

Clinical Evaluation of the Sleepy and Sleepless Patient

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REVIEW ARTICLE



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ABSTRACT

OBJECTIVE: This article addresses the approach to the evaluation of patients who present to a neurologist with excessive daytime sleepiness or difficulty sleeping.

LATEST DEVELOPMENTS: Greater emphasis on the importance of sleep reflects the growing scientific understanding that sleep is critical to overall health and well-being. Consumer sleep technologies, which measure parameters related to sleep, may provide insight into an individual's sleep-related symptoms and tendencies and have a role in patient-centered sleep evaluation when used within an appropriate clinical context.

ESSENTIAL POINTS: A thorough review of a patient's history and physical examination findings are important components of the assessment and management of their sleep-related symptoms. An understanding of how the clinical context relates to the categorization of sleep disorders can impact a patient's symptoms, comorbid neurologic disorders, and overall well-being. Many neurologic conditions are strongly associated with sleep disturbance, risk factors for the development of a sleep disorder, or both. Therefore, it is critical for neurologists to be familiar and comfortable with taking a focused sleep history. Modalities such as in-laboratory polysomnography, home sleep apnea testing, multiple sleep latency testing, and actigraphy, as well as contextualized and prudent use of data obtained from consumer sleep technologies, can be helpful in appropriately selected patients. Mindful integration of these objective data facilitates the diagnosis and management of sleep disorders.

INTRODUCTION

Excessive sleepiness and the inability to sleep are commonly encountered neurologic symptoms that may occur in isolation or in combination with one another. These disturbances of wakefulness and sleep may represent a primary sleep-wake disorder, be part of a separate neurologic disease or syndrome, or be a side effect of some other treatment. Identification of the symptom time course (eg, paroxysmal versus progressive, acute versus chronic) and familiarity with the diagnostic categories of sleep disorders provides a framework for differential diagnosis to guide diagnostic and therapeutic care plans.

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KEY POINTS

- Familiarity with the main categories of sleep-wake disorders provides a framework for differential diagnosis to guide diagnostic and therapeutic care plans.
- The evaluation of excessive daytime sleepiness requires direct inquiry about the presence of associated sleep paralysis, sleep-related hallucinations, cataplexy, and disrupted or fragmented sleep.

Diagnostic data may be gathered from several sources including, but not limited to, objective neurophysiologic testing, patient-reported data (eg, sleep diaries, survey instruments), and consumer sleep technologies. These modalities vary in measurement frequency, specificity, and sensitivity. Polysomnography is not required for the diagnosis of every sleep-wake disorder but has a role in the evaluation and longitudinal management of specific disease processes. Other in-laboratory and home-based procedures are supported by evidence-based guidelines for specified sleep-wake disorders. The general population is increasingly collecting data through consumer wearable devices, and neurologists are seeing more patients with these devices, although differences across devices and the proprietary nature of their algorithms make it difficult to develop evidence-based guidelines on the use of each available consumer technology. Consumer sleep technologies enhance patients' engagement with their health and help to better define behavioral and, to a lesser extent, physiologic trends. At present, however, data from consumer sleep technologies cannot be used to confirm the diagnosis of a sleep disorder. Awareness of the strengths and limitations of the multitude of sleep-related data sources is akin to the familiarity that neurologists must also have with other evaluation tools (eg, reflex hammer, tuning fork) used in clinical practice.

SLEEP HISTORY

A detailed sleep history is necessary to place a patient's sleep concerns in context with their neurologic and medical history.

Clinical History

A general framework for obtaining the clinical history, along with an awareness of the six major categories of sleep disorders, informs the clinical approach to each patient.^{1,2} The six major categories of sleep disorders are:

- ◆ Insomnia
- ◆ Sleep-related breathing disorders
- ◆ Central disorders of hypersomnolence
- ◆ Circadian rhythm sleep-wake disorders
- ◆ Parasomnias
- ◆ Sleep-related movement disorders

SLEEP HISTORY. The approach to the sleep history should be consistent for all individuals, whether the chief concern is excessive sleepiness, inability to sleep, or another sleep-related symptom. Additional history from a bed partner, roommate, or caregiver can provide insight about the individual's sleep-related symptoms and behaviors.

Discussion about sleep quality can elucidate characteristics of the sleep disturbance or concern. Questions such as "How would you describe your sleep quality?" or "Do you feel restored from your sleep?" can help identify the primary sleep concern. Assessment of sleep duration and continuity with questions such as "How much sleep do you get in a 24-hour period?" and "Do you awaken frequently during sleep?" provide important historical details. Timing of sleep can be discussed with questions such as "What time do you go to bed?", "How long does it take you to fall asleep?", "What time do you wake up?", and

“What time do you rise (get out of bed) to begin your day?” These historical details establish a framework from which formulation emerges to inform the assessment and differential diagnosis, leading to a specific sleep disorder classification.^{1,2}

The sleep history should also include questions about sleep-disordered breathing (eg, snoring, witnessed apneas, choking or gasping during sleep, morning headaches), symptoms of sleep-related movement disorders (eg, bruxism, restless legs syndrome [RLS]), clinical evidence of parasomnias (eg, sleepwalking, sleep talking, dream enactment behavior), and daytime sequelae. Information about sleeping position and history of nasal or other upper airway surgeries can be pertinent for those with sleep-disordered breathing concerns. Collateral history can provide additional context about the individual's sleep-related routines, behaviors, and symptoms (**CASE 2-1**). As is done with the general neurologic history, the sleep history should include a discussion about prior and current medications, supplements, and behavioral measures taken to alleviate the presenting concerns.

