02 - 16.2 Sleep Wake Disorders

16.2 Sleep-Wake Disorders

Roth T. Characteristics and determinants of normal sleep. J Clin Psychol. 2004;65(Suppl 16):8–11. Thomas SJ, Lichstein KL, Taylor DJ, Riedel BW, Bush AJ. Epidemiology of bedtime, arising time, and time in bed: Analysis of age, gender, and ethnicity. Behav Sleep Med. 2014;12(3):169–182. Wright KP, Lowry CA, Lebourgeois MK. Circadian and wakefulness-sleep modulation of cognition in humans. Front Mol Neurosci. 2012;5:50. 16.2 Sleep-Wake Disorders Sleep is regulated by several basic mechanisms, and when these systems go awry, sleep disorders occur. Interest in sleep disorders was initially found among psychiatrists, psychologists, and neurologists. The past three decades have witnessed discoveries that make sleep medicine truly multidisciplinary. Research illustrating the medical consequences of sleep-disordered breathing attracted many pulmonary and internal medicine specialists to the field. Sleep-wake disorder–related endocrinology and circadian rhythm research has migrated from the laboratory bench to the bedside. Nonetheless, the seriousness of sleep disorders remains poorly recognized by the general public and the vast majority of clinical practitioners. Sleep disorders are both dangerous and expensive to treat. Obstructive sleep apnea research verifies its contribution to hypertension, heart failure, and stroke. Investigations link many major industrial catastrophes to sleepiness. Sleepiness is a serious, potentially life-threatening condition that affects not only the sleepy individual but also his or her family, coworkers, and society in general. In fact, sleep-related motor vehicle accidents represent a major public safety concern, and some states have enacted criminal statues to deter sleepy driving. Sleep disorders' direct cost per annum in the United States is estimated at $16 billion, with indirect costs ranging upward to more than $100 billion. Table 16.2-1 lists the terms used in this section to diagnose and describe sleep disorders. Table 16.2-1 Common Polysomnographic Measures SLEEP DISORDER CLASSIFICATION

DSM-5 The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) of the American Psychiatric Association (APA) lists ten disorders or disorder groups as sleepwake disorders. The DSM-5 classifies sleep disorders on the basis of clinical diagnostic criteria and presumed etiology. The disorders described in DSM-5 are only a fraction of the known sleep disorders; they provide a framework for clinical assessment. The sleepwake disorders' current classifications in accordance with the DSM-5 include the following:

1. Insomnia Disorder

2. Hypersomnolence Disorder
3. Narcolepsy
4. Breathing-Related Sleep Disorders: a. Obstructive Sleep Apnea Hypopnea b. Central Sleep Apnea i. Idiopathic central sleep apnea ii. Cheyne-Stokes breathing iii. Central sleep apnea comorbid with opioid use c. Sleep-Related Hypoventilation
5. Circadian Rhythm Sleep-Wake Disorders: a. Delayed sleep phase type b. Advanced sleep phase type c. Irregular sleep-wake type d. Non-24-hour sleep-wake type e. Shift work type f. Unspecified type
6. Parasomnias
7. Non-Rapid Eye Movement Sleep Arousal Disorders: a. Sleepwalking type b. Sleep terror type
8. Nightmare Disorder
9. Rapid Eye Movement Sleep Behavior Disorder
10. Restless Legs Syndrome
11. Substance/Medication-Induced Sleep Disorder Other Classification Systems ICSD-2. A different classification system of sleep-wake disorders is used by the American Sleep Disorders Association published in the second edition of International

Classification of Sleep Disorders: Diagnostic and Coding Manual (ICSD-2). ICSD-2 provides a detailed and comprehensive classification system for sleep-wake disorders. Table 16.2-2 presents an outline of this classification. Table 16.2-2 Outline of Sleep-Wake Disorders in the Second Edition of the International Classification of Sleep Disorders

ICD-10. The tenth revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) of the World Health Organization (WHO) includes many (but not all) of the ICSD-2 diagnostic classifications. In addition, their organizational schemas differ from DSM-5 and often lump multiple nosological entities

into a single diagnostic classification. The subject of sleep disorders covers only those of nonorganic type in ICD-10. These disorders are classified as dyssomnias, psychogenic conditions “in which the predominant disturbances...[are] in the amount, quality, or timing of sleep” because of emotional causes, and parasomnias, “abnormal episodic events occurring during sleep.” The dyssomnias include insomnia, hypersomnia, and disorder of the sleep-wake schedule. The parasomnias in childhood are related to development; those in adulthood are psychogenic and include sleepwalking, sleep terrors, and nightmares. Sleep disorders of organic origin, nonpsychogenic disorders such as narcolepsy and cataplexy, and sleep apnea and episodic movement disorders are discussed under other categories. The ICD-10 notes that sleep disorders are often symptoms of other disorders, but even when they are not, the specific sleep disorder should be diagnosed along with as many other relevant diagnoses as necessary to describe the “psychopathology and/or pathophysiology involved in a given case.” Table 16.2-3 presents the ICD-10 criteria for nonorganic sleep disorders. Table 16.2-3 ICD-10 Diagnostic Criteria for Nonorganic Sleep Disorders

INSOMNIA DISORDER Insomnia is defined as difficulty initiating or maintaining sleep. It is the most common

sleep complaint and may be transient or persistent. Population surveys show a 1-year prevalence rate of 30 to 45 percent in adults. DSM-5 defines insomnia disorder as dissatisfaction with sleep quantity or quality associated with one or more of the following symptoms: difficulty in initiating sleep, difficulty in maintaining sleep with frequent awakenings or problems returning to sleep, and early morning awakening with inability to return to sleep (Table 16.2-4). Table 16.2-4 DSM-5 Diagnostic Criteria for Insomnia Disorder It is now recognized that insomnia can be an independent condition. In the past, practitioners were admonished to treat insomnia's cause rather than the symptoms. There was an implicit notion that by doing so, the sleep problems would improve. Clinical experience suggested otherwise. Consequently, current therapeutics favor providing relief and managing symptoms. In the past it was argued that if insomnia was related to depression, treating the insomnia would mask the depression and thereby interfere with antidepressant treatment regimens. This does not appear to happen. Descriptively, insomnia can be categorized in terms of how it affects sleep (e.g., sleeponset insomnia, sleep-maintenance insomnia, or early-morning awakening). Insomnia can also be classified according to its duration (e.g., transient, short term, and long term). According to the Gallup Survey, approximately one third of the US population has several serious bouts of insomnia yearly; however, in 9 percent of the general population, insomnia is a chronic condition. Individuals with chronic insomnia have more than twice as many motor vehicle accidents as the general population, but only 5

percent of those with chronic insomnia see a health care provider to seek help for sleeplessness. Nonetheless, 40 percent or more of those individuals with chronic insomnia self-medicate with over-the-counter drugs, alcohol, or both. A brief period of insomnia is most often associated with anxiety, either as a sequela to an anxious experience or in anticipation of an anxiety-provoking experience (e.g., an examination or an impending job interview). In some persons, transient insomnia of this kind may be related to grief, loss, or almost any life change or stress. The condition is not likely to be serious, although a psychotic episode or a severe depression sometimes begins with acute insomnia. Specific treatment for the condition is usually not required. When treatment with hypnotic medication is indicated, both the physician and the patient should be clear that the treatment is of short duration and that some symptoms, including a brief recurrence of the insomnia, may be expected when the medication is discontinued. Persistent insomnia is composed of a fairly common group of conditions in which the problem is difficulty falling asleep or remaining asleep. This insomnia involves two sometimes separable, but often intertwined, problems: somatized tension and anxiety and a conditioned associative response. Patients often have no clear complaint other than insomnia. They may not experience anxiety per se but discharge the anxiety through physiological channels; they may complain chiefly of apprehensive feelings or ruminative thoughts that appear to keep them from falling asleep. Sometimes (but not always) a patient describes the condition's exacerbation at times of stress at work or at home and its remission during vacations. Sleep state misperception (also known as subjective insomnia) is characterized by a dissociation between the patient's experience of sleeping and the objective polygraphic measures of sleep. The ultimate cause of this dissociation is not yet understood, although it appears to be a specific case of a general phenomenon seen in many areas of medicine. Sleep state misperception is diagnosed when a patient complains of difficulty initiating or maintaining sleep and no objective evidence of sleep disruption is found. For example, a patient sleeping in the laboratory reports taking more than an hour to fall asleep, awakening more than 30 times, and sleeping less than 2 hours the entire night. By contrast, the polysomnogram shows sleep onset occurring within 15 minutes, few awakenings, a 90 percent

sleep efficiency, and total sleep time exceeding 7 hours. Sleep state misperception can occur in individuals who are apparently free from psychopathology or it can represent a somatic delusion or hypochondriasis. Some patients with sleep state misperception have obsessional features concerning somatic functions. Short-term sleep state misperception can occur during periods of stress, and some clinicians believe it can result from latent or ineffectively treated anxiety or depressive disorders. Cognitive relabeling, diffusing the worry about being unable to sleep, or both can help. Interestingly, anxiolytics can profoundly reduce the perception of sleeplessness without markedly changing sleep physiologically. Psychophysiological insomnia typically presents as a primary complaint of difficulty in going to sleep. A patient may describe this as having gone on for years and usually denies that it is associated with stressful periods in his or her life. Objects associated

with sleep (e.g., the bed, the bedroom) likewise become conditioned stimuli that evoke insomnia. Thus, psychophysiological insomnia is sometimes called conditioned insomnia. Psychophysiological insomnia often occurs in combination with other causes of insomnia, including episodes of stress and anxiety disorders, delayed sleep phase syndrome, and hypnotic drug use and withdrawal. In contrast to the insomnia in patients with psychiatric disorders, daytime adaptation is generally good. Work and relationships are satisfying; however, extreme tiredness can exist. Other features include (1) excessive worry about not being able to sleep; (2) trying too hard to sleep; (3) rumination, inability to clear one's mind while trying to sleep; (4) increased muscle tension when attempting to sleep; (5) other somatic manifestations of anxiety; (6) being able to sleep better away from one's own bedroom; and (7) being able to fall asleep when not trying (e.g., watching television). The sleep complaint becomes fixed over time. Interestingly, many patients with psychophysiological insomnia sleep well in the laboratory. Ms. W, a 41-year-old divorced white woman, presented with a 2.5-year complaint of sleeplessness. She had some difficulty falling asleep (30 to 45 minutes sleep onset latency) and awakened every hour or two after sleep onset. These awakenings could last 15 minutes to several hours, and she estimated approximately 4.5 hours of sleep on an average night. She rarely took daytime naps notwithstanding feeling tired and edgy. She described her sleep problem as follows: "It seems like I never get into a deep sleep. I have never been a heavy sleeper, but now the slightest noise wakes me up. Sometimes I have a hard time getting my mind to shut down." She viewed the bedroom as an unpleasant place of sleeplessness and stated, "I tried staying at a friend's house where it is quiet, but then I couldn't sleep because of the silence." At times, Ms. W would be unsure whether she was asleep or awake. She had a history of clock watching (to time her wakefulness) but stopped doing this when she realized it was contributing to the problem. Reportedly the insomnia is unrelated to seasonal changes, menstrual cycle, or time-zone translocation. Her basic sleep hygiene was good. Appetite and libido were unchanged. She denied mood disturbance, except that she was quite frustrated and concerned about sleeplessness and its effect on her work. Her work involved sitting at a microscope for 6 hours of a 9-hour working day and meticulously documenting her findings. Her final output had not suffered, but she now had to "double check" for accuracy. She described herself as a worrier and a Type A personality. She did not know how to relax. For example, on vacation she continually worried about things that could go wrong. She could not even begin to unwind until she had arrived at the destination, checked in, and unpacked. Even then, she was unable to relax. Medical history was unremarkable except for tonsillectomy (age 16 years), migraine headaches (current), and diet-controlled hypercholesterolemia. She took naproxen (Aleve) as needed for headache. She did not drink caffeinated beverages, smoke tobacco, or drink

alcoholic beverages. She did not use recreational drugs.

