of sleep, with initiation of continuous positive airway pressure therapy or bilevel ventilation, attended by a technologist.

**CPT: Unattended Study**

Code 95806 Sleep study, unattended, simultaneous recording of heart rate, oxygen saturation, respiratory airflow, and respiratory effort (eg,
thoracoabdominal movement) (Note that this CPT code is identical to 95807 except that the study is not monitored)
Code 95800 Sleep study, unattended, simultaneous recording; heart rate, oxygen saturation, respiratory analysis (eg, by airflow or peripheral arterial tone), and sleep time
Code 95801 Sleep study, unattended, simultaneous recording; minimum of heart rate, oxygen saturation, and respiratory analysis (eg, by airflow or peripheral arterial tone).

These codes differ from code 95806 in the description of a single respiratory sensor (either air flow or peripheral arterial tone) instead of the standard configuration of both respiratory effort and respiratory airflow (ventilation).

Use of overnight oximetry alone would be indicated by CPT code 94762: Noninvasive ear or pulse oximetry for oxygen saturation; by continuous overnight monitoring (separate procedure).

HCPCS
There is a HCPCS code identifying a CPAP device (E0601) and 2 HCPCS codes for bilevel positive airway pressure devices (E0470, E0471). HCPCS codes do not distinguish among fixed CPAP or bilevel positive airway pressure devices and auto-adjusting CPAP devices.

In 2008, Medicare created G codes to facilitate their national coverage decision:
G0398 Home sleep study test (HST) with type II portable monitor, unattended; minimum of 7 channels: EEG, EOG, EMG, ECG/heart rate, airflow, respiratory effort and oxygen saturation
G0399 Home sleep test (HST) with type III portable monitor, unattended; minimum of 4 channels: 2 respiratory movement/airflow, 1 ECG/heart rate and 1 oxygen saturation
G0400 Home sleep test (HST) with type IV portable monitor, unattended; minimum of 3 channels.

There is a HCPCS code for the oral interface used with devices such as the Winx system:
A7047 Oral interface used with respiratory suction pump, each.

The system would be reported using code E0600 (Respiratory Suction Pump, Home Model, Portable or Stationary, Electric) and code A7002 (Tubing, Used with Suction Pump, Each).

Refer to separate policy for further information on neonatal home cardiorespiratory monitoring (CPT codes 94774-94777). These codes are not appropriate for the diagnosis of sleep apnea in children.
### Description of Procedure or Service

<table>
<thead>
<tr>
<th>Populations</th>
<th>Interventions</th>
<th>Comparators</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Individuals:</strong> Onset sleep apnea</td>
<td>Interventions of interest are:  - Home sleep apnea testing with at least 3 recording channels</td>
<td>Comparators of interest are:  - Polysomnography</td>
<td>Relevant outcomes include:  - Test accuracy  - Symptoms  - Functional outcomes  - Resource utilization</td>
</tr>
<tr>
<td><strong>Individuals:</strong> With suspected obstructive sleep apnea</td>
<td>Interventions of interest are:  - Limited channel home sleep apnea testing</td>
<td>Comparators of interest are:  - In-laboratory polysomnography  - Home sleep testing with at least 3 recording channels</td>
<td>Relevant outcomes include:  - Test accuracy  - Symptoms  - Functional outcomes  - Resource utilization</td>
</tr>
<tr>
<td><strong>Individuals:</strong> With obstructive sleep apnea</td>
<td>Interventions of interest are:  - Positive airway pressure devices</td>
<td>Comparators of interest are:  - Weight loss  - Position therapy</td>
<td>Relevant outcomes include:  - Symptoms  - Functional outcomes  - Quality of life</td>
</tr>
<tr>
<td><strong>Individuals:</strong> With obstructive sleep apnea</td>
<td>Interventions of interest are:  - Oral appliances</td>
<td>Comparators of interest are:  - Continuous positive airway pressure therapy</td>
<td>Relevant outcomes include:  - Symptoms  - Functional outcomes  - Quality of life</td>
</tr>
<tr>
<td><strong>Individuals:</strong> With obstructive sleep apnea</td>
<td>Interventions of interest are:  - Novel obstructive sleep apnea treatment (e.g., palate expansion, expiratory positive airway pressure, oral pressure therapy)</td>
<td>Comparators of interest are:  - Continuous positive airway pressure therapy</td>
<td>Relevant outcomes include:  - Symptoms  - Functional outcomes  - Quality of life</td>
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</table>

Obstructive sleep apnea (OSA) syndrome is characterized by repetitive episodes of upper airway obstruction due to the collapse of the upper airway during sleep. Polysomnography and portable sleep apnea testing (with sensors for respiratory effort, airflow, and oxygen saturation, or alternatively with peripheral arterial tone (PAT), actigraphy, and oxygen saturation) are established methods for diagnosing OSA. Other proposed methods of diagnosing OSA include limited channel home sleep monitors. Conventional medical management of OSA includes weight loss, avoidance of stimulants, body position adjustment, oral appliances, and use of continuous positive airway pressure (CPAP) during sleep. Novel treatments include nasal expiratory positive airway pressure and oral pressure therapy.

### Diagnosis

For individuals who have suspected OSA who receive home sleep apnea testing with at least three recording channels, the evidence includes randomized controlled trials (RCTs). The relevant outcomes are test accuracy, symptoms, functional outcomes, and resource utilization. RCTs have reported that home sleep apnea testing (with sensors for respiratory effort, airflow, and oxygen saturation, or alternatively with PAT, actigraphy and oxygen saturation) is
noninferior to testing in the sleep lab for adults with a high pretest probability of OSA and absence of comorbid conditions as determined by clinical evaluation. A positive portable monitoring study with channels that include arterial oxygen saturation, airflow, and respiratory effort or alternatively PAT, actigraphy and oxygen saturation has a high positive predictive value for OSA and can be used as the basis for a CPAP trial to determine the efficacy of treatment. A negative home sleep apnea test cannot be used to rule out OSA. Patients who have a negative result from portable monitoring or have a positive study but do not respond to CPAP should undergo further evaluation. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals who have suspected OSA who receive limited channel home sleep apnea testing, the evidence includes studies on diagnostic accuracy. The relevant outcomes are test accuracy, symptoms, functional outcomes, and resource utilization. The ability to detect clinically significant OSA without sensors for respiratory effort, airflow, and oxygen saturation, or alternatively without PAT, actigraphy, and oxygen saturation, lacks support in the literature. The evidence is insufficient to determine the effects of the technology on health outcomes.

**Treatment**

For individuals who have OSA who receive positive airway pressure devices or oral appliances, the evidence includes RCTs and systematic reviews of RCTs. The relevant outcomes are symptoms, functional outcomes, and quality of life. Conventional medical management of OSA includes weight loss, avoidance of stimulants, body position adjustment, oral appliances, and use of CPAP during sleep. A diagnostic sleep study may be followed by a trial of auto-adjusting positive airway pressure to evaluate the efficacy and adjust pressure. Auto-adjusting positive airway pressure or bilevel positive airway pressure may also be indicated if the patient is intolerant of CPAP. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

The policy statements focus on criteria for the diagnosis and treatment of sleep apnea for procedures considered standard of care and are based in part on evidence-based practice guidelines. In addition, clinical input was obtained in 2014, 2010, and 2009 to assess, among other items, the sensors required for portable monitors, diagnosis and treatment of OSA in children, and screening of patients scheduled to undergo bariatric surgery. Informed by clinical input and clinical practice guidelines, testing is indicated for patients who are suspected of OSA, prior to bariatric surgery, for certain pediatric patients, and with type 4 monitors under certain circumstances.

For individuals who have OSA who receive novel OSA treatments (eg, palate expansion, expiratory positive airway pressure, oral pressure therapy), the evidence includes an RCT and a meta-analysis of case series. The relevant outcomes are symptoms, functional outcomes, and quality of life. The evidence on palate and mandible expansion devices includes a few small series. Further study
with well-designed trials is needed to evaluate this treatment. The evidence on expiratory positive airway pressure devices in patients with OSA has been reported in prospective case series, an industry-sponsored RCT, and a systematic review that did not include the RCT. The main finding of the RCT was a decrease in the Apnea/Hypopnea Index, with minor impact on oxygenation, and a decrease in Epworth Sleepiness Scale score. One comparative trial with historical controls used a positive airway pressure nap to study patients with complex insomnia resistant to CPAP titration or use. Additional study is needed to evaluate with greater certainty the efficacy of this intervention. No evidence was identified on the use of the oral therapy device. The evidence is insufficient to determine the effects of the technology on health outcomes.

Background
Obstructive sleep apnea
Obstructive sleep apnea (OSA) syndrome is characterized by repetitive episodes of upper airway obstruction due to the collapse of the upper airway during sleep. This causes a drop in blood oxygenation and brief arousal and can occur as frequently as every minute throughout the night. The most common signs and symptoms in adults are snoring, excessive daytime sleepiness, and hypertension. Excessive daytime sleepiness may be subjective and is assessed by questionnaires such as the Epworth Sleepiness Scale, a short self-administered, questionnaire that asks patients how likely they are to fall asleep in different scenarios such as watching TV, sitting quietly in a car, or sitting and talking to someone. Daytime sleepiness is uncommon in young children with OSA. Symptoms in children may include disturbed sleep and daytime neurobehavioral problems. In otherwise healthy children, OSA is usually associated with adenotonsillar hypertrophy and/or obesity.

The hallmark of OSA is snoring. The snoring abruptly ceases during the apneic episodes and during the brief period of patient arousal and then resumes when the patient again falls asleep. The sleep fragmentation associated with repeated sleep disruption can lead to impairment of daytime activity. Adults with OSA-associated daytime somnolence are thought to be at higher risk for collisions involving motorized vehicles (ie, cars, trucks, heavy equipment), while OSA in children may result in neurocognitive impairment and behavioral problems.