DAYTIME SYMPTOMS. For patients who present with excessive daytime sleepiness, contextual details are critical to gauge the severity and potential safety risks. Specific questions should include driving safety, academic and occupational performance, and interpersonal relationships. Individuals may use a variety of terms such as tiredness, fatigue, lethargy, and sleepiness to describe the symptom that affects their level of daytime alertness and energy level. The evaluation of excessive daytime sleepiness requires direct inquiry about the presence of associated sleep paralysis, sleep-related hallucinations (hypnagogic: at sleep onset; hypnopompic: at sleep offset), cataplexy (transient loss of muscle tone induced by abrupt emotion, such as laughter), and disrupted or fragmented sleep.

Insomnia and, more generally, sleeplessness, are among the most common sleep-related concerns. In the United States, approximately 30% of people

CASE 2-1

A 54-year-old man with a history of obesity and hypertension presented at the insistence of his wife, who noted that he had a long history of snoring and now had observable apneas during sleep. He was unaware of the described symptoms but noted that his sleep quality had worsened with gradual weight gain over the past few years. On further discussion, he endorsed multiple awakenings for nocturia, frequent tossing and turning, and waking with severe morning headaches that resolved within 30 minutes of waking. He felt intermittently sleepy during the day, especially when sitting quietly at his desk, which affected his work performance. He had occasional difficulty staying awake on the commute home when stopped for a prolonged period at a stoplight.

This case exemplifies symptoms suggestive of obstructive sleep apnea and thus merits further diagnostic evaluation with either a home sleep apnea test or in-laboratory polysomnography. The case also illustrates the importance of gathering information from a collateral historian whenever possible in the evaluation of sleep-wake disorders.

COMMENT

report some degree of clinically significant insomnia at some point in their life, and approximately 10% will develop chronic insomnia disorder.¹ The prevalence of insomnia is even higher in individuals with Parkinson disease, multiple sclerosis, or stroke.³ Insomnia can impair quality of life as well as school and work performance. Insomnia can exist as a distinct disorder or may be a symptom of another primary sleep disorder such as obstructive sleep apnea (OSA). Adults are recommended to get at least 7 hours of sleep nightly⁴; less total sleep time on a regular basis may cause chronic partial sleep deprivation that could result in daytime sleepiness. The three-process (3-P) model of chronic insomnia disorder is a conceptual framework introduced by Arthur Spielman and colleagues⁵ that describes the evolution of a patient's insomnia based upon predisposing, precipitating, and perpetuating factors and tendencies.

Insomnia generally manifests in four forms:

- ◆ Difficulty initiating sleep
- ◆ Difficulty maintaining sleep
- ◆ Early morning awakenings
- ◆ Overall poor sleep quality despite adequate time allowed to sleep, which is not otherwise associated with or explained by any medical condition, another primary sleep disorder, or medication or substance use

Critical details about nocturnal awakenings include timing, duration, and presumed causes (eg, ambient noise, need to urinate, pain) of each awakening, and measures taken to fall back asleep after each awakening. This information helps to identify difficulties with sleep initiation, maintenance, or both and provides a general idea of average total sleep time on a regular basis. Discussion about the sleeping environment and sleep-related habits provides useful insight about potential perpetuating factors of the individual's insomnia.

The time course of the current bout of insomnia (ie, acute, subacute, or chronic) and the presence of a personal or family history of insomnia highlights risk factors for insomnia disorder and can guide discussions about potential treatment options and anticipated treatment response.

MEDICAL HISTORY. A review of the patient's medical history identifies comorbid conditions (eg, anxiety, depression, posttraumatic stress disorder) that may influence insomnia and its treatment. Additionally, individuals with neurodegenerative disorders such as Parkinson disease and dementia with Lewy bodies more commonly experience recalcitrant or progressive insomnia.³ Optimization of pain control is central to the management of insomnia associated with chronic pain; collaboration between the neurologist and the patient's other clinicians may be required.

The medical history may help broaden the differential diagnosis and assess the risk for sleep disorders. For instance, hypertension and cardiovascular or neurovascular disease are associated with an increased risk of OSA. A history of heart failure (especially with reduced ejection fraction), atrial fibrillation, and central neurologic disorders such as stroke and multiple sclerosis can each be associated with central sleep apnea. Neuromuscular disorders, especially those associated with respiratory muscle dysfunction, may confer a predisposition

to hypoventilatory disorders. Individuals with known α -synucleinopathy may develop rapid eye movement (REM) sleep behavior disorder (RBD). In addition, RBD may be a prodromal biomarker for later development of α -synucleinopathies (eg, Parkinson disease, dementia with Lewy bodies, multiple system atrophy).¹

MEDICATION USE. A detailed medication history is also important to contextualize the patient's sleep-related symptoms and inform future management decisions. A detailed medication history, including over-the-counter medications and herbal supplements and the time course over which they were used, can yield insight about hypersomnolence and insomnia. For example, many antiseizure medications are associated with some degree of hypersomnolence, especially when first initiated, and particularly in an acute setting. Selective serotonin reuptake inhibitors (SSRIs) and tricyclic antidepressants may contribute to hypersomnolence, RBD, or RLS. Benzodiazepines, dopamine agonists, and opioid analgesics can cause daytime sleepiness, while stimulant medications and corticosteroid medications may increase the risk for insomnia.