The problem with insomnia began after relocation to a new city and place of employment. She attributed her insomnia to the noisy neighborhood in which she lived. She first sought treatment 18 months previously. Her family practice physician diagnosed depression and she was started on fluoxetine (Prozac), which made her “climb the walls.” Antihistamines were tried next with similar results. She was then switched to low-dose trazodone (Desyrel; for sleep) and developed nausea. After these medical interventions, she sought medical care elsewhere. Zolpidem (Ambien), 5 mg, was prescribed, but it made her feel drugged, and on discontinuation she had withdrawal effects. Another family practice physician diagnosed “nonspecific anxiety disorder” and began buspirone (BuSpar), an experience she described as “having an alien try to climb out of my skin.” Buspirone was discontinued. Paroxetine (Paxil) was tried for 8 weeks with no effect. Finally, a psychiatrist was consulted, who diagnosed adult attention-deficit disorder (without hyperactivity) and suggested treatment with methylphenidate (Ritalin). At this point, the patient was convinced that a stimulant would not help her insomnia and demanded referral to a sleep disorders center. Ms. W’s symptoms fell into the broad category of insomnia, and the symptoms had begun after she had moved from one city to another. Environmental sleep disorder (noise) and adjustment sleep disorder (new job, city, and apartment) were likely initial diagnoses. However, a more chronic, endogenous problem had become operative. Ms. W was a “worrier” and meticulous, but she did not reach diagnostic criteria for personality or anxiety disorders. Dyssomnia associated with mood disorder should be considered in any patient with sleep maintenance problems and earlymorning awakening insomnia. However, this patient did not have other significant signs of depression. Unfortunately, many patients are misdiagnosed with depression or “masked depression” on the sole basis of an insomnia complaint and unsuccessfully treated with antidepressant medication. Ms. W’s job demanded long hours with focused concentration. Her job performance had been superior for many years notwithstanding insomnia. Thus, a diagnosis of attention-deficit disorder was unlikely. Idiopathic insomnia implies a childhood complaint, which Ms. W denied. The likely working diagnosis was psychophysiological insomnia (PPI). There may have been some sleep state misperception (she was sometimes unclear on whether she was awake or asleep), but this could not adequately account for the constellation of symptoms. An initial treatment plan should include further documentation of the sleep pattern using a sleep log. Behavioral treatments would likely benefit this patient. Medications with sedative effects are sometimes useful during the initial treatment of PPI. However, thus far in this patient they had done more harm than good. She would likely be a challenging patient to treat. (Courtesy of Max Hirshkowitz, Ph.D., Rhoda G. Seplowitz-Hafkin, M.D., and Amir Sharafkhaneh, M.D., Ph.D.) Idiopathic insomnia typically starts early in life, sometimes at birth, and continues throughout life. As the name implies, its cause is unknown; suspected causes include

neurochemical imbalance in brainstem reticular formation, impaired regulation of brainstem sleep generators (e.g., raphe nuclei, locus ceruleus), or basal forebrain dysfunction. Treatment is difficult, but improved sleep hygiene, relaxation therapy, and judicious use of hypnotic medicines are reportedly helpful. Primary insomnia is diagnosed when the chief complaint is nonrestorative sleep or difficulty in initiating or maintaining sleep, and the complaint continues for at least a month (according to ICD-10, the disturbance must occur at least three times a week for a month). The term primary indicates that the insomnia is independent of any known physical or mental condition. Primary insomnia is often characterized both by difficulty falling asleep and by repeated

awakening. Increased nighttime physiological or psychological arousal and negative conditioning for sleep are frequently evident. Patients with primary insomnia are generally preoccupied with getting enough sleep. The more they try to sleep, the greater the sense of frustration and distress and the more elusive sleep becomes. Treating Insomnia Pharmacological Treatment. Primary insomnia is commonly treated with benzodiazepines, zolpidem, eszopiclone (Lunesta), zaleplon (Sonata), and other hypnotics. Hypnotic drugs should be used with care. In general, sleep medications should not be prescribed for more than 2 weeks because tolerance and withdrawal may result. For many years, benzodiazepines were the most commonly prescribed sedative–hypnotic medications for treating insomnia. Benzodiazepine-receptor agonists represent the current standard for sedative–hypnotic medications used to treat insomnia. Longacting sleep medications (e.g., flurazepam [Dalmane], quazepam [Doral]) are best for middle-of-the-night insomnia; short-acting drugs (e.g., zolpidem, triazolam [Halcion]) are useful for persons who have difficulty falling asleep. The melatonin-receptor agonist ramelteon (Rozerem) has also been approved for treating sleep-onset insomnia. Sedating antidepressants, such as trazodone, are also frequently prescribed as sleep aids. A variety of over-the-counter (OTC) sleep aids are also available. Nonprescription formulas include sedating antihistamines, protein precursors, and other substances. LTryptophan was popular and readily available at health food stores until an outbreak of eosinophilia led to its being pulled off the shelves. Melatonin is a leader among selfadministered food additives believed by some to alleviate sleeplessness. Melatonin is an endogenous hormone produced by the pineal gland, which is linked to the regulation of sleep. Administration of exogenous melatonin has yielded mixed results, however, in clinical research. Prescription medicines are rigorously tested in clinical trials; therefore, they hold an advantage over the virtually untested OTCs. To attain U.S. Food and Drug Administration (FDA) approval as a hypnotic, a medication must be safe and effective. Most hypnotic medications are approved for short-term, not long-term, use. Exceptions include zolpidem modified release, eszopiclone, and ramelteon, all of which are approved for long-term therapy. When properly used, hypnotics can provide immediate

and adequate relief from sleeplessness. Insomnia, however, usually returns on discontinuation of dosing. Cognitive-Behavioral Therapy Cognitive-behavioral therapy (CBT) as a treatment modality uses a combination of behavioral and cognitive techniques to overcome dysfunctional sleep behaviors, misperceptions, and distorted, disruptive thoughts about sleep. Behavioral techniques include universal sleep hygiene, stimulus control therapy, sleep restriction therapy, relaxation therapies, and biofeedback. Studies repeatedly show significant, sustained improvement in sleep symptoms, including number and duration of awakenings and sleep latency from CBT. Short-term benefits are similar to that of medication, but CBT tends to have lasting benefits even 36 months after treatment. With cessation of the medication, insomnia frequently returns and is sometimes accompanied by rebound insomnia. CBT has not been shown to produce any adverse effects. There are no established “best practice” guidelines for length or quantity of sessions. CBT, however, is not without limitations. Most data do not compare the efficacy of the individual components of CBT. However, sleep hygiene education alone produces an insignificant effect on sleep. In addition, there are no studies demonstrating evidence for improved efficacy with the combination of the aforementioned components or what cognitive therapy adds to the behavioral component. Intuitively, it would seem that the multicomponent approach addresses many of the variables contributing to insomnia. The effects of CBT take longer to emerge than effects of medications. Usually when patients finally come for treatment of their insomnia, they are desperate. This makes

it difficult to convince them to try a therapy that may take several weeks before it will provide relief. Furthermore, patients do not assume a passive role in this type of therapy; they must be active participants. Many individuals not only want a “quick fix,” but they also want to undergo a procedure or have something administered rather than be involved in the therapeutic process. For CBT to be effective, patients must commit to come to multiple sessions and also be open to the idea that modifying thoughts and behaviors about sleep can improve the symptoms of insomnia. The “quick fix” model is more familiar to primary care providers, whereas psychiatrists are used to the delayed response of antidepressants and other psychotropics. Therefore, psychiatrists may be more amenable to recommending CBT. Another barrier for physicians using CBT in clinical practice is that providing CBT for insomnia requires a greater time commitment than prescribing a sleep aid. Although firmly focused on cognitive and behavioral issues, it helps to extend CBT just slightly into the psychodynamic sphere. For some patients with long-standing difficulty sleeping, being an insomniac becomes an important part of their identity. There may be primary or secondary gain to such identification. It is the negative emotional response (i.e., anger at the inability to control one’s sleep, feeling like a failure because one cannot sleep) to insomnia that contributes to its chronicity. In general, these individuals

tend to internalize rather than express emotion, feel a heightened need for control, experience interpersonal difficulties, and have significant discontent with past events. For this subset of people, if the emotional response is not addressed, there is more likely to be a limited response to CBT or a relapse of insomnia over time. The clinician who is attuned to a patient’s tendency to view something as a failure rather than a challenge will be better able to intercept barriers to treatment. Universal Sleep Hygiene. A common finding is that a patient’s lifestyle leads to sleep disturbance. This is usually phrased as inadequate sleep hygiene, referring to a problem in following generally accepted practices to aid sleep. These include, for instance, keeping regular hours of bedtime and arousal, avoiding excessive caffeine, not eating heavy meals before bedtime, and getting adequate exercise. Many behaviors can interfere with sleep and may do so by increasing nervous system arousal near bedtime or by altering circadian rhythms. The focus of universal sleep hygiene is on modifiable environmental and lifestyle components that may interfere with sleep, as well as behaviors that may improve sleep. Treatment should focus on one to three problem areas at a time. Especially because some of these behaviors are difficult to change, only one or two items that are collaboratively chosen by the patient and clinician should be addressed. This gives the patient the best chance at a successful intervention. Overwhelming the patient with too many lifestyle changes or a complex regimen seldom succeeds. Some general “dos and don’ts” are instructive. Sleep-enhancing directives are enumerated in Table 16.2-5. Often a few simple alterations in a patient’s habits or sleep environment can be effective. The clinician, however, needs to spend time reviewing both the patient’s routine and its irregularity. In some respects, the essence of insomnia is its variability. The day-to-day changes in behavior and the changing severity of sleeplessness can obscure the factors responsible for the problem. A carefully explained program of sleep hygiene, with follow-up, represents a fairly inexpensive but effective intervention. Furthermore, improving sleep habits can enhance sleep even when the major cause of insomnia is physical. Table 16.2-5 Dos and Don’ts for Good Sleep Hygiene

Stimulus Control Therapy. Stimulus control therapy is a deconditioning paradigm developed by Richard Bootzin and colleagues at the University of Arizona. This treatment aims to break the cycle of problems commonly associated with difficulty initiating sleep. By attempting to undo

conditioning that undermines sleep, stimulus control therapy helps reduce both primary and reactive factors involved in insomnia. The rules attempt to enhance stimulus cues for sleeping and diminish associations with sleeplessness. The instructions are simple; however, they must be followed consistently. The first rule is, go to bed only when sleepy to maximize success. Second, use the bed only for sleeping. Do not watch television in bed, do not read, do not eat, and do not talk on the telephone while in bed. Third, do not lie in bed and become frustrated if unable to sleep. After a few minutes (do not watch the clock), get up, go to another room, and do something nonarousing until sleepiness returns. The goal is to associate the bed with rapid sleep onset. Rule three should be repeated as often as needed. The fourth and final instruction attempts to enhance the mechanisms underlying the circadian and sleep-wake cycles—that is, awaken at the same time every morning (regardless of bedtime, total sleep time, or day of week) and totally avoid napping. Stimulus control therapy does work; however, results might not be seen during the first few weeks or month. If continually practiced, the bouts of insomnia lessen in both frequency and severity. Sleep Restriction Therapy. Sleep restriction therapy is a strategy designed to increase sleep efficiency by decreasing the amount of time spent awake while lying in

bed. Developed by Arthur Spielman, this therapy specifically targets those patients who lie awake in bed unable to sleep. Restricting time in bed can help to consolidate sleep. If the patient reports sleeping only 5 hours of a scheduled 8-hour time in bed, reduce the time in bed. It is advised, however, not to reduce bedtime to less than 4 hours per night and to warn the patient about the hazards of daytime sleepiness. Sleep at other times during the day must be avoided, except in the elderly, who may take a 30-minute nap. The clinician then monitors sleep efficiency (time asleep as a percentage of the time in bed). When sleep efficiency reaches 85 percent (averaged over five nights), time in bed is increased by 15 minutes. Sleep restriction therapy produces a gradual and steady decline in nocturnal wakefulness. Relaxation Therapy and Biofeedback. The most important aspects of relaxation therapy are that it be performed properly. Self-hypnosis, progressive relaxation, guided imagery, and deep breathing exercises are all effective if they produce relaxation. The goal is to find the optimal technique for each patient, but not all patients need help in relaxing. Progressive muscle relaxation is especially useful for patients who experience muscle tension. The patients should purposefully tense (5 to 6 seconds) and then relax (20 to 30 seconds) muscle groups, beginning at the head and ending at the feet. The patient should appreciate the difference between tension and relaxation. Guided imagery has the patient visualize a pleasant, restful scene, engaging all of his or her senses. Breathing exercises are practiced for at least 20 minutes per day for 2 weeks. Once mastered, the technique should be used once at bedtime for 30 minutes. If it does not work, the patient should try again another night. It is important that the technique not become associated with failure to fall asleep. The patient is instructed to perform abdominal breathing as follows. The patient must become comfortable with each step before moving on to the next: First, in the supine position, the patient should breathe normally through his or her mouth or nose, whichever is more comfortable, and attend to his or her breathing pattern. Second, while maintaining that rhythm, the patient should begin to breathe more with his or her abdomen and less with his or her chest. Third, the patient should pause for a half second after each breath cycle (in and out) and evaluate the breath. How did it feel? Was it smooth? Eventually each breath will become uniform and smooth. Fourth, the patient should find a place where he or she can best feel the air move in and out. Concentrate on that spot and on the air moving in and out. Fifth, the patient should visualize intrusive thoughts as floating away; if there are too many thoughts, stop practicing and try again later. Biofeedback provides stimulus cues for physiological

markers of relaxation and can increase self-awareness. A machine is used to measure muscle tension in the forehead or finger temperature. Finger temperature rises when a person becomes more relaxed.

