13 Healthy Lifestyle Behaviors: Sleep to Remain Well Around the Clock

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About Sleep

Normal Sleep Architecture

Life has become busier and more demanding than ever for health-care providers, including physicians. No matter how hectic our schedules may be, taking care of ourselves remains a priority so that we can remain well and function at our best as we provide care to others. In considering self-care, sleep is a core component as it is essential to maintaining human life. Let us take a further look at why sleep is so important to our overall health.

During the 24-hour cycle, the circadian clock regulates all body functions, including fluctuations in body temperature, blood pressure, heart rate, and various hormones [1, 2]. Most adults

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experience a major sleepiness peak between 2:00 and 4:00 AM and a minor peak between 1:00 and 3:00 PM, although there are individual variations [3].

Given the ethical limitations in researching human sleep deprivation, studies have been unable to show conclusive findings on how extended (i.e., more than a few days) sleep loss affects humans. However, research on sleep-deprived rats has shown that death has occurred usually in about 2–3 weeks of total sleep deprivation [4]. The cause of death may be precipitated by multiple factors including impaired immune function, possibly enhancing the rat's exposure to potentially life-threatening systemic infections [4, 5]. In humans, studies have shown that sleep deprivation, even in the short term, adversely affects stress responsivity, mood, cognition, and quality of life [5]. In the long term, it is believed to disrupt metabolism, and increase the risk of chronic disorders including cardiovascular disease, type 2 diabetes mellitus, and certain types of malignancy (e.g., colorectal cancer, prostate cancer) [5]. Although some findings suggest an association between sleep deprivation and maladaptive emotional regulation, more research is needed to further evaluate the effects of sleep deprivation on mood and behavior [6]. Moreover, acute sleep loss in some healthy adults has been demonstrated to cause a mood-elevating effect, commonly described as episodes of inappropriate euphoria and giddiness and oscillating periods of lopsided positive emotional reactivity to situations [7].

A great deal happens physiologically in the body while we sleep [5]. Once asleep, we cycle between non-REM and REM (rapid eye movement) sleep. Non-REM sleep occurs first, followed by a period of REM sleep. There are four phases of non-REM sleep, and each stage lasts between 5 and 15 minutes. In stage 1, referred to as light sleep, we transition from being awake to being asleep; in this stage, it is easy to wake up. In stage 2, we are still in light sleep, but now the heart rate slows and body temperature drops, preparing us for deep sleep [5]. In stages 3 and 4, collectively referred to as slow-wave sleep, we reach deep sleep, when it is harder to rouse. Stages 3 and 4 typically occur during the first one-third of the night [5]. During this period of slow-wave sleep, if external stimuli awake us, we would feel disoriented

for a few minutes, which is referred to as sleep inertia, or a state of impaired cognition upon awakening from deep sleep (detailed later in section "Sleep Inertia"). These deep stages of non-REM sleep are restorative, offering a time for the body to repair and strengthen tissues and the immune system [5]. Regarding cognitive development, non-REM sleep is associated with consolidation of declarative (explicit) memory, best described as "knowing that" (e.g., facts that need to be consciously remembered, such as dates) [8]. After all four subsequent phases, we reach REM sleep, in which our heart rate and respiration rate increases [5]. Studies have shown that REM sleep may be associated with consolidation of procedural memory, a nondeclarative (implicit) memory, best described as "knowing how" (e.g., performing certain tasks without conscious awareness of these previous experiences) [8]. REM sleep occurs approximately 90 minutes after falling asleep [9]. REM sleep takes up more of the cycle as the night goes on and is longest in the last one-third of the night [5]. Regardless of when we fall asleep, we typically tend to experience more non-REM sleep in the earlier hours of the night and more REM sleep in the later hours of the night (See Fig. 13.1). Dreams can occur anytime during sleep, but most vivid dreams occur during REM sleep,