SOCIAL AND FAMILY HISTORY. A detailed social history may also elucidate other etiologies of sleep disturbance. Knowledge of the patient's occupation, work hours, and distance and duration of commute informs risk stratification and counseling about the avoidance of drowsy or impaired driving. In fact, some transportation industries include OSA screening as part of standard operating procedures. Discussion about substance use may help identify contributors of hypersomnolence or other sleep disturbances. Nicotine is a stimulant that can increase the likelihood of insomnia in some people.

Assessment of family history is also important in the evaluation of sleep disorders. Non-REM parasomnias of childhood, intrinsic circadian rhythm sleep-wake disorders, narcolepsy, and RLS can have hereditary components. Genetic underpinnings of craniofacial anatomy can influence the likelihood of OSA development. The rare disorder known as fatal familial insomnia also has a genetic influence.

Physical Examination

A focused physical examination can be invaluable in the assessment of sleep disorders. Cardiopulmonary and head and neck examinations are particularly important when evaluating for the possibility of a sleep-related breathing disorder. Individuals with a body mass index greater than or equal to 40 kg/m² and a serum bicarbonate greater than 27 mmol/L are at increased risk of obesity hypoventilation syndrome as well as OSA.⁵ Anatomic risk factors for sleep-related breathing disorders include micrognathia, retrognathia, macroglossia (evidenced by lateral scalloping of the tongue), a high-arched and narrow hard palate, and overjet (horizontal difference between the upper and lower teeth) (**CASE 2-2**). A neck circumference greater than 43 cm (17 in) in men and 38 cm (15 in) in women confers an increased risk of OSA.¹ The Mallampati classification, which was developed to gauge the complexity of intubation and airway management during sedation or anesthesia, describes the patency of the oral airway via visualization of the oral cavity with the tongue protruded and no phonation (**FIGURE 2-1**⁶). Mallampati classes I and II represent greater oral airway patency, with more structures readily visualized. Mallampati classes III and IV

KEY POINTS

- Understanding the 3-P model of insomnia (predisposing, precipitating, and perpetuating factors) is important to both contextualize the patient's sleeplessness and provide a solid foundation for patient education regarding the assessment and care plan.
- The four manifestations of insomnia include difficulty initiating sleep, difficulty maintaining sleep, unintended early morning awakenings, and overall poor sleep quality despite adequate time allowed to sleep.
- Individuals with neurodegenerative disorders such as Parkinson disease and dementia with Lewy bodies more commonly experience recalcitrant or progressive insomnia.
- Non-rapid eye movement (non-REM) parasomnias of childhood, intrinsic circadian rhythm sleep-wake disorders, narcolepsy, and restless legs syndrome can have hereditary components.
- The Mallampati system, developed to assess the complexity of intubation and airway management during sedation or anesthesia, describes various levels of oral airway patency and is used stratify the risk of sleep-disordered breathing.

represent a higher degree of upper airway crowding, which portends an increased risk for obstructive sleep-related breathing disorders such as OSA.

A detailed neurologic examination is important for specific patient populations. Patients with distal polyneuropathy may have comorbid RLS. In the case of RBD, a detailed neurologic examination is necessary to evaluate for signs of neurodegenerative disease (eg, increased tone, rigidity, gait disturbance, bradykinesia, cognitive deficits, frontal release signs).

The physical examination of people with insomnia is frequently unremarkable, although clinicians should remain vigilant for signs of comorbid medical, neurologic, or mental health conditions which might predispose to or precipitate insomnia.

Subjective Rating Scales and Sleep Diaries

The Epworth Sleepiness Scale (**FIGURE 2-2**⁷) is one of the most widely used subjective assessment tools to gauge excessive daytime sleepiness.⁷ This tool assesses tendencies toward sleepiness over the past several weeks by numerically ranking the likelihood of dozing during eight different scenarios. Each scenario is scored between 0 (no likelihood of dozing) and 3 (high likelihood of dozing), with a total score range from 0 to 24. A score above 10 suggests excessive daytime sleepiness in the general adult population.⁸ A pediatric version of this scale includes modifications such as including questions about the tendency to doze while playing video games instead of while driving. The Epworth Sleepiness Scale is useful for following sleepiness (and treatment response) in the same individual over time, but it is not used to compare levels of sleepiness between individuals.⁹

Validated clinical survey instruments such as the Pittsburgh Sleep Quality Index or Insomnia Severity Index may help clarify the features and overall

CASE 2-2

A 45-year-old woman with relapsing-remitting multiple sclerosis and moderate asthma presented with persistent daytime fatigue despite a nightly total sleep time of 8 hours. She was diagnosed with multiple sclerosis 20 years prior, had been on disease-modifying monotherapy and in stable remission for over 10 years, and had experienced no exacerbations in the past 5 years. However, her daytime fatigue had persistently worsened without appreciable change in her sleep, diet, or exercise habits. She occasionally snored, particularly after a long or physically challenging day. She did not have a bed partner so was unsure if she had apneas during sleep. Physical examination showed a neck circumference of 41 cm (16 in) and a narrow, high-arched hard palate.