Patients require careful and adequate training; simply giving them an instruction tape is not especially helpful. Techniques are ideally mastered during the day for several weeks before application to the sleep problem; this is best achieved outside of the bed. By the time the techniques are applied in bed, the skill should be automatic. Relaxation techniques readily lend themselves to being combined with sleep hygiene and stimulus control therapies. Sometimes, they make for good distractions from thinking about the inability to sleep. The ruminations fuel the insomnia, and if the ruminator can be distracted, then the person may sleep better. Cognitive Training. This effective, validated treatment for a variety of psychiatric conditions, including major depression and generalized anxiety, has been adapted for use with insomnia. The cognitive aspect of insomnia treatment targets the negative emotional response to an appraisal of a sleep-related situation. The negative emotional response is thought to produce emotional arousal, which in turn contributes to or perpetuates insomnia. People who have maladaptive cognitions tend to exaggerate the negative consequences of insomnia: “There must be something really wrong with me if I can’t fall asleep in 40 minutes.” They also tend to have unrealistic expectations about their sleep requirements: “If I don’t sleep 8 hours a night then my whole day will be ruined.” The first step is to identify these cognitions, then challenge their validity, and finally substitute them with more adaptive cognitions. DH was a 42-year-old man with a 5-year history of insomnia. He identified being fired from his job and the birth of a colicky baby as precipitating factors in his inability to sleep. However, even after he found a new position with better hours and pay and with the child sleeping through the night, DH continued to experience difficulty falling and staying asleep. Perpetuating factors included low back pain and a spouse with periodic limb movement disorder. He reported spending 8 to 9 hours in bed each night and sleeping only 4 to 5 hours intermittently. He watched 1 hour of television in bed before turning out the light for bedtime. He spent hours watching his minutes tick away. He did not awake feeling rested, and when his alarm went off he was frequently already awake and had thoughts such as, “I hardly slept at all last night. I should be able to get more sleep. There must be something wrong with me. Great, I’ll be too tired to concentrate on anything today.” Examples of maladaptive thoughts: “I should be able to get more sleep.” This is a faulty appraisal of sleeping ability and may relate to a need for control over sleep. This need for control interferes with having a more laissez-faire attitude about a few missed hours of rest. Such thoughts can also lead to feelings of frustration and anger. “Great, I’ll be too tired to concentrate on anything today.” This is a misattribution of daytime impairment due to poor sleep. DH was also magnifying the negative and discounting the positive with his black-and-white or all-or-nothing thinking. Could DH be too tired to concentrate on some things but not all things? Might his inability to concentrate be due to a myriad of other factors? “There must be something wrong

with me [if I can’t get enough sleep].” This is catastrophizing and emotional reasoning: Just because a person had a feeling does not mean that the thought or feeling is true. A strongly held belief that sleeplessness negatively affects physical and mental health can set off catastrophizing. (Courtesy of Max Hirshkowitz, Ph.D., Rhoda G. Seplowitz-Hafkin, M.D., and Amir Sharafkhaneh, M.D., Ph.D.) Paradoxical Intention. This is a cognitive technique with conflicting evidence regarding its efficacy. In clinical practice compliance is often a barrier, but it does work for a limited number

of patients. The theory is that performance anxiety interferes with sleep onset. Thus, when the patient tries to stay awake for as long as possible rather than trying to fall asleep, performance anxiety will be reduced and sleep latency will improve. HYPERSOMNOLENCE DISORDER Excessive sleepiness (hypersomnolence) is a serious, debilitating, potentially lifethreatening noncommunicable condition. It affects not only the afflicted individual but also his or her family, coworkers, and the public at large. Sleepiness can be a consequence of (1) insufficient sleep, (2) basic neurologic dysfunction in brain systems regulating sleep, (3) disrupted sleep, or (4) the phase of an individual's circadian rhythm. A sleep history questionnaire is often helpful in diagnosing a patient's sleep disorder (Table 16.2-6). The sleep debt produced by insufficient sleep is cumulative. If one reduces sleep duration by 1 to 2 hours per night and continues this regimen for a week, sleepiness will reach pathological levels. When sleep debt is added to sleep disruption or a basic neurologic dysfunction in sleep mechanisms, there is increasing risk that an individual will lapse unexpectedly into sleep. Sleep onset in such circumstances characteristically occurs without warning. Sleepiness can be episodic and occur as irresistible sleep attacks, occur in the morning as sleep drunkenness, or be chronic. Fatigue, tiredness, and sleepiness are terms that are used by most people synonymously; however, one can be tired but not sleepy, sleepy but not tired, or sleepy and tired. In this section, the term sleepiness will refer to drowsiness, a propensity to lapse into sleep, and when extreme, an inability to maintain wakefulness. Table 16.2-6 Sleep History Questionnaire

Sleepiness adversely affects attention, concentration, memory, and higher-order cognitive processes. Serious results of sleepiness include failure at school, loss of

employment, motor vehicle accidents, and industrial disasters. The transportation industry, including trucking, railroad, marine, and aviation, is particularly prone to sleep-related accidents. There are many sleep disorders associated with excessive daytime sleepiness; however, sleep-disordered breathing is by far the most common dyssomnia seen in sleep disorder centers. Primary hypersomnia is diagnosed when no other cause can be found for excessive somnolence occurring for at least 1 month. Some persons are long sleepers who, as with short sleepers, show a normal variation. Their sleep, although long, is normal in architecture and physiology. Sleep efficiency and the sleep-wake schedule are normal. This pattern is without complaints about the quality of sleep, daytime sleepiness, or difficulties with the awake mood, motivation, and performance. Long sleep may be a lifetime pattern, and it appears to have a familial incidence. Many persons are variable sleepers and may become long sleepers at certain times in their lives. Some persons have subjective complaints of feeling sleepy without objective findings. They do not have a tendency to fall asleep more often than is normal and do not have any objective signs. Clinicians should try to rule out clear-cut causes of excessive somnolence. Types of Hypersomnia Kleine-Levin Syndrome. Kleine-Levin syndrome is a relatively rare condition consisting of recurrent periods of prolonged sleep (from which patients may be aroused) with intervening periods of normal sleep and alert waking. During the hypersomniac episodes, wakeful periods are usually marked by withdrawal from social contacts and return to bed at the first opportunity. Kleine-Levin syndrome is the best-recognized recurrent hypersomnia though it is uncommon. It predominantly afflicts males in early adolescence; however, it can occur later in life and in females. With few exceptions, the first attack occurs between the ages of 10 and 21 years. Rare instances of onset in the fourth and fifth decades of life have been reported. In its classic form, the recurrent episodes are associated with extreme sleepiness (18-hour to 20-hour sleep periods), voracious eating, hypersexuality, and

disinhibition (e.g., aggression). Episodes typically last for a few days up to several weeks and appear once to ten times per year. A monosymptomatic hypersomnolent form can occur. The frequency of the human leukocyte antigen (HLA) is increased in patients with this syndrome. Menstrual-Related Hypersomnia. In some women, recurrent episodes of hypersomnia are related to the menstrual cycle, experiencing intermittent episodes of marked hypersomnia at, or shortly before, the onset of their menses. The symptoms typically last for 1 week and resolve with menstruation. Nonspecific electroencephalogram (EEG) abnormalities similar to those associated with Kleine-Levin syndrome have been documented in several instances. Endocrine factors are probably involved, but no specific abnormalities in laboratory endocrine measures have been reported. Treatment with oral contraceptives is effective, and therefore the disorder is

believed to be secondary to a hormone imbalance. Idiopathic Hypersomnia. Idiopathic hypersomnia (IH) presents in several forms. It may be associated with very long sleep periods, after which the individual remains sleepy. IH can also occur without long sleep periods. IH is a disorder of excessive sleepiness in which patients do not have the ancillary symptoms associated with narcolepsy. Unlike narcolepsy, sleep is usually well preserved, and sleep efficiency remains high even in forms associated with very extended sleep schedules (12 hours or more). Furthermore, the patient readily falls asleep if given an opportunity to nap the following day. There is often elevated slow wave sleep; however, the EEG sleep pattern is essentially the same as that found in normal individuals who are sleep deprived. Unlike a sleep-deprived individual, the sleep pattern continues in this profile even after several nights of extended sleep. As the name indicates, the etiology of idiopathic hypersomnia is not known; however, a central nervous system cause is presumed. Three general categories have been developed. Subgroup 1 includes individuals who are HLACw2 positive, have autonomic nervous system dysfunctions, and have other affected family members. Subgroup 2 includes status postviral infection patients (e.g., GuillainBarré syndrome [ascending polyneuropathy], mononucleosis, and atypical viral pneumonia). Subgroup 3 idiopathic hypersomnia patients are nonfamilial and are not postviral (i.e., truly idiopathic). Age of onset is characteristically between 15 and 30 years, and the hypersomnia becomes a lifelong problem. In addition to the prolonged, undisturbed, and unrefreshing nocturnal sleep, IH is associated with long nonrefreshing naps, difficulty awakening, sleep drunkenness, and automatic behaviors with amnesia. Other symptoms suggesting autonomic nervous system dysfunction are typical, including migraine-like headaches, fainting spells, syncope, orthostatic hypotension, and Raynaud-type phenomena with cold hands and feet. Some patients with IH sleep less than 10 hours per night, have difficulty awakening, awake unrefreshed and even confused, and may take unintentional, unrefreshing daytime naps provoked by their daytime somnolence. Onset is typically before 25 years of age, and the course of the disorder is persistent and unremitting. A 60-year-old accountant complained of excessive sleepiness and reported that he had to take about five half-hour naps throughout the day. He awakened feeling refreshed but unless he napped he could not function at work. He did not abuse substances and narcolepsy was ruled out; but on history he reported that both his father and paternal grandfather had the same sleep pattern. He was examined in a sleep laboratory and had a normal polysomnograph with 10 hours of uninterrupted sleep. A genetic predisposition for hypersomnolence was presumed to be the cause of his symptoms. He obtained some relief from small doses of amphetamine (2.5 mg) which he would use when he could not take his normal naps because of specific work obligations.

Behaviorally Induced Insufficient Sleep Syndrome. Insufficient sleep syndrome stems from an individual's disregard for the sleep-wake schedule. It is usually subclinical and occurs in a great proportion of the population. Medical help is generally not sought because the individual is aware of the cause of his or her sleepiness. Insufficient sleep, however, is an insidious killer and is related to many vehicular and industrial accidents. When an individual becomes progressively more and more sleep deprived, eventually payment for the sleep debt will be exacted. Excessive sleepiness associated with insufficient sleep can be unmasked by a heavy meal, low-dose alcohol ingestion, a warm room, and sedentary activity. Insufficient sleep syndrome is diagnosed when an individual does not schedule an adequate amount of time for sleep and as a result suffers from daytime sleepiness, fatigue, loss of concentration, memory impairment, irritability, and moodiness. Often the individual will fast and binge on sleep, nap, and extend the sleep period on weekends. Although caffeinated beverages are commonly self-administered, appropriate treatment involves increasing the duration and regularity of sleep. Recent studies indicate that metabolic disorders and insulin resistance may result from chronic insufficient sleep. Hypersomnia Due to a Medical Condition. Medical conditions known to cause hypersomnia include head trauma, stroke, encephalitis, Parkinson's disease, inflammatory conditions, tumors, genetic diseases, and neurodegenerative diseases. Hypersomnia Due to Drug or Substance Use. Sleepiness can be caused by use or abuse of sedative hypnotics, sedating antihistamines, sedating antidepressants, antiepileptics, neuroleptics, and opioid analgesics. Hypersomnia may also be provoked by withdrawal from traditional stimulants (cocaine, amphetamines), caffeine, or nicotine. Treating Hypersomnia Hypersomnia caused by insufficient sleep is treated by extending and regularizing the sleep period. If, however, the sleepiness arises from narcolepsy, medical conditions, or idiopathic hypersomnia, it is usually managed pharmacologically. There is no cure for these conditions, but symptoms are managed with either the wake-promoting substance modafinil (Provigil; first-line treatment) or traditional psychostimulants such as amphetamines and their derivatives (if modafinil fails). For narcolepsy (discussed below), rapid-eye-movement (REM) sleep–suppressing drugs (e.g., many antidepressants) are used to treat the cataplexy. This approach capitalizes on the anticholinergic REM sleep-suppressant properties of these drugs. Because cataplexy is presumably an intrusion of REM sleep phenomena into the awake state, the rationale is clear. Many reports indicate that imipramine (Tofranil) and protriptyline (Vivactil) are quite effective for reducing or eliminating cataplexy. Selective serotonin reuptake inhibitors (SSRIs) have gained popularity because they are associated with fewer side

effects than the tricyclic antidepressants. More recently, sodium oxybate (Xyrem) has proven to be extremely effective for reducing cataplexy, even in cases in which the cataplexy was thought to be intractable. Studies also suggest that sodium oxybate helps to improve sleep and relieves some of the sleepiness associated with narcolepsy. Although drug therapies are the treatment of choice, the overall therapeutic approach should include scheduled naps, lifestyle adjustment, psychological counseling, drug holidays to reduce tolerance (if stimulants are used), and careful monitoring of refills, general health, and cardiac status. NARCOLEPSY Narcolepsy is a condition characterized by excessive sleepiness, as well as auxiliary symptoms that represent the intrusion of aspects of REM sleep into the waking state (Table 16.2-7). The sleep attacks of narcolepsy represent episodes of irresistible sleepiness, leading to perhaps 10 to 20 minutes of sleep, after which the patient feels refreshed, at least briefly. They can occur at inappropriate times (e.g., while eating, talking, or driving and during sex). The REM sleep includes hypnagogic and hypnopompic hallucinations, cataplexy, and sleep paralysis. The appearance of REM sleep within 10 minutes of sleep onset

(sleep-onset REM periods) is also considered evidence of narcolepsy. The disorder can be dangerous because it can lead to automobile and industrial accidents. Table 16.2-7 DSM-5 Diagnostic Criteria for Narcolepsy

Narcolepsy is not as rare as was once thought. It is estimated to occur in 0.02 to 0.16 percent of adults and shows some familial incidence. Narcolepsy is neither a type of epilepsy nor a psychogenic disturbance. It is an abnormality of the sleep mechanisms— specifically, REM-inhibiting mechanisms—and it has been studied in dogs, sheep, and humans. Narcolepsy can occur at any age, but it most frequently begins in adolescence or young adulthood, generally before the age of 30. The disorder either progresses slowly or reaches a plateau that is maintained throughout life. The most common symptom is sleep attacks: Patients cannot avoid falling asleep. Often associated with the problem (close to 50 percent of long-standing cases) is cataplexy, a sudden loss of muscle tone, such as jaw drop, head drop, weakness of the knees, or paralysis of all skeletal muscles with collapse. Patients often remain awake during brief cataplectic episodes; the long episodes usually merge with sleep and show the electroencephalographic signs of REM sleep. Other symptoms include hypnagogic or hypnopompic hallucinations, which are vivid perceptual experiences, either auditory or visual, occurring at sleep onset or on awakening. Patients are often momentarily frightened, but within 1 or 2 minutes they return to an entirely normal frame of mind and are aware that nothing was actually there. Another uncommon symptom is sleep paralysis, most often occurring on awakening in the morning; during the episode, patients are apparently awake and conscious but unable to move a muscle. If the symptom persists for more than a few seconds, as it often does in narcolepsy, it can become extremely uncomfortable. (Isolated brief episodes of sleep paralysis

occur in many nonnarcoleptic persons.) Patients with narcolepsy report falling asleep quickly at night but often experience broken sleep. When the diagnosis is not clinically clear, a nighttime polysomnographic recording reveals a characteristic sleep-onset REM period (Fig. 16.2-1). A test of daytime multiple sleep latency (several recorded naps at 2-hour intervals) shows rapid sleep onset and usually one or more sleep-onset REM periods. A type of human leukocyte antigen, HLA-DR2, is found in 90 to 100 percent of patients with narcolepsy and only 10 to 35 percent of unaffected persons. One recent study showed that patients with narcolepsy are deficient in the neurotransmitter hypocretin, which stimulates appetite and alertness. Another study found that the number of hypocretin neurons (Hrct cells) in narcoleptics is 85 to 95 percent lower than in nonnarcoleptic brains. FIGURE 16.2-1 Polygraphic tracing comparing normal sleep onset with that of a patient with narcolepsy. Each panel illustrates approximately 30 seconds of polysomnographic recording beginning with relaxed wakefulness. A: Normal sleep progression, showing a reduction of electroencephalogram (EEG) alpha activity and the development of slow rolling eye movements. B: The normally expected abatement of EEG alpha activity associated with increased theta activity and the appearance of a few slow eye movements. However, within 25 seconds (far right) a swift loss of muscle tone occurs, accompanied by rapid eye movements. This appearance of sleep-onset REM sleep (SOREM) characterizes narcolepsy and is part of the diagnostic criteria. EMG, electromyogram; EOG, electro-oculogram. (Courtesy of Constance A. Moore, M.D., Robert W. Williams, M.D., and Max Hirshkowitz, Ph.D.) Narcolepsy is the prototypical example of sleepiness produced by a basic central nervous system dysfunction of sleep mechanisms. The etiology stems from a genetically triggered hypocretin dysfunction and deficit. It has become apparent that the hypocretin system plays a critical role in narcolepsy. In a canine model of narcolepsy, mutations of

hypocretin receptor-2 were identified that result in malfunctioning of this receptor. In human narcolepsy with HLA-DQB1*0602– positive individuals, levels of hypocretin receptor-1 are undetectable in cerebrospinal fluid (CSF). A strong association between narcolepsy and specific HLA suggests an autoimmune process that damages hypocretin-containing cells in the central nervous system (CNS). The classic form of narcolepsy (narcolepsy with cataplexy) is characterized by a tetrad of symptoms: (1) excessive daytime sleepiness, (2) cataplexy, (3) sleep paralysis, and

