The Power of Zzzzs

Uncovering why sleep is essential to our well-being & how to get more of it

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THE Longwood SEMINARS AT HARVARD MEDICAL SCHOOL

HARVARD MEDICAL SCHOOL

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Uncovering why sleep is essential to our well-being & how to get more of it

Moderator

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Speakers

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Peter C. Farrell Professor of Sleep Medicine,
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Stuart Quan, MD
Gerald E. McGinnis Professor of Sleep Medicine,
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About the Speakers

Elizabeth Klerman, MD, PhD

At Brigham and Women's Hospital and Harvard Medical School, Dr. Klerman's efforts are concentrated in clinical and biomathmatical research, teaching and clinical practice. Within the Division of Sleep Medicine, her areas of research are the application of circadian and sleep research principles to normal and pathophysiologic states and mathematical analysis and modeling of human circadian, sleep, and neurobehavioral mood and performance rhythms.

Dr. Klerman's clinical research focuses on the areas of (i) the interaction of endocrine, circadian and sleep rhythms in normal and pathological states; and (ii) mathematical analysis and modeling of sleep, circadian system and markers of its function. Research projects within the BWH Clinical Translational Research Center have included studies of sleep and circadian rhythms in blind people, changes in sleep and performance in healthy aging, the effects of chronic sleep restriction on neurobehavioral performance and alertness and the effects of light and darkness on circadian rhythms. She collaborates with investigators from other Divisions and hospitals to apply the principles of circadian rhythms research to the study of human physiology and pathophysiology.

Susan Redline, MD

Dr. Redline is the Peter C. Farrell Professor of Sleep Medicine at Harvard Medical School. She directs Programs in Sleep and Cardiovascular Medicine and Sleep Medicine Epidemiology at Brigham and Women's Hospital and Beth Israel Deaconess Medical Center. Dr. Redline's research includes epidemiological studies and clinical trials designed to (i) elucidate the etiologies of sleep disorders, including the role of genetic and early life developmental factors, and (ii) understand the cardiovascular and other health outcomes of sleep disorders and the role of sleep interventions in improving health. She leads the Sleep Reading Center for a number of major NIH multicenter studies, including the Sleep Heart Health Study and has led several large cohort studies including the Cleveland Children's Sleep and Health Study. She has published over 250 peer reviewed articles and has served the sleep research community in a number of capacities, including as a member of the Boards of Directors for the American Academy of Sleep Medicine and the Sleep Research Society, the NIH's Sleep Disorders Research Advisory Board, the Institute of Medicine's Committee on Sleep Medicine and Research, and Deputy Editor for the journal *Sleep*.

Stuart Quan, MD

Dr. Quan is a graduate of the University of California, San Francisco School of Medicine. He is professor emeritus of Medicine at the University of Arizona where he was chief of pulmonary and critical care medicine, associate head of the Department of Medicine, program director of the GCRC and director of the Sleep Disorders Center, and is the Gerald E. McGinnis Professor of Sleep Medicine at Harvard Medical School. He is currently the editor-in-chief of the *Journal of Clinical Sleep Medicine* and the editor of the Sleep and Health Education Program at Harvard Medical School's Division of Sleep Medicine. Dr. Quan also has served as the president of the American Academy of Sleep Medicine, chair of the Sleep Medicine Test and Policy Committee of the American Board of Internal Medicine and as a member of the Residency Review Committee for Internal Medicine of the Accreditation Council for Graduate Medical Education. Dr. Quan's current research activities focus on the epidemiology of sleep and sleep disorders, particularly sleep disordered breathing.

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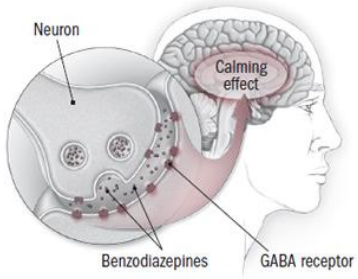
Better sleep means better health …

… but are sleep aids and prescription drugs hurting or helping?

Sleep is essential to good health, and a lack of it can lead to heart disease, high blood pressure, stroke, weight gain, and diabetes. Yet 22% of Americans struggle with insomnia every night, according to the National Sleep Foundation, and people ages 65 and older are one-and-a-half times more likely to battle the condition.

What's behind the problem? Your doctor may point out that aging causes some changes in sleep patterns, as do some chronic medical conditions. But a major culprit may be lurking in your medicine cabinet. "Prescription drugs can be a serious problem," says sleep expert Dr. Lawrence Epstein, an instructor in medicine at Harvard Medical School. "A number of medications can interfere with sleep."

How benzodiazepines work



Benzodiazepines bind to GABA receptors, and they enhance GABA's calming effects.

Sleeping pills

A prime suspect that can rob you of sleep is one that's supposed to promote rest: prescription sleep aids. "You get benefits early on, but if you use them long-term you adapt to them, they're less effective and can interfere with sleep," Dr. Epstein explains.

Sleep medications, called sedative hypnotics, come in three forms:

Benzodiazepines, such as alprazolam (Xanax), clonazepam (Klonopin), lorazepam (Ativan), and temazepam (Restoril), affect a chemical in the brain (gamma-aminobutyric acid, or GABA) that reduces nerve activity and promotes sleep. These can be habit-forming and may cause daytime sleepiness.

Non-benzodiazepines, such as eszopiclone (Lunesta) zaleplon (Sonata), and zolpidem (Ambien), also target GABA, but leave the body faster and have fewer side effects, allowing for regular waking and daytime functioning the next day.

Melatonin-receptor agonists such as ramelteon (Rozerem) also leave the body quickly. They target melatonin receptors in the brain and are not thought to be habit-forming.

All three types of hypnotics are intended for short-term use, about two weeks, but Dr. Epstein says he often sees patients who've been on these drugs for years. "Some people feel it's easier to take a pill than to try other methods to treat insomnia, and many physicians continue giving them prescriptions because they aren't trained in sleep medicine or they feel pressured to help their patients get sleep immediately." Some patients require long-term treatment, but it is best to take these medications for the shortest possible time.