OSA can also affect the cardiovascular and pulmonary systems. For example, apnea leads to periods of hypoxemia, alveolar hypoventilation, hypercapnia, and acidosis. This, in turn, can cause systemic hypertension, cardiac arrhythmias, pulmonary hypertension, and cor pulmonale. Systemic hypertension is common in patients with OSA. Severe OSA is also associated with decreased survival, presumably related to severe hypoxemia, hypertension, or an increase in automobile collisions related to daytime sleepiness. It is estimated that about 7% of adults have moderate or severe OSA, 20% have mild OSA, and the referral population of OSA patients represents a small proportion of patients who have clinically significant and treatable disease.
**Diagnosis**

The criterion standard for a diagnosis of sleep disorders is a polysomnogram performed in a sleep laboratory. A standard polysomnogram includes electroencephalogram (EEG), submental electromyogram, and electrooculogram (to detect rapid eye movement sleep) for sleep staging. Polysomnography also typically includes electrocardiography and monitoring of respiratory airflow, effort, snoring, oxygen desaturation, and sleep position. An attended study ensures that the electrodes and sensors are functioning adequately and do not dislodge during the night. In addition, an attendant is able to identify severe OSA in the first part of the night and titrate continuous positive airway pressure (CPAP) in the second part of the night, commonly known as a "split-night" study. If successful, this strategy eliminates the need for additional polysomnography for CPAP titration.

**Table 1. Definitions of Terms and Scoring Criteria for OSA**

<table>
<thead>
<tr>
<th>Terms</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Respiratory event</td>
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<tr>
<td>Apnea</td>
<td>The frequency of apneas and hypopneas is measured from channels assessing oxygen desaturation, respiratory airflow, and respiratory effort. In adults, apnea is defined as a drop in airflow by 90% or more of pre-event baseline for at least 10 seconds. Due to faster respiratory rates in children, pediatric scoring criteria define an apnea as 2 or more missed breaths, regardless of its duration in seconds.</td>
</tr>
<tr>
<td>Hypopnea</td>
<td>Hypopnea in adults is scored when the peak airflow drops by at least 30% of pre-event baseline for at least 10 seconds in association with either at least 4% arterial oxygen desaturation or an arousal. Hypopneas in children are scored by a 50% or greater drop in nasal pressure and either a 3% or more decrease in oxygen saturation or associated arousal.</td>
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<td>RERA</td>
<td>Respiratory event-related arousal is defined as an event lasting at least 10 seconds associated with flattening of the nasal pressure waveform and/or evidence of increased respiratory effort, terminating in arousal but not otherwise meeting criteria for apnea or hypopnea.</td>
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<tr>
<td>Respiratory event reporting</td>
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<tr>
<td>AHI</td>
<td>The apnea/hypopnea index is the average number of apneas or hypopneas per hour of sleep.</td>
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<tr>
<td>RDI</td>
<td>The respiratory disturbance index is the number of apneas, hypopneas, or respiratory event-related arousals per hour of sleep time. RDI is often used synonymously with the AHI.</td>
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<tr>
<td>REI</td>
<td>The respiratory event index is the number of events per hour of monitoring time. Used as an alternative to AHI or RDI in-home sleep studies when actual sleep time from EEG is not available.</td>
</tr>
<tr>
<td>OSA</td>
<td>Obstructive sleep apnea is repetitive episodes of upper airway obstruction due to the collapse and obstruction of the upper airway during sleep.</td>
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</tbody>
</table>
| Mild OSA | •In adults: AHI or RDI of 5 to <15  
•In children: AHI ≥1.5 is abnormal |
| Moderate OSA | AHI or RDI of 15 to < 30 |
| Severe OSA | •Adults: AHI or RDI ≥30  
•Children: AH1 of ≥10 |
| UARS | Upper airway resistance syndrome is characterized by a partial collapse of the airway and results in increased resistance to airflow. The increased respiratory effort is associated with multiple sleep fragmentations, as measured by very short alpha EEG arousals. |
| Positive airway pressure |  |
Auto-adjusting positive airway pressure may be used either to provide treatment or to determine the most effective pressure for CPAP.

Positive airway pressure (PAP) may be continuous (CPAP) or auto-adjusting (APAP) or bi-level (bi-PAP). CPAP is a more familiar abbreviation for delivery of positive airway pressure.

Usually defined as an AHI >20 events per hour while using CPAP.

CPAP use for <4 hours per night for ≥5 nights per week, or refusal to use CPAP.

CPAP intolerance may be observed in patients with mild, moderate, or severe OSA.

Due to faster respiratory rates in children, pediatric scoring criteria define an apnea as two or more missed breaths, regardless of its duration in seconds. In pediatric patients, an AHI greater than 1.5 events per hour is considered abnormal, and an AHI of 10 or more may be considered severe.

A variety of devices have been developed specifically to evaluate OSA at home. They range from portable full polysomnography systems to single-channel oximeters. Available devices evaluate different parameters, which may include oximetry, respiratory and cardiac monitoring, and sleep/wake activity, but most portable monitors do not record EEG activity.

**Treatment**

Medical management of OSA in adults may include weight loss, avoidance of stimulants, body position adjustment, oral appliances, and use of various types of positive airway pressure therapy (ie, fixed CPAP, bilevel positive airway pressure, or auto-adjusting positive airway pressure) during sleep. This evidence review, addresses CPAP, oral appliances, and novel devices including the Daytime-Nighttime Appliance (BioModeling Solutions), the mandibular Repositioning Nighttime Appliance (BioModeling Solutions), Provent and Winx. Provent is a single-use nasal expiratory resistance valve device containing valves inserted into the nostrils and secured with adhesive. The Winx system uses oral pressure therapy to treat OSA.

Surgical management of OSA (ie, adenotonsillectomy, uvulopalatopharyngoplasty, orthognathic surgery) is discussed in separate policy (surgical treatment of snoring and OSA syndrome).

**Regulatory Status**

A variety of oral appliances have been cleared for marketing by the U.S. Food and Drug Administration (FDA) through the 510(k) process for treatment of snoring and mild-to-moderate OSA, including the Narval™ CC, Lamberg Sleep Well Smartrusion, 1st Snoring Appliance, Full Breath Sleep Appliance, PM Positioner, Snoorenti, Snorex, Osap, DeSRA, Elastomeric Sleep Appliance, Snoremaster Snore Remedy, Snore-no-More, Napa, Snoar™ Open Airway Appliance, and The Equalizer Airway Device. FDA product code: LQZ.
In 2014, the mRNA Appliance® (BioModeling Solutions) was cleared for marketing by the FDA through the 510(k) process (K130067) for the treatment of snoring and mild-to-moderate OSA. FDA product code: LRK.

Various PAP devices have been cleared by the FDA through the 510(k) process since 1977. Bilevel positive airway pressure devices were first cleared for marketing in 1996. FDA product codes: BZD, MNT.

In 2010, a nasal expiratory resistance valve (Provent®, Ventus Medical) was cleared for marketing by the FDA through the 510(k) process for the treatment of OSA. The Winx™ system received marketing clearance in 2012. FDA product codes: OHP, OZR.

**Rationale**

This evidence review was created in November 1996 and has been updated regularly with searches of the MEDLINE database. The most recent literature update was performed through April 16, 2019.

Evidence reviews assess the clinical evidence to determine whether the use of technology improves the net health outcome. Broadly defined, health outcomes are the length of life, quality of life (QOL), and ability to function—including benefits and harms. Every clinical condition has specific outcomes that are important to patients and managing the course of that condition. Validated outcome measures are necessary to ascertain whether a condition improves or worsens; and whether the magnitude of that change is clinically significant. The net health outcome is a balance of benefits and harms.

To assess whether the evidence is sufficient to draw conclusions about the net health outcome of technology, two domains are examined: the relevance, and quality and credibility. To be relevant, studies must represent one or more intended clinical use of the technology in the intended population and compare an effective and appropriate alternative at a comparable intensity. For some conditions, the alternative will be supportive care or surveillance. The quality and credibility of the evidence depend on study design and conduct, minimizing bias and confounding that can generate incorrect findings. The randomized controlled trial (RCT) is preferred to assess efficacy; however, in some circumstances, nonrandomized studies may be adequate. RCTs are rarely large enough or long enough to capture less common adverse events and long-term effects. Other types of studies can be used for these purposes and to assess generalizability to broader clinical populations and settings of clinical practice.

**Suspected Obstructive Sleep Apnea**

**Clinical Context and Test Purpose**

The purpose of home sleep apnea tests in patients with suspected obstructive sleep apnea (OSA) is to diagnose the condition and to inform a decision on appropriate treatment.
The question addressed in this evidence review is: Do home sleep apnea tests improve the net health outcome?

The following PICOTS were used to select literature to inform this review.

**Patients**
The relevant populations of interest are patients with suspected OSA.

**Interventions**
The tests being considered is home sleep apnea testing. Tests reviewed are multichannel home sleep testing and limited channel sleep testing (auto-adjusting positive airway pressure [APAP], Apnea Risk Evaluation System).

**Comparators**
The established test for OSA is in-laboratory polysomnography (PSG). Laboratory PSG is a more complex procedure than home testing and more limited in its availability.

**Outcomes**
The general outcomes of interest are the number of apneas or hypopneas during sleep, measured by the Apnea/Hypopnea Index (AHI), and subjective symptoms of sleepiness, typically measured with the Epworth Sleepiness Scale (ESS) or the Functional Outcomes of Sleep Questionnaire (FOSQ) (see Table 2).