(4) hypnagogic hallucinations. Patients with narcolepsy often have an abnormal sleep architecture in which REM sleep occurs soon after sleep onset both at night and during daytime naps (Fig. 16.2-2). This, in connection with the symptom tetrad, makes narcolepsy appear to be a REM sleep intrusion syndrome presumably resultant from dysfunction of REM sleep generator gating mechanisms. The features of the tetrad match REM sleep characteristics. The sleep paralysis is similar to the muscle atonia that occurs during REM sleep. The hypnagogic hallucinations are vivid “dreams” that occur while the patient is still conscious or partially conscious. However, not all patients have the full constellation of symptoms. Narcolepsy is estimated to afflict 10 to 60 individuals per 10,000. Symptoms commonly appear in the second decade of life. Strong emotions usually act as the “trigger” for cataplexy. Common emotional triggers include laughter and anger. The severity of cataplexy ranges widely from transient weakness in the knees to total paralysis while the patient is fully conscious. Episodes may last from several seconds to minutes. Usually, the patient is unable to speak and may fall to the floor. Nocturnal sleep is often fragmented, and there can be considerable sleep disturbance. Patients may experience depression in relation to the narcolepsy, especially when it is not treated. Social isolation, difficulty with academics and employment, and fear of driving contribute to a sense of loss experienced by patients with narcolepsy. FIGURE 16.2-2 Example of an obstructive sleep apnea event on polysomnogram. CZ-O2, electroencephalogram channel; ECG, electrocardiogram; EMG, electromyogram; LOC, left electro-oculogram; ROC, right electro-oculogram. Treating Narcolepsy

No cure exists for narcolepsy, but symptom management is possible. A regimen of forced naps at a regular time of day occasionally helps patients with narcolepsy and, in some cases, the regimen alone, without medication, can almost cure the condition. When medication is required, stimulants are most commonly used. Modafinil, an α1-adrenergic receptor agonist, has been approved by the FDA to reduce the number of sleep attacks and to improve psychomotor performance in narcolepsy. This observation suggests the involvement of noradrenergic mechanisms in the disorder. Modafinil lacks some of the adverse effects of traditional psychostimulants. Nonetheless, the clinician must monitor its use and be sensitive to the patient developing a tolerance. Sleep specialists often prescribe tricyclic drugs or SSRIs to reduce cataplexy. This approach capitalizes on the REM sleep-suppressant properties of these drugs. Because cataplexy is presumably an intrusion of REM sleep phenomena into the awake state, the rationale is clear. Many reports indicate that imipramine, modafinil, and fluoxetine are effective in reducing or eliminating cataplexy. Although drug therapy is the treatment of choice, the overall therapeutic approach should include scheduled naps, lifestyle adjustment, psychological counseling, drug holidays to reduce tolerance, and careful monitoring of drug refills, general health, and cardiac status. BREATHING-RELATED SLEEP DISORDERS Sleep-disordered breathing includes conditions ranging from upper airway resistance syndrome to severe obstructive sleep apnea. Sleep-related breathing impairments such as apnea (absence of airflow) and hypopnea (reduction in airflow) are most often caused by airway obstruction; however, sometimes respiratory reduction results from central

(brainstem) changes in ventilatory control, metabolic factors, or heart failure. Each sleep-disordered breathing event can be classified as central, obstructive, or mixed. Central apnea refers to decreased or absent respiratory effort. In DSM-5, three disorders are included under the category of breathing-related sleep disorders: obstructive sleep apnea hypopnea, central sleep apnea, and sleep-related hypoventilation. Obstructive Sleep Apnea Hypopnea Obstructive sleep apnea hypopnea, also referred to as obstructive sleep apnea (OSA), is characterized by repetitive collapse or partial collapse of the upper airway during sleep. As a person falls asleep, airway resistance increases. In some individuals this leads to increased respiratory effort or airway occlusion. These periods of functional obstruction of the upper airway result in decreases in arterial oxygen saturation and a transient arousal, after which respiration (at least briefly) resumes normally. An episode of sleep apnea is defined as a cessation of breathing for 10 seconds or more during sleep. During an obstructive apnea episode, respiratory effort continues but airflow ceases due to loss of airway patency. A reduction in breathing for at least 10 seconds is termed hypopnea. Partial obstructions (hypopnea) can lead to arousals and sleep fragmentation. The consequent reduction in ventilation can decrease oxyhemoglobin concentrations.

Predisposing factors for OSA include being male, reaching middle age, being obese, and having micrognathia, retrognathia, nasopharyngeal abnormalities, hypothyroidism, and acromegaly. A review of more than 4 million records from the Veterans Health Administration (VHA) found a 2.91 percent prevalence of sleep apnea in that population. Comorbid diagnoses included hypertension (60.1 percent), obesity (30.5 percent), diabetes mellitus (32.9 percent), and cardiovascular disease, including angina and myocardial infarction (27.6 percent), heart failure (13.5 percent), and stroke, including transient ischemic attacks (5.7 percent). Psychiatric comorbidity in the sleep apnea group was significantly higher ($P < 0.0001$) than in the non–sleep apnea group for the diagnoses of mood disorders, anxiety and posttraumatic stress disorder, psychosis, and dementia. There are several theories about the reasons for this association. Psychiatric disorders may be a consequence of sleep apnea (and disturbed sleep and hypoxia). Conversely, psychiatric disorders may predispose people to developing sleep disturbances such as sleep apnea. Diagnosis. Clinical features associated with OSA hypopnea include excessive sleepiness, snoring, obesity, restless sleep, nocturnal awakenings with choking or gasping for breath, morning dry mouth, morning headaches, and heavy nocturnal sweating. Patients may also have hypertension, erectile failure in men, depression, heart failure, nocturia, polycythemia, and memory impairment as a result of obstructive sleep apnea hypopnea. Obstructive apnea and hypopnea episodes can occur in any state of sleep but are more typical during REM sleep, non-rapid-eye-movement (NREM) stage 1, and NREM stage 2 sleep. On the polysomnogram, episodes of OSA in adults are characterized by multiple periods of at least 10 seconds in duration in which nasal and oral airflow ceases completely (an apnea) or partially (a hypopnea), while the abdominal and chest expansion leads indicate continuing efforts of the diaphragm and accessory muscles of respiration to move air through the obstruction (see Fig. 16.2-2). The arterial oxygen saturation drops and often a bradycardia is seen that may be accompanied by other arrhythmias, such as premature ventricular contractions. At the end, an arousal reflex takes place, seen as a waking signal and possibly as a motor artifact on the EEG channels. At this moment, sometimes called the breakthrough, the patient can be observed making brief restless movements in bed. According to the American Academy of Sleep Medicine scoring manual, polysomnographic recordings are scored for events according to the following rules: Airway obstruction producing complete cessations of breathing for 10 or more seconds is scored as apnea. Partial obstructions with consequent drops in oxygen

saturation are designated as hypopnea (4 percent or more required according to Medicare rules), and partial obstructions without significant oxygen saturation but terminated by an arousal are scored as respiratory effort–related arousal (RERA) episodes. The number of apnea episodes per hour of sleep is termed the apnea index (AI), the number of apnea plus hypopnea episodes per hour is called the apnea plus hypopnea index (AHI), and the number of apnea plus hypopnea plus RERA episodes is designated the respiratory disturbance index (RDI).

Treatment. A number of treatments are available for obstructive sleep apnea hypopnea, including weight loss, surgical intervention, positive airway pressure, and oral appliances. Weight loss is known to help many patients. However, because losing weight and keeping it off is difficult and unreliably achieved, the prudent clinician should recommend weight loss but also rely on other therapies. Aggressive surgical treatments evolved soon after OSA's pathophysiological and potentially life-threatening consequences were recognized. The earliest surgical intervention was designed to create a patent airway; thus, in the late 1970s tracheostomies were performed on individuals with severe apnea. There is little doubt that tracheostomy succeeds in creating an airway. Although no longer the preferred treatment, it remains a standard against which newer, more refined therapies are judged. Second-generation surgical approaches attempt to correct airway obstructions and malformations. Early studies of uvulopalatopharyngoplasty (UPPP) suggested that modification of the soft palate effectively relieved most sleep apnea. Later follow-up results were less impressive. Approximately 30 to 50 percent of patients with sleep apnea benefit from UPPP. These patients are likely those with oropharyngeal obstruction; thus, careful attention to selection criteria presumably improves outcome. However, if obstruction occurs in the posterior airway space (PAS), maxillomandibular surgery may be appropriate. In retrognathic patients or in patients with cephalometrics revealing compromised PAS, moving the jaw forward can achieve impressive normalization of breathing during sleep. Positive airway pressure (PAP) is the preferred treatment for sleep-disordered breathing (Fig. 16.2-3). The PAP apparatus consists of a fan-driven blower, a nasal or oronasal mask, and tubing connecting the two. The airflow through the mask provides a positive pressure that offsets oropharyngeal collapse produced by inspiratory negative thoracic pressure. In this manner it acts as a pneumatic splint, thereby maintaining the airway. When the pressure is properly titrated, even the most severe sleep apnea can be alleviated. Results are usually dramatic. PAP devices come in several varieties. The most common are systems that provide a single set continuous positive airway pressure (CPAP). For individuals who find it difficult to exhale against a continuous pressure, bilevel positive airway pressure (BPAP) may provide a solution. BPAP devices have different inspiratory and expiratory pressure settings. More recently, systems that sense the patient's changes in airway resistance and automatically adjust the positive airway pressure (APAP) have been gaining popularity. Such APAP systems should theoretically be able to adapt to changes in pressure requirements produced by sleep deprivation, medications, weight change, sleep stage, illness, and aging. Finally, timed bilevel and servoventilation systems have also been developed but fall into the category of noninvasive positive pressure ventilation (NIPPV) systems, which are more appropriate for treating other pulmonary diseases and breathing problems in neuromuscular diseases. The tremendous efficacy and remarkable safety of PAP therapies has made them the standard of care for patients who can tolerate sleeping with the machine. The major therapeutic challenge is utilization. Patient education and systematic follow-up are crucial. When problems with the mask, the pressure, nasal stuffiness, and other barriers to routine, nightly use arise, they must be remedied quickly to ensure therapeutic adherence. When used properly, the success of PAP therapy has rendered surgical

intervention a secondary option, resorted to mainly after PAP failure, rejection, or nonadherence.