Unfortunately, long-term use of sleep medications carries risks. You can develop medication tolerance: the medicine loses its punch with repeated use, so you keep needing to increase the dose. Many also cause lingering daytime sleepiness. Long-term use also can cause strange behaviors while the brain is still asleep: walking, binge eating, or taking the car out for a drive. Besides raising the risk of injury, these behaviors can lead to fatigue the next day by reducing the time you spent in deep, restorative sleep.

Prescription interferences

A number of other prescription medications may also interfere with sleep. Some medications may wake you with nausea, night sweats, or a need to go to the bathroom. Stimulants in prescription drugs can also cause poor-quality sleep or a lack of sleep. Prescription drugs with stimulant effects include steroids, antidepressants, and medications for migraines, heart disease, hypertension, and allergies. Many over-the-counter decongestants and weight-loss drugs contain stimulants.

How to get better sleep

If you suspect that a prescription medication for a chronic condition is interfering with your sleep, talk to your doctor. In many cases, the fix is a matter of adjusting the type of medicine you're taking, the time of day you're taking it, or the dosage. Don't stop taking your medication without consulting your physician first. In some cases, adjustments do not help. When that happens, says Dr. Epstein, the benefits of the medicine in controlling the condition for which it was prescribed need to be weighed against its effects in disrupting sleep.

If you've been taking prescription sleep medicine for a long time and you're not sleeping well, Dr. Epstein says it's time to seek alternative treatments. He is not a fan of supplements such as the hormone melatonin or the herb valerian root. He says there is little evidence they help. He does recommend behavior therapies with the help of a sleep specialist or a psychologist.

One behavior therapy is sleep restriction, a method of actually cutting down the amount of time in bed to create more consolidated sleep. Another method is stimulus control, which changes the associations with sleep to change sleep behavior. You can improve sleep hygiene by looking at your sleeping habits and

environment. Finally, there's cognitive therapy, which teaches you to adjust your thoughts or anxiety about sleep to change your behavior.

Sometimes a combination of sleep therapy and a gradual decrease in sleep medications is effective. But don't stop taking sleep drugs on your own. Enlist your doctor's help for instruction and to monitor for withdrawal symptoms. Be aware that each time you make a shift in the dose, your sleep will be disrupted for several days, so consider making the change on a weekend.

And most of all, be patient, even at 3:30 in the morning. "Insomnia and chronic sleep problems can be fixed," says Dr. Epstein.

To learn more…
This information is prepared by the editors of the Harvard Health Publications division of Harvard Medical School. It originally appeared in the December 2012 issue of the *Harvard Health Letter* available from health.harvard.edu/health.

8 secrets to a good night's sleep

Tired of feeling tired? Here are some simple tips to help you get to sleep.

After a night spent tossing and turning, you wake up feeling like a couple of the Seven Dwarves: sleepy…and grumpy. Restless nights and weary mornings can become more frequent as we get older and our sleep patterns change—which often begins around the time of menopause, when hot flashes and other symptoms awaken us.

"Later in life there tends to be a decrease in the number of hours slept," says Dr. Karen Carlson, associate professor of medicine at Harvard Medical School and director of Women's Health Associates at Massachusetts General Hospital. "There are also some changes in the way the body regulates circadian rhythms," she adds. This internal clock helps your body respond to changes in light and dark. When it undergoes a shift with age, it can be harder to fall asleep and stay asleep through the night.

We all have trouble sleeping from time to time, but when insomnia persists day after day, it can become a real problem. Beyond making us tired and moody, a lack of sleep can have serious effects on our health, increasing our propensity for obesity, heart disease, and type 2 diabetes.

If you've been having trouble falling asleep or staying asleep, you may have turned to sleep medications in search of more restful slumber. However, these drugs can have side effects—including appetite changes, dizziness, drowsiness, abdominal discomfort, dry mouth, headaches, and strange dreams. A recent study in the British Medical Journal associated several hypnotic sleep aids, including zolpidem (Ambien) and temazepam (Restoril), with a possible increased risk of death (although it couldn't confirm how much of the risk was related to these drugs).

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You don't need to avoid sleep aids if you absolutely need them, but before you turn to pills, try these eight tips to help you get a better night's sleep:

1. Exercise

Going for a brisk daily walk won't just trim you down, it will also keep you up less often at night. Exercise boosts the effect of natural sleep hormones such as melatonin, Dr. Carlson says. A study in the journal Sleep found that postmenopausal women who exercised for about three-and-a-half hours a week had an easier time falling asleep than women who exercised less often. Just watch the timing of your workouts. Exercising too close to bedtime can be stimulating. Carlson says a morning workout is ideal. "Exposing yourself to bright daylight first thing in the morning will help the natural circadian rhythm," she says.

2. Reserve bed for sleep and sex

Don't use your bed as an office for answering phone calls and responding to emails. Also avoid watching late-night TV there. "The bed needs to be a stimulus for sleeping, not for wakefulness," Dr. Carlson advises. Reserve your bed for sleep and sex.

3. Keep it comfortable

Television isn't the only possible distraction in your bedroom. Ambience can affect your sleep quality too. Make sure your bedroom is as comfortable as possible. Ideally you want "a quiet, dark, cool environment," Dr. Carlson says. "All of these things promote sleep onset."

4. Start a sleep ritual

When you were a child and your mother read you a story and tucked you into bed every night, this comforting ritual helped lull you to sleep. Even in adulthood, a set of bedtime rituals can have a similar effect. "Rituals help signal the body and mind that it's coming to be time for sleep," explains Dr. Carlson. Drink a glass of warm milk. Take a bath. Or listen to calming music to unwind before bed.