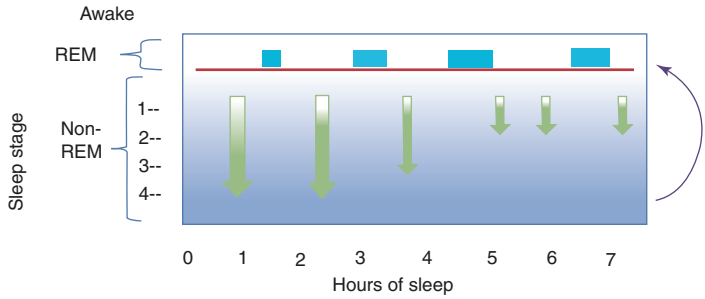

Fig. 13.1 Nocturnal sleep architecture in humans [5, 9]. There are four stages of non-REM sleep. REM sleep typically occurs approximately 90 minutes after falling asleep. A full sleep cycle generally takes about 90 minutes (1–2 hours) and is normally repeated several times each night. In normal sleep, there is more non-REM sleep in the earlier hours of the night (light green arrows) and more REM sleep in the later hours of the night (aqua bars) [5, 9]

when the brain is most active. A full sleep cycle in humans generally takes about 90 minutes (1–2 hours) and is normally repeated several times each night [9].

With age, our sleep changes. As we get older, the duration of stages 1 and 2 increases such that we sleep more lightly, the duration of stages 3 and 4 decreases so that we have less deep sleep, and REM sleep and REM latency significantly decrease [10]. Overall, this means that we sleep less in total, less soundly, and with less of the restorative and reparative effects. Thus, while our need for sleep does not change as we age, it becomes increasingly more difficult to achieve this basic need. The US federal government's Healthy People 2020 initiative has established a goal of educating people on how to achieve adequate sleep on a regular basis [11]. According to the 2019 American Academy of Sleep Medicine guidelines, the definition of sufficient sleep during a 24-hour period for adults aged 18 and older is 7 or more hours [11].

Alertness and Performance

Alertness is associated with performance and is determined by quantity of sleep, circadian effects, and sleep inertia [12].

Quantity of Sleep

An appropriate quantity of sleep is needed for an individual to feel refreshed and capable of functioning without significant effort. However, a deficit in sleep quantity can be due to either an acute sleep loss or chronic partial sleep loss. Acute sleep loss occurs when an individual does not sleep for an extended period of time. Chronic partial sleep loss occurs when an individual persistently acquires less sleep than in a more sufficient sleep state (i.e., sufficient sleep is defined as 7 or more hours during a 24-hour period) [11]. Interestingly, chronic sleep deprivation can lead to a dose-dependent decrease in cognitive performance comparable to acute deprivation. In a randomized study of 48 healthy adults, those who slept less than 6 hours per night for 2 weeks had cognitive

abilities similar to individuals with one night of total sleep deprivation [13]. Subjects who slept less than 4 hours per night for 2 weeks had cognitive abilities similar to those who had 2 nights of total sleep deprivation [13].

Circadian Effects

The circadian pacemaker is located in hypothalamus and regulates sleep-wake cycles. Research on diurnal variation in cognitive performance has demonstrated a performance peak that occurs during the day and a performance nadir that occurs in the early morning hours (3:00–5:00 AM) [14]. In this view, some studies suggest that there may an increased risk for errors among night shift workers across a range of professions [15, 16]. How these findings translate into the risk of actual clinical errors in medicine remains to be seen in future studies.

Sleep Inertia

Sleep inertia is defined as the state of sleepiness and impaired cognition, including disorientation, commonly experienced upon awakening from deep sleep [17]. Sleep inertia increases with the depth of prior sleep. Cognitive performance upon awakening from deep sleep is worse than performance during subsequent sleep deprivation [18]. Research has reported severe performance impairment within the first 3 minutes of waking from sleep, and lasting up to 10 minutes thereafter, although noticeable effects on performance can persist for 2 hours or longer [12, 17, 18]. In a study of nine healthy volunteers, cognitive performance measured upon awakening from sleep was worse than performance measured at all times with 26 hours of sleep deprivation [18]. Although not performed in an operational setting, the cognitive skills tested in that study included processing speed, short-term memory, counting skills, and number, fact, and lexical retrieval (i.e., lexical retrieval is the process of getting from a concept to a spoken word) [18].

As such, the impact of sleep inertia is particularly relevant to resident physicians who are frequently required to complete complex cognitive tasks immediately after waking at night on call

[18]. (See more at section "Sleep Deprivation and Mental/Emotional Functioning" on cognitive performance and sleep deprivation.) Patient assessment can require prompt, high-pressure decision-making. A physician can be expected to quickly and accurately order diagnostic tests and medications and perform invasive procedures that require significant concentration and skill. Although many of the tasks that physicians are required to do on call and during the night are not always in high-pressure decision-making situations, the daily practice of medicine requires physicians to be optimally alert.