FIGURE 16.2-3 Sleep stage histogram illustrating the immediate, dramatic improvement in sleep architecture produced by treating obstructive sleep apnea with continuous positive airway pressure (CPAP) therapy. A: Illustrates the abnormal sleep pattern on a night when the patient had more than 200 episodes of obstructive sleep apnea. Sleep is disturbed by frequent awakenings while rapid eye movement (REM) and slow wave (stages 3 and 4) sleep are nearly absent. B: Data from the same patient being treated with CPAP on the next night. Normalization of sleep continuity with a massive rebound in REM and slow wave sleep is evident. (Courtesy of Constance A. Moore, M.D., Robert L. Williams, M.D., and Max Hirshkowitz, Ph.D.) Oral appliances represent another therapeutic option that is gaining popularity. A variety of oral appliances have also been developed to treat snoring, and they appear to be beneficial for mild to moderate OSA cases. The general approach is to manipulate the position of the mandible, lift the palate, or retain the tongue. Randomized trials indicate that some oral appliances improve airway patency sufficiently to treat patients with sleep apnea. However, in patients with severe OSA, improvement does not always reach satisfactory levels; therefore, follow-up evaluations are needed. In some patients, sleep-disordered breathing occurs only in the supine position. In such situations, preventing patients from sleeping on their backs may produce beneficial results. Tennis balls sewn onto or placed into pockets on the back of the nightshirt or foam wedges may accomplish this goal. Although such interventions are found to be useful in clinical practice, large-scale systematic clinical trials of this approach have not been performed. Finally, drug therapies have been tried for OSA but without success. Medroxyprogesterone acetate (Provera) was originally thought to be helpful but is seldom used now. Similarly, tricyclic antidepressants sometimes decrease apnea severity by reducing REM sleep, the stage of sleep in which obstructive apnea is usually more frequent. Theophylline was reported to reduce apnea, but further study is needed. There were also animal studies suggesting that mirtazapine (Remeron) and similar serotonin presynaptic–affecting compounds improved breathing; however, studies in humans were disappointing. The only drug therapy approved for use in patients with OSA is the wake-promoting substance modafinil. Modafinil, however, does nothing to treat the

pathophysiology of airway occlusion, but rather is used as an adjunct for treating the residual sleepiness that persists in about 8 to 12 percent of patients who are otherwise well treated with and adequately use PAP therapy. Central Sleep Apnea Central sleep apnea (CSA), which tends to occur in the elderly, results from periodic failure of CNS mechanisms that stimulate breathing. CSA is defined as the absence of breathing due to lack of respiratory effort. It is a disorder of ventilatory control in which repeated episodes of apneas and hypopneas occur in a periodic or intermittent pattern during sleep caused by variability in respiratory effort. The original teaching was that OSA results in a complaint of excessive sleepiness, whereas CSA is manifest as insomnia, but later case series have emphasized that either symptom may appear in either disorder. The polysomnogramic features of CSA are similar to those of OSA, except that, during the periods of apnea, a cessation of respiratory effort is seen in the abdominal and chest expansion leads. DSM-5 specifies three subtypes of CSA: idiopathic CSA, Cheyne-Stokes breathing pattern, and CSA comorbid with opioid use. However, there are several different etiologies that can result in diminished effort to breath, including the three subtypes above, as well as high altitude, brainstem lesions, specific medical conditions, specific drugs or substances, and congenital abnormalities. Idiopathic CSA. There is an idiopathic form of CSA. Patients typically have low normal arterial carbon dioxide tension ($PaCO_2$)

while awake and have a high ventilatory response to CO2. They present with daytime sleepiness, insomnia, or awakening with shortness of breath. Respiratory cessations during sleep occur independent of ventilatory effort. Polysomnography reveals five or more central apneas per hour of sleep. Cheyne-Stokes Breathing. Cheyne-Stokes breathing is a unique breathing pattern consisting of prolonged hyperpneas during which tidal volume gradually waxes and wanes in a crescendo–decrescendo fashion. The hyperpneas alternate with apnea and hypopnea episodes that are associated with reduced ventilatory effort. This pattern is most common in older men with congestive heart failure or stroke. As with primary CSA, the patient presents with daytime sleepiness, insomnia, and awakening short of breath. Polysomnography reveals ten or more central apnea and hypopnea episodes per hour of sleep. CSA Comorbid with Opioid Use. This is a third subtype of CSA in DSM-5, specified if opioid use disorder is present. There is an association with chronic use of long-acting opioid medications and impairment of neuromuscular respiratory control leading to CSA. CSA Due to High Altitude. Central apnea at sleep onset is universal at

elevations above 7,600 m but can occur at 5,000 m (especially with a rapid ascent). This subtype is no longer included in DSM-5 but may still have clinical significance. Periods of central apnea alternate with periods of hyperpnea in a 12-second to 34-second cycle. This is an extension of normal respiratory control at sleep onset where medullary pH receptors raise their set-point and require lower pH to respond. At high altitudes, hyperventilation causes a hypocapnic alkalosis that reduces ventilation during sleep. Sleep architecture may suffer, with increased duration in stages 1 and 2 and less slow wave sleep. REM sleep may not be affected. This condition can be treated with acetazolamide, which lowers serum pH and increases the respiratory drive. Acetazolamide side effects include metabolic acidosis, electrolyte imbalance, anaphylaxis, Stevens-Johnson syndrome, toxic epidermal necrolysis, and agranulocytosis. Common reactions include but are not limited to fatigue, anorexia, taste changes, polyuria, diarrhea, melena, tinnitus, and photosensitivity. CSA Due to Medical Condition that Is Not Cheyne-Stokes. This form of CSA is usually caused by a brainstem lesion associated with a wide range of variable etiologies. Cardiac and renal disorders can also cause central apnea. Diagnostic criteria requires polysomnographically verified rate of ten or more central apneas and hypopneas per hour of sleep with a crescendo–decrescendo breathing pattern accompanied by arousals and fragmented sleep. CSA Due to Drug or Substance Use. Central apnea episodes can be provoked by a variety of drugs or drug combinations, most notably long-acting opiates. However, other substances or medications have also been associated with alterations in neuromuscular control leading to CSA. Diagnostic criteria are a central apnea index (number of episodes per hour) of 5 or more and the patient taking a drug(s) for at least 2 months. Primary Sleep Apnea of Infancy. This form of CSA involves prolonged apneas or hypopneas with concomitant hypoxemia, bradycardia, or both. This condition afflicts preterm neonates, presumably because their brainstems are not fully developed. The condition may be exacerbated by other medical problems that further compromise the infant’s physiological and developmental status. Sleep-Related Hypoventilation Idiopathic Hypoventilation. Patients with idiopathic hypoventilation have normal lungs and a decrease in alveolar ventilation resulting in sleep-related arterial oxygen desaturation likely due to blunted chemoresponsiveness. They do not have lung disease, obesity, kyphoscoliosis, or other structural conditions that might cause hypoventilation. Polysomnography shows episodes of shallow breathing longer than 10 seconds in duration associated with arterial oxygen desaturation and frequent arousals from sleep associated with the breathing disturbances or bradytachycardia. Patients

often complain of excessive daytime sleepiness, frequent arousals during sleep, or insomnia. Congenital Central Alveolar Hypoventilation. Sometimes called Ondine's curse, congenital central alveolar hypoventilation parasomnia cannot be explained by primary pulmonary disease or ventilatory muscle weakness. The sleep-related hypoventilation results from a failure in automatic control of breathing. Although present at birth, congenital central hypoventilation syndrome may initially be unrecognized. In severe forms, treatment requires continual ventilatory support. Comorbid Sleep-Related Hypoventilation. Comorbid sleep-related hypoventilation occurs when hypoventilation is a consequence of a medical condition, for example, pulmonary parenchymal or vascular pathology, lower airway obstruction, or neuromuscular or chest wall disorders. SLEEP-RELATED HYPOVENTILATION DUE TO PULMONARY PARENCHYMAL OR VASCULAR PATHOLOGY. Parenchymal lung disease or vascular disease is the primary cause of the hypoxemia. These diseases include interstitial lung diseases, idiopathic and secondary forms of pulmonary hypertension, cystic fibrosis (which affects lung parenchyma and lower airway), and hemoglobinopathies such as sickle cell anemia. Nocturnal hypoxemia can lead to pulmonary artery hypertension, cor pulmonale, and neurocognitive dysfunction. Sleep studies reveal sustained oxyhemoglobin desaturation during sleep occurring in the absence of detectable apnea or hypopnea episodes. SLEEP-RELATED HYPOVENTILATION DUE TO LOWER AIRWAY OBSTRUCTION. This is diagnosed by a forced expiratory volume in 1 second (FEV1)/forced vital capacity (FVC) ratio that is less than 70 percent of predicted value on pulmonary function tests (PFTs). Chronic obstructive pulmonary disease (COPD) including emphysema and chronic bronchitis, α-1-antitrypsin deficiency, bronchiectasis, and cystic fibrosis form the majority of disorders that cause this sleep disturbance. Nocturnal hypoxemia can potentially lead to pulmonary artery hypertension and cor pulmonale. Sustained hypoxemia can also cause brain damage. Sleep studies reveal sustained oxyhemoglobin desaturation during sleep occurring in the absence of detectable apnea or hypopnea episodes. SLEEP-RELATED HYPOVENTILATION DUE TO NEUROMUSCULAR AND CHEST WALL DISORDERS. Myasthenia gravis and amyotrophic lateral sclerosis (ALS) occurring together with OSA can exacerbate the hypoxemia produced by the neuromuscular and chest wall disorders. CIRCADIAN RHYTHM SLEEP DISORDERS Circadian rhythm sleep disorders include a wide range of conditions involving a misalignment between desired and actual sleep periods. This collection of sleep disorders shares the same basic underlying etiology—a desynchrony between an individual's internal circadian biological clock and the desired or conventional sleepwake cycle. The circadian (circa plus dias, "approximately 1 day") pacemaker is located

in the suprachiasmatic nucleus (SCN). SCN firing oscillates with an almost sinusoidal pattern, the period of which is 24 hours, and the output correlates with the daily fluctuations in core body temperature. SCN firing patterns persists even in cerveau isolé preparations (an animal with its mesencephalon transected). Mismatched circadian clock and desired schedules can arise from improper phase relationships between the two, travel across time zones, or dysfunctions in the basic biological rhythm. Under normal circumstances the internal circadian pacemaker is reset each day by bright light, social cues, stimulants, and activity. In cases in which these factors fail to re-entrain the circadian rhythm, the circadian sleep disorders occur. DSM-5 lists six types of circadian rhythm sleep disorders: delayed sleep phase type, advanced sleep phase type, irregular sleep-wake type, non-24-hour sleep-wake type, shift work type, and unspecified type. Jet lag type and "due to a medical condition" are not included in DSM5 but are included in other classification systems such as ICSD-2. Delayed Sleep Phase Type The delayed sleep phase circadian disorder occurs when the biological clock runs slower than 24 hours or is shifted later than the desired

schedule. This produces a phase delay in the sleepiness–alertness cycle. Individuals with delayed sleep phase are more alert in the evening and early nighttime, stay up later, and are more tired in the morning. These individuals are commonly referred to as night owls. Advanced Sleep Phase Type Advanced sleep phase occurs when the circadian rhythm cycle is shifted earlier. Therefore, the sleepiness cycle is advanced with respect to clock time. Individuals with advanced sleep phase are drowsy in the evening, want to retire to bed earlier, awaken earlier, and are more alert in the early morning. Individuals with this pattern of advanced sleep phase are sometimes called early birds or larks. Irregular Sleep-Wake Type The irregular sleep-wake pattern occurs when the circadian sleep-wake rhythm is absent or pathologically diminished. The sleep-wake pattern is temporally disorganized, and the timing of sleep and wakefulness is unpredictable. Individuals with this condition have a normal amount of sleep during a 24-hour period; however, it is fragmented into three or more episodes that occur irregularly. There are symptoms of insomnia at night and excessive sleepiness during the day. Long daytime naps and inappropriate nocturnal wakefulness occur. Except in unusual circumstances, activities of daily life are significantly impaired. A history of reclusion or isolation may be associated with this disorder because decreased exposure to external stimuli can contribute to symptoms. Irregular sleep-wake type is typically associated with neurodegenerative disorders, such as Alzheimer’s disease and some neurodevelopmental disorders in children. Non-24-Hour Sleep-Wake Type (Free Running) When the circadian sleep-wake pacemaker has a cycle length greater or less than 24 hours and is not reset each morning, a person may develop this type of circadian rhythm disorder, such as in blind or visually impaired persons. Under normal

circumstances, resynchronization of the circadian rhythm occurs daily in response to the light–dark cycle. Problems occur incrementally when internal and environmental clocks become more and more out of phase. If the circadian clock’s period is longer than 24 hours and does not reset each day, the patient experiences progressively worsening sleep-onset insomnia and daytime sleepiness. Sleep problems peak when circadian and environmental clocks are 12 hours out of phase and then begin to lessen, emulating progressively resolving advanced sleep phase. Eventually the clocks correlate, and the sleep-wake cycle is normal for a few days, after which the insomnia–hypersomnia cycle begins again. For this reason, non-24-hour sleep-wake disorder has been called periodic insomnia and periodic excessive sleepiness. Traumatic brain injury (TBI) has been associated with non-24-hour sleep-wake type. Blindness is a known risk factor. In both sighted and blind individuals, sequential measurement of phase markers such as melatonin may help in determining circadian phase. Both phototherapy and melatonin are being tried as treatments for this disorder. Shift Work Type Many service industries require 24-hour operation (e.g., transportation, health care). Similarly, as Western cultures became more capital intensive, mining and manufacturing became around-the-clock enterprises. The number of individuals doing shift work has been increasing steadily for decades. Shift workers commonly suffer from insomnia, excessive sleepiness, or both. Some individuals require only a short time to adjust to a shift change, whereas others have great difficulty. Frequent shift rotation adds to the problem. Furthermore, to meet social demands, shift workers often adopt a nonshifted sleep-wake schedule on weekends and holidays. Even those individuals who try to stay shifted usually retain an unshifted circadian rhythm. The result can be severe insomnia when attempting to sleep and excessive sleepiness when attempting to remain awake. The result is profound sleep deprivation as circadian rhythm continues to be poorly entrained to the sleep-wake schedule. The natural low point in the normal sleep-wake rhythm occurs at approximately 3:00 to 5:00 A.M. Of interest, this is

precisely the time frame during which transportation and industrial accidents commonly occur as a direct consequence of sleepiness. Though unclear, DSM-5 seems to indicate that individuals experiencing jet lag are included under this subtype, noting that, despite different etiologies, individuals who travel across many time zones frequently may experience effects similar to those of shift work disorder. Jet Lag Type Removed from DSM-5, jet lag is still recognized as a circadian rhythm sleep disorder by the ICSD-2. With the advent of high-speed air travel, an induced desynchrony between circadian and environmental clocks became possible. Thus, the term jet lag came into use. When an individual rapidly travels across many time zones, either a circadian phase advance or a phase delay is induced, depending on the direction of travel. Typically, translocation of one or two time zones will not produce a sustained problem; however, overseas travel can be marked by great difficulty in adjusting one's sleep-wake routine. Individuals who frequently travel for business can find themselves quite impaired at the time they need to make important decisions. Furthermore, "night owls" will experience greater difficulty adjusting to eastward travel because resynchronization requires phase advance. Similarly, "larks" theoretically will have more difficulty with westward travel. The number of time zones crossed is a critical factor. Normally, healthy individuals can easily adapt to one to two time zone changes per day; therefore, natural adjustment to an 8-hour translocation may take 4 or more days. Due to Medical Condition During illnesses that keep patients bedridden, during hospitalizations, and in some forms of dementia, individuals often