### Table 2. Health Outcome Measures Relevant to OSA

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Measure</th>
<th>Description</th>
<th>Clinically Meaningful Difference (If Known)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in AHI</td>
<td>AHI</td>
<td>Mean change in AHI from baseline to posttreatment</td>
<td>Change from severe-to-moderate or mild OSA</td>
</tr>
<tr>
<td>AHI success</td>
<td>Percentage of</td>
<td>Studies may use different definitions of success, but the most common for</td>
<td>Sher criteria include a decrease in AHI of ≥50% and an AHI &lt;20 events per hour and an AHI &lt;15, &lt;10, or &lt;5 events per hour</td>
</tr>
<tr>
<td></td>
<td>patients</td>
<td>AHI success is the Sher criteria</td>
<td></td>
</tr>
<tr>
<td></td>
<td>achieving</td>
<td>Studies may use different definitions of success, but the most common for</td>
<td></td>
</tr>
<tr>
<td></td>
<td>success</td>
<td>AHI success is the Sher criteria</td>
<td></td>
</tr>
<tr>
<td>ODI</td>
<td>Oxygen levels</td>
<td>The number of times per hour of sleep that the blood oxygen level drops by ≥4 percentage points</td>
<td>More than 5 events per hour</td>
</tr>
<tr>
<td>ESS</td>
<td>Scale ranges</td>
<td>The ESS is a short self-administered questionnaire that asks patients how</td>
<td>An ESS of ≥10 is considered excessively sleepy</td>
</tr>
<tr>
<td></td>
<td>from 0 to 24</td>
<td>likely they are to fall asleep in 8 different situations (eg, watching TV,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>sitting quietly in a car, or sitting and talking to someone)</td>
<td></td>
</tr>
<tr>
<td>FOSQ</td>
<td>30 questions</td>
<td>Disease-specific quality of life questionnaire that evaluates functional</td>
<td>A score of ≥18 is the threshold for normal sleep-related functioning, and a change of ≥2 points is considered clinically meaningful improvement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>status related to excessive sleepiness</td>
<td></td>
</tr>
</tbody>
</table>

AHI: Apnea/Hypopnea Index; ESS: Epworth Sleepiness Score; FOSQ: Functional Outcomes of Sleep Questionnaire; ODI: Oxygen Desaturation Index; OSA: obstructive sleep apnea.
Beneficial outcomes of a true-positive are effective treatment resulting in a decrease in respiratory events during sleep and a reduction in subject sleepiness.

Harmful outcomes of a false-positive test include unnecessary treatment. Harmful outcomes of a false-negative test include not receiving the correct treatment.

**Multichannel Home Sleep Apnea Testing**

Balk et al (2011) conducted a comparative effectiveness review for the Agency for Healthcare Research and Quality (AHRQ) on the diagnosis and treatment of OSA in adults. Reviewers found strong evidence that an AHI greater than 30 events per hour is an independent predictor of all-cause mortality, with low or insufficient evidence for an association between AHI and other clinical outcomes. Reviewers found moderate evidence that type 3 and 4 monitors may have the ability to accurately predict an AHI suggestive of OSA and that type 3 monitors perform better than type 4 monitors at AHI cutoffs of 5, 10, and 15 events per hour.

Home sleep testing with three recording channels that include respiratory effort, airflow, and oxygen saturation, but not heart rate, are considered by some, including the Centers for Medicare & Medicaid, to be sufficient for home sleep apnea tests. Corral et al (2017) reported a multicenter noninferiority trial of home sleep testing using a 3-channel monitor compared with in-laboratory PSG in 430 patients. Included in the study were patients referred to tertiary hospitals in Spain for suspected OSA, who had snoring or sleep apneas observed by a partner, ESS score of ten or greater, and absence of clinical suspicion of any other sleep pathology. Both groups of patients who were diagnosed with OSA received continuous positive airway pressure (CPAP) titration with a single APAP session at home. The median baseline ESS score was 13 in both groups. CPAP was indicated in 68% of patients in the PSG arm compared with 53% in the home sleep testing group, with the difference attributed to the underestimation of AHI in-home sleep studies. All patients, including those treated with CPAP and those who were not, were assessed at six-month follow-up. ESS score improved by -4.2 (95% confidence interval [CI], -4.8 to -3.6) in the home sleep testing group and by -4.9 (95% CI, -5.4 to -4.3) in the PSG group. With a noninferiority margin of two points on the ESS, home sleep testing was noninferior to in-laboratory PSG.

**Section Summary: Multichannel Home Sleep Apnea Testing**

Based on this evidence and society guidelines, portable monitoring with a minimum of four recording channels (including oxygen saturation, respiratory movements, airflow, an electrocardiogram or heart rate), or with a device that measures peripheral arterial tone, actigraphy, and oxygen saturation, for the diagnosis of OSA in adults who are at high-risk for OSA improves outcomes, when clinical evaluation and follow-up are conducted by a medical professional experienced in the diagnosis and treatment of sleep disorders.
**Limited Channel Home Sleep Apnea Testing**  
Use of Auto-Adjusting Positive Airway Pressure for Diagnosis and Treatment Supervised by a Sleep Specialist

Mulgrew et al (2007) published a randomized validation study of the diagnosis and management of OSA with a single-channel monitor followed by APAP. They developed a diagnostic algorithm that had a 94% positive predictive value for moderate-to-severe OSA assessed by PSG. Patients who passed the screening (n=68) were randomized to attend in-laboratory PSG with CPAP titration or home monitoring with a portable APAP unit. No difference was observed between lab PSG and home-managed patients for any of the outcome measures. Senn et al (2006) assessed whether an empirical approach, using a 2-week trial of APAP, could effectively diagnose OSA. Patients (n=76) were included in the study if they had been referred by primary care physicians for evaluation of suspected OSA, were habitual snorers, complained of daytime sleepiness, and had an ESS score of 8 or greater (mean, 13.6). At the end of the two-week trial, patients were asked to rate the perceived effect of treatment and to indicate whether they had used CPAP for more than two hours per night and were willing to continue treatment. Patients without a clear benefit of CPAP received further evaluation, including clinical assessment and PSG. Compared with PSG, patient responses showed a sensitivity of 80%, a specificity of 97%, a positive predictive value of 97%, and a negative predictive value of 78%.

Berry et al (2008) randomized 106 patients referred for a sleep study for suspected OSA at a local Veterans Administration center to portable monitoring followed by APAP or to PSG for diagnosis and treatment. Patients were screened with a detailed sleep and medical history questionnaire, and patients on α-blockers or not in sinus rhythm were excluded due to the type of portable monitoring device used (Watch-PAT 100). Of the 53 patients randomized to PSG, 6 (11%) did not have PSG-defined OSA; in the portable monitoring arm, 4 (8%) of 53 patients were found not to have OSA. Treatment outcomes were similar in both groups, with a 7-point improvement in ESS score, 3-point improvement in the FOSQ score, and a machine estimate of residual AHI of 3.5 events per hour in the portable monitoring APAP group and 5.3 in the PSG group.

**Apnea Risk Evaluation System**

Ayappa et al (2008) reported on a validation study of a small apnea monitor that is self-applied to the forehead. The device measures blood oxygen saturation and pulse rate, airflow, snoring levels, head movement, and head position. The study enrolled 80 individuals with a high likelihood of OSA and 22 with a low-risk of OSA; results of simultaneous Apnea Risk Evaluation System recording and PSG were available for 92 individuals. When healthy subjects were excluded from the analysis, sensitivity (91%) and specificity (92%) were relatively high for an AHI of 15 or more events per hour but dropped considerably with an AHI between 5 and 15 (sensitivity, 97%; specificity, 78%). Five percent of the subjects could not tolerate the device and were excluded from the analysis.
Monitoring of APAP use by daily transmission to a web-based database and review by a research coordinator has been shown to improve compliance to positive airway pressure (PAP) therapy (191 min/d vs 105 min/d). For the telemedicine arm of this randomized trial, as reported by Fox et al (2012), the research coordinator reviewed the transmitted data daily and contacted the patient if any of the following were present: mask leak greater than 40 L/min for more than 30% of the night, less than 4 hours of use for 2 consecutive nights, machine-measured AHI of more than 10 events per hour, and 90th percentile of pressure greater than 16 cm H2O. Evaluation by their physician sleep specialist after three months of therapy showed a similar modest decrease in AHI for the two groups (1.6 for telemedicine vs 0.7 for controls).

Section Summary: Limited Channel Home Sleep Apnea Testing
The evidence for limited channel home sleep apnea testing (includes type four monitors) in patients who have OSA consists of studies on diagnostic accuracy. A number of questions remain about the ability of this home sleep apnea tests to detect clinically significant OSA without sensors for respiratory effort, airflow, and oxygen saturation (or alternatively peripheral arterial tone, actigraphy, and oxygen saturation).

Diagnosed Obstructive Sleep Apnea

Clinical Context and Therapy Purpose
The purpose of medical management in patients who have OSA is to provide a treatment option that is an alternative to or an improvement on existing therapies.

The question addressed in this evidence review is: Does management with PAP, oral appliances, or novel OSA treatments improve the net health outcome?

The following PICOTS were used to select literature to inform this review.

Patients
The relevant population of interest are patients with OSA.

Interventions
The therapy being considered is the medical management of OSA in adults, which may include the use of various types of PAP therapy (ie, fixed CPAP, bilevel PAP, or APAP) during sleep.

CPAP involves the administration of air, usually through the nose, by an external device at a fixed-pressure to maintain the patency of the upper airway. Bilevel PAP is similar to CPAP but these devices are capable of generating two adjustable pressure levels. APAP adjusts the level of pressure based on the level of resistance and thus administers a lower mean level of positive pressure during the night. It has been hypothesized that both bilevel PAP and APAP are more comfortable for the patient and thus might improve patient compliance or acceptance.
Oral appliances can be broadly categorized as mandibular advancing or positioning devices or tongue-retaining devices. Oral appliances can either be "off the shelf" or customized for the patient by a dental laboratory or similar provider.