Key Points

- Cognitive performance is typically suboptimal immediately upon awakening because of sleep inertia.
- The effects of sleep inertia are most apparent during the initial 10 minutes upon awakening and may take hours to completely disappear.
- Sleep inertia is most prominent in individuals with sleep deprivation and particularly when awakening occurs during performance nadir (i.e., during the early morning hours) [18].

Sleep Deprivation in Medicine

Sleep deprivation may be considered an adverse hallmark of medical training, with the problem likely being worse in some specialties and stages of training than others [19, 20]. In fact, some research has shown that junior physicians working a 34-hour shift can commit 460% more diagnostic mistakes than when well rested, and 36% more serious medical errors than those working less than 16 hours [21]. Senior physicians are similarly at increased risk of making medical errors. One study found that a senior attending surgeon who has slept less than 6 hours the night

before surgery is 170% more likely to make a surgical error compared to when he or she has slept adequately [21].

Did You Know?

The Canadian Medical Association's 2018 National Physician Health Survey has shown that [22]

- *Physicians averaged 6.7 hours of sleep per night; resident physicians reported fewer hours of sleep compared to practicing physicians (6.41* vs. *6.76 hours).*
- *Physicians working in hospitals had less sleep than those in private practice.*
- *Physicians in practice for 31 or more years reported getting more sleep compared to all categories of physicians with less than 20 years of practice.*

Furthermore, a growing body of literature has demonstrated that extended work hours may be associated with a negative impact on the medical trainee's well-being and education, as well as patient care, although the results have been conflicting [23]. Because of concerns for patient safety, in North America there have been minimum standards for duty hours instituted by the Accreditation Council for Graduate Medical Education and the Royal College of Physicians and Surgeons of Canada [24, 25]. These standards were based on findings about the sleep deprivation effects of extended shifts on resident physician performance, and subsequently required significant schedule restructuring; however, the schedule restructuring has proven to produce only a modest improvement in sleep duration for resident physicians [26]. Nevertheless, the relationship between one's work schedule, the degree of impairment, and patient outcomes still remains unclear due to the heterogeneity of study protocols, schedules, and medical environments [23]. Many of these studies have significant limitations and should be interpreted with caution. Further research is needed to clarify duty hours that optimize patient outcomes, as well as resident education and well-being. Until then, it is recommended that current accreditation program regulations be

followed. Table 13.1 highlights a summary of the accreditation program requirements and guidelines for resident physicians in the USA and Canada [25, 27]. In recent years, "strategic napping," especially after 16 hours of continuous duty and between

Table 13.1 North American guidelines regarding resident physician work hours

ACGME	RCPSC
Duty hours must be limited to 80 hours per week, averaged over a 4-week period, inclusive of all in-house clinical and educational activities, clinical work done from home, and all moonlighting.	Duty hours are a key component of medicine and medical training.
Residents must have at least 14 hours free of clinical work and education after 24 hours of in-house call.	Residents are not solely responsible to provide 24/7 patient care; rather, this is to be shared collectively among a team of healthcare providers.
Residents must be scheduled for a minimum of 1 day in 7 free of clinical work and education (when averaged over 4 weeks); at-home call cannot be assigned on these free days.	Efforts should be undertaken to avoid duty periods of more than 24 hours without a period of restorative sleep.
Residents must not be assigned additional clinical and educational work periods after 24 hours of continuous scheduled clinical assignments.	Resident duty hours may only be one factor among many which contribute to resident fatigue, safety concerns, and suboptimal functioning.
Residents must not be scheduled for in-house call more frequently than every third night (when averaged over a 4-week period).	Residency programs and specialties vary largely and so there is no one-size-fits-all approach to duty hours. Each training program may need to consider what is best to optimize the educational experience and well-being of their residents, as well as provide safe and efficient patient care.

Adapted from the 2019 RCPSC 5 Key Principles for Resident Duty Hours [25] and 2017 ACGME Common Program Requirements [27]. Note: *ACGME* Accreditation Council for Graduate Medical Education, *RCPSC* Royal College of Physicians and Surgeons of Canada

the hours of 10:00 PM and 8:00 AM, was suggested by the Accreditation Council for Graduate Medical Education (ACGME) after determining that the original Institute of Medicine (IOM) committee's recommendation of an uninterrupted 5-hour sleep period was "unworkable" [28]. When fatigue sets in, a quick nap can help restore your psychological and physical stamina [29]. However, keep in mind that getting enough sleep on a regular basis is the best way to stay alert and optimize your cognitive performance.