5. Eat—but not too much

A grumbling stomach can be distracting enough to keep you awake, but so can an overly full belly. Avoid eating a big meal within two to three hours of bedtime. If you're hungry right before bed, eat a small healthy snack (such as an apple with a slice of cheese or a few whole-wheat crackers) to satisfy you until breakfast.

6. Avoid alcohol and caffeine

If you do have a snack before bed, wine and chocolate shouldn't be part of it. Chocolate contains caffeine, which is a stimulant. Surprisingly, alcohol has a similar effect. "People thinks it makes them a little sleepy, but it's actually a stimulant and it disrupts sleep during the night," Dr. Carlson says. Also stay away from anything acidic (such as citrus fruits and juices) or spicy, which can give you heartburn.

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7. De-stress

The bills are piling up and your to-do list is a mile long. Daytime worries can bubble to the surface at night. "Stress is a stimulus. It activates the fight-or-flight hormones that work against sleep," Dr. Carlson says. Give yourself time to wind down before bed. "Learning some form of the relaxation response can promote good sleep and can also reduce daytime anxiety." To relax, try deep breathing exercises. Inhale slowly and deeply, and then exhale.

8. Get checked

An urge to move your legs, snoring, and a burning pain in your stomach, chest, or throat are symptoms of three common sleep disrupters—restless legs syndrome, sleep apnea, and gastroesophageal reflux disease or GERD. If these symptoms are keeping you up at night or making you sleepy during the day, see your doctor for an evaluation.

Taking sleep medicines safely

If you've tried lifestyle changes and they aren't working, your doctor may prescribe hypnotic sleep medications. These drugs can help you fall asleep faster and stay asleep longer, but they also can have side effects. Here are some tips for ensuring that you're taking these medicines as safely as possible:

- Tell your doctor about all other medicines you're taking. Some drugs can interact with sleep medications.
- Take only the lowest possible effective dose, for the shortest possible period of time.
- Carefully follow your doctor's instructions. Make sure you take the right dose, at the right time of day (which is typically just before bed).
- Call your doctor right away if you experience any side effects, such as excess sleepiness during the day or dizziness.
- While you're taking the sleep medicine, also practice the good sleep habits outlined in this article.
- Avoid drinking alcohol and driving while taking sleep aids.

Sleep medications may make you walk unsteadily if you get out of bed in a drowsy state. If you routinely have to get out of bed during the night to urinate, be sure the path to your bathroom is clear of obstacles or loose rugs so you don't fall.

To learn more…
This information is prepared by the editors of the Harvard Health Publications division of Harvard Medical School. It originally appeared in the July 2012 issue of the *Harvard Women's Health Watch* available from health.harvard.edu/womens.

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Learning while you sleep: Dream or reality?

A good night's sleep is remarkably powerful. It restores mind and body, preparing both for the challenges that lie ahead. Without restful sleep, mood, concentration, and mental performance suffer. Sleep deprivation is a major cause of car crashes and other accidents, and it has been linked to important medical problems ranging from hypertension, obesity, and diabetes to heart disease, erectile dysfunction, and possibly even prostate cancer.

Health-conscious men don't take sleep for granted, and scientists don't either. In fact, research suggests that even a brief nap may help boost learning, memory, and creative problem solving — all while your head is on the pillow.

Setting the stage

Four reports suggest that sleep may improve cognitive function. To understand the results, though, it's important to review the stages of sleep.

Sleep is divided into two major phases, rapid-eye-movement (REM) and non–rapid-eye-movement (NREM) sleep. Sleep begins with the NREM state. In turn, NREM sleep passes through four stages: onset (Stage 1), light sleep (Stage 2), and deep sleep (Stages 3 and 4). After about 60 to 90 minutes, REM sleep kicks in; it lasts some 20 to 30 minutes, and then NREM sleep returns to start a new sleep cycle. During the course of a normal night, a healthy adult will experience four to six consecutive sleep cycles.

NREM and REM sleep follow on each other's heels; both are important for health, but they are vastly different. During NREM sleep, body movements continue, but eye movements are quiet or absent. Breathing slows and the heart rate and blood pressure fall. Blood flow to the brain decreases, and electroencephalograms (EEGs) show slowing of the brain's activity.

In many ways, REM sleep is the opposite of NREM sleep. The body is immobile, but although the lids remain closed, the eyes dart rapidly in all directions. The blood pressure, heart rate, and respiratory rate swing up and down, and healthy men develop erections. Blood flow to the brain increases sharply, and EEGs show spiking activity. Dreaming is most common during REM sleep, but it may also occur during the early stages of NREM sleep.

To dream, perhaps to learn

A 2010 Harvard study suggested that dreaming may reactivate and reorganize recently learned material, improving memory and boosting performance. The subjects were 99 healthy college students who agreed to avoid alcohol, caffeine, and drugs for at least 24 hours prior to the experiment. All the volunteers demonstrated normal sleep patterns before enrolling in the study.

Each of the subjects spent an hour learning how to navigate through a complex three-dimensional maze-like puzzle. After the training period, half of the students were allowed to nap for 90 minutes, while the others

read or relaxed. Following a lunch break, all the volunteers tackled the virtual maze again. The only students whose performance substantially improved were the few who dreamed about the maze during their naps. Although the dreams didn't actually depict solutions to the puzzle, the researchers believe they show how the dreaming brain can reorganize and consolidate memories, resulting in better performance on learned tasks. And all the amazing dreams occurred early in NREM sleep.

Shorter naps

Another Harvard study tested the effects of a 45-minute daytime nap. The subjects were 33 college students; each spent 30 minutes working on the computer to master one verbal and two spatial tasks: memorizing 60 pairs of unrelated words, solving a maze puzzle, and copying an intricate figure. All the students were tested on the tasks, after which half were allowed to nap while the others rested quietly. Researchers repeated all the tests later in the afternoon. They found that NREM napping — sleeping for less than 90 minutes — further boosted performance for the students whose initial tests demonstrated good learning, but napping did not help the students who scored poorly on their first tests.