COMMENT

This case presents an example of two conditions (multiple sclerosis and possible obstructive sleep apnea [OSA]) that can have an overlapping symptom of fatigue and can coexist in the same individual. Diagnosis and treatment of OSA can improve quality of life and daytime fatigue for people with multiple sclerosis. An in-laboratory polysomnogram should be pursued to evaluate for OSA.

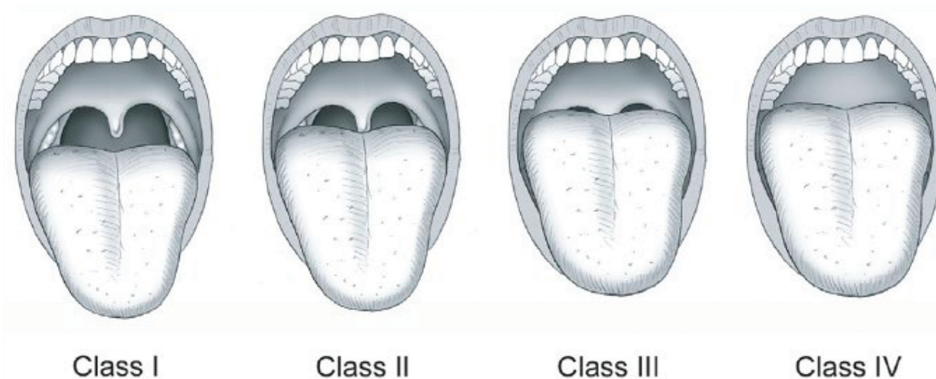


FIGURE 2-1

Mallampati classification. Although initially developed to predict intubation difficulty, the classification was also found to correlate with the risk of obstructive sleep apnea. Class I: the soft and hard palate, uvula, and tonsillar pillars can be seen. Class II: all structures except the tonsillar pillars can be seen. Class III: only the soft and hard palate and the base of the uvula can be seen. Class IV: only the hard palate can be seen.

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KEY POINTS

- The Epworth Sleepiness Scale is useful for following sleepiness (and treatment response) in the same individual over time, but it is not used to compare levels of sleepiness between individuals.
- The in-laboratory, fully attended polysomnogram is the gold standard test for the evaluation of sleep and identification of most sleep disorders.

severity of insomnia and may help assess treatment response over time.¹⁰

Other useful scales include the STOP-BANG scale for OSA risk stratification (**TABLE 2-1**¹¹) and the International Restless Legs Syndrome Study Group RLS severity rating scale.^{12,13}

Sleep diaries are not clinical rating scales, but rather tools that individuals can use to self-record their estimated bedtime, number of awakenings, wake time, and naps. Sleep diaries are often maintained for 7 to 14 days. These diaries may be used clinically to estimate wake, rise, and total sleep times and to provide additional context to the patient's experience of sleep disturbance, hypersomnolence, or insomnia. Sleep diaries can be used in conjunction with actigraphy (see below) to obtain a more objective estimation of sleep-wake times and patterns.

Testing

The gold standard test for the evaluation of sleep is the in-laboratory attended polysomnogram (PSG). As the name signifies, polysomnography includes simultaneous recordings with multiple channels of physiologic data to assess sleep architecture, respiratory parameters, and leg movements, perform limited cardiac monitoring, and observe any abnormal events that might arise from sleep (**FIGURE 2-3**). The baseline PSG records the following minimum channels: bilateral limited EEG (ie, bilateral frontal, central, and occipital electrode referenced to the bilateral mastoid processes) and electrooculography, chin surface EMG, snore microphone recording, limited ECG, bilateral anterior tibialis surface EMG, nasal pressure transducer, nasal-oral thermistor, chest and abdominal respiratory inductance plethysmography belts, and pulse oximetry. Body position is also scored continuously throughout the study.¹⁴ Carbon dioxide monitoring (end-tidal, transcutaneous, or both) is added for all pediatric studies and can be added for adults in whom sleep-related hypoventilation is suspected. Surface EMG electrodes on the bilateral extensor digitorum may be added to create an extended parasomnia montage for the evaluation of parasomnias, particularly RBD. The addition of pH monitoring or esophageal manometry is

Epworth Sleepiness Scale

Name: _____ Today's date: _____

Your age (yrs): _____ Your gender (Male = M, Female = F): _____

How likely are you to doze off or fall asleep in the following situations, in contrast to just feeling tired?

This refers to your usual way of life recently.

Even if you haven't done some of these things recently, try to figure out how they would have affected you.