sleep ad lib. The resulting chaotic sleep-wake pattern adversely affects the circadian rhythm. The breakdown in the sleepwake cycle may be further exacerbated by medication with sedative properties. Sleep in patients in the intensive care unit is disturbed by noise, light, and the therapeutic and monitoring procedures being performed. The resulting disorganized sleep-wake pattern can produce a significant sleep disorder. In addition, abuse of recreational street drugs (e.g., methamphetamine and 3,4-methylenedioxymethamphetamine ["ecstasy"]) is associated with individuals remaining awake overnight or continuously for several days at a time. These episodes of prolonged wakefulness ultimately produce periods of profound hypersomnia (commonly called crashing). Treatment of Circadian Rhythm Sleep Disorders Chronotherapy is one technique used to reset the biological clock. It involves progressively phase delaying a person until the circadian oscillator is synchronized with the desired sleep-wake schedule. When individuals are deprived of environmental time cues and told to sleep when they feel sleepy, the typical "day" lasts 25 to 26 hours. This suggests that young and middle-aged adults have a propensity to phase delay. Thus, phase delaying each night by 2 to 3 hours is thought to be easier than phase advancing because it capitalizes on a natural tendency. Halting the phase delay at the appropriate moment and maintaining the desired synchrony can be a challenge. The patient also has to cope with an odd sleep-wake schedule for the better part of a week during therapy (which can interfere with school or work). For these reasons, the development of light therapy has in the past few years superseded chronotherapy. Light or Photo- Therapy. Sleep disorders' research indicates that exposing an individual to bright lights (greater than 10,000 lux) can alter the endogenous biological rhythm. With precise timing of bright light exposure, the biological clock can be stopped and reset. Exposure to light modifies the set-point of the biological clock. Using core body temperature as a physiological marker, one can use bright lights to produce phase delay when presented before the temperature nadir. By contrast, light exposure after the temperature nadir evokes phase advance. The closer one presents light to the point of inflection (temperature nadir), the more robust is the response in altering the cycle. Thus, early-morning bright-light therapy can be used to phase

advance individuals with delayed sleep phase syndrome. Similarly, exposure to bright light in the evening can help patients with advanced sleep phase syndrome. More recently, it was discovered that the blue part of the light spectrum is the crucial ingredient in phase setting and shifting. Light therapy is being applied to reset the circadian rhythm of shift workers, astronauts, and individuals experiencing jet lag. Melatonin. Experimental use of melatonin to treat circadian rhythm disorders in the blind, e.g. non-24-hour sleep-wake disorder (see above), has proven successful. Researchers posit that melatonin secretion acts as the biological substrate for the internal circadian oscillator. Under normal circumstances, melatonin levels begin to rise at dusk and remain elevated until dawn. Bright light suppresses the release of melatonin. Melatonin, in a sense, is the signal of darkness in the brain. As such, it can

be used clinically to manage sighted patients with disturbed sleep-wake cycles. Melatonin is available over the counter. A prescription form of melatonin (Circadin) is available in Europe, and a synthetic melatonin agonist (ramelteon [Rozerem]) is available in the United States. Ramelteon is FDA approved for treating patients with sleep-onset insomnia but is used off label for the entire spectrum of circadian rhythm sleep disorders. Of interest, the only medication approved for shift work sleep disorder is the wake-promoting compound modafinil. Modafinil is approved for treating sleepiness occurring during night shift work. PARASOMNIAS Parasomnias are sometimes referred to as disorders of partial arousal. In general, the parasomnias are a diverse collection of sleep disorders characterized by physiological or behavioral phenomena that occur during or are potentiated by sleep. One conceptual framework posits many parasomnias as overlaps or intrusions of one basic sleep-wake state into another. Wakefulness, NREM sleep, and REM sleep can be characterized as three basic states that differ in their neurological organization. During wakefulness, both the body and brain are active. In NREM sleep, both the body and brain are much less active. REM sleep, however, pairs an atonic body with an active brain (capable of creating elaborate dream fantasies). Regional cerebral blood flow, magnetic resonance imaging (MRI), and other imaging studies confirm increased brain activation during REM sleep. It certainly appears that in some parasomnias there are state boundary violations. For example, sleepwalking and sleep terrors involve momentary or partial wakeful behaviors suddenly occurring in NREM (slow wave) sleep. Similarly, isolated sleep paralysis is the persistence of REM sleep atonia into the wakefulness transition, whereas REM sleep behavior disorder is the failure of the mechanism, creating paralytic atonia such that individuals literally act out their dreams. The frequency of significant parasomnias is variable, and the clinical significance often has more to do with the medical consequences or the evoked level of distress than with how often the abnormal events occur. For example, biannual REM sleep behavior disorder, in which the patient is seriously injured while enacting a dream, is more clinically urgent than weekly bruxism. Similarly, monthly recurrent nightmares that provoke severe insomnia and fear of sleeping can be more distressing than night terrors of the same frequency (at least to the patient). The irregularities of occurrence of most parasomnias make them difficult to document in the sleep laboratory. Sleep studies, however, are often conducted to make a differential diagnosis and rule out that the unusual behavior is secondary to seizure, sleep-disordered breathing, or another sleep disorder. NREM Sleep Arousal Disorders Sleepwalking. See Table 16.2-8 for DSM-5 diagnostic criteria for NREM sleep arousal disorders. Sleepwalking in its classic form, as the name implies, is a condition in

which an individual arises from bed and ambulates without fully awakening. It is sometimes called somnambulism, and individuals can engage in a variety of complex behaviors while unconscious.

Sleepwalking usually occurs during slow wave sleep and lies in the middle of a parasomnia continuum that ranges from “confused arousal” to “sleep terror.” Sleepwalks characteristically begin toward the end of the first or second slow wave sleep episodes. Sleep deprivation and interruption of slow wave sleep appear to exacerbate, or even provoke, sleepwalking in susceptible individuals. Sleepwalking episodes may range from sitting up and attempting to walk to conducting an involved sequence of semipurposeful actions. The sleepwalker often can successfully interact with the environment (e.g., avoiding tripping over objects). However, the sleepwalker may interact with the environment inappropriately, which sometimes results in injury (e.g., stepping out of an upstairs window or walking into the roadway). There are cases in which sleepwalkers have committed acts of violence. An individual who is sleepwalking is difficult to awaken. Once awake, the sleepwalker will usually appear confused. It is best to gently attempt to lead sleepwalkers back to bed rather than to attempt to awaken them by grabbing, shaking, or shouting. In their confused state, sleepwalkers may think they are being attacked and may react violently to defend themselves. Sleepwalking in adults is rare, has a familial pattern, and may occur as a primary parasomnia or secondary to another sleep disorder (e.g., sleep apnea). By contrast, sleepwalking is very common in children and has peak prevalence between ages 4 and 8 years. After adolescence, it usually disappears spontaneously. Nightly to weekly sleepwalking episodes associated with physical injury to the patient and others are considered severe. There are “specialized” forms of sleepwalking, most notably sleeprelated eating behavior and sexsomnia. Table 16.2-8 DSM-5 Diagnostic Criteria for Non-Rapid Eye Movement Sleep Arousal Disorders

SLEEP-RELATED EATING. This occurs when an individual experiences episodes of ingesting food during sleep with varying degrees of amnesia. Individuals may find evidence of these episodes the next morning with little to no memory of their eating. SEXSOMNIA. Sleep-related sexual behavior, or sexsomnia, is when a person engages in sexual activities (e.g., masturbation, fondling, sexual intercourse) during sleep without conscious awareness. Sleep Terrors. Sleep terror disorder is an arousal in the first third of the night during deep NREM (stages 3 and 4) sleep. It is characterized by a sudden arousal with intense fearfulness. They usually begin with a piercing scream or cry and are accompanied by behavioral manifestations of intense anxiety bordering on panic. Autonomic and behavioral correlates of fright typically mark the experience. In a typical case of night terrors, no signs of temporal lobe epilepsy or other seizure disorders are seen, either clinically or on EEG recordings (Fig. 16.2-4). An individual experiencing a sleep terror usually sits up in bed, is unresponsive to stimuli, and, if awakened, is confused or disoriented. Vocalizations may occur, but they usually are incoherent. Notwithstanding the intensity of these events, amnesia for the episodes usually occurs. Like sleepwalking, these episodes usually arise from slow wave sleep. Fever and CNS depressant withdrawal potentiate sleep terror episodes. Unlike

nightmares, in which an elaborate dream sequence unfolds, sleep terrors may be devoid of images or contain only fragments of very brief but frighteningly vivid but sometimes static images. It is sometimes called pavor nocturnus, incubus, or night terror, and a familial pattern has been reported. As with other slow wave sleep parasomnias, sleep deprivation can provoke or exacerbate sleep terrors. Psychopathology is seldom associated with sleep terrors in children; however, a history of traumatic experience or frank psychiatric problems is often comorbid in adults with this disorder. Severity ranges from less than once per month to almost nightly occurrence (with injury to the patient or others). FIGURE 16.2-4 Polysomnogram of a sleep terror. A: Approximately 14 seconds of tracing occurring immediately before the sleep terror. Prominent electroencephalogram

(EEG) slow wave activity and other characteristics of stage 4 sleep are seen. B: The awakening, accompanied by tachycardia and movement. EEG activity is ambiguous, and the patient eventually disconnected his electrodes as he thrashed about in bed (visible at the far right). Although the patient was screaming and greatly agitated, there was no report of dreaming. In the morning, there was little recollection of anything having occurred during the night. AT, anterior tibialis; EKG, electrocardiogram; EMG, electromyogram; EOG, electro-oculogram; RC MVMNT, rib cage movement. (Courtesy of Constance A. Moore, M.D., Robert L. Williams, M.D., and Max Hirshkowitz, Ph.D.) Parasomnias Usually Associated with REM Sleep REM Sleep Behavior Disorder (Including Parasomnia Overlap Disorder and Status Dissociatus). REM behavior disorder (RBD) involves a failure of the patient to have atonia (sleep paralysis) during the REM stage sleep. The result is that the patient literally enacts his or her dreams. Under normal circumstances, the dreamer is immobilized by REM-related hypopolarization of alpha and gamma motor neurons. Without this paralysis or with intermittent atonia, punching, kicking, leaping, and running from bed during attempted dream enactment occur. The activity has been

correlated with dream imagery, and, unlike during sleepwalking, the individual seems unaware of the actual environment but rather is acting on the dream sensorium. Thus, a sleepwalker may calmly go to a bedroom window, open it, and step out. By contrast, a person with REM sleep behavior disorder would more likely dive through the window thinking it is a dream-visualized lake. Patients and bed partners frequently sustain injury, which is sometimes serious (e.g., lacerations, fractures). A wide variety of drugs and comorbid conditions can precipitate or worsen RBD. In animals, presumed RBD can be produced with bilateral peri-locus coeruleus lesions. In humans, there is a suggestion that RBD may result from diffuse hemispheric lesions, bilateral thalamic abnormalities, or brainstem lesions. Clonazepam (Klonopin) has been used successfully to treat RBD. Recurrent Isolated Sleep Paralysis. Sleep paralysis is, as the name implies, an inability to make voluntary movements during sleep. It becomes a parasomnia when it occurs at sleep onset or on awakening, a time when the individual is partially conscious and aware of the surroundings. This inability to move can be extremely distressing, especially when it is coupled with the feeling that there is an intruder in the house or when hypnagogic hallucinations are occurring. Sleep paralysis is one of the tetrad of symptoms associated with narcolepsy; however, it is known to occur (with or without hypnagogia) in individuals that have neither cataplexy nor excessive daytime sleepiness. Although it is sometimes frightening, sleep paralysis is a feature of normal REM sleep briefly intruding into wakefulness. The paralysis may last from 1 to several minutes. It is interesting that the occurrence of sleep paralysis with hypnagogia may account for a variety of experiences in which the sleeper is confronted or attacked by some sort of “creature.” The common description is that a “presence” was felt to be near, the individual was paralyzed, and the creature talks, attacks, or sits on the sleeper’s chest and then vanishes. Whether it is called an incubus, “Old Hag,” a vampire, ghost oppression (kanashibari in Japanese), witch riding, or an alien encounter, elements common to sleep paralysis are seen. Irregular sleep, sleep deprivation, psychological stress, and shift work are thought to increase the likelihood of sleep paralysis occurring. Occasional sleep paralysis occurs in 7 to 8 percent of young adults. Estimates of at least one experience of sleep paralysis during the lifetime range from 25 to 50 percent. Improved sleep hygiene and assurance of sufficient sleep are first-line therapies. Sometimes, if the individual voluntarily makes very rapid eye movements or is touched by another person, the episode will terminate. Nightmare Disorder. Nightmares are frightening or terrifying dreams. Sometimes called dream anxiety attacks, they produce sympathetic activation and ultimately awaken the dreamer.