Micro naps

Busy men may not be able to set aside 45 minutes for a nap — but in 2008, German scientists reported that even a six-minute snooze may help improve memory. The subjects were 44 university students who were given two minutes to memorize a list of 30 words. Recall was tested an hour later, but during that hour, some of the subjects remained awake, another group napped for six minutes, and a third group took longer naps that averaged 36 minutes. The subjects who did not nap recalled an average of less than seven words; the students who napped for six minutes averaged more than eight words; and those who took longer naps averaged just over nine words. The changes may seem small, but they could come in handy if you have to tell your boss that nodding off at your desk is actually boosting your efficiency.

REM sleep and creativity

The studies from Harvard and Germany suggest that NREM napping may improve memory and learning. A 2009 report from California indicates that REM sleep may be even better, at least for creative problem solving. In the morning, the researchers gave 77 volunteers a series of creative problems and then asked them to spend the afternoon mulling over solutions before being tested at 5 p.m. One group of subjects rested quietly but stayed awake, while another was allowed to nap. All the nappers were monitored during sleep. Only those who took longer naps entered REM sleep, which occupied about 14 minutes of the 73-minute naps. NREM napping did not boost creative problem solving, but people who entered REM sleep enhanced their performance by nearly 40%, as compared with both non-nappers and NREM nappers. The improvement was specific for problems that were introduced before napping; rather than simply boosting alertness and attention, REM sleep allowed the brain to work creatively on problems posed before sleep.

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Perspectives

Sorry to say, a nap or two won't make you smart or assure success. But doctors know that a good night's sleep is associated with good health, and a 2007 Greek investigation linked napping with a reduced risk of heart disease. Now four studies suggest that naps may boost intellectual performance, at least in the short term. The research shows that NREM sleep can improve memory and that REM sleep can enhance creative problem solving. It's a two-step approach that should give every man something to sleep on.

To learn more…
This information is prepared by the editors of the Harvard Health Publications division of Harvard Medical School. It originally appeared in the February 2012 issue of the *Harvard Men's Health Watch* available from health.harvard.edu/newsletters/mens.

When to seek help for sleep problems

Although two-thirds of Americans have sleep problems, the vast majority of people with sleep disturbances suffer in silence. They enjoy life less, are less productive, and endure more illnesses and accidents at home, on the job, and on the road.

The American Academy of Sleep Medicine recommends seeking medical advice if sleep deprivation has compromised your daytime functioning for more than a month. Don't hesitate to ask for help when you're sleeping badly following a death in the family or other stressful event. A physician may suggest the short-term use of a sedative to help you sleep at night and thus cope better during the day and prevent development of a long-term sleep disorder.

It's not always easy for people to get evaluation and treatment for a sleep problem. According to a National Sleep Foundation survey, most primary care physicians do not routinely ask their patients about sleep. And while most of the physicians who took part in the survey admitted they had limited knowledge about sleep-related matters, more than half did not consult with an expert in sleep medicine. So it's in your best interest to seek out the help you need.

Your sleep history

A sleep disturbance cannot be accurately diagnosed unless your physician is familiar with your sleep habits and history. This information may be gleaned from an interview or from written questionnaires that you review and discuss with your doctor. A bedroom partner may be able to help answer some of these questions and should contribute to the discussion.

Some people are so used to sleep deprivation that they don't realize they're tired; instead, they may see themselves as lazy, lethargic, or not very motivated. Or they may not think it is unusual to fall asleep at a movie or while sitting at dinner with friends. Someone considered by family members to be a "good napper,"

able to drop off quickly and sleep through anything, may actually be displaying signs of abnormal sleepiness. Your physician may ask how likely you are to doze off in certain situations. The less appropriate the circumstances (such as waiting in traffic while driving or having a conversation), the more dangerously sleepy you are considered to be.

A sample sleep history questionnaire

Your physician may ask you some of the following questions during an evaluation for a sleep problem. You may find it helpful to write down your answers to these questions and bring the completed questionnaire to the exam so you and your doctor can discuss it.

- What bothers you most about your sleep habits?
- How long have you had trouble sleeping, and what do you think started the problem? Did it come on suddenly?
- How would you describe your usual night's sleep?
- What time do you go to bed, and when do you wake up?
- How long does it take you to fall asleep?
- Once you're asleep, do you sleep through the night or wake up frequently?
- What's your bedroom like?
- What do you do in the few hours before bedtime?
- Do you follow the same sleep pattern during the week and on weekends? If not, how are weekends different?
- How well do you sleep on the first few nights when you're away from home? At home, do you sleep better in your bedroom or in another room in the house?
- Do you often feel sleepy during the day?
- Do you fall asleep at inappropriate times or places?
- Have you ever been in a car accident or had a close call because you nodded off at the wheel?
- Do allergies or nasal congestion bother you at night?
- Do you have physical aches and pains that interfere with sleep?
- What medications or drugs (including alcohol and nicotine) do you use? Have you ever taken sleep medications? If so, which ones?

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- Do you often have indigestion at night?
- Do you ever feel discomfort or a fidgety sensation in your legs and feet when you lie down? Do you have to get up and walk around to relieve the feeling?
- Do you kick or thrash around at night?
- Do you ever have trouble breathing when you lie down, or do you awaken because it's hard to breathe?
- Does your bed partner or roommate mention that you snore loudly or gasp for air at night?
- Do you ever awaken with a choking sensation or a sour taste in your mouth?
- Do you wake up with a headache or with cramps in your legs?
- How have you been feeling emotionally? Does your life seem to be going as well as you would like?

Ruling out mental health issues

Sleep disturbances, particularly insomnia, are often related to psychological difficulties that respond well to treatment once they've been identified. Physicians may screen problem sleepers for symptoms of depression, anxiety, childhood physical or sexual abuse, or other psychological problems or traumatic experiences. If one of these conditions is diagnosed, your primary care physician may refer you to a psychologist or psychiatrist for treatment.