Use the following scale to choose the **most appropriate number** for each situation:

- 0 = **no chance** of dozing
- 1 = **slight chance** of dozing
- 2 = **moderate chance** of dozing
- 3 = **high chance** of dozing

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

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

THANK YOU FOR YOUR COOPERATION

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FIGURE 2-2

Epworth Sleepiness Scale.

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occasionally used to evaluate for reflux-associated sleep-related breathing disorders and more subtle forms of sleep-related breathing disorders, respectively. Polysomnography can also be performed to guide titration of continuous positive airway pressure (CPAP), bilevel positive airway pressure (BiPAP) therapy, more advanced forms of noninvasive positive pressure ventilation, or titration of supplemental oxygen with or without positive airway pressure therapy. Because insomnia is a clinical diagnosis, polysomnography is not recommended for the diagnosis or management of insomnia.¹⁵ Polysomnography or home sleep apnea testing may be used to evaluate for suspected comorbid OSA in addition to insomnia.

The STOP-BANG Questionnaire^a

TABLE 2-1

1 Snoring

- ◆ Do you snore loudly (louder than talking or loud enough to be heard through closed doors)?
◇ Yes/No

2 Tired

- ◆ Do you often feel tired, fatigued, or sleepy during the daytime?
◇ Yes/No

3 Observed

- ◆ Has anyone observed you stop breathing during your sleep?
◇ Yes/No

4 Blood pressure

- ◆ Do you have or are you being treated for high blood pressure?
◇ Yes/No

5 BMI

- ◆ BMI more than 35 kg/m²?
◇ Yes/No

6 Age

- ◆ Age more than 50 years old?
◇ Yes/No

7 Neck circumference

- ◆ Neck circumference greater than 40 cm (15.75 in)?
◇ Yes/No

8 Gender

- ◆ Gender male?
◇ Yes/No

High risk of obstructive sleep apnea: answering yes to three or more items.

Low risk of obstructive sleep apnea: answering yes to fewer than three items.

BMI = body mass index.
^a Reprinted from Chung F, et al, *Anesthesiology*.¹¹ © 2008, American Society of Anesthesiologists.

FIGURE 2-3
A standard polysomnographic montage. The typical montage includes: electrooculography (LOC and ROC), EEG of the bilateral frontal (F), central (C), and occipital (O) regions, ECG, bilateral surface EMG of the anterior tibialis, snore microphone signal (SNORE), nasal pressure (PTAF) and nasal-oral thermistor airflow (FLOW) signals, respiratory inductance plethysmography of the chest and abdomen (ie, respiratory effort signals, CHEST and ABD), and pulse oximetry (ie, oxygen saturation, SaO₂). Several additional specialized channels may be recorded depending on the suspected sleep related condition, such as bilateral surface EMG of the arm musculature for suspected parasomnia, pH monitoring for suspected gastroesophageal reflux disease-associated sleep-disordered breathing, or esophageal pressure manometry transducer for accurate measurement of quantitative respiratory effort for enhanced diagnosis of sleep related breathing disorders.

The multiple sleep latency test (MSLT) is the gold standard technique for quantifying daytime sleepiness and is used in the diagnostic evaluation of central disorders of hypersomnolence, which include narcolepsy and idiopathic hypersomnia.¹ The MSLT is a limited polysomnographic study that includes only the following channels: bilateral limited EEG, bilateral electrooculography, chin surface EMG, and limited ECG.¹⁴ An overnight PSG performed the night prior to the MSLT allows for the measurement of total sleep time, assessment of sleep architecture, and assessment of other sleep disorders, such as OSA. Current guidelines indicate that the overnight PSG should record at least 6 hours of sleep prior to the MSLT. If a sleep-related breathing disorder or other sleep disorder that might result in excessive daytime sleepiness is detected on the overnight PSG, the MSLT should be deferred until the patient is clinically stable and when treatments for comorbid sleep disorders (eg, OSA) are well established and effective.¹⁶

The MSLT includes five nap trials, scheduled at different circadian time points throughout the day and each separated by 2 hours. Each nap opportunity is terminated after 20 minutes if the patient does not achieve electrographic sleep.

If the patient achieves electrographic sleep before 20 minutes have passed, the patient is allowed to sleep for an additional 15 minutes. At the conclusion of the five nap opportunities, the mean sleep latency is calculated as the average of the latency to the first epoch (30-second interval) of any stage of electrographic sleep. A mean sleep latency of fewer than 8 minutes in adults indicates excessive daytime sleepiness per comparison with normative data; a mean sleep latency of fewer than 5 minutes indicates severe excessive sleepiness.¹⁶