The Daytime-Nighttime Appliance (DNA Appliance) and the mandibular Repositioning Nighttime Appliance (mRNA Appliance) are customized palate and mandible expanding devices. In addition to the upper-jaw device that is common to both the DNA Appliance and the mRNA Appliance (worn both during the day and night), the mRNA Appliance moves the mandible forward and is worn during sleep. The DNA Appliance and mRNA Appliance systems use 3-dimensional axial springs, which are proposed to gradually expand the upper and lower jaw and airway to treat and eventually eliminate mild-to-moderate OSA.

Other devices being marketed for the treatment of OSA are Provent and Winx. Provent is a single-use nasal expiratory resistance valve device containing valves inserted into the nostrils and secured with adhesive. The Winx system uses oral pressure therapy to treat OSA. Oral pressure therapy provides light negative pressure to the oral cavity by using a flexible mouthpiece connected to a bedside console that delivers negative pressure. This device is proposed to increase the size of the retropalatal airway by pulling the soft palate forward and stabilizing the base of the tongue.

Comparators
The following therapy is currently being used to make decisions about the treatment of OSA. The criterion standard treatment is CPAP or its variants. The major limitation of PAP therapy is poor patient compliance due to the need to wear a face or nasal mask.

Outcomes
The outcomes of interest are a decrease in AHI and oxygen desaturation Index on PSG and improvement in a measure of sleepiness such as the ESS or FOSQ (see Table 2), which are typically conducted within weeks or months.

Positive Airway Pressure Devices
The American Academy of Sleep Medicine (AASM) commissioned a task force (Patil et al[2019]) to conduct an updated systematic review and meta-analysis of studies for the AASM (2019) guidelines on PAP for the treatment of OSA. Meta-analyses of 184 studies indicated that PAP use leads to clinically significant reductions in disease severity (−23 events/h; 95% CI: −29 to −18 events/h), both subjective and objective sleepiness, daytime and nighttime blood pressure, and motor vehicle accidents, and improved sleep-related QOL. The overall quality of evidence for the outcome of sleepiness was high and the overall quality of evidence for sleep-related QOL and for blood pressure was moderate. The quality of evidence on the effect of PAP on cardiovascular events and mortality was low to moderate, with benefits reported in non-randomized studies but not in RCTs. The task force concluded that the potential benefits of CPAP outweighed the harms in symptomatic patients. PAP initiation in the home had equivalent effects on patient outcomes compared to in-laboratory titration, and there were no clinically
significant differences in patient outcomes with the use of auto-adjusting or bilevel PAP compared with standard continuous PAP. PAP adherence was improved with the use of educational, behavioral, troubleshooting, and telemonitoring interventions.

The review by Balk et al (2011) for AHRQ concluded that the strength of evidence for CPAP for OSA was moderate based on the large magnitude of effect on the intermediate outcomes of the AHI, ESS score, and arousal index, even though there was weak evidence demonstrating an effect of CPAP on clinical outcomes. In addition, reviewers found moderate evidence that APAP and fixed-pressure CPAP result in similar levels of compliance (hours used per night) and treatment effects for patients with OSA. There was moderate evidence that CPAP is superior to mandibular advancement devices in improving sleep study measures.

Evidence-based guidelines from the AASM concluded that CPAP and APAP devices have similar outcomes in terms of AHI, oxygen saturation, and arousals. As indicated in the AHRQ report, increased compliance with APAP devices has not been well-documented in clinical trials. Thus, the issues associated with APAP are similar to those for bilevel PAP.

Yu et al (2017) conducted a meta-analysis assessing the association between PAP and cardiovascular events and death. They included 10 trials with a total of 7266 patients with sleep apnea. There were 356 major adverse cardiovascular events and 613 deaths observed during follow-up (range, 6-57 months). The analysis found no significant association of PAP with a composite outcome of acute coronary syndrome events, stroke, or vascular death (relative risk, 0.77; 95% CI, 0.53 to 1.13). Trials were grouped according to adherence to PAP (<4 vs ≥ 4 h/d), type of sleep apnea (obstructive vs central), and type of PAP (CPAP vs adaptive servo-ventilation). Meta-regression identified no association between PAP with outcomes for different levels of apnea severity, follow-up duration, or adherence to PAP. As reported by McEvoy et al (2016), the largest trial included in the meta-analysis was the Sleep Apnea Cardiovascular Endpoints RCT, which found no benefit of CPAP on the primary composite outcome of death or hospitalization for cardiovascular events in 2717 adults with moderate-to-severe OSA and cardiovascular disease who were followed for a median of 44 months. With a mean duration of adherence to CPAP therapy of 3.3 hours per night, CPAP significantly reduced daytime sleepiness (adjusted difference in ESS score, -2.5; 95% CI, -2.8 to -2.2; p<0.001) and improved health-related QOL and mood. Lisan et al (2019) reported 11-year follow-up of a cohort of 392 patients from the Sleep Heart Health Study who had obesity and severe OSA. For the 81 patients who were prescribed PAP therapy, the propensity-matched hazard ratio for all-cause mortality was 0.58 (95% CI, 0.35 to 0.96) compared to matched patients who did not receive a prescription for PAP. Survival curves indicated that the difference in mortality appeared six to seven years after initiation of PAP. Exploratory analysis indicated that PAP might also be associated with a lower risk of cardiovascular mortality.
An improvement in postoperative outcomes with CPAP was suggested by Mutter et al (2014) in a matched comparison of patients with OSA who had been diagnosed prior to surgery (2640 surgeries), those not diagnosed until up to 5 years after surgery (1571 surgeries), and 16277 surgeries for patients without a diagnosis of OSA over 21 years of available data.22 In multivariate analysis, the risk of respiratory complications was increased for both diagnosed and undiagnosed OSA patients compared with controls (odds ratio, 2.08; p<0.001). The risk of cardiovascular complications, primarily cardiac arrest and shock, was higher in OSA patients not diagnosed until after surgery (relative risk, 2.20; 95% CI, 1.16 to 4.17; p=0.02), but not in those diagnosed prior to surgery (relative risk, 0.75; 95% CI, 0.43 to 1.28; p=0.29); the difference between groups was statistically significant (p=0.009). There was a significant trend toward a higher risk with increasing OSA severity. Study limitations included the inability to determine whether CPAP was used perioperatively, and, because body mass index could not be determined, potential confounding from the close association between obesity and OSA.

Subsection Summary: PAP Devices
PAP devices are accepted therapies for OSA. Studies have suggested that both CPAP and APAP are associated with improvements in sleep architecture. Although PAP has been associated with an improvement in intermediate outcomes in multiple studies, it has not been shown to improve hard cardiovascular outcomes. Interpretation of this finding is limited by the duration of follow-up (from 6 to 57 months) and mean CPAP use (<4 hours per night in the largest studies). Eleven-year follow-up of obese patients with severe OSA from the Sleep Heart Health Study found a reduction in all-cause mortality with PAP use which appeared after six to seven years.

Oral Appliances
A systematic review of the evidence on the treatment of OSA with oral appliance therapy was performed by Ramar et al (2015), as part of an update of practice guidelines by AASM and the American Academy of Dental Sleep Medicine.23 Meta-analysis showed that oral appliances reduced the AHI, arousal index, and Oxygen Desaturation Index, and increase oxygen saturation. However, oral appliances had no significant effect on sleep architecture or sleep efficiency. The meta-analysis found CPAP to be more effective than oral appliances in reducing the AHI, arousal index, and Oxygen Desaturation Index, and in improving oxygen desaturation, supporting the use of CPAP as first-line therapy for treating OSA.

Johal et al (2017) reported on a randomized crossover trial of ready-made vs custom-made mandibular repositioning devices.24 Twenty-five patients with mild-to-moderate OSA (mean AHI, 13.3 events per hour; range, 10.9-25 events per hour) were randomized to a 3-month trial of a ready-made or the custom-made device, with a 2-week washout between treatments. An overnight home sleep apnea test was performed at baseline and on the last night of the three-month trial period. Patients used the custom-made device for more nights per week (7 vs 3, p=0.004) and hours per night (5 vs 3, p=0.006) than the ready-made device. Treatment response (AHI <5 events per hour) was obtained in 64%
of patients during use of the custom-made device phase compared with a 24% response rate using the ready-made device (p<0.001). Treatment failure (<50% reduction in AHI) was more frequent with the ready-made device (36%) than with the custom device (4%), while an ESS score of at least 10 was more frequent during the ready-made phase (66%) than with the custom-made phase (33%). An improvement in the QOL was observed only during the custom-made device phase.

In the AHRQ report (2011) on the diagnosis and treatment of OSA in adults, the strength of the evidence that mandibular advancement devices improve sleep apnea signs and symptoms was rated moderate.3

**Subsection Summary: Oral Appliances**
Custom oral appliances, which may include mandibular repositioning or tongue-retaining devices, are an accepted therapy for mild-to-moderate OSA. A 2015 meta-analysis found the efficacy of oral appliances for measures of OSA but they were less effective than CPAP. The strength of evidence for mandibular repositioning devices was rated as moderate by AHRQ.

**Novel OSA Treatments**

**Palate and Mandible Expansion**
Singh et al (2016) reported on a series of 15 consecutive patients with severe sleep apnea who were treated with a DNA Appliance or mRNA Appliance.25 All patients had failed to comply with CPAP. Pre- and posttreatment AHI was assessed in a home sleep apnea test without the oral appliance. AHI decreased from a mean 45.9 events per hour to 16.5 (p<0.01) after a mean 9.7 months of treatment. Singh et al (2016) and Cress (2017) reported on a series of 19 patients who had mild-to-moderate OSA who were treated with a DNA or mRNA Appliance.26 Only patients who complied with oral appliance wear were included in the study. The mean AHI was reduced from 12.85 to 6.2 events per hour (p<0.001) without the appliance while the Oxygen Saturation Index improved from 6.3% to 2.6% (p<0.01). Limitations of these studies included the use of a home sleep apnea test rather than the more accurate laboratory PSG, uncertain blinding of the physician evaluating the sleep study, the small number of patients studied, the lack of intention-to-treat analysis, and the lack of long-term follow-up.