Sleep laboratory evaluation

Most people with sleep problems don't need to visit a sleep laboratory. Insomnia and circadian rhythm disorders, for example, can be diagnosed by a thorough history and physical examination. However, when a doctor suspects a sleep disorder such as narcolepsy, periodic limb movement disorder, sleep apnea, or one of the parasomnias, he or she may recommend formal sleep testing.

Fees depend on the level of testing required. Check with your insurance company in advance because reimbursement varies and may depend on your diagnosis.

The American Academy of Sleep Medicine has a listing accredited sleep disorder centers and board-certified sleep specialists. Some centers allow you to make an appointment directly, while others require a physician referral. The center will request medical records and may send you a sleep questionnaire or diary to use before your visit. You may also be asked to change your sleep habits in certain ways before scheduling the visit. Sometimes these changes alone correct the problem.

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How sleepy are you?

Sleep specialists often use this measure, called the Epworth Sleepiness Scale, to gauge a patient's level of daytime sleepiness.

Imagine yourself in the following situations, and then select your likelihood of dozing using the 0–3 scale below. Add up these numbers. If you score 10 points or more, consider seeing a physician for an evaluation.

Scale:

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

Situation	**Score**
Sitting and reading	
Watching TV	
Sitting inactive in a public place, like a theater or meeting	
As a passenger in a car for an hour without a break	
Lying down to rest in the afternoon	
Sitting and talking to someone	
Sitting quietly after lunch (when you've had no alcohol)	
In a car while stopped in traffic	
TOTAL	

Overnight sleep tests

When you spend the night in a sleep laboratory, you'll wear your own nightclothes and you can use a pillow from home. You can take your regular medications, but the clinicians will need to know what they are. The lab usually provides a regular bed in a private room with a bathroom attached. The room is kept as quiet as possible.

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After a technician sets up the sleep-monitoring equipment, you'll be left alone to relax until bedtime. Throughout the night, laboratory staff will monitor the instruments in a nearby control room. Procedures used may include polysomnography, audio and video recording, and daytime sleep tests.

Polysomnography. In this procedure, small wafer-thin electrodes and other sensors are pasted on specific body sites to take a variety of readings during the night. They may be placed on your scalp to track brain waves; under your chin to measure fluctuations in muscle tension (called an electromyogram, or EMG); near your eyes to measure eye movements; near your nostrils to measure airflow; on your earlobe or finger to measure the amount of oxygen in your blood (using a device called an oximeter); on your chest or back to record heart rate and rhythm; on your legs to record twitches or jerks; and over your rib muscles or around the rib cage and abdomen to monitor breathing.

Readings are collected on a single printout (called a polysomnogram) and analyzed by a technician and physician. If a breathing problem is detected early on, you may be awakened and given treatment, such as PAP, during the second half of the night. This allows the sleep experts to monitor how well the treatment works for you. Sometimes this process requires two nights. A standard polysomnogram cannot diagnose sleep-related epilepsy. If your doctor suspects that you have a seizure disorder, you may undergo a full electroencephalogram (EEG) during the night.

Audio and video recording. Audio equipment may be used to record snoring, talking during sleep, or other sounds. A video may also be taken to compare with the polysomnogram. This may show, for example, that you snore only when in a certain position. Signs of movement disorders (such as periodic limb movement disorder) or parasomnias will probably be apparent on the video.

Daytime sleep tests. Daytime sleep tests may be administered after a night in the sleep lab. The multiple sleep latency test measures how long it takes you to fall asleep while lying down in a quiet room and what stages of sleep occur during a brief nap. The procedure is usually repeated four or more times during the day at two-hour intervals. This test measures sleepiness and looks for signs of narcolepsy. Falling asleep within five minutes each time indicates extreme sleepiness.

In the maintenance of wakefulness test, which is less commonly used, you're given the opposite instructions: try to stay awake. This ability is also affected by the degree of sleepiness. People are sometimes given both tests at different times.

To learn more…
This information is prepared by the editors of the Harvard Health Publications division of Harvard Medical School, and excerpted from the special report, *Improving sleep: A guide to a good night's rest*. You can learn more about this publication at health.harvard.edu/IS.

Disturbances of sleep timing

When their internal clocks are disturbed, people may long for sleep when they need to be awake or may stay up until the wee hours of the morning without feeling tired.

Delayed sleep phase syndrome

Almost everyone is programmed for a day that lasts slightly longer than 24 hours, but "night owls" are less sensitive to the environmental cues that help most people maintain the usual 24-hour cycle. Left to their own devices, they would generally go to sleep and wake up much later each day. Only by relying on external cues, such as alarm clocks, do they manage to stay in sync with a more conventional schedule. Night owls have trouble getting anything done in the morning.

They may be able to gradually synchronize their schedule with others by going to bed and getting up at the same time every day. However, it's easy for their sleep patterns to go awry when they go on vacation or retire. Night owls often find that a minor shift in sleep/wake cycles — such as the onset of daylight savings time, a coast-to-coast trip, or a weekend of late-night parties — can throw them off kilter unless they force themselves to get up at the same time every day.

Resetting your internal clock

Exposure to bright light as directed by a sleep specialist — a technique known as light therapy — may be useful in treating delayed sleep phase syndrome. Upon awakening, patients typically sit for 30 minutes facing a specially manufactured box that emits bright light with a minimal amount of ultraviolet light. Initial studies used white light, which contains the entire spectrum of light wavelengths. More studies suggest that blue light is the most potent part of the spectrum for resetting the circadian clock.

Another option is to move your bedtime progressively later until you've shifted around the clock and are back in sync. To do this, go to bed three hours later each night. Once you have synchronized your schedule to match that of the other people around you, wake yourself up at the same time each day.

A delayed sleep phase also can be reset in a single weekend. This requires staying up all night on Friday and all day Saturday, then going to bed around 10 p.m. On Sunday, get up at 7 a.m. From then on, adhere closely to the same bedtime and waking time seven days a week.

