

OSA Diagnosis and Treatment – Part 1

RESP001a

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Description

This is the first in a two-part series of modules which make up a course on obstructive sleep apnea (OSA), a serious breathing disorder characterized by periodic cessation or markedly diminished breathing during sleep. Part 1 explains how OSA is identified and diagnosed. Part 2 will discuss treatment options, comorbid conditions, and consequences if OSA is untreated.

To successfully complete this course, you must attain a minimum score of 80% on the final exam and complete the course training survey.

Chapter 1 – Getting Started

This chapter contains the following page titles:

- About the Authors
- Introduction
- Objectives

About the Authors

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This course was developed from material provided by Philips Respironics.

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Introduction

Obstructive sleep apnea (OSA) is a serious breathing disorder caused by an airway blockage. Hallmark symptoms of OSA include **excessive daytime sleepiness** (EDS) and loud, disruptive snoring. Left untreated, OSA can result in very serious consequences to a person's overall health.

The National Sleep Foundation estimates 50 million to 70 million Americans are affected by sleep disorders. Of that number, 12 million to 25 million people have obstructive sleep apnea. It's difficult to know how many people suffer from the disorder: the American Sleep Apnea Association estimates that approximately 80 percent of cases of moderate to severe OSA go undiagnosed.

Studies have shown that OSA is highly prevalent in adults:

- 1 in 5 adults has at least mild OSA
- 1 in 15 adults has moderate or severe OSA

Objectives

Upon completion of Part 1 of this course, you will be able to:

1. Define obstructive sleep apnea (OSA).
2. Identify the signs and symptoms of OSA.
3. Explain the prevalence of OSA.



4. Explain approaches to diagnostic testing of OSA.

Chapter 2 – Defining and Identifying OSA

This chapter contains the following page titles:

- OSA Defined
- The Flow of Air
- Hallmark Symptoms
- Additional Symptoms
- Clinical Signs
- Craniofacial Abnormality
- Risk Factors
- Demographic Characteristics

OSA Defined

Obstructive sleep apnea, pronounced AP-nee-ah, is a breathing disorder characterized by periodic cessation or markedly diminished breathing during sleep. An airway blockage causes obstructive sleep apnea, or OSA, when muscles relax during sleep and cause soft tissue in the back of the throat to partially or completely collapse and block the upper airway.

This syndrome is defined as five or more **apneas** (complete pauses) or **hypopneas** (partial reductions) per hour of sleep associated with daytime sleepiness. These intermittent periods of airway obstruction during the night result in characteristic symptoms and clinical signs. Sleep apnea is a chronic (ongoing) condition.

The Flow of Air



**Normal
Airway**

On the left is an illustration of a normal airway. Notice the flow of air from the nose through the patent (open) airway.



Now note the obstructed airway on the right. Air entering from the nose and the mouth cannot flow past the obstruction.



**Obstructed
Airway**

Hallmark Symptoms

The most characteristic symptoms of OSA include excessive daytime sleepiness (EDS) unexplained by other factors and two or more of the following:

- Loud, disruptive snoring; often described as snoring louder than normal conversation.
- Nocturnal (nighttime) gasping and choking, often resulting in a resuscitative snorting sound when the apnea is broken.
- Apneas typically witnessed by the bed partner as snoring interrupted by periods of breath-holding or silence.
- The patient feels unrefreshed and sleepy during the day even though they complain of sleeping a lot; this disorder is defined as EDS.
- The patient may complain of intellectual deterioration that presents as a lack of concentration, poor judgment, or forgetfulness.
- In severe cases, the patient experiences a frequent overwhelming desire to sleep while talking, eating, or driving; however, the patient may only complain of general fatigue.

Additional Symptoms

In addition to hallmark symptoms, a person with OSA may present with additional symptoms:

- Unexplained chest pain during sleep that awakens them.
- Memory loss; often mistakenly attributed to aging as the majority of sleep apnea patients are middle aged.
- Personality changes including irritability, depression, grumpiness, or impatience.
- Morning headaches that are typically frontal and end by midday.



- Impotence and decreased sexual drive.
- Nocturia (frequent nighttime urination) and enuresis (bedwetting); typically seen in children.
- Falling asleep while watching TV, reading, or working.
- Feeling sleepy — or falling asleep — while driving.

Clinical Signs

Clinical signs of OSA include **hypoxemia** (low concentration of oxygen in the blood) and **hypercapnia** (excessive carbon dioxide in the blood); this is initially seen nocturnally in a cyclical pattern but can progress to daytime in severe sleep apnea.

Cardiac arrhythmias can also be present, ranging from premature **atrial** contractions to third-degree heart block, and runs of ventricular **tachycardia**. A typical nocturnal (nighttime) cardiac pattern for an OSA sufferer will include tachycardia during the snoring periods and **bradycardia** during the apneic periods.

Hypertension has been found in greater than 50 percent of patients with obstructive sleep apnea, according to a 2004 report.

Craniofacial Abnormality

Anatomical factors can contribute to OSA. A small airway — due to an abnormal amount of pharyngeal tissue, a large tongue, large tonsils, or nasal obstruction such as a deviated septum — places the patient at risk for sleep apnea.

A disproportionate anatomy such as **retrognathia** and **micrognathia** should alert you to the potential for OSA.

Risk Factors

Risk factors for OSA include the following:

- 50 percent of individuals with OSA are overweight or obese (body mass index greater than 25 for overweight, greater than 30 for obese).
- Getting older — men 40 and older, women 50 and older.
- Family history of OSA.



- OSA is more common in people with thick necks (greater than 17 inches in men, greater than 16 inches in women).
- OSA is more common in people with small airways through their nose, throat, or mouth.
- People with excess soft tissue at the back of the throat or a larger than average tongue are more likely to develop OSA.
- Smoking increases the risk for sleep apnea.

Demographic Characteristics

OSA affects all races, ages, and socio-economic groups. According to the American Lung Association:

- About twice as many men as women suffer from OSA.
- 1 in 25 middle-aged men has OSA compared to 1 in 50 middle-aged women.
- Age increases the chance of developing OSA to 1 in 10 people over the age of 65.
- African Americans, Hispanics, and Pacific Islanders are more likely to develop sleep apnea than non-Hispanic whites.

Chapter 3 – Diagnosing OSA

This chapter contains the following page titles:

- Screening Questionnaires
- Epworth Sleepiness Scale
- Berlin Questionnaire
- Physical Exam
- Questions to Identify OSA
- Diagnostic Testing
- Polysomnography
- Polysomnography Parameters
- Multi-Channel All-Night Polysomnogram
- REM Sleep and OSA
- Home Sleep Study
- HST or In-Lab Polysomnography?



Screening Questionnaires

While taking a patient's medical history, two simple questions should always be asked:

- "Do you snore and/or stop breathing during sleep?"
- "Are you sleepy during the day?"

These questions are not typically in a medical questionnaire, but a "yes" is the first step in identifying OSA.

There are several questionnaires that can be used to begin to identify OSA.

Epworth Sleepiness Scale

Epworth Sleepiness Scale

Name: _____ Today's date: _____
Your age (Yr): _____ Your sex (Male = M, Female = F): _____

How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired?
This refers to your usual way of life in recent times.
Even if you haven't done some of these things recently try to work out how they would have affected you.
Use the following scale to choose the most appropriate number for each situation.

0 = would never doze
1 = slight chance of dozing
2 = moderate chance of dozing
3 = high chance of dozing

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

Situation	Chance of Dozing (0-3)
Sitting and reading	_____
Watching TV	_____
Sitting, inactive in a public place (e.g. a theatre or a meeting)	_____
As a passenger in a car for an hour without a break	_____
Lying down to rest in the afternoon when circumstances permit	_____
Sitting and talking to someone	_____
Sitting quietly after a lunch without alcohol	_____
In a car, while stopped for a few minutes in the traffic	_____

THANK YOU FOR YOUR COOPERATION

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The **Epworth Sleepiness Scale** (ESS) is a self-administered, eight-item questionnaire used as a simple method for measuring daytime sleepiness in adults. The scoring range is 0 (would never doze) to 3 (high chance of dozing) for each situation. These situations include watching TV, sitting and reading, and in a car while stopped for a few minutes in traffic.

This test allows the identification of moderate to severe daytime sleepiness, which is associated with the presence of OSA. However, patients with OSA may score within the normal range, and the ESS does not identify the cause of sleepiness.

(Image of 1997 Version of ESS from The Official website of the Epworth Sleepiness Scale, epworthsleepinessscale.com)



Berlin Questionnaire

BERLIN QUESTIONNAIRE

Height (m) _____ Weight (kg) _____ Age _____ Male / Female _____

Please choose the correct response to each question.

<p>CATEGORY 1</p> <p>1. Do you snore?</p> <p><input type="checkbox"/> a. Yes</p> <p><input type="checkbox"/> b. No</p> <p><input type="checkbox"/> c. Don't know</p> <p><i>If you snore:</i></p> <p>2. Your snoring is:</p> <p><input type="checkbox"/> a. Slightly louder than breathing</p> <p><input type="checkbox"/> b. As loud as talking</p> <p><input type="checkbox"/> c. Louder than talking</p> <p><input type="checkbox"/> d. Very loud – can be heard in adjacent rooms</p> <p>3. How often do you snore?</p> <p><input type="checkbox"/> a. Nearly every day</p> <p><input type="checkbox"/> b. 3-4 times a week</p> <p><input type="checkbox"/> c. 1-2 times a week</p> <p><input type="checkbox"/> d. 1-2 times a month</p> <p><input type="checkbox"/> e. Never or nearly never</p> <p>4. Has your snoring ever bothered other people?</p> <p><input type="checkbox"/> a. Yes</p> <p><input type="checkbox"/> b. No</p> <p><input type="checkbox"/> c. Don't know</p> <p>5. Has anyone noticed that you quit breathing during your sleep?</p> <p><input type="checkbox"/> a. Nearly every day</p> <p><input type="checkbox"/> b. 3-4 times a week</p> <p><input type="checkbox"/> c. 1-2 times a week</p> <p><input type="checkbox"/> d. 1-2 times a month</p> <p><input type="checkbox"/> e. Never or nearly never</p>	<p>CATEGORY 2</p> <p>6. How often do you feel tired or fatigued after your sleep?</p> <p><input type="checkbox"/> a. Nearly every day</p> <p><input type="checkbox"/> b. 3-4 times a week</p> <p><input type="checkbox"/> c. 1-2 times a week</p> <p><input type="checkbox"/> d. 1-2 times a month</p> <p><input type="checkbox"/> e. Never or nearly never</p> <p>7. During your waking time, do you feel tired, fatigued or not up to par?</p> <p><input type="checkbox"/> a. Nearly every day</p> <p><input type="checkbox"/> b. 3-4 times a week</p> <p><input type="checkbox"/> c. 1-2 times a week</p> <p><input type="checkbox"/> d. 1-2 times a month</p> <p><input type="checkbox"/> e. Never or nearly never</p> <p>8. Have you ever nodded off or fallen asleep while driving a vehicle?</p> <p><input type="checkbox"/> a. Yes</p> <p><input type="checkbox"/> b. No</p> <p><i>If yes:</i></p> <p>9. How often does this occur?</p> <p><input type="checkbox"/> a. Nearly every day</p> <p><input type="checkbox"/> b. 3-4 times a week</p> <p><input type="checkbox"/> c. 1-2 times a week</p> <p><input type="checkbox"/> d. 1-2 times a month</p> <p><input type="checkbox"/> e. Never or nearly never</p> <p>CATEGORY 3</p> <p>10. Do you have high blood pressure?</p> <p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> No</p> <p><input type="checkbox"/> Don't know</p>
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The **Berlin Questionnaire** is a simple and easy-to-use screening tool to help physicians identify patients at risk for OSA. The questionnaire identifies specific signs and symptoms of OSA. To predict if a patient would benefit from the diagnostic procedure, this questionnaire evaluates factors, e.g., snoring frequency and volume and/or BMI greater than 30.

The questionnaire takes a short amount of time to administer; physician support staff can easily administer and score this questionnaire. This allows the physician to quickly evaluate the results and use their time to focus on patients with positive symptoms of OSA.

(Image of Berlin Questionnaire from American Sleep Apnea Association, sleepapnea.org).

Physical Exam

A physical exam performed by a physician is essential to OSA diagnosis. This exam should include a general medical examination and sleep history. The history questions should ask about sleep and sleepiness or fatigue that occurs during the day, which indicate a sleep problem. Patients with certain conditions or physical characteristics should be considered for sleep apnea screening. These include:

- Complaints of fatigue or unrefreshing sleep
- Newly diagnosed, resistant, or refractory hypertension
- **Congestive heart failure** (CHF) with nighttime chest pain or cardiovascular disease
- Bariatric patients
- Large neck circumference — greater than 17 inches in men, greater than 16 inches in women
- Small jaw
- Diabetes



Questions to Identify OSA

A physician can ask these common questions to help to identify OSA:

- Do you fall asleep easily while watching TV, reading, or at other times when you do not intend to fall asleep?
- How often do you wake feeling unrefreshed?
- Is your snoring louder than your talking?
- Has your snoring or nighttime breathing bothered other people?
- Does anything unusual happen at night while you sleep?

Diagnostic Testing

Once OSA is suspected, a physician will prescribe a sleep study. A **polysomnography** (PSG), also called a sleep study, is a test commonly used to diagnose sleep disorders including OSA. Standard polysomnography is performed in a sleep center by a trained polysomnographic technologist. **Polysomnogram** refers to the test results. Polysomnography typically measures brain wave activity, eye movement, leg activity, respiratory pattern, airflow, chest and abdomen movement, oxygen saturation, and **electrocardiogram** (EKG). Newer than in-lab polysomnogram is the at-home sleep study. These will be discussed later in the chapter.

There are approximately 2,500 sleep centers in the United States that have achieved the American Academy of Sleep Medicine accreditation. Proper patient selection and trained sleep medicine professionals are critical factors for the success of portable testing for OSA.



Polysomnography

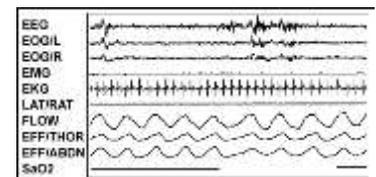
The patient is typically studied for one full night to confirm the diagnosis of OSA using polysomnography. If the diagnosis is made, the patient is also studied the following night to determine treatment. However, some sleep centers can perform the diagnostic and treatment studies all in one night. One-night testing may be done if the patient meets specific criteria that indicate the presence of OSA early enough in the night's study to allow enough time for appropriate treatment to be tried.

The physiologic parameters noted while monitoring determine the type and severity of the sleep disorder and the effects of treatment.

Polysomnography Parameters

Let's look at what is recorded during a sleep study.

The readout (tracing) to the right represents non-REM sleep. The first line (channel) in this tracking is the **electroencephalogram (EEG)**. These brain wave signals are used to identify sleep stages and wakefulness. The EEG also identifies sleep fragmentation, which is referred to as **arousals**. Arousals from sleep directly affect an OSA patient's daytime alertness and function.



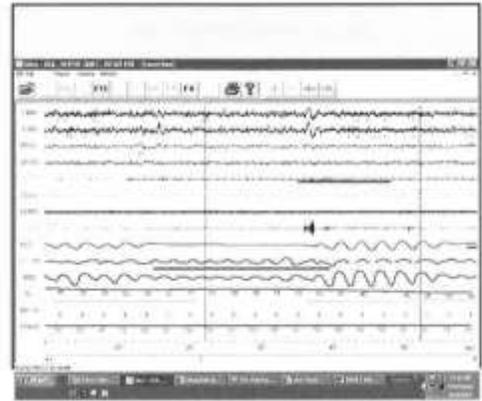
The **electrooculogram (EOG)** records eye movements to identify sleep onset and REM sleep or non-REM sleep.

Another parameter is the **electromyogram (EMG)**. The EMG measures muscle activity, often in the chin or in the legs during sleep. The chin EMG helps identify sleep onset and REM sleep. The leg EMG (LAT/RAT channels) assists in diagnosing a sleep disorder called **periodic limb movement during sleep (PLMS)**.



Multi-Channel All-Night Polysomnogram

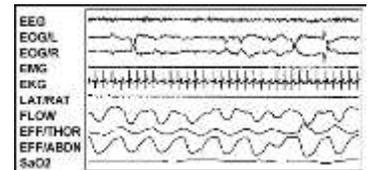
This graphic demonstrates a page from a standard multi-channel all-night polysomnogram. The sleep stage is determined using EEG, EOG, and EMG. The lower series of channels measures respiratory parameters and are used to detect sleep apnea. These channels represent nasal-oral airflow, chest and abdominal wall motion, and arterial oxygen saturation. Additional parameters measured can include EKG and leg movement. Such a recording allows for careful assessment of all desired variables over the course of an entire night, providing a relatively complete picture of events that occur during sleep.



REM Sleep and OSA

Apnea and oxygen desaturation typically will be most severe during REM sleep, especially when the patient is in the supine position.

The tracing to the right represents REM sleep, often referred to as the dreaming state. Note the rapid eye movements on the EOG channel. A typical person will experience REM sleep approximately every 90 minutes, five to six times during seven to nine hours of sleep. Breathing will be compromised during REM sleep due to a decrease in muscle tone of the upper airway and large muscles.



Home Sleep Testing

The **Home Sleep Test (HST)** has become more popular in the diagnosis of pure OSA. HST is designed to be a convenient and efficient way to collect information about a person's sleep when there is a high probability of moderate to severe OSA and there are no comorbid conditions.

Centers for Medicare & Medicaid Services (CMS) first reviewed HST as an option for diagnosing OSA in 1989; coverage for HST under certain conditions was approved in 2008.

There are both advantages and disadvantages to using HST.

Advantages:



- It is less costly — up to one-fourth the cost of in-lab polysomnography.
- Testing is performed in the patient's home.
- It is a good diagnostic tool for uncomplicated OSA.

Disadvantages:

- If a sensor falls off no one will know.
- HST does not measure EEG to positively capture when a patient is in REM sleep.
- Usage is limited to OSA that is not complicated by comorbidities.

HST or In-Lab Polysomnography?

There are circumstances when a physician may recommend HST. These include when the physician believes it is highly likely that the patient has moderate to severe OSA and no significant medical conditions, other than OSA, are known or suspected.

However, HST is not advised in other situations. In-lab polysomnography should be done in place of HST when a patient does not have a high-risk of OSA, or the physician suspects the patient may have a sleep disorder other than OSA. Patients with comorbid conditions — such as **chronic obstructive pulmonary disease (COPD)**, CHF, or **restless leg syndrome (RLS)** — should be tested in a lab setting. HST is also not advised when a patient has certain medical conditions including neuromuscular disease or history of stroke.

After HST, there may be instances when an in-lab polysomnography still may be necessary. For example:

- HST did not record enough data for a physician to make a diagnosis.
- HST results indicate that the patient does not have OSA and the physician suspects another sleep disorder.



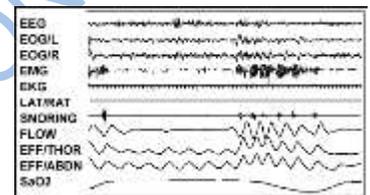
Chapter 4 – Types of Sleep Apnea

This chapter contains the following page titles:

- Obstructive Sleep Apnea
- Central Apnea
- Complex/Mixed Apnea
- Obstructive Hypopnea
- Pathology of OSA

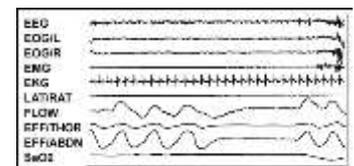
Obstructive Sleep Apnea

OSA is a type of apnea. This is a tracing indicative of OSA. Note the flat line in the airflow channel (FLOW) representing no airflow, with corresponding activity in the thorax and abdomen channels (EFF/THOR and EFF/ABDN) representing the presence of effort in an attempt to breathe. The apnea was interrupted by an EEG arousal and was associated with a corresponding desaturation (SaO₂).



Central Apnea

Central apnea is a type of apnea that is sometimes seen in patients who experience OSA. Central apnea is the cessation of airflow for 10 seconds or longer because there is no effort to breathe.

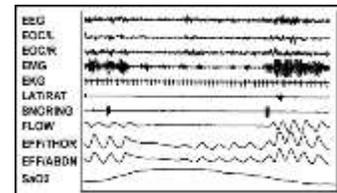


Note the flat line on the airflow channel as well as no activity on the effort channels. The lack of effort and flow results in slight oxygen desaturation. The apnea may be terminated by an arousal from sleep. Pure central apnea without an obstructive component is rare in OSA.



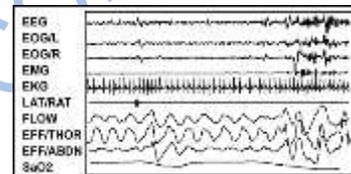
Complex/Mixed Apnea

Complex/mixed apnea is a third type of apnea in which a significant portion of patients who have severe obstructive sleep apnea fail to breath normally after the obstructive defect has been corrected by PAP. By definition, the patient has central apneas (greater than 5/hour) when obstructive events are treated with the appropriate PAP device, and there is not a clear cause for the central apneas.

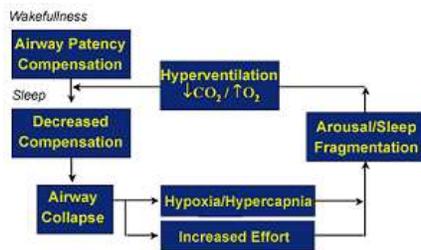


Obstructive Hypopnea

This is an example of an **obstructive hypopnea**, a type of apnea which can be identified by the reduction of airflow with respiratory effort present, followed by a significant desaturation. An arousal from sleep ends the hypopnea. Obstructive hypopneas merit the same treatment as apneas.



Pathology of OSA



This flow chart depicts the pathology of OSA.

During wakefulness, the dilator muscles maintain the upper airway wide open. With sleep onset, this compensatory mechanism is decreased, which may contribute to airway narrowing or collapse. The collapse can occur in the

velopharynx, which is behind the uvula and soft palate, or in the **hypopharynx**, behind the tongue.

The resulting reduced or absent airflow will cause hypercapnia and hypoxia. These blood gas changes stimulate the patient to breathe by increasing the patient's breathing effort against the collapsed airway. The increased effort arouses the patient from sleep and causes sleep fragmentation.



With arousal from sleep, the patient will hyperventilate to increase oxygenation and decrease carbon dioxide levels. As the patient's blood gas returns to normal, the patient will fall back to a deeper stage of sleep — and the OSA cycle will begin again.

This pattern may be repeated numerous times during the night, leading to the symptoms and clinical signs that the OSA patient experiences.

Chapter 5 – Measures of Sleep Apnea Frequency

This chapter contains the following page titles:

- Measures of Sleep Apnea Frequency
- Apnea-Hypopnea Index
- Classification of OSA by CMS

Measures of Sleep Apnea Frequency

The most commonly used terms to describe the frequency of sleep apnea are **Apnea Index**, **Apnea-Hypopnea Index (AHI)**, and **Respiratory Disturbance Index (RDI)**.

The Apnea Index is defined as the number of apneas, obstructive apneas, and central apneas per hour of sleep. The **Hypopnea Index** represents the reduction in patient flow per hour of sleep and number of central or obstructive hypopneas per hour of sleep. The number of sleep disruptions — arousals — per hour of sleep, observed in EEG activity during a sleep study is the **Arousal Index (AI)**. This is associated with apnea, hypopnea, and desaturation events and with other events such as periodic limb movement disorder or seizure.

Apnea-Hypopnea Index

More relevant to the presence of sleep apnea is the AHI. This index identifies the number of apneas and hypopneas per hour of sleep. This is also called the RDI. AHI and RDI are terms often used interchangeably. However, CMS differentiates between the two: "The AHI is equal to the average number of episodes of apnea and hypopnea per hour. The RDI is equal to the average number of respiratory disturbances per hour."



In sleep labs, sleep technologists are looking for the presence of these respiratory events and quantifying them by establishing the AHI. The AHI is used to quantify the severity of sleep apnea and to help determine proper treatment options.

An AHI of fewer than 5 is considered normal. What frequency above 5 requires therapy or leads to adverse clinical consequences is controversial. Sleep apnea syndrome — clinical sleep apnea — is defined as recurrent apneas or hypopneas that are associated with clinical impairments such as daytime sleepiness, motor vehicle accidents, or cardiovascular disease.

- Mild OSA: AHI of 5-15 with excessive daytime sleepiness
- Moderate OSA: AHI of 15-30 with excessive daytime sleepiness
- Severe OSA: AHI of more than 30 with excessive daytime sleepiness

Classification of OSA by CMS

CMS does not have a specific classification for OSA. Simply put, an individual either has OSA or doesn't. An AHI equal to or greater than 15 qualifies the Medicare patient for treatment.

According to CMS, "A positive test for OSA is established if either of the following criterion using the Apnea-Hypopnea Index (AHI) or Respiratory Disturbance Index (RDI) are met:

- AHI or RDI greater than or equal to 15 events per hour, or
- AHI or RDI greater than or equal to 5 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."



Chapter 6 – Summary

This chapter contains the following page title:

- Summary

Summary

Although OSA is a serious breathing disorder, most people with OSA have not been diagnosed. Obesity, age, and certain physical characteristics are among the risk factors. About twice as many men than women suffer from OSA, and older people are more likely to develop OSA. Common symptoms of OSA include excessive daytime sleepiness and loud, disruptive snoring.

Diagnosis of OSA typically involves a physical exam and screening questionnaires, followed by a sleep study performed in a lab (polysomnography) or at home (home sleep study). The sleep study testing measures the number of apneas (cessation of breathing) and hypopneas (decreased breathing) to determine if a person has OSA and, if so, whether it is mild, moderate, or severe.

Part 2 of this course will discuss treatment options for OSA and consequences of untreated OSA.

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