A sleep-onset REM period is defined as the onset of REM sleep during any nap trial of the MSLT or within 15 minutes of sleep onset during the PSG. Comprehensive urine drug screens are typically performed on the day of the MSLT to identify any medications that might influence the level of daytime sleepiness. The use of prescription medications such as amphetamines and other stimulants may contribute to false-negative results, and sedating medications such as barbiturates, opiates, anxiolytics, and hypnotic agents may contribute to false-positive results. More extensive or quantitative drug screening panels may be needed in specific clinical scenarios, such as for individuals with chronic pain who routinely take medications that might cause sedation. A 1- to 2-week sleep diary with or without actigraphy should be performed prior to the PSG-MSLT to understand the patient's sleep-wake schedule and duration in the time leading up to the PSG-MSLT. If clinically safe and feasible, medications that might affect wakefulness or confound the study results are typically avoided for approximately 2 weeks or 5 pharmacologic half-lives of the medication to minimize their effects on testing. This approach often applies to antidepressant medications, such as SSRIs or serotonin-norepinephrine reuptake inhibitors (SNRIs), which are known REM-suppressing medications. However, in some instances it may be most prudent to consult with the prescribing provider before discontinuing any medication with a significant risk of withdrawal or rebound symptoms to ensure safety, facilitate coordination of care, and establish adequate interval monitoring as clinically warranted.

No more than one sleep-onset REM period should be seen on an MSLT in the absence of sleep deprivation or medication effects. A mean sleep latency of fewer than 8 minutes with two or more sleep-onset REM periods is supportive of a diagnosis of narcolepsy if all other causes of hypersomnolence have been excluded. A mean sleep latency of less than 8 minutes with one sleep-onset REM period or less may indicate idiopathic hypersomnia in the appropriate clinical context.

In contrast to the MSLT, the maintenance of wakefulness test is a daytime test intended to assess the patient's ability to remain awake during the testing. A PSG may be performed but is not required prior to the maintenance of wakefulness test, which consists of four 40-minute wake trials that are each separated by 2 hours. The normative reference for mean latency of sleep on the maintenance of wakefulness test is 30.4 plus or minus 11.2 minutes, with a lower limit of normal of 8 minutes. The maintenance of wakefulness test is performed rather infrequently, often in those for whom the possibility of daytime sleepiness may pose a safety threat (eg, individuals who work in the transportation industry).

Actigraphy monitors movement as a surrogate measure of wakefulness to determine periods of activity versus rest. This monitoring is typically performed by a wearable clinical device that measures movement via an accelerometer. Actigraphy can provide a higher degree of objectivity than patient-completed sleep diaries alone when attempting to define the patient's sleep routine and

KEY POINTS

- Diagnostic testing with polysomnography or home sleep apnea testing is not recommended for the diagnosis or management of insomnia.

- The multiple sleep latency test is the current gold standard for quantifying sleepiness and is used in the diagnosis of central disorders of hypersomnolence such as narcolepsy and idiopathic hypersomnia.

- A multiple sleep latency test showing a mean sleep latency of less than 8 minutes with two or more sleep-onset REM periods is supportive of a diagnosis of narcolepsy if all other causes of hypersomnolence have been excluded.

- Medications that might affect wakefulness or confound multiple sleep latency test results are typically avoided for approximately 2 weeks or 5 pharmacological half-lives of the medication to minimize their effects on testing.

- In the proper clinical context, actigraphy can be a useful tool to increase measurement objectivity in the evaluation of insomnia and circadian rhythm sleep-wake disorders.

duration.¹⁷ Thus, actigraphy can be highly useful in the assessment of circadian rhythm sleep-wake disorders and can more objectively evaluate for insufficient sleep prior to MSLT.¹⁷ A practical limitation to the clinical use of actigraphy is the lack of coverage by most insurance companies. Sleep diaries and consumer wearable devices might be able to accomplish similar goals; however, they lack the higher degree of objectivity of clinical actigraphy.¹⁸

Home sleep apnea testing may be used for the evaluation of OSA in appropriately selected individuals. Home sleep apnea testing involves limited cardiorespiratory monitoring that typically consists of the following channels: nasal pressure transducer, thoracic respiratory inductance plethysmography belt, pulse oximetry, and heart rate. Some home sleep apnea testing devices also include a body position sensor. Home sleep apnea testing does not include EEG monitoring and thus is not used in the diagnostic evaluation of sleep disorders other than OSA.

Consumer Sleep Technologies

As previously mentioned, consumer sleep technologies continue to grow in popularity, variety, and adoption by individuals of all ages. These devices can provide considerable insight into a patient's sleep tendencies and behaviors as well as provide a foundation for optimizing sleep habits. However, the limitations of these devices must always be kept in mind. Many consumer devices work similarly to clinical actigraphy devices but with less precision.¹⁸ Not all commercially available devices are validated for clinical accuracy for measures such as sleep stage identification. As with other tools, the key to unlocking their potential lies in understanding limitations to and opportunities for incorporating these technologies into the management of sleep disorders and sleep quality. As consumer sleep technologies become more sophisticated and achieve a higher degree of validation, they may play an increasing role in the diagnosis and management of sleep disorders and may create opportunities to provide sleep health care to more communities and reduce sleep health disparities.¹⁹⁻²¹ Increased access to useful sleep data via consumer sleep technologies may provide deeper insights into the sleep health of underserved populations.²⁰

SLEEP SAFETY COUNSELING

Safety counseling is a key component of caring for patients with suspected or confirmed sleep disorders, particularly for disorders associated with excessive sleepiness. Each clinic visit should include counseling to refrain from driving (or any activity that might result in harm to self or others) when feeling sleepy, drowsy, or inattentive. Federal, state, and local laws are increasingly recognizing drowsy driving as another form of impaired driving.²²⁻²⁴ As drowsiness itself is the first stage of physiologic sleep, it should not be ignored or minimized when performing activities that require alertness and attention. Behaviors such as listening to loud music, turning down the temperature in the vehicle, and rolling down the windows may increase the amount of distraction when someone is feeling sleepy or inattentive.²⁴ If drowsiness develops while driving, the recommended actions include pulling over as soon as is safely possible and napping for 15 to 20 minutes, using caffeine, or allowing someone else who is alert to drive. In light of these factors, the use of public transportation or a transportation service might also be considered if financially and logistically feasible to optimize safety in the setting of excessive daytime sleepiness.