**PAP-NAP**
Krakow et al (2008) reported on the use of a daytime abbreviated sleep study to acclimate patients with complex insomnia to PAP.27 Patients had been referred by psychiatrists or primary care physicians for unspecified insomnia conditions, insomnia due to a mental disorder, or hypnotic dependence. Nearly all patients had anxiety, fear, and/or resistance regarding PAP therapy or the diagnosis of OSA. Thirty-nine patients who would not complete a titration protocol (full-night or split-night) were offered a daytime procedure (PAP-NAP) prior to night-time titration. The PAP-NAP protocol had five components: pretest instructions to maximize chances for daytime napping; introduction of PAP therapy addressing barriers to use; type 3 monitoring hookup (ten channels without
electroencephalography leads); PAP therapy during one to two hours in bed in which the patient had the opportunity to fall asleep with the mask in place; and posttest follow-up. Thirty-five of 39 nap-tested patients subsequently scheduled and completed an overnight titration or split-night study with full PSG. The effect of the PAP-NAP intervention on compliance was compared with historical controls (n=38) who had insomnia, mental health conditions, and OSA with resistance to CPAP who completed titration. A prescription for PAP therapy was filled by 85% of the PAP-NAP group compared with 35% of controls. Regular use during a 30-day period was recorded by the PAP device in 67% of the intervention group and in 23% of controls. Adherence, defined as at least 5 days a week with an average of at least 4 hours a day, was 56% in the PAP-NAP group and 17% in controls.

**Nasal Expiratory Positive Airway Pressure**

Evidence on nasal EPAP includes a moderately sized RCT and a systematic review of the Provent device. Berry et al (2011) reported on an industry-sponsored multicenter, double-blind, randomized sham-controlled trial of EPAP. Two hundred fifty patients with OSA and an AHI of 10 or more events per hour were randomized to nasal EPAP (n=127) or to a sham device (n=123) for 3 months. PSG was performed on 2 nights (device-on, device-off, in random order) at week 1 (92% follow-up) and after 3 months of treatment (78% follow-up). EPAP reduced median AHI from 13.8 to 5.0 events per hour (-52.7%) at week 1 and from 14.4 to 5.6 events per hour (-42.7%) at 3 months. This reduction in AHI in the treatment group was significantly greater (-7.3% at week 1, -10.1% at 3 months) than in the sham group. Over three months, the decrease in ESS score was statistically greater in the EPAP group (from 9.9 to 7.2) than in the sham group (from 9.6 to 8.3), although the clinical significance of a 1-point difference in ESS score is unclear. Treatment success and oxygenation data were presented only for the 58% of per-protocol patients who had an AHI of 5 or more events per hour on the device-off PSG night. The oxygenation results (Oxygenation Desaturation Index and percent of total sleep time with oxygen saturation <90%) showed small but statistically significant decreases at 1 week and 3 months. Treatment success, defined as a 50% or greater reduction in the AHI or an AHI reduction to less than 10 events per hour (if device-off AHI was ≥10 events per hour), was greater in the EPAP group at 1 week (62% vs 27.2%) and at 3 months (50.7% vs 22.4%). Device-related adverse events were reported by 45% of patients in the EPAP group and by 34% of patients in the sham group, with 7% of patients in the EPAP group discontinuing due to adverse events. Overall, the validity of these results was limited by the high dropout rate, and the clinical significance of the results is uncertain.

Kryger et al (2011), in an open-label extension of the randomized study by Berry et al (2011), evaluated 12-month safety and durability of the treatment response in patients who had an initially favorable response to EPAP. Included were 41 (32%) of the 127 patients in the EPAP arm of the study who used the device for an average of at least 4 hours per night on at least 5 nights a week during months 1 and 2 and had at least a 50% reduction in AHI, or reduction to less than 10 events per hour, compared with the device-off PSG. Of the 51 (40%)
of 127 eligible patients, 41 enrolled in the extension study, and 34 (27%) of 127 were still using the EPAP device at the end of 12 months. Median AHI was reduced from 15.7 to 4.7 events per hour; the percentage of patients who met criteria for success was not reported. The arousal index was modestly decreased (from 23.9 to 19.0). After 12 months of treatment, the ESS score decreased from 11.1 to 6.0. The median percentage of reported nights used (entire night) was 89.3%. Device-related adverse events were reported by 42% of patients, most frequently difficulty exhaling, nasal discomfort, dry mouth, headache, and insomnia. This open-label extension study was limited by its inclusion only of responders and by the potential for a placebo effect on the ESS score. However, the data suggested that some patients might have responded to this device, and the patient compliance data might indicate a positive effect on daytime sleepiness that leads to continued use of the device in about 25% of patients. Additional controlled studies are needed to distinguish between these alternatives.

A systematic review by Riaz et al (2015) identified 18 studies (total n=920 patients) that had data on pre- and postnasal EPAP. Study designs included ten conference papers and eight publications (case series, cohort studies, RCTs). For patients included in the meta-analysis (n=345 patients), AHI decreased from 27.32 to 12.78 events per hour (p<0.001). For 359 patients, ESS score modestly improved from 9.9 to 7.4 (p<0.001). Data from the Berry et al (2011) RCT (described above) were not included in this meta-analysis because mean data were not reported. Response to the nasal EPAP was variable and inconsistent, and there were no clear characteristics (demographic factors, medical history, and/or physical exam finding) that predicted a favorable response.

Kureshi et al (2014) reported on a small (n=14) double-blind, pilot, crossover RCT of EPAP in children to evaluate efficacy and compliance with this new treatment. PSG with EPAP or a placebo device showed a significant mean improvement in Obstructive Apnea Index with EPAP (0.6 vs 4.2, p=0.01), but responses varied (three did not improve, two worsened). No other measures were statistically significant in this trial. For responders who used the devices at home for 30 days, adherence was 83% of nights. ESS scores improved from 11 to 7 (p=0.031) and Obstructive Sleep Apnea-18 questionnaire scores improved from 50 to 39 (p=0.028). Other outcome measures did not improve significantly.

**Oral Pressure Therapy**
No full-length, peer-reviewed studies on oral pressure therapy were identified in the published literature. Therefore, it is not possible to evaluate the efficacy of this treatment based on scientific evidence.

**Section Summary: Novel OSA Treatments**
The evidence on palate and mandible expansion devices includes a few small cohort studies. Further study with well-designed trials is needed to evaluate this treatment.

The evidence on EPAP devices in patients with OSA has been reported in several prospective case series, an industry-sponsored RCT, and a systematic review that
did not include the RCT. The main finding of the RCT was a decrease in AHI with a minor impact on oxygenation and ESS scores.

One comparative trial with historical controls used a PAP-NAP study of patients with complex insomnia who are resistant to CPAP titration or use. This single study of PAP-NAP does not provide sufficient evidence to form conclusions on the efficacy of this approach in improving compliance with CPAP. The patient population was highly selected and the behavioral intervention may be dependent on the specific clinicians providing treatment. In addition, historical controls were used, and they were not well-matched to the study population. For these reasons, the internal validity and generalizability of the results are uncertain.

There is no evidence on the use of oral pressure therapy to treat OSA.

**Summary of Evidence**

**Diagnosis**
For individuals who have suspected OSA who receive home sleep apnea testing with at least three recording channels, the evidence includes RCTs. The relevant outcomes are test accuracy, symptoms, functional outcomes, and resource utilization. RCTs have reported that home sleep apnea testing (with sensors for respiratory effort, airflow, and oxygen saturation, or alternatively with peripheral arterial tone, actigraphy and oxygen saturation) is noninferior to testing in the sleep lab for adults with a high pretest probability of OSA and absence of comorbid conditions as determined by clinical evaluation. A positive portable monitoring study with channels that include arterial oxygen saturation, airflow, and respiratory effort has a high positive predictive value for OSA and can be used as the basis for a CPAP trial to determine the efficacy of treatment. A negative portable monitoring study cannot be used to rule out OSA. Patients who have a negative result from portable monitoring or have a positive study but do not respond to CPAP should undergo further evaluation. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals who have suspected OSA who receive limited channel home sleep apnea testing, the evidence includes studies on diagnostic accuracy. The relevant outcomes are test accuracy, symptoms, functional outcomes, and resource utilization. The ability to detect clinically significant OSA without sensors for respiratory effort, airflow, and oxygen saturation, or alternatively without peripheral arterial tone, actigraphy and oxygen saturation, lacks support in the literature. The evidence is insufficient to determine the effects of the technology on health outcomes.

**Treatment**
For individuals who have OSA who receive PAP devices or oral appliances, the evidence includes RCTs and systematic reviews of RCTs. The relevant outcomes are symptoms, functional outcomes, and QOL. Conventional medical management of OSA includes weight loss, avoidance of stimulants, body position adjustment,
oral appliances, and use of CPAP during sleep. A diagnostic sleep study may be followed by a trial of APAP to evaluate the efficacy and adjust pressure. APAP or bilevel PAP may also be indicated if the patient is intolerant of CPAP. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals who have OSA who receive novel OSA treatments (e.g., palate expansion, EPAP, oral pressure therapy), the evidence includes an RCT and a meta-analysis of case series. The relevant outcomes are symptoms, functional outcomes, and QOL. The evidence on palate and mandible expansion devices includes a few small series. Further study with well-designed trials is needed to evaluate this treatment. The evidence on EPAP devices in patients with OSA has been reported in prospective case series, an industry-sponsored RCT, and a systematic review that did not include the RCT. The main finding of the RCT was a decrease in the AHI, with minor impact on oxygenation, and a decrease in ESS score. One comparative trial with historical controls used a PAP-NAP to study patients with complex insomnia resistant to CPAP titration or use. Additional study is needed to evaluate with greater certainty the efficacy of this intervention. No evidence was identified on the use of the oral therapy device. The evidence is insufficient to determine the effects of the technology on health outcomes.