Melatonin may also have a role in treating delayed sleep phase syndrome; taking 1 to 3 milligrams at your desired bedtime may help advance your sleep schedule.

Advanced sleep phase syndrome

People whose body rhythm cycles are shifted much earlier go to bed earlier, wake up in the early morning, and eventually can't stay awake past early evening. This condition, called advanced sleep phase syndrome, is

more common among older people. Treatments being studied include bright light therapy in the evening, which helps reset the body's clock, and carefully timed doses of melatonin.

Jet lag

Many people find that crossing several time zones makes their internal clocks go haywire. In addition to having headaches, stomach upset, and difficulty concentrating, they may suffer from fitful sleep.

Younger people usually adapt more quickly to time changes than older people. It takes about a day to adjust for every time zone crossed. Many people have more difficulty traveling eastward, but older people may have more symptoms traveling westward.

The standard way to handle jet lag is to try to sleep only at night upon arrival and to get up early in the morning, although it may be difficult the first few days. You can also gradually adjust your sleep time prior to leaving (see Figure). This way your body can start adjusting to the new time zone as soon as possible. Short-term use of timed doses of melatonin or ramelteon to shift circadian rhythms or over-the-counter or prescription sleep aids to help you sleep at night also can be helpful.

Ways to avoid jet lag

- **Don't time-shift.** On a brief trip just one or two time zones away, it may be possible to wake up, eat, and sleep on home time. Schedule appointments for times when you would be alert at home.

- **Gradually switch before the trip.** For several days before you leave, move mealtimes and bedtime incrementally closer to the schedule of your destination. Even a partial switch may make the trip easier.

- **Switch as rapidly as possible upon arrival.** On a long trip, don't turn in until it's bedtime in the new time zone. For the first day or two, spend as much time outdoors as possible to let daylight reset your internal clock.

- **Use the sun.** If you need to wake up earlier in the new setting (flying west to east), get out in the early morning sun. If you need to wake up later (flying east to west), expose yourself to late afternoon sunlight.

- **Drink plenty of fluids, but not caffeine or alcohol.** Caffeine and alcohol promote dehydration, which worsens the physical symptoms of jet lag. They can also disturb sleep.

The Power of Zzzzs
Uncovering why sleep is essential to our well-being and how to get more of it
Longwood Seminars, March 19, 2013
The following content is provided by Harvard Health Publications

Jet lag: How to reset your biological clock

Traveling west to east

Help reset your biological clock when you travel through time zones. If you'll be traveling through several time zones, as when flying coast to coast, you can gradually adjust your sleep time. For example, three days before you plan to travel from the West Coast to the East Coast, go to bed half an hour earlier than usual, and get up half an hour earlier the next morning. The next night, go to bed an hour earlier than usual and get up an hour earlier. The day before you travel, make it 90 minutes. By the fourth day — the day of your trip — you'll find it easier to adjust to your new time zone.

Sunday insomnia

People often have trouble falling asleep on Sunday nights. While anxiety about work or school on Monday is a potential cause, often the most important factor is weekend changes in sleep habits. When you stay up later Friday night and sleep in Saturday morning, you are primed to stay up even later Saturday night and sleep in the next day. By Sunday evening, your body's clock is programmed to stay up late. People who have developed a pattern of Sunday insomnia may feel their anxiety mount as they anticipate a difficult night ahead.

The best way to avoid the Sunday blues is to maintain the same wake-up time and bedtime on the weekends as during weekdays. If this isn't possible and you end up staying up later than usual on Friday and Saturday, the next best thing is to force yourself to get up at your weekday wake-up time and take an early afternoon nap on Saturday and Sunday. This way, you maintain the same wake-up time while still compensating for your sleep deprivation.

Shift work

More than 20% of American workers — including health care workers, police officers, security guards, and transit workers — are on the evening or night shift. About 60% to 70% of shift workers experience sleep disturbances. These people fall asleep on the job two to five times more often than day-shift workers do. Sleepiness can be catastrophic for people in these vital roles. Sleep-deprived physicians, for example, make a

greater number of errors than their better-rested colleagues, and it's common for fatigue to play a role in overnight rail, plane, truck, and maritime accidents.

Shift workers' sleep disruption can be eased somewhat by incorporating scheduled breaks, by rotating shifts from day to evening to night rather than the other way around, or by maintaining the same schedule seven days a week. Shift workers can also benefit from practicing good sleep hygiene. Dark curtains or eyeshades can keep daylight out, and running a fan can help block external noise. Shift workers need to enlist the help of family members to get enough sleep while maintaining a schedule at odds with the rest of the world. The most successful shift workers are those who block out time for sleep in advance and then are vigilant about protecting their sleep time from outside intrusions. Light therapy is sometimes recommended to help people get used to a new schedule, as is the short-term use of sleep medications.

Seasonal affective disorder

In some parts of North America, winter means less exposure to sunlight. As the days get shorter, some people find themselves depressed, sleepy, and drawn to high-carbohydrate foods.

Researchers speculate that people who suffer from this condition, called seasonal affective disorder (SAD), produce too much melatonin (or are extra-sensitive to normal amounts of this drowsiness-inducing hormone) and don't make enough serotonin, which may induce the craving for carbohydrates. Exposure to bright light in the morning for 30 minutes may alleviate the symptoms of SAD and help people wake up in the mornings. Antidepressants can also be helpful.

To learn more…
This information is prepared by the editors of the Harvard Health Publications division of Harvard Medical School, and excerpted from the special report, *Improving sleep: A guide to a good night's rest*. You can learn more about this publication at health.harvard.edu/IS.