Nightmares occur in REM sleep and usually evolve from a long, complicated dream that becomes increasingly frightening. The person having been aroused to wakefulness, he or she typically remembers the dream (in contrast to sleep terrors). Some nightmares are recurrent, and reportedly when they occur in association with posttraumatic stress disorder they may be recollections of actual events. Common in children ages 3 to 6 years (prevalence estimates range from 10 to 50 percent),

nightmares are rare in adults (1 percent or less). Frequent and distressing nightmares are sometimes responsible for insomnia because the individual is afraid to sleep. In Freudian terms, the nightmare is an example of the failure of the dream process that defuses the emotional content of the dream by disguising it symbolically, thus preserving sleep. Most patients afflicted with nightmares are free from psychiatric conditions. Nonetheless, individuals at risk for nightmares include those with schizotypal, borderline, and schizoid personality disorders, as well as those with schizophrenia. Having thin boundaries makes these individuals more vulnerable; furthermore, they may be at risk for schizophrenia. Traumatic events are known to induce nightmares, sometimes immediately, but at other times delayed. The nightmares can persist for many years. Several medications are known to sometimes provoke nightmares, including L-DOPA and β-adrenergic blockers, as does withdrawal from REM suppressant medications. Finally, drug or alcohol abuse is associated with nightmares. Frequently occurring nightmares often produce a “fear of sleeping” type of insomnia. In turn, the insomnia may provoke sleep deprivation, which is known to exacerbate nightmares. In this manner, a vicious cycle is created. Treatment using behavioral techniques can be helpful. Universal sleep hygiene, stimulus control therapy, lucid dream therapy, and cognitive therapy reportedly improve sleep and reduce nightmares. In patients with nightmares related to posttraumatic stress disorder, nefazodone (an atypical antidepressant) reportedly provides therapeutic benefit. Benzodiazepines may also be helpful; however, systematic controlled trials are lacking. Evidence for the use of prazosin (Minipress), a central nervous system α-1–receptor antagonist, in the treatment of posttraumatic stress disorder–related nightmares is growing. Prazosin significantly increased total sleep time and REM sleep time and significantly reduced trauma-related nightmares and distressed awakenings. Other Parasomnias Sleep Enuresis. Sleep enuresis is a disorder in which the individual urinates during sleep while in bed. Bed-wetting, as it is commonly called, has primary and secondary forms. In children, primary sleep enuresis is the continuance of bed-wetting since infancy. Secondary enuresis refers to relapse after toilet training was complete and there was a period during which the child remained dry. Usually, after toilet training bed-wetting spontaneously resolves before age 6 years. Prevalence progressively declines from 30 percent at age 4 years, to 10 percent at age 6 years, to 5 percent at age 10 years, and to 3 percent at age 12 years. Parental primary enuresis increases the likelihood that the children will also have enuresis. A single recessive gene is suspected. Secondary enuresis in children may occur with the birth of a sibling and represent a “cry for attention.” Secondary enuresis can also be associated with nocturnal seizures, sleep deprivation, and urological anomalies. In adults, sleep enuresis is sometimes seen in patients with sleep-disordered breathing. In most cases, embarrassment, shame, and guilt are the most serious consequences. Nonetheless, if sleep enuresis is not addressed, it may leave psychosocial scars. A variety of medications have been used to treat sleep enuresis, including imipramine, oxybutynin chloride, and synthetic

vasopressin. Behavioral treatments, including bladder training, using conditioning devices (bell and pad), and fluid restriction, have reportedly had good success when properly administered. Other

treatments include psychotherapy, motivational strategies, and hypnotherapy. Sleep-Related Groaning (Catathrenia). This disorder is a chronic condition characterized by prolonged, frequently loud groans during sleep. The groaning can occur in any sleep stage. The parasomnia may begin during childhood but often remains occult until the child has to share a room. Catathrenia is not related to any psychiatric or physiologic abnormalities. There is no known treatment, and it reportedly does not improve with CPAP therapy. Polysomnography with respiratory-sound monitoring reveals sounds during exhalation and respiratory dysrhythmia. Sleep-Related Hallucinations. Sleep-related hallucinations are typically visual images occurring at sleep onset (hypnagogic) or on awakening (hypnopompic) from sleep. Sometimes difficult to differentiate from dreams, they are common in patients with narcolepsy. Complex hallucinations are rare and usually happen with abrupt awakening and without remembrance dreaming. Images tend to be vivid and immobile and persists for several minutes (usually disappearing when a light is turned on). The images can be frightening. Sleep-Related Eating Disorder. This syndrome involves an inability to get back to sleep after awakening unless the individual has something to eat or drink. After eating or drinking, return to sleep is normal. Nocturnal eating (drinking) syndrome predominantly affects infants and children; however, adult cases have been reported. It is believe that the problem is mainly associated with breastfeeding or bottle feeding. An infant will drink 4 to 8 oz or more at each awakening. Wetting is also excessive. Infants should be able to sleep through the night without feeding after age 6 months; however, in afflicted individuals, this does not happen. The syndrome invariably leads to the caregiver becoming sleep deprived. In adults, nocturnal eating can be conditioned to awakening. Eating may become obsessional, and several small meals may be eaten during the course of a night. The individual may be unaware of the activity, and weight gain can become a problem. Parasomnia Due to Drug or Substance Use and Parasomnia Due to Medical Conditions. Many drugs and substances can trigger parasomnias, particularly those agents that lighten sleep; however, alcohol is notorious for producing sleepwalking (even in individuals who have taken sleeping pills). RBD can be provoked or worsened by biperiden (Akineton), tricyclic antidepressants, monoamine oxidase inhibitors (MAOIs), caffeine, venlafaxine (Effexor), selegiline (Eldepryl), and serotonin agonists. RBD may also occur during withdrawal from alcohol, meprobamate (Meprospan), pentazocine (Talwin), and nitrazepam (Nitrazadon). Medications known to provoke nightmares include L-DOPA and β-blockers. Nightmares can also be caused by drug-induced REM sleep rebound (e.g., withdrawal from REM-suppressing drugs such

as methamphetamine) and alcohol abuse or withdrawal. Seizure disorder should always be on the top of a differential diagnosis list for most parasomnias. In fact, the American Academy of Sleep Medicine practice guidelines concerning the indications for polysomnography include using sleep testing to rule out seizures when diagnosing sleep terror, sleepwalking, RBD, nightmares, and other parasomnias. Sleep-related breathing disorders are also known to trigger sleepwalking, enuresis, sleep terror, confusional arousal, and nightmares. RBD is associated with a variety of neurological conditions, including Parkinson’s disease, dementia, progressive supranuclear palsy, Shy-Drager syndrome (a movement disorder with autonomic arousal symptoms), narcolepsy, and others. Ms. R, a 20-year-old white woman, was referred with symptoms of talking, mumbling, and crying out during sleep. At least twice per week she screamed in her sleep. She was bothered with excessive sleepiness and falling asleep inappropriately, such as during a conversation. When inactive, she was tired and sleepy, even after a full 8-hour night of sleep. However, she had energy when motivated and led a vigorous life. Once, she awakened outside of her apartment and her roommate had to let her back in because she had locked herself out. She did not recall the sleepwalking

episode or other nocturnal wanderings but sometimes remembered yelling. From the history, crying seemed to occur in light sleep, but she rarely recalled any sleep-related thoughts or dreams. However, there was a history of occasional nightmares and bruxism. The patient used an oral appliance to protect her teeth. Leg kicking and mild snoring without gasping or choking were noted. The patient also complained of leg kicking during sleep. Her sleep-wake schedule was irregular, and she averaged between 5 and 7 hours of sleep per night. She occasionally awakened with a headache in the morning. Previous health history included a hospitalization for febrile convulsions during infancy, ophthalmologic surgery for strabismus during childhood, and tonsillectomy as a teenager. Her health was otherwise excellent. The patient did not smoke tobacco or drink alcohol. By history, Ms. R had one or more of the parasomnias. Sleep talking alone does not require a sleep study, but this patient had nocturnal wanderings. Polysomnography with clinical EEG are indicated to rule out unrecognized nocturnal seizure disorder or other organic factors inducing sleepwalking. Sleepwalking is common and not necessarily considered abnormal in young children; however, in the adult it is rare and merits careful evaluation. Ms. R's excessive daytime sleepiness was likely due to insufficient sleep (5 to 7 hours per night) and possibly parasomnia-related disruption. Of interest, many parasomnias are exacerbated by sleep deprivation, as is nocturnal seizure disorder. Sleep studies were performed using comprehensive, attended, laboratory polysomnography. Prior to the overnight study, a clinical EEG was performed. The clinical EEG study did not reveal any significant abnormal EEG activity during

baseline, photic stimulation, or hyperventilation. An extended EEG montage was used during the sleep study. Overall sleep quality was within the normal range. Sleep efficiency was 96 percent, and latency to sleep was 1 minute. REM sleep percentage was elevated (31 percent), and latency to REM sleep was less than normal (57 minutes). Slow wave sleep was normal in percentage, but EEG delta activity was of very high amplitude. The overall macroarchitectural sleep pattern suggested rebound from sleep deprivation. By contrast, sleep microarchitecture contained many abnormal features. There were high-amplitude paroxysmal EEG bursts. Excessively prolonged sleep spindles were noted, and rhythmic K complexes were observed (Fig. 16.2-5). There was one arousal out of slow wave sleep, with rhythmic EEG discharges alternating with sharp waves. Sharps and spikes occurred several times; however, the focus was difficult to localize (possibly right temporal lobe). There were frequent body movements and full body jerks, most of which occurred during NREM sleep. There were episodes of moaning during slow wave sleep and laughing during stage 2 sleep that was followed by highamplitude theta bursts and REM sleep. There were frequent movements and arousals from REM sleep but no REM-related spikes or sharp waves. Seizure-like EEG activity was noted during the night and occurred predominantly during slow wave sleep. However, the patient did not attempt to sleepwalk. Sharp wave-and-spike activity increased during the final 45 minutes of the sleep study. FIGURE 16.2-5 Tracings comparing normal sleep spindle activity during stage 2 sleep (A) with that of a patient chronically using a benzodiazepine (B). This patient had been treated with benzodiazepines for more than a decade and was currently taking an extremely high

dose before being seen at the sleep disorders center. Sleep was grossly abnormal. The most obvious aberration was the tremendous increase in the frequency, magnitude, and duration of electroencephalogram (EEG) spindle activity (see panel B). In addition, slow wave sleep was absent, stage 2 was grossly elevated, and spindles even intruded into rapid eye movement sleep. EOG, electro-oculogram. Note: This sample is not from the patient described in the case. (Courtesy

of Max Hirshkowitz, Ph.D., Rhoda G. Seplowitz-Hafkin, M.D., and Amir Sharafkhaneh, M.D., Ph.D.) The patient did not have any sleep-related breathing impairment, and oxygen saturation nadir was 90 percent. She had no periodic limb movements during sleep, and polygraphic features associated with restless legs syndrome were absent. (Courtesy of Max Hirshkowitz, Ph.D., Rhoda G. Seplowitz-Hafkin, M.D., and Amir Sharafkhaneh, M.D., Ph.D.) SLEEP-RELATED MOVEMENT DISORDERS Restless Legs Syndrome Restless legs syndrome (RLS) (also known as Ekbom syndrome) is an uncomfortable, subjective sensation of the limbs, usually the legs, sometimes described as a "creepy crawly" feeling, and the irresistible urge to move the legs when at rest or while trying to fall asleep. Patients often report the sensation of ants walking on the skin and crawling feelings in their legs. It tends to be worse at night and moving the legs or walking helps to alleviate the discomfort (Fig. 16.2-6). Thus, as the individual is lying in bed and relaxing, he or she is disturbed by these sensations. Then he or she moves the legs and again tries to fall asleep. This cycle sometimes continues for hours and results in profound insomnia. A National Institutes of Health workshop established criteria for the diagnosis of RLS. Uremia, neuropathies, and iron and folic acid deficiency anemias can produce secondary RLS. RLS is also reported in association with fibromyalgia, rheumatoid arthritis, diabetes, thyroid diseases, and COPD. Detailed history and physical examination are important parts of the RLS workup. In addition, the ferritin level should be checked in every patient with symptoms consistent with RLS. Pharmacologically, the dopaminergic agonists pramipexole (Mirapex) and ropinirole (Requip) are FDA approved and represent the treatments of choice. Other agents used to treat RLS include dopamine precursors (e.g., levodopa), benzodiazepines, opiates, and antiepileptic drugs (e.g., gabapentin [Neurontin]). Nonpharmacological treatments include avoiding alcohol use close to bedtime, massaging the affected parts of the legs, taking hot baths, applying hot or cold to the affected areas, and engaging in moderate exercise.

FIGURE 16.2-6 Restless legs syndrome. This patient presented with complaints of uncomfortable, crawling sensations in the legs when trying to fall asleep. Patients commonly report an urge to move the leg to dispel the sensation. This figure shows a bilateral pattern of leg electromyogram (EMG) activity; however, the discharge is more pronounced in the left anterior tibialis (EMG-AT-L) than the right (EMG-AT-R). This pattern continued for more than an hour as the patient attempted to fall asleep; note that the sharp activity in central and occipital encephalogram (EEG) (C3–A2 and O1–A2, respectively) and electro-oculogram (EOG) is an electrocardiographic (ECG) artifact and not an EEG abnormality. (Courtesy of Constance A. Moore, M.D., Robert L. Williams, M.D., and Max Hirshkowitz, Ph.D.) Periodic Limb Movement Disorder Periodic limb movement disorder (PLMD), previously called nocturnal myoclonus, involves brief, stereotypic, repetitive, nonepileptiform movements of the limbs, usually the legs. It occurs primarily in NREM sleep and involves an extension of the big toe. A partial flexion of the ankle, knee, and hip may also occur. These movements range from 0.5 to 5 seconds in duration and occur every 20 to 40 seconds. The leg movements are frequently associated with brief arousals from sleep and as a result can (but do not always) disturb sleep architecture. The prevalence of PLMD increases with aging and can occur in association with folate deficiency, renal disease, anemia, and the use of antidepressants. Pharmacotherapy for PLMD associated with RLS is the same as for RLS. Clinical trials of pharmacotherapy for other forms of PLMD are lacking. However, benzodiazepines, especially clonazepam, and opiates improve sleep in patients with

PLMD. Sleep-Related Leg Cramps Nocturnal leg cramps are much like leg cramps that occur during wakefulness. They usually affect the calf and are painful muscle contractions. The pain awakens the sleeper and thereby disrupts sleep. Metabolic disorders, mineral deficiencies, electrolytic imbalances, diabetes, and pregnancy are known precipitators. The reason that some individuals have repeated leg cramps during sleep and not during the day is not known. Sleep-Related Bruxism Sleep-related bruxism is diagnosed when an individual grinds or clenches the teeth during sleep. Formerly classified as a parasomnia, sleep bruxism can produce abnormal wear on the teeth, damage teeth, provoke tooth and jaw pain, or make loud unpleasant sounds that disturb the bed partner. Sometimes atypical facial pain and headache also result. More than 85 percent of the population may brux at one time or another; however, it is clinically significant in only about 5 percent. Teeth grinding occurs in any sleep stage but appears to be most common at transition to sleep, in stage 2 sleep, and during REM sleep. Some evidence indicates that teeth grinding during REM sleep is more commonly associated with dental wear or damage. Sleep bruxism does not appear to be exacerbated by dental malocclusion. It worsens during periods of stress. Researchers studying sleep bruxism have found that many patients seem to have less frequent teeth grinding when sleeping in the laboratory; therefore, repeated study may be needed to document the disorder. By contrast, bruxism frequently appears on polysomnographic recordings made for other purposes (Fig. 16.2-7). Sleep bruxism may occur secondary to sleep-related breathing disorders, the use of psychostimulants (e.g., amphetamine, cocaine), alcohol ingestion, and treatment with SSRIs. Differential diagnosis should rule out nocturnal seizures. Sleep bruxism can occur infrequently (monthly), regularly (weekly), or frequently (nightly). Severity is judged on the basis of sleep disruption, consequent pain, and dental damage. The usual treatment involves having the patient wear an oral appliance to protect the teeth during sleep. There are two basic types of appliances: the soft one (mouth guard) is typical used in the short term, whereas the hard acrylic one (bite splint) is used longer term and requires regular follow-up. Relaxation, biofeedback, hypnosis, physical therapy, and stress management are also used to treat sleep bruxism. A variety of drug therapies have been tried (benzodiazepines, muscle relaxants, dopaminergic agonists, and propranolol [Inderal]), but outcome data are not available.