SUPPLEMENTAL INFORMATION
Clinical Input From Physician Specialty Societies and Academic Medical Centers

While the various physician specialty societies and academic medical centers may collaborate with and make recommendations during this process, through the provision of appropriate reviewers, input received does not represent an endorsement or position statement by the physician specialty societies or academic medical centers, unless otherwise noted.

2014 Input
In response to requests, input was received from 7 physician specialty societies (8 reviewers) and 4 academic medical centers (6 reviewers) while this policy was under review in 2014. Input focused on the routine screening of patients scheduled to undergo bariatric surgery. There was a consensus that routine screening is considered medically necessary in this population due to the high prevalence of obstructive sleep apnea (OSA) in patients with a body mass index greater than 40 kg/m², combined with the increased rate of perioperative complications in patients with OSA. The input was mixed on whether the use of portable home sleep testing was appropriate for patients scheduled for bariatric surgery. Concerns were raised about the high prevalence of obesity hypoventilation syndrome in this population, which is a contraindication to home sleep testing. Other reviewers considered home sleep testing to be appropriate in patients scheduled for bariatric surgery, with the caveat that obesity hypoventilation syndrome should be ruled out prior to home sleep testing.
2010 Input
In response to requests, input was received from 1 physician specialty society and 6 academic medical centers (8 reviewers) while this policy was under review in 2010. Input focused on the sensors required for unattended home sleep studies and on diagnosis and treatment of OSA in children. In general, reviewers supported the requirement that home monitors measure four parameters, including respiratory effort, airflow, and oxygen saturation, and their use is restricted to adults. Some exceptions were noted for specific situations. The 2010 update included recommendations from reviewers on indications specific to pediatric patients.

2009 Input
In response to requests, input was received from 5 physician specialty societies (6 reviewers) and 3 academic medical centers while this policy was under review in 2009. Professional society guidelines and position statements were also reviewed. In general, input supported the use of polysomnography, portable sleep monitoring tests, multiple sleep latency tests, and continuous positive airway pressure for adults as described in the policy. The update included reviewers' recommendations for clarifications and modifications to the policy statements.

Practice Guidelines and Position Statements

American Academy of Sleep Medicine
The AASM (2017) published clinical practice guidelines on diagnostic testing for adult OSA. The AASM provided the following recommendations (see Table 3).

Table 3. Recommendations on Diagnostic Testing for Adult OSA

<table>
<thead>
<tr>
<th>Recommendation Statement</th>
<th>SOR</th>
<th>QOE</th>
<th>Benefits vs Harms</th>
</tr>
</thead>
<tbody>
<tr>
<td>We recommend that clinical tools, questionnaires, and prediction algorithms not be used to diagnose OSA in adults, in the absence of PSG or HSAT</td>
<td>Strong</td>
<td>Moderate</td>
<td>High certainty that harms outweigh benefits</td>
</tr>
<tr>
<td>We recommend that PSG, or HSAT with a technically adequate device, be used for the diagnosis of OSA in uncomplicated adult patients presenting with signs and symptoms that indicate an increased risk of moderate to severe OSA.</td>
<td>Strong</td>
<td>Moderate</td>
<td>High certainty that benefits outweigh harms</td>
</tr>
<tr>
<td>We recommend that if a single HSAT is negative, inconclusive, or technically inadequate, PSG be performed for the diagnosis of OSA.</td>
<td>Strong</td>
<td>Low</td>
<td>High certainty that benefits outweigh harms</td>
</tr>
<tr>
<td>We recommend that PSG, rather than home sleep testing, be used for patients with significant cardiorespiratory disorder, potential respiratory muscle weakness, awake or suspected sleep hypoventilation, chronic opioid medication use, history of stroke or severe insomnia.</td>
<td>Strong</td>
<td>Very low</td>
<td>High certainty that benefits outweigh harms</td>
</tr>
<tr>
<td>We suggest that, if clinically appropriate, a split-night diagnostic protocol, rather than a full-night diagnostic protocol for PSG be used for the diagnosis of OSA.</td>
<td>Weak</td>
<td>Low</td>
<td>Low certainty that benefits outweigh harms</td>
</tr>
<tr>
<td>We suggest that when the initial PSG is negative, and there is still clinical suspicion for OSA, a second PSG be considered for the diagnosis of OSA.</td>
<td>Weak</td>
<td>Very low</td>
<td>Low certainty that benefits outweigh harms</td>
</tr>
</tbody>
</table>
The AASM considers a technically adequate home sleep apnea test (HSAT) device to incorporate "a minimum of the following sensors: nasal pressure, chest and abdominal respiratory inductance plethysmography, and oximetry; or else PAT [peripheral arterial tone] with oximetry and actigraphy." The guidelines refer to the AASM Manual for the Scoring of Sleep and Associated Events for additional information regarding HSAT sensor requirements.

The AASM also issued guidelines in 2009 on the evaluation, management, and long-term care of adults with OSA. The levels of recommendation are "standard" (generally accepted patient-care strategy, with a high degree of certainty; level 1 to 2 evidence), "guideline" (moderate degree of clinical certainty; level 2 to 3 evidence), or "option" (uncertain clinical use; insufficient or inconclusive evidence).

**Diagnosis**

The AASM recommended that patients who are obese, retrognathic, hypertensive, or who complain of snoring or daytime sleepiness should be assessed for presence or absence as well as the severity of OSA using the following methods (standard):

- Sleep history assessment includes witnessed apneas, gasping/choking at night, excessive sleepiness, total sleep amount, nocturia, morning headaches, and decreased concentration and memory.
- Physical assessment includes evaluation of respiratory, cardiovascular, and neurologic systems and signs of upper respiratory narrowing.
- Objective testing, under an AASM-accredited program, and attended by trained technical personnel. The diagnosis of OSA is confirmed if the number of obstructive events (apneas, hypopneas plus respiratory event related to arousals) is greater than 15 events/hour or greater than 5 events/hour in a patient reporting any of the following: unintentional sleep episodes during wakefulness; daytime sleepiness, unrefreshing sleep; fatigue; insomnia; waking up breath holding, gasping, or choking; or a bed partner describing loud snoring, breathing interruptions, or both.
  - In laboratory polysomnography (standard) records electroencephalogram, electrooculogram, chin electromyogram, airflow, oxygen saturation, respiratory effort, and heart rate.
  - Home testing with portable monitors should at minimum, record airflow, respiratory effort, and blood oxygenation.

**Treatment with positive airway pressure**

- Continuous positive airway pressure (CPAP) is indicated for patients with moderate to severe OSA (Standard) and mild OSA (Option).
- Bilevel positive airway pressure can be considered in CPAP-intolerant patients (Consensus).
- Autotitrating positive airway pressure can be considered in CPAP-intolerant patients (Consensus).
Treatment with oral appliances (OA) is indicated for "patients with mild to moderate OSA, who prefer OAs to CPAP, or who do not respond to CPAP, or are not appropriate candidates for CPAP, or who fail CPAP ... (Guideline)."

- Mandibular repositioning appliance covers the upper and lower teeth.
- Tongue-retaining device holds the tongue in a forward position.

The AASM (2019) published a clinical practice guideline on the treatment of OSA with positive airway pressure (PAP) that was based on a systematic review of the evidence.10,11. "A STRONG (ie, "We recommend...") recommendation is one that clinicians should follow under most circumstances. A CONDITIONAL recommendation (ie, "We suggest...") reflects a lower degree of certainty regarding the outcome and appropriateness of the patient-care strategy for all patients."

The AASM provided strong recommendations for the following use of PAP therapy in adults:

- Use of PAP to treat OSA in adults with excessive sleepiness.
- That PAP therapy be initiated at home using APAP or in-laboratory PAP titration in adults with no significant morbidities.
- Use of CPAP or APAP for ongoing treatment of OSA.
- That clinicians provide educational interventions with the initiation of PAP.

The AASM provided conditional recommendations (suggest) for the following use of PAP therapy in adults:

- Use of PAP to treat OSA in adults with impaired sleep-related quality of life.
- Use of PAP to treat OSA in adults with comorbid hypertension.
- Use CPAP or APAP over BPAP in the routine treatment of OSA.
- That behavioral and/or troubleshooting interventions be given during the initial period of PAP therapy.
- That clinicians use telemonitoring during the initial period of PAP therapy.

The AASM and the American Academy of Dental Sleep Medicine (2015) published guidelines on the treatment of OSA and snoring with oral appliance therapy.23. The two societies provided a recommendation of "standard" that sleep physicians consider prescription of oral appliance, rather than no treatment, for adults with OSA who are intolerant of CPAP therapy or prefer alternative therapy. The quality of evidence was rated as moderate. "Guideline" recommendations were provided for the use of custom, titratable appliance over noncustom oral devices, that qualified dentists provide oversight, that sleep physicians conduct follow-up sleep testing to improve or confirm treatment efficacy, and that patients return for periodic office visits with a qualified dentist and a sleep physician.

The AASM (2011) published evidence-based guidelines on respiratory indications for PSG in children.34. "Standard" recommendations were made for the following: PSG in children should be performed and interpreted in accordance with the AASM Manual for the Scoring of Sleep and Associated Events; PSG is indicated when the clinical assessment suggested the diagnosis of OSA in children; children with mild
OSA preoperatively should have clinical evaluation following adenotonsillectomy to assess for residual symptoms. If there are residual symptoms of OSA, PSG should be performed; PSG was indicated following adenotonsillectomy to assess for residual OSA in children with preoperative evidence for moderate-to-severe OSA, obesity, craniofacial anomalies that obstruct the upper airway, and neurologic disorders; PSG was indicated for positive airway pressure titration in children with OSA.