CONCLUSION

A detailed sleep history and physical examination are keys to accurate and effective evaluation of sleep-related concerns. Many conditions, including neurologic disease, may have a reciprocal relationship with comorbid sleep disorders. Knowledge of the different categories of sleep disorders can help guide the assessment and diagnostic approach for each person.²⁵ The clinical evaluation of sleep-related concerns is an important first step toward helping all individuals achieve the sufficient, restorative sleep that is integral to overall health and well-being.

USEFUL WEBSITES

AMERICAN ACADEMY OF NEUROLOGY (AAN)–SYNAPSE SLEEP MEDICINE SECTION COMMUNITY

Excellent collegial resource for neurologists engaged in the evaluation and management of sleep disorders.

synapse.aan.com/communities

AMERICAN ACADEMY OF SLEEP MEDICINE (AASM)

Official website of the only professional organization dedicated exclusively to the medical subspecialty of sleep medicine.

aasm.org

AMERICAN SLEEP APNEA ASSOCIATION

Useful patient-centered resource for obstructive sleep apnea.

sleephealth.org

BRAIN BASICS: UNDERSTANDING SLEEP

Useful resource from the National Institute of Neurologic Disorders and Stroke for patient- and caregiver-centered education and support regarding sleep disorders from a neurologic perspective.

ninds.nih.gov/health-information/patient-caregiver-education/brain-basics-understanding-sleep

PITTSBURGH SLEEP QUALITY INDEX

Well-validated and frequently used survey instrument that assesses overall sleep quality and characteristics.

sleep.pitt.edu/wp-content/uploads/Study_Instruments_Measures/PSQI-Instrument.pdf

RESOURCES: SLEEP AND SLEEP DISORDERS

Useful resource for patients and their families regarding sleep disorder education and support, maintained by the Centers for Disease Control and Prevention.

cdc.gov/sleep/resources.html

SCREENING QUESTIONS–SLEEP HISTORY & PHYSICAL

Useful template to help organize sleep history collection and assessment.

[aasm.org/resources/medsleep/\(harding\)questions.pdf](http://aasm.org/resources/medsleep/(harding)questions.pdf)

SLEEP EDUCATION (AASM)

Excellent patient- and caregiver-centered resource for sleep disorders education.

sleepeducation.org

SLEEP FOUNDATION

Helpful educational resource for patients and their families presented in an easily understandable format.

sleepfoundation.org

TWO WEEK SLEEP DIARY

A highly useful tool from the American Academy of Sleep Medicine to more objectively characterize and quantify sleep timing and tendencies.

sleepeducation.org/docs/default-document-library/sleep-diary.pdf

KEY POINTS

- Home sleep apnea tests are limited cardiorespiratory tests used for the diagnosis of obstructive sleep apnea. These devices are not used to diagnose other sleep disorders.

- Consumer sleep technologies may have a role in the clinical evaluation and management of sleep disorders and the optimization of sleep quality, but they are currently not sufficient to establish a diagnosis of any sleep disorder.

- If drowsiness develops while driving, the recommended actions include pulling over as soon as is safely possible and napping for 15 to 20 minutes, using caffeine, or allowing someone else who is alert to drive.

REFERENCES

- 1 Epstein LJ, Kristo D, Strollo PJ Jr, Friedman N, Malhotra A, Patil SP, et al. Clinical guideline for the evaluation, management and long term care of obstructive sleep apnea in adults. *J Clin Sleep Med* 2009;5(3):263-276.
- 2 American Academy of Sleep Medicine. International classification of sleep disorders. 3rd ed. Text revision. Darien, IL: American Academy of Sleep Medicine, 2023.
- 3 Mantovani S, Smith SS, Gordon R, O'Sullivan JD. An overview of sleep and circadian dysfunction in Parkinson's disease. *J Sleep Res* 2018;27(3):e12673. doi:10.1111/jsr.12673
- 4 Watson NF, Badr MS, Belenky G, et al. Recommended amount of sleep for a healthy adult: a joint consensus statement of the American Academy of Sleep Medicine and Sleep Research Society. *Sleep* 2015;38(6):843-844. doi:10.5665/sleep.4716
- 5 Mokhlesi B, Masa JF, Brozek JL, et al. Evaluation and management of obesity hypoventilation syndrome. an official American Thoracic Society Clinical Practice guideline. *Am J Respir Crit Care Med* 2019;200(3):e6-e24. doi:10.1164/rccm.201905-1071ST