FIGURE 16.2-7 Sleep-related bruxism. Approximately 25 seconds of tracing obtained from a patient during an episode of bruxism. Bruxism can occur during any stage of sleep or wakefulness. The interference pattern of electroencephalogram (EEG), electrooculogram (EOG), and electromyogram (EMG) channels is typical and reflects the rhythmic jaw movement and grinding of the teeth. This patient had many such episodes, some of which caused awakening. Readily observable tooth damage and jaw pain were noted. AT-L, left anterior tibialis; AT-R, right anterior tibialis; EKG, electrocardiogram; INTRC, intercostal. (From Sadock BJ, Sadock VA, Ruiz P, eds. Kaplan & Sadock’s Comprehensive Textbook of Psychiatry. 9th ed. Philadelphia: Lippincott Williams & Wilkins; 2009.) Sleep-Related Rhythmic Movement Disorder This sleep disorder is marked by repetitive, rhythmic movements usually involving the head and neck. Usually occurring at the transition from wakefulness to sleep, this movement disorder may also continue during light sleep. Formerly classified as a parasomnia, sleep-related rhythmic movement disorder has many names, including jactatio capitis nocturna, head banging, head rolling, body rocking, and rhythmie du sommeil. A majority of infants body rock. Some clinicians believe that body rocking develops from the soothing effect of vestibular stimulation. If the rhythmic movement persists into childhood and involves head banging, the risk of injury increases. The male to female ratio is 4 to 1. Severity ranges from less than one episode weekly to nightly episodes producing injury. Sleep-Related Movement Disorder

Due to Drug or Substance Use and Sleep-Related Movement Disorder Due to Medical Condition

A variety of drugs, substances, and comorbid conditions can produce or exacerbate sleep-related movement disorders. Stimulants can produce rhythmic movement disorders and bruxism. Antidepressants (including most tricyclics and SSRIs), antiemetics, lithium (Eskalith), calcium-channel blockers, antihistamines, and neuroleptics can provoke restless legs symptoms and periodic limb movement disorder. Neurologic diseases that are associated with daytime movement disorders can also be associated with sleeprelated movement disorders. Stress, anxiety, and sleep deprivation may contribute to bruxism. ISOLATED SYMPTOMS, APPARENTLY NORMAL VARIANTS, AND UNRESOLVED ISSUES Long Sleeper Some individuals are sleepy when they have what most people consider a normal amount of sleep; however, when given the chance to sleep 10 to 12 hours, they are refreshed. These people are classified as long sleepers. This pattern of requiring more than the average amount of sleep is usually present since childhood. Polysomnography may help to differentiate a long sleeper from someone with idiopathic hypersomnia. There may be associated autonomic nervous system dysfunction or polysomnographic evidence of elevated slow wave sleep percentage in patients with idiopathic hypersomnia. Short Sleeper People who fall under the category of short sleeper require less than 5 hours of sleep per 24-hour period in order to maintain normal daytime functioning and mood. This appears to run in families, but the specific genes are unknown. Snoring Primary snoring consists of loud snoring in the absence of recurrent apnea or hypopnea episodes. The sound may disturb the bed partner to the extent that the persons sleep in separate rooms. To be classified as primary snoring, the individual must not be suffering from excessive sleepiness. Snoring may become louder when the individual sleeps supine or during REM sleep. A variety of oral appliances have been developed to decrease snoring (see “Treatment” under “BreathingRelated Sleep Disorders”). Sleep Talking As the name implies, sleep talking in its classic form involves unconscious speech during sleep. It is seldom recognized in an individual unless it annoys the bed partner. It can be induced by fever, stress, or conversing with the sleeper. Somniloquy may accompany sleep terror, sleepwalking, confusional arousals, OSA, and REM sleep behavior disorder. Sleep Starts (Hypnic Jerk) Sleep starts are sudden, brief muscle contractions that occur at the transition between wakefulness and sleep in 60 to 70 percent of adults. The contractions commonly involve the legs; however, sometimes there is movement in the arms and

head. This “hypnic jerk,” as it is sometimes called, is usually benign. The sleep start, however, can interfere with the ability to fall asleep and may be accompanied by sensations of falling, a hallucinated flash of light, or a loud crackling sound. In severe cases the sleep start produces profound sleep-onset insomnia. Benign Sleep Myoclonus of Infancy Previously called benign neonatal sleep myoclonus, this disorder is characterized by asynchronous jerking of limbs and trunk during quiet sleep in neonates. This benign, apparently rare parasomnia usually begins within the first week of life and may last a few days or several months. No treatment is recommended. Hypnagogic Foot Tremor and Alternating Leg Muscle Activation during Sleep Hypnagogic foot tremor (HFT) occurs at sleep onset or during stages 1 and 2 of sleep. It consists in a rhythmic movement of the toes or feet for seconds to minutes. Alternating leg muscle activation (ALMA) consists of brief activation of the anterior tibialis in one leg and then the other. Propriospinal Myoclonus at Sleep Onset This is a spinal cord–mediated movement disorder that is sometimes associated with spinal cord lesions. Movements appear during times of wakeful relaxation and then may interfere with sleep onset. They start in the abdominal and truncal muscles and then progress

to the neck and proximal muscles of the limbs. Treatment with clonazepam or anticonvulsants may be effective. Excessive Fragmentary Myoclonus These small movements or muscle fasciculations of the fingers, toes, or corners of the mouth are involuntary and can occur during wakefulness or sleep. Although no visible movement is present, the patient is typically aware of the twitching. In patients with apnea, twitching may worsen during periods of hypoxemia. OTHER SLEEP DISORDERS Other Physiological (Organic) Sleep Disorders This category is for sleep disorders that do not fit into any other ICSD-2 classification. The disorders in this category are suspected to have a medical or physiological etiology even if the etiology is not known at the time of diagnosis. Other Sleep Disorder Not Due to Substance Use or Known Physiological Conditions This category is for sleep disorders that do not fit into any other ICSD-2 classification and are believed to be due to psychiatric or behavioral factors.

Environmental Sleep Disorder This is a sleep disorder secondary to environmental factors that contribute to insomnia or daytime somnolence (from insomnia or poor sleep). Noise, heat, cold, light, bed partner noise, bed partner activity, or perceived danger can induce an environmental sleep disorder. The insomnia or hypersomnia are directly caused by the disturbing environmental factor. An example of an environmental factor is having a neighbor who plays music loudly every night. Onset, course, and termination of the problem are correlated with the introduction, presence, and removal of the specific factor or factors. Thus, treatment involves identifying and removing the environmental irritant. TOOLS IN SLEEP MEDICINE Clinical Interview A careful and thorough clinical interview is one of the most informative parts of a patient workup for sleep disorders. The habitual bedtime and arising times for both weekdays and weekends, the frequency, duration, and refreshingness of naps, and overall level of sleepiness are good places to begin. Specific sleep problems relating to difficulty initiating and maintaining sleep are important, including whether there is rumination at bedtime, fear of not being able to sleep, or excessive worry when attempting to sleep. Leg movement, leg sensations, leg cramps, teeth grinding, dream enactments (with or without injury), and other movements should be queried. Morning headaches, morning dry mouth, nocturnal reflux, hyperhidrosis, nocturia, enuresis, nocturnal tongue biting, nightmares, sleep terrors, and other sleep-related problems should be reviewed. Asking about the presence of family pets and whether they sleep in the bedroom (or bed) can be important in some cases. Polysomnography Polysomnography is the continuous, attended, comprehensive recording of the biophysiological changes that occur during sleep. Each 30-second segment of the recording is considered an “epoch.” A polysomnogram is typically recorded at night and lasts between 6 and 8 hours. Brain wave activity, eye movements, submental electromyography activity, nasal–oral airflow, respiratory effort, oxyhemoglobin saturation, heart rhythm, and leg movements during sleep are measured. Body position is usually noted, and snoring sounds may be recorded. Brain wave activity, eye movements, and submental electromyogram are important for identifying sleep stages. Muscle tension and movements subside with deeper sleep and can also be useful in the diagnosis of periodic limb movement disorder and restless legs syndrome. Nasal airflow, respiratory effort, and oxyhemoglobin saturation are instrumental in diagnosing sleep apnea and other sleep-related breathing disorders. Indications for polysomnography include (1) diagnosis of sleep-related breathing disorders, (2) positive airway pressure titration and assessment of treatment efficacy, and (3) evaluation of sleep-related behaviors that are violent or may potentially harm the patient or bed partner. Polysomnography can also be used to diagnose atypical

parasomnias, sleep-related problems secondary to neuromuscular disorders, periodic limb movement disorder, and arousals secondary to seizure disorder. In addition, patients with excessive daytime sleepiness or those who wake up gasping or choking should be referred for polysomnography. A sleep study is not needed to diagnose RLS. Referrals for polysomnography should be considered in cases in which sleeplessness has been present for 6 months or more for a minimum of four nights a week. It should also be considered when insomnia has not responded to pharmacological or behavioral therapy, sleep-promoting medications are contraindicated, or a medical or psychiatric cause has been excluded. Referral should also be made if the treatment of an underlying medical or psychiatric comorbidity has failed to resolve the insomnia. Polysomnography is also recommended to assess sleep quality and quantity on the night just prior to a multiple sleep latency test being conducted to diagnose narcolepsy. Multiple Sleep Latency Test The multiple sleep latency test (MSLT) is indicated for diagnosing narcolepsy. Beginning 2 hours after morning awakening, 20-minute nap opportunities are provided during which the patient is instructed to let himself or herself fall asleep and not resist falling asleep. Electroencephalographic, electro-oculographic, and submental electromyography activity is recorded to determine sleep stage. The latency to sleep is used to assess the level of sleepiness, and the appearance of REM sleep on two or more nap opportunities confirms narcolepsy, especially when other ancillary symptoms are present (e.g., cataplexy, sleep paralysis, hypnagogia, and excessive sleepiness). If the patient falls asleep on a given nap opportunity, the nap is terminated 15 minutes after initial sleep onset. If the patient does not fall asleep, the session is terminated after 20 minutes of recording. Five nap opportunities are provided at 2-hour intervals across the day. Maintenance of Wakefulness Test Similar procedurally to the MSLT, the maintenance of wakefulness test (MWT) provides 40-minute test sessions at 2-hour intervals across the day, but the patient is instructed to try to remain awake. This technique is used to assess treatment outcomes and is sometimes required as part of “fit for duty” testing. Patients sit in a comfortable chair or on the bed with a bolster pillow in a darkened room while recordings are made. The first epoch of stage 2, 3, or 4 sleep or REM or three consecutive epochs of stage 1 mark unequivocal sleep onset. Falling asleep on MWT indicates some level of sleepiness. Fifty-nine percent of volunteers (presumably normal) remain awake for the entire 40 minutes across all four trials (using unequivocal sleep criteria). Any sleep latency of less than 8 minutes is abnormal. Sleep latency ranging from 8 to 40 minutes is of unknown significance. The mean sleep latency (first sleep epoch) is 30.4 ± 11.2 minutes, and the upper 95 percent confidence interval is 40 minutes. Actigraphy

An actigraph is a device that measures and records movement. It is usually worn on the wrist (like a watch) and can be used as a rough measure of the sleep-wake cycle. Depending on the model and the settings, it can make continuous recordings for days or weeks. It can be especially useful for assessing insomnia, circadian rhythm disorders, movement disorders, and an assortment of rare events. Home Sleep Testing Recently approved by Medicare, home sleep testing involves recording a limited number of cardiopulmonary parameters to assess patients for sleep-related breathing disorders. Home sleep testing is much less expensive than polysomnography. Usually, airflow, respiratory effort, heart rhythm, snoring sounds, and oximetry are recorded. A number of devices are commercially available that are capable of detecting sleep apnea in patients with moderate to severe pathophysiology. Negative studies are problematic because home sleep testing is less sensitive than full laboratory polysomnography. Patients with negative tests notwithstanding obvious symptoms or comorbidity should be scheduled for laboratory sleep study. In addition, home sleep testing does not check for the full spectrum of sleep disorders; therefore, residual

symptoms after a breathing disorder is diagnosed in this manner need careful follow-up.
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