The AASM (2017) published a position statement on the clinical use of a home sleep apnea test. The AASM indicated that a home sleep apnea test should be ordered by a physician after "a face-to-face examination" to diagnose OSA or evaluate treatment efficacy and should not be used for general screening of asymptomatic populations. The AASM supported the review of raw data and interpretation by a physician board-certified in sleep medicine, stating that automatically scored data "could lead to sub-optimal care that jeopardizes patient health and safety".

American Academy of Pediatrics
The American Academy of Pediatrics (AAP; 2012) published guidelines on the diagnosis and management of uncomplicated childhood OSA associated with adenotonsillar hypertrophy and/or obesity in an otherwise healthy child treated in the primary care setting, which updated the AAP's 2002 guidelines. AAP recommended that all children or adolescents be screened for snoring, and PSG is performed in children or adolescents with snoring and symptoms or signs of OSA as listed in the guideline. If PSG is not available, an alternative diagnostic test or referral to a specialist may be considered (option). The estimated prevalence rates of OSA in children or adolescents ranged from 1.2% to 5.7%. Adenotonsillectomy was recommended as the first-line treatment for patients with adenotonsillar hypertrophy, and patients should be reassessed clinically postoperatively to determine whether additional treatment is required. High-risk patients should be reevaluated with an objective test or referred to a sleep specialist. CPAP was recommended if adenotonsillectomy was not performed or if OSA persisted postoperatively. Weight loss was recommended in addition to other therapy in patients who are overweight or obese, and intranasal corticosteroids are an option for children with mild OSA in whom adenotonsillectomy is contraindicated or for mild postoperative OSA.

American College of Physicians
The guidelines on the diagnosis of OSA in adults from the American College of Physicians (ACP; 2014) recommended that clinicians target their assessment of OSA to individuals with unexplained daytime sleepiness. The ACP recommended PSG for diagnostic testing in patients suspected of OSA, and portable sleep monitors in patients without serious comorbidities as an alternative to PSG when PSG is not available for diagnostic testing (weak recommendation, moderate-quality evidence). Inconclusive areas of evidence included preoperative screening for OSA, phased testing for the diagnosis of OSA, and the utility of portable monitors for diagnosis OSA in patients with comorbid conditions.
The ACP (2013) guidelines on the management of OSA in adults recommended that all overweight and obese patients diagnosed with OSA be encouraged to lose weight (strong recommendation, low-quality evidence). The ACP recommended CPAP as initial therapy for patients diagnosed with OSA (strong recommendation; moderate-quality evidence), and mandibular advancement devices as an alternative therapy to CPAP for patients diagnosed with OSA who prefer mandibular advancement devices or for those with adverse events associated with CPAP (weak recommendation, low-quality evidence).

**American Academy of Craniofacial Pain**
The American Academy of Craniofacial Pain (2013) published a position paper. It indicated that oral appliance therapy was recognized as an effective therapy for many with primary snoring and mild-to-moderate OSA, as well as those with more severe OSA who cannot tolerate PAP therapies, but that oral appliance therapy has the potential to cause adverse events, including temporomandibular joint pain and dysfunction. The Academy recommended that dentists engaged in, or who want to engage in, the assessment and management of patients with snoring and OSA using mandibular advancement OA be properly trained and experienced in the assessment, diagnosis, and management of temporomandibular joint and craniofacial pain.

**American Society of Metabolic and Bariatric Surgery**
The American Society of Metabolic and Bariatric Surgery (2012) published guidelines on the perioperative management of OSA (reviewed in October 2015). The guidelines noted that while some reports in the literature have recommended routine screening for OSA prior to bariatric surgery, other reports have suggested clinical screening only does not result in any increase in postoperative pulmonary complications after laparoscopic Roux-en-Y gastric bypass, and that most current surgical practices refer patients with clinical symptoms of OSA for PSG, but do not make this a routine preoperative test prior to bariatric surgery. The Society provided, based on the evidence in the literature to date, the following guidelines on OSA in the bariatric surgery patient and its perioperative management:

1. "OSA is highly prevalent in the bariatric patient population...."  
2. "Patients with moderate to severe OSA] should bring their CPAP machines, or at least their masks, with them at the time of surgery and use them following bariatric surgery at the discretion of the surgeon."

3. "Routine pulse oximetry or capnography for postoperative monitoring of patients with OSA after bariatric surgery should be utilized, but the majority of these patients do not routinely require an ICU [intensive care unit] setting."

4. "No clear guidelines exist upon which to base recommendations for retesting for OSA following bariatric surgery...."
American Academy of Otolaryngology-Head and Neck Surgery
The American Academy of Otolaryngology-Head and Neck Surgery (2011) published guidelines on PSG for sleep-disordered breathing prior to tonsillectomy in children, which included the following42:

1. "Before determining the need for tonsillectomy, the clinician should refer children with SDB [sleep-disordered breathing] for PSG if they exhibit the following: obesity, Down syndrome, craniofacial abnormalities, neuromuscular disorders, sickle cell disease, or mucopolysaccharidoses.
2. The clinician should advocate for PSG prior to tonsillectomy for SDB in children without any of the comorbidities [listed above] for whom the need for surgery is uncertain or when there is discordance between tonsillar size of physical examination and the reported severity of SDB.
3. Clinicians should communicate PSG results to the anesthesiologist prior to the induction of anesthesia for tonsillectomy in a child with SDB.
4. Clinicians should admit children with OSA documented on PSG for inpatient, overnight monitoring after tonsillectomy if they are younger than age 3 years or have severe OSA (apnea-hypopnea index of 10 or more obstructive events/hour, oxygen saturation nadir less than 80%, or both).
5. In children for whom PSG is indicated to assess SDB prior to tonsillectomy, clinicians should obtain laboratory-based PSG, when available."

American Thoracic Society
The American Thoracic Society (2016) published a statement on the long-term effects and treatment of mild OSA in adults.43 The Society's systematic review concluded:

- Daytime sleepiness: subjective improvement with CPAP; unclear effect of non-CPAP therapies
- Quality of life: small improvements seen in different domains in different studies
- Neurocognition: treatment effects inconsistent.

U.S. Preventive Services Task Force Recommendations
The U.S. Preventive Services Task Force (2017) reported on the evidence assessing screening for OSA in adults and concluded that "the current evidence is insufficient to assess the balance and harms of screening for obstructive sleep apnea (OSA) in asymptomatic adults. Evidence on screening tools to accurately detect persons in asymptomatic populations who should receive further testing and treatment of subsequently diagnosed OSA to improve health outcomes is lacking, and the balance of benefits and harms cannot be determined."44,45

Medicare National Coverage
The Centers for Medicare & Medicaid Services (CMS; 2001) published a decision memorandum on CPAP that addressed how to define moderate-to-severe OSA as a guide to a coverage policy for CPAP. This review of the literature suggested there is a risk of hypertension with an AHI greater than 15 events per hour, and thus treatment would be warranted for these patients without any additional signs and symptoms. For patients with an AHI between 5 and 15 events per hour and associated symptoms, CMS concluded that the data from 3 randomized controlled
trials demonstrated improved daytime somnolence and functioning in those treated with CPAP.

The CMS (2008) expanded coverage of CPAP to include those beneficiaries with a diagnosis of OSA made with a combination of clinical evaluation and unattended home sleep monitoring using a device with at least 3 channels.46,47. There is variability in the published medical literature about the definition of the events that constitute a respiratory disturbance, and, for the purposes of this national coverage decision, a respiratory disturbance was defined in the context of the sleep test technology of interest and, for portable monitoring devices that do not measure AHI or Respiratory Disturbance Index (RDI) directly, does not require direct measurement of airflow.

Effective in March 2008, CMS determined that CPAP therapy, when used in adults with OSA, would be considered reasonable and necessary in the following situations:

1. "The use of CPAP is covered under Medicare when used in adult patients with OSA. Coverage of CPAP is initially limited to a 12-week period to identify beneficiaries diagnosed with OSA as subsequently described who benefit from CPAP. CPAP is subsequently covered only for those beneficiaries diagnosed with OSA who benefit from CPAP during this 12-week period.

2. The provider of CPAP must conduct education of the beneficiary prior to the use of the CPAP device to ensure that the beneficiary has been educated in the proper use of the device. A caregiver, for example, a family member, may be compensatory, if consistently available in the beneficiary's home and willing and able to safely operate the CPAP device.

3. A positive diagnosis of OSA for the coverage of CPAP must include clinical evaluation and a positive:
   
   a. attended PSG performed in a sleep laboratory; or
   b. unattended HST [home sleep test] with a Type II home sleep monitoring device; or
   c. unattended HST with a Type III home sleep monitoring device; or
   d. unattended HST with a Type IV home sleep monitoring device that measures at least 3 channels.

4. The sleep test must have been previously ordered by the beneficiary's treating physician and furnished under appropriate physician supervision.

5. An initial 12-week period of CPAP is covered in adult patients with OSA if either of the following criteria using the AHI or RDI are met:
   
   a. AHI or RDI greater than or equal to 15 events per hour, or
   b. AHI or RDI greater than or equal to 5 events and less than or equal to 14 events per hour with documented symptoms of excessive daytime sleepiness, impaired cognition, mood disorders or insomnia, or documented hypertension, ischemic heart disease, or history of stroke.

6. The AHI or RDI is calculated on the average number of events of per hour. If the AHI or RDI is calculated based on less than 2 hours of continuous recorded sleep, the total number of recorded events to calculate the AHI or RDI during sleep testing must be at minimum the number of events that would have been required in a 2-hour period.
7. Apnea is defined as a cessation of airflow for at least 10 seconds. Hypopnea is defined as an abnormal respiratory event lasting at least 10 seconds with at least a 30% reduction in thoracoabdominal movement or airflow as compared to baseline and with at least a 4% oxygen desaturation.