HarvardMedicine

The following articles are selections from *Harvard Medicine* magazine's spring 2012 edition. Additional content can be found online, please visit:
http://harvardmedicine.hms.harvard.edu/

Blues Cues

Researchers cast a little light on the subject of sleep

by Elizabeth Dougherty

ONE SHOE, TWO SHOE: The effects of disrupted sleep patterns or insufficient sleep can affect a person's judgment in matters large and small, such as the choice of which boot matches which foot.
Photo credit: NASA

"Dr. Czeisler, Houston has a problem." NASA's mayday came to Charles Czeisler in August 1990, shortly after he had reported in the *New England Journal of Medicine* that he had shifted the circadian clocks of night workers with nothing but a healthy dose of light. In Houston, the space shuttle *Discovery* had been facing repeated delays. Week after week, the astronauts readied for a nighttime launch only to face another deferral. Meanwhile, astronauts were struggling to adjust to the inverted schedule required by the mission's rigid launch window.

Sleeping when required, rather than when biologically cued, seemed impossible. NASA administrators told Czeisler they were so desperate for solutions that they were considering a plan to set up a facility overseas, where the astronauts could adjust to a schedule more in sync with what they'd need while on their mission.

Czeisler did not like the sound of this plan. He left for Houston the next day.

Despite the urgency of the situation, NASA decided it needed to launch a decade-long research program before jumping into using light to control the astronauts' sleep–wake cycle. After all, the agency reasoned, Czeisler, the Frank Baldino, Jr., Professor of Sleep Medicine at HMS and chief of the Division of Sleep Medicine at Brigham and Women's Hospital, had reported shifting the clocks of only a dozen or so people.

The only thing that mattered to the astronauts, however, was that Czeisler's light therapy worked. They wanted the lights, and they wanted them now. Based on their flight schedule, Czeisler had two weeks to replicate his laboratory's light-controlled, one-room environment.

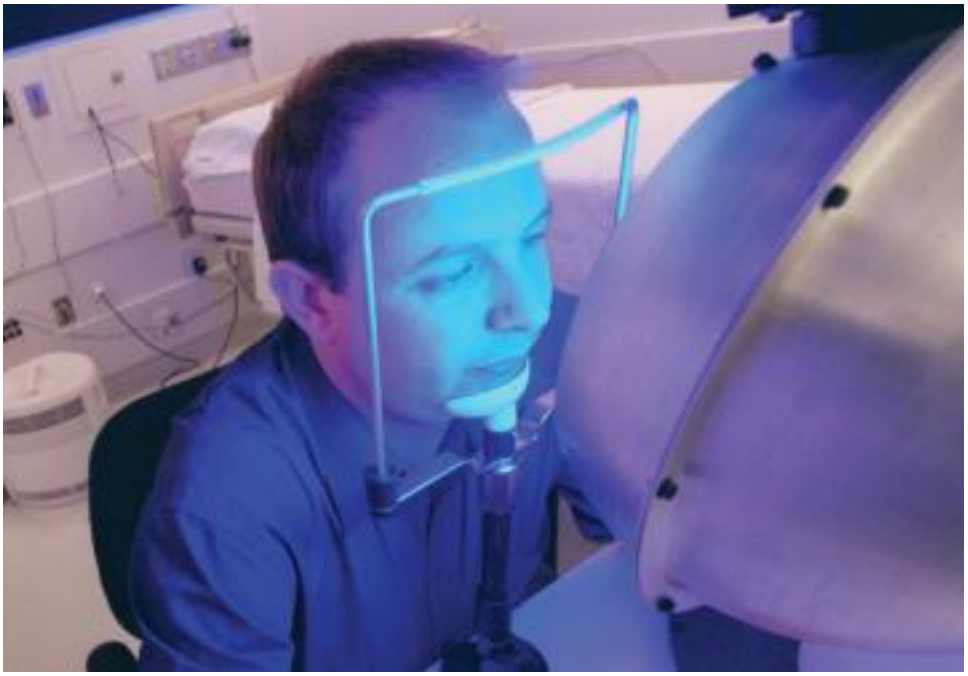
When the astronauts finally did launch, they left Czeisler a gift: preflight urine samples that showed they were releasing melatonin, a hormone normally released during periods of darkness, during their night, which was daytime on Earth. The astronauts had successfully inverted their physiological schedules. NASA has since used the lighting treatment for astronauts on any mission that launches at a time requiring a shift of more than three hours from local time.

NASA did carry out a ten-year research program on light therapy, the results of which have led a growing number of astronauts and mission controllers to work with flight surgeons to develop sleep–wake prescriptions tailored to individual schedules. The lessons learned by NASA have the potential to help night-shift workers of all sorts, from police officers and firefighters to hospital workers. The trick, however, has been in translating discoveries from a controlled laboratory environment into a messy world where nurses fit 40-hour weeks into three days but still need to get their kids on the bus every morning, and where almost everyone uses artificial lighting to make each day far too long.

The Eyes Have It

In Czeisler's early studies of totally blind people, he observed a person without any rod or cone function, the only known light-sensitive cells in the eye, who still responded to light cues by repressing melatonin. It wasn't until 2000 that studies, many funded by the National Space

Biomedical Research Institute (NSBRI) and carried out by researchers such as Czeisler and Steven Lockley, an HMS associate professor of medicine in BWH's Division of Sleep Medicine, indicated how this was possible.



BLUE LIGHT SPECIAL: Steven Lockley, of the sleep medicine lab at Brigham and Women's Hospital, resets his circadian rhythm with blue light therapy.
Photo credit: Kris Snibbe/Harvard News Service

Studies in animals revealed the presence of melanopsin, a blue-light–sensitive photopigment, in the ganglion cell layer of the eye, which had been thought to be light insensitive. Although few in number, these cells form a light-detecting network across the retina, a web that allows the ganglion cells to react to even indirect light.

The network sends signals to the suprachiasmatic nucleus, a bundle of approximately 50,000 cells, each acting as an individual pacemaker, which nestles in the brain's hypothalamus. This bundle acts as the body's master clock to control circadian rhythms in a number of physiological, metabolic, and behavioral processes.

"This was a new photoreceptor," says Lockley. "People had studied the eye for a long time, and they all had missed it."

Lockley's studies confirmed that this light-sensitive circuit was more responsive to blue light and that blue light was twice as effective as green at shifting the circadian clock and alerting the brain.

These findings have helped make light therapy more targeted and tolerable. "We now know that just having light in the room can be therapeutically effective," says Lockley. "It doesn't need to be in your face." A recent study from the Netherlands illustrates Lockley's point. Researchers there showed that placing brighter lights in the common areas of care facilities for dementia

patients slows the rate of patients' cognitive decline, reduces depression, and delays the onset of functional limitations. With support from NASA and NSBRI, Lockley and others are testing the effectiveness of prototype light fixtures that use blue-enriched white light to alert the body when needed and blue-depleted light to increase sleepiness before slumber.

It turns out that lighting technology, too, has matured, offering functionality that can exploit our understanding of the physiological effects of color. A single LED light fixture, for example, can be made to shine blue, green, red, or thousands of different colors or types of white light, at the flip of a switch, allowing alertness and sleepiness to be initiated from one source. "The technology opens new avenues," says Lockley. "We can now consider how to use light in hospitals and other environments that have multiple requirements."

In for the Long Haul

In 1996, when people were walking around Houston wearing "Mars or Bust" buttons, NASA launched the first Mars mission with the rover*Sojourner*.

ON CALL: Laura Barger found that the hours required of flight control staff can disrupt performance and alertness. Photo credit: John Chase/Harvard News Service

Each day, *Sojourner* woke with the sun, set into action by its own built-in circadian clock. On Earth, controllers had spent the night calculating where the rover had traveled based on the data it had transmitted before going to sleep.
When *Sojourner* woke up, the controllers sent it directions for the day ahead.

This schedule would have been sustainable for the controllers if not for the fact that a Mars day is 39 minutes longer than an Earth day. "It was like traveling across two time zones every three days. Continuously. For months," says Laura Barger, an HMS instructor in medicine and an associate physiologist in the Division of Sleep Medicine at BWH. Eventually, the Earth-bound crew felt so fatigued they clamored to stop.

When NASA launched the Mars lander, the *Phoenix*, in 2003, Barger and Lockley teamed up with the controllers to provide a blue-light intervention, the first NASA application of blue-light research. "We were successful at keeping the biological clocks on a Martian day," says Lockley. The results, which show the controllers' melatonin production shifting to match the day length on Mars, are being reviewed.

Vital Signs

Similar research is underway for astronauts on the International Space Station, a space-based research facility. Launched in 1998 and continuously occupied since late 2000, the station is expected to provide a platform for studying how living in space affects human health.

Barger monitored sleep activity among ISS astronauts using actigraphy, a technique that charts sleep–wake cycles by measuring a person's movements with a watch-like device that contains an accelerometer. During sleep cycles, there is less movement.

Barger found that astronauts slept only about six hours per night, far short of the eight hours Czeisler recommends, for example, to professional basketball players to maintain performance. Continuous sleep deprivation has a cumulative effect, so after about a week of short nights, cognitive performance declines in a way similar to that seen with intoxication. Barger hopes that one day every astronaut will wear an actigraph as an operational medical requirement, making sleep measurements a new vital sign for space-based personnel.

That hope may become an easy reality. NASA is so convinced of the importance of restful sleep that, when it upgrades the lighting in the ISS in 2014, it plans to install programmable LED lights that will allow the astronauts to maintain a regular day–night cycle by shifting lights from blue and green to red as the day progresses.

Land of Nod

Throughout the day, alertness waxes and wanes, body temperature and heart rate fluctuate, the body responds differently to medications, and creativity ebbs and flows. "I realized that these cycles would likely affect most biological experiments," says Elizabeth Klerman '86, an HMS associate professor of medicine and associate physician in the Division of Sleep Medicine at BWH. Klerman builds mathematical models of circadian rhythms. "One person's noise," she says, "is another's fascination."

At NASA's request, Klerman and her team continued developing models that predict objective performance and subjective alertness under different work-shift conditions, such as the abrupt schedule changes that occur when a shuttle docks at the space station at off hours. Over the years, NSBRI funded Klerman's work to evolve the mathematical models into sophisticated software tools that predict how the circadian clock's internal time and rhythm will change with a shift in schedule. Using data specific to an individual, the software can suggest a schedule of light interventions. It can even predict a person's periods of peak performance and alertness.

Such knowledge could help astronauts plan the best ways to prepare themselves to perform complex tasks.

For terrestrial applications, says Klerman, the software could be used by the military to select the most rested pilot for a long-distance mission. And Klerman is discussing with an airline an application that could help commercial pilots assess sleep and safety factors when making their bids for flights. Taking on an extra flight to Hawaii might lose its appeal if a pilot learns she will likely fall asleep midflight.

Power to the Sleepers

In 2001, Czeisler formed the Harvard Work Hours, Health and Safety Group, of which Barger and Lockley are members. The group works with a variety of safety-sensitive professions, such as police officers, firefighters, physicians, airline workers, NASA mission controllers, and most recently, federal air marshals. A major effort of the group centers around designing safer schedules for shift workers.

Klerman, for example, is working with Christopher Landrigan, an HMS associate professor of medicine and an associate physician in the Division of Sleep Medicine at BWH, to apply her software to the design of safer, but still effective, schedules for Children's Hospital Boston, where Landrigan also works in pediatrics.

Two decades have passed since NASA called Czeisler. Today, the use of light and smart scheduling to optimize alertness has become an integral part of NASA missions and operations. Perhaps soon these insights will be tools that help sleep-deprived people on Earth.

—Elizabeth Dougherty

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For More Information

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https://sleep.med.harvard.edu/

Harvard Medical School Division of Sleep Medicine - Sleep and Health Education Program
www.understandingsleep.org

Factory Profits and Sleep: Highlight from How America's Sleep Deficit is…
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