Key Points

- The IOM initially recommended that resident shifts longer than 16 hours include an uninterrupted 5-hour sleep period. However, the ACGME task force concluded that this sleep period was unworkable, and instead recommended "strategic napping" during long continuous shifts [28].
- The National Sleep Foundation recommends that a short nap of about 20 minutes can help to improve alertness, performance, and mood; however, note that naps do not necessarily make up for inadequate or poor quality of nocturnal sleep [29].

The Impact of Sleep Deprivation

Sleep Deprivation and Safety Risks

As discussed previously, reduced levels of alertness during and after on-call nights need to be addressed and mitigated. Understanding the potential impact of sleep deprivation and fatigue on physician performance and safety and using this knowledge to optimize shift schedules can reduce risks to both physicians and patients. Resident physicians typically work shifts of 24–36 hours while on minimal sleep. Consequently, this can place

Table 13.2 Sleep deprivation and potential risks to the resident physician and to patient safety [30, 31]

Resident physician safety	Patient safety
Motor vehicle accidents	Handover errors
Percutaneous injuries	Medical errors
Psychological distress and mental health issues, including substance use	Patient morbidity and mortality

the physician and their patients at risk in several ways as summarized in Table 13.2 [30, 31]. Although sleep deprivation can result in excessive sleepiness, its contribution to vehicle crash risk in the general population remains uncertain. A study by Gottlieb et al. has shown that sleep deficiency in adults, either due to insufficient sleep (sleep duration of less than 7 hours) or due to sleep apnea, was associated with motor vehicle crashes in the general population, independent of self-reported excessive sleepiness [31]. However, further studies are needed to explicitly elucidate the adverse outcomes correlated with shift work and sleep deprivation and, more specifically, whether there is any mutual causality.

Sleep Deprivation and Mental/Emotional Functioning

Lack of sleep is often associated with increased risk of mood disorders, anxiety, and difficulty coping with negative stimuli and regulating one's emotions. These effects are likely related to hypothesized changes in functional connectivity and messaging among the amygdala, anterior cingulate cortex, and prefrontal cortex [32]. Cognitive functions are also significantly affected by sleep deprivation and include psychomotor and cognitive speed, working memory, vigilance and executive attention, and higher cognitive abilities (e.g., cognitive control, planning capacity, ethical behavior, risk taking, leadership style) [33]. Some of the effects on higher cognitive changes may be explained from a biological perspective, as sleep deprivation appears to impair cere-

Table 13.3 The effects of sleep deprivation on cognitive functioning [33, 35, 36]

Cognitive function	How sleep deprivation interferes
Attention	Attention declines in dose-dependent fashion with sleep loss (i.e., more time sleep deprived = worse attention) Ability to maintain one's attention becomes more variable and can impact productivity and task performance
Memory	Increased difficulty receiving and retaining new information Sleep is key to learning and memory consolidation; however, a sleep deficit can impair ability to recall information previously learned or to master a new skill
Processing speed and response	Processing speed slows, as does reaction time for and accuracy of psychomotor responses
Executive functioning	Decline in cognitive flexibility, impairing decision-making and problem-solving Decline in inhibitory control, leading to impulsivity, risk-taking, impaired judgment, and heightened emotional reactions Poor insight into performance limitations or deficits

bral function by reduced glucose metabolic activity in the prefrontal and parietal cortices, secondary sensory processing areas, and thalamic areas [33]. The dorsolateral prefrontal cortex seems to be the area of self-restraint; self-control thus appears susceptible to glucose metabolism [34]. This may be important as self-control is an essential component of decision-making processes. Table 13.3 summarizes the effects of sleep deprivation on cognitive functioning [33, 35, 36].

Sleep Deprivation and Disease

While many are aware of the risks that sleep deprivation can pose with regard to our safety, mood, and cognitive functioning, it is also important to recognize that sleep deprivation can have an impact on

morbidity and mortality. Sleep is crucial to various homeostatic processes including the functioning of our autonomic nervous system, as well as regulating hormone production and release. In considering this, failure to achieve adequate sleep can disrupt these natural cycles, leading to dysfunction within these bodily systems, which over time can place us at risk of cardiovascular, immunological, and metabolic diseases [37]. Table 13.4 summarizes the common effects of sleep deprivation on various bodily systems, and how this can result in medical problems [37–39].

Key Points

- In general, sleep deprivation leads to decline in cognitive abilities, impaired motor skills, and also altered mood.
- There is increasing evidence that sleep deprivation has long-term health consequences such as increased cardiovascular mortality, obesity, and diabetes mellitus.
- Sleep-deprived resident physicians are at increased risk for motor vehicle crashes and percutaneous injuries, whereas their patients are at heightened risk for being subject to medical errors.

Did You Know?

Literature suggests that if we stay awake for longer than 18 hours, our reaction speed, cognitive speed, short-term and long-term memory, ability to concentrate and make decisions, and spatial orientation all start to decline. If we reduce our sleep to 5–6 hours per night for several days in a row, the accumulated sleep deficit may further magnify these negative effects [31].

Table 13.4 The effects of sleep deprivation on various bodily systems and resulting medical problems [37–39]

Physical health problem	How sleep deprivation interferes
Weight gain and obesity	Slows metabolism, reduces leptin (a hormone that signals satiety or a sense of fullness), and increases ghrelin (a hormone that signals hunger) leading to increased appetite and oral intake [37]
Impaired glycemic control and diabetes mellitus	Leads to elevations in thyroid hormone, cortisol, and norepinephrine which can impact carbohydrate metabolism and promote insulin resistance [37]
Hypertension, heart disease, and stroke	Activates the hypothalamus-pituitary-adrenal axis, promoting increased production and release of stress hormones including cortisol [37] Increases peripheral resistance, sympathetic outflow to the heart, and alters baroreflex sensitivity and set point [37]
Weakened immune system and infection	Decreases production and release of protective cytokine as well as impairs the functioning of immune cells and antibodies that help to fight off illness and infection [38]
Reduced life expectancy	Short sleep (<6–7 hours per night) has been associated with increased all-cause mortality [39] Different hypothesized pathways for this although most frequently thought to be attributed to the various cardiovascular, metabolic, and inflammatory processes sleep loss disturbs [39]

Effects of Caffeine on Sleep Quality and Daytime Functioning

Research has shown that performance deficits caused by sleep deprivation may be reversed by caffeine consumption during the subsequent daytime period [40]. Caffeine (1,3,7-trimethylxanthine) acts primarily on A1 and A2A adenosine receptors, which in turn are related to brain functions associated with arousal, sleep, and

cognition. Caffeine is quickly absorbed by the stomach and small intestine, with peak plasma concentrations occurring in the first 30 minutes, requiring about 45 minutes to achieve 99% bioavailability [41]. Majority of the caffeine metabolism is through the CYP1A2 (phase I oxidation reactions), with only a minimal amount being excreted by urine [41]. Caffeine has a half-life ranging from 2 to 10 hours, depending on endogenous and exogenous factors [40]. Caffeine's short half-life may allow a strategic increase in daytime functioning; however, it should be noted that the caffeine's residual effects can last several hours putting our sleep at risk. Daytime caffeine consumption causes a decrease in the excretion of the main metabolite of melatonin (6-sulfatoxymelatonin) during the subsequent night, which is one of the mechanisms by which sleep is disrupted [42].

While caffeine ingestion has been shown to have positive impact on cognitive function, on the other hand it can contribute to sleep deprivation, which impairs performance, leading to deficits in attention, alertness, speed of cognitive processing, and psychomotor responses. Studies have demonstrated that a nocturnal sleep deficit of only 90 minutes can lead to a one-third reduction of daytime objective alertness [40]. It remains unclear how exactly the purported psychoactive benefits of caffeine consumption impact the sleep-deprivation performance deficits and the subsequent quality and quantity of nighttime rest (See Fig. 13.2). Further research is required to elucidate the complexities of the relationship among caffeine, sleep, and daytime functioning.

Did You Know?

Studies have shown that nicotine and its metabolic inductive effects can significantly increase caffeine metabolism and thus a higher caffeine intake may be seen in tobacco smokers (up to 4 times the caffeine intake) compared to non-smokers in order to get similar plasma caffeine concentrations [43].

Fig. 13.2 Benefits and harms of caffeine consumption on sleep and daytime performance

Recovering from Sleep Loss: How to Repay the "Sleep Debt"

Patients are ill and need help at all hours. Therefore, the practice of medicine has to be around the clock. Nevertheless, modifications may be necessary in order to mitigate against sleep