8. Coverage with Evidence Development (CED): Medicare provides the following limited coverage for CPAP in adult beneficiaries who do not qualify for CPAP coverage based on criteria 1-7 above. A clinical study seeking Medicare payment for CPAP provided to a beneficiary who is an enrolled subject in that study must address one or more of the following questions:
   a. In Medicare aged subjects with clinically identified risk factors for OSA, how does the diagnostic accuracy of a clinical trial of CPAP compare with PSG and Types II, III & IV HST in identifying subjects with OSA who will respond to CPAP?
   b. In Medicare aged subjects with clinically identified risk factors for OSA who have not undergone confirmatory testing with PSG or Types II, III & IV HST, does CPAP cause clinically meaningful harm?

In March 2009, CMS issued a national coverage decision (CAG-00405N) for the types of sleep testing devices that would be approved for coverage. CMS found that the evidence was sufficient to determine that the results of the sleep tests identified below can be used by a beneficiary’s treating physician to diagnose OSA:

1. "Type I PSG is covered when used to aid the diagnosis of OSA in beneficiaries who have clinical signs and symptoms indicative of OSA if performed attended in a sleep lab facility.
2. A Type II or Type III sleep testing device is covered when used to aid the diagnosis of OSA in beneficiaries who have clinical signs and symptoms indicative of OSA if performed unattended in or out of a sleep lab facility, or attended in a sleep lab facility.
3. A type IV sleep testing device measuring three or more channels, one of which is airflow, is covered when used to aid the diagnosis of OSA in beneficiaries who have signs and symptoms indicative of OSA if performed unattended in or out of a sleep lab facility, or attended in a sleep lab facility.
4. Sleep testing devices measuring three or more channels that include actigraphy, oximetry, and peripheral arterial tone, are covered when used to aid the diagnosis of OSA in beneficiaries who have signs and symptoms indicative of OSA if performed unattended in or out of a sleep lab facility, or attended in a sleep lab facility."

**Ongoing and Unpublished Clinical Trials**
A search of ClinicalTrials.gov in May 2019 identified over 200 studies on diagnosis and medical management of OSA.

REFERENCES


Billing Coding/Physician Documentation Information

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>94660</td>
<td>Continuous positive airway pressure ventilation (CPAP), initiation and management</td>
</tr>
<tr>
<td>94762</td>
<td>Noninvasive ear or pulse oximetry for oxygen saturation; by continuous overnight monitoring (separate procedure)</td>
</tr>
<tr>
<td>95800</td>
<td>Sleep study, unattended, simultaneous recording; heart rate, oxygen saturation, respiratory analysis (e.g., by airflow or peripheral arterial tone), and sleep time</td>
</tr>
<tr>
<td>95801</td>
<td>Sleep study, unattended, simultaneous recording; minimum of heart rate, oxygen saturation, and respiratory analysis (e.g., by airflow or peripheral arterial tone)</td>
</tr>
<tr>
<td>95805</td>
<td>Multiple sleep latency or maintenance of wakefulness testing, recording, analysis and interpretation of physiological measurements of sleep during multiple trials to assess sleepiness</td>
</tr>
</tbody>
</table>
| 95806  | Sleep study, unattended, simultaneous recording of, heart rate, oxygen saturation, respiratory airflow, and respiratory effort (eg,
Thoracoabdominal movement

95807  Sleep study, simultaneous recording of ventilation, respiratory effort, ECG or heart rate, and oxygen saturation, attended by a technologist

95808  Polysomnography; any age, sleep staging with 1-3 additional parameters of sleep, attended by a technologist

95810  Polysomnography; age 6 years or older, sleep staging with 4 or more additional parameters of sleep, attended by a technologist

95811  Polysomnography; age 6 years or older, sleep staging with 4 or more additional parameters of sleep, with initiation of continuous positive airway pressure therapy or bilevel ventilation, attended by a technologist

95782  Polysomnography; younger than 6 years, sleep staging with 4 or more additional parameters of sleep, attended by a technologist

95783  Polysomnography; younger than 6 years, sleep staging with 4 or more additional parameters of sleep, with initiation of continuous positive airway pressure therapy or bilevel ventilation, attended by a technologist

A7027  Combination oral/nasal mask, used with continuous positive airway pressure device, each

A7028  Oral cushion for combination oral/nasal mask, replacement only, each

A7029  Nasal pillows for combination oral/nasal mask, replacement only, pair

A7034  Nasal interface (mask or cannula type) used with positive airway pressure device, with or without head strap

A7035  Headgear used with positive airway pressure device

A7036  Chinstrap used with positive airway pressure device

A7037  Tubing used with positive airway pressure device

A7038  Filter, disposable, used with positive airway pressure device

A7039  Filter, non disposable, used with positive airway pressure device

A7047  Oral interface used with respiratory suction pump, each

E0470  Respiratory assist device, bi-level pressure capability, without backup rate feature, used with noninvasive interface, e.g., nasal or facial mask (intermittent assist device with continuous positive airway pressure device)

E0471  Respiratory assist device, bi-level pressure capability, with back-up rate feature, used with noninvasive interface, e.g., nasal or facial mask (intermittent assist device with continuous positive airway pressure device)

E0472  Respiratory assist device, bi-level pressure capability, with backup rate feature, used with invasive interface, e.g., tracheostomy tube (intermittent assist device with continuous positive airway pressure device)

E0485  Oral device/appliance used to reduce upper airway collapsibility, adjustable or non-adjustable, prefabricated, includes fitting and adjustment

E0486  Oral device/appliance used to reduce upper airway collapsibility, adjustable or non-adjustable, custom fabricated, includes fitting and adjustment

E0561  Humidifier, non-heated, used with positive airway pressure device

E0562  Humidifier, heated, used with positive airway pressure device

E0601  Continuous airway pressure (cpap) device
Home sleep study test (HST) with type II portable monitor, unattended;
minimum of 7 channels: EEG, EOG, EMG, ECG/heart rate, airflow,
respiratory effort and oxygen saturation

Home sleep test (HST) with type III portable monitor, unattended;
minimum of 4 channels: 2 respiratory movement/airflow, 1 ECG/heart
rate and 1 oxygen saturation

Home sleep test (HST) with type IV portable monitor, unattended;
minimum of 3 channels

ICD-10 Codes
R06.81 Apnea, not elsewhere classified elsewhere
R40.0 Somnolence
G47.30 Sleep apnea, unspecified
G47.33 Obstructive sleep apnea (adult) (pediatric)
G47.8 Other sleep disorders
G47.9 Sleep disorder unspecified

Category III codes (0203T and 0204T) were replaced by category I
codes (95800 and 95801) effective January 1, 2011.

Additional Policy Key Words
Watch PAT is based on actigraphy, please refer to policy 2.01.73.
Winx Sleep Therapy System

Policy Implementation/Update Information
1/1/06 New policy added to Medical and Durable Medical Equipment
sections. This policy combines the previous two policies titled: Diagnostic Sleep
Studies and Continuous Positive Airway Pressure CPAP, BiPAP, and
AUTO CPAP
1/1/07 Policy statement revised to include atrial pacing as investigational.
1/1/08 No policy statement changes.
10/1/08 Interim change, updated coding.
1/1/09 No policy statement changes.
5/1/09 Policy statements clarified and revised; portable monitoring may be
medically necessary under specified conditions
1/1/10 New Category III codes added. No policy statement changes.
1/1/11 Atrial pacing policy statement removed as it is beyond the scope of the
current policy, other policy statements unchanged. Coding updated.
1/1/12 Policy statements revised to add criteria for oral appliances; policy
statement added for repeated unattended (unsupervised) home sleep
studies; definition of AHI for pediatrics was added; added policy
statement regarding the use of unattended sleep studies for pediatrics
(considered investigational).
1/1/13 Criteria for oral appliances clarified; nasal expiratory positive airway
pressure (EPAP) added as investigational
1/1/14 Oral pressure therapy added as investigational; clarification of a single
night for a home sleep study; clarification of adult patients in the
statement on oral appliances; PAP-NAP studies considered investigational; telemonitored home sleep studies addressed in Considerations section.

1/1/15 Added CPT 94762. Added "Supervised or unattended home sleep studies that do not meet the above criteria are not medically necessary", removed "Unattended home sleep studies are considered investigational in children (younger than 18 years of age)", removed "syndrome except to exclude or confirm narcolepsy in the diagnostic workup of OSAS" from investigative section, statement added that screening of bariatric surgery patients may be medically necessary. Updated and added generously to medically necessary statement on Supervised polysomnography performed in a sleep laboratory. Updated medically necessary statement regarding single unattended home sleep study. Removed medically necessary statement regarding repeat supervised polysomnography in a sleep laboratory. Medically necessary statement regarding APAP, removed 2 week trial portion. Also added screening of bariatric surgery patients may be medically necessary; revised criteria for home sleep studies and in laboratory polysomnography. 

4/1/15 No policy statement changes. Considerations section updated with coding clarification.

1/1/16 Policy statements on parasomnias and sleep-related movement disorders revised for consistency with separate policy on polysomnography for non-respiratory sleep disorders.

1/1/17 No policy statement changes.

8/1/17 Investigational statement added on palate expansion devices.

1/1/18 No policy statement changes.

9/1/18 Policy statements clarified that sleep studies may report the Respiratory Disturbance Index or Respiratory Event Index. Criteria for changes in weight or changes in symptoms were removed from the policy statement on in-laboratory polysomnography and added to the statement on auto-adjusting positive airway pressure. Clinically significant OSA was defined.

1/1/19 No policy statement changes.

8/1/19 Terminology changed from home sleep study to home sleep apnea test. Devices that include a minimum of the following 3 sensors: nasal pressure, chest and abdominal respiratory inductance plethysmography, and oximetry; or alternatively peripheral arterial tone with oximetry and actigraphy may be considered adequate for home sleep apnea testing for obstructive sleep apnea. Policy statements revised to include new terminology of home sleep apnea test and clarify that devices include a minimum of 3 sensors.

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