- 6 Nuckton TJ, Glidden DV, Browner WS, Claman DM. Physical examination: Mallampati score as an independent predictor of obstructive sleep apnea. *Sleep* 2006;29(7):903-908. doi:10.1093/sleep/29.7.903
- 7 Bastien CH, Vallières A, Morin CM. Validation of the insomnia severity index as an outcome measure for insomnia research. *Sleep Med* 2001;2(4):297-307. doi:10.1016/s1389-9457(00)00065-4
- 8 Walker NA, Sunderram J, Zhang P, Lu SE, Scharf MT. Clinical utility of the Epworth sleepiness scale. *Sleep Breath Schlaf Atm* 2020;24(4):1759-1765. doi:10.1007/s11325-020-02015-2
- 9 Onen F, Moreau T, Gooneratne NS, et al. Limits of the Epworth Sleepiness Scale in older adults. *Sleep Breath Schlaf Atm* 2013;17(1):343-350. doi:10.1007/s11325-012-0700-8
- 10 Morin CM, Belleville G, Bélanger L, Ivers H. The insomnia severity index: psychometric indicators to detect insomnia cases and evaluate treatment response. *Sleep* 2011;34(5):601-608. doi:10.1093/sleep/34.5.601
- 11 Chung F, Yegneswaran B, Liao P, et al. STOP questionnaire: a tool to screen patients for obstructive sleep apnea. *Anesthesiology* 2008;108(5):812-821. doi:10.1097/ALN.0b013e31816d83e4
- 12 Sharon D, Allen RP, Martinez-Martin P, et al. Validation of the self-administered version of the international restless legs syndrome study group severity rating scale - The sIRLS. *Sleep Med* 2019;54:94-100. doi:10.1016/j.sleep.2018.10.014
- 13 Chiu HY, Chen PY, Chuang LP, et al. Diagnostic accuracy of the Berlin questionnaire, STOP-BANG, STOP, and Epworth sleepiness scale in detecting obstructive sleep apnea: a bivariate meta-analysis. *Sleep Med Rev* 2017;36:57-70. doi:10.1016/j.smrv.2016.10.004
- 14 Berry R, Brooks R, Gamaldo C, et al. The AASM manual for the scoring of sleep and associated events: rules, terminology and technical specifications, version 2.6. www.aasmnet.org.
- 15 Schutte-Rodin S, Broch L, Buysse D, Dorsey C, Sateia M. Clinical guideline for the evaluation and management of chronic insomnia in adults. *J Clin Sleep Med* 2008;4(5):487-504.
- 16 Krahn LE, Arand DL, Avidan AY, et al. Recommended protocols for the Multiple Sleep Latency Test and Maintenance of Wakefulness Test in adults: guidance from the American Academy of Sleep Medicine. *J Clin Sleep Med* 2021;17(12):2489-2498. doi:10.5664/jcsm.9620
- 17 Marino M, Li Y, Rueschman MN, et al. Measuring sleep: accuracy, sensitivity, and specificity of wrist actigraphy compared to polysomnography. *Sleep* 2013;36(11):1747-1755. doi:10.5665/sleep.3142
- 18 Roberts DM, Schade MM, Mathew GM, Gartenberg D, Buxton OM. Detecting sleep using heart rate and motion data from multisensor consumer-grade wearables, relative to wrist actigraphy and polysomnography. *Sleep* 2020;43(7):zsaa045. doi:10.1093/sleep/zsaa045
- 19 Johnson DA, Jackson CL, Guo N, et al. Perceived home sleep environment: associations of household-level factors and in-bed behaviors with actigraphy-based sleep duration and continuity in the Jackson Heart Sleep Study. *Sleep* 2021;44(11):zsab163. doi:10.1093/sleep/zsab163
- 20 Troxel WM, DeSantis A, Richardson AS, et al. Neighborhood disadvantage is associated with actigraphy-assessed sleep continuity and short sleep duration. *Sleep* 2018;41(10):zsy140. doi:10.1093/sleep/zsy140
- 21 Yip T, Cheon YM. Sleep, psychopathology and cultural diversity. *Curr Opin Psychol* 2020;34:123-127. doi:10.1016/j.copsyc.2020.02.006
- 22 MacLean AW, Davies DRT, Thiele K. The hazards and prevention of driving while sleepy. *Sleep Med Rev* 2003;7(6):507-521. doi:10.1016/s1087-0792(03)90004-9
- 23 Bhat A, Marciari AM, Stevens D, Ingram DG. Drowsy driving considerations in non-commercial drivers for the sleep physician. *J Clin Sleep Med* 2019;15(7):1069-1071. doi:10.5664/jcsm.7898
- 24 Venkateshiah SB, Hoque R, DelRosso LM, Collop NA. Legal and regulatory aspects of sleep disorders. *Sleep Med Clin* 2017;12(1):149-160. doi:10.1016/j.jsmc.2016.10.002
- 25 Pourmand R, ed. Neurological formulation. In: *Practicing Neurology: what you need to know, what you need to do*. Current Clinical Neurology. Humana Press; 2008:29. doi:10.1007/978-1-59745-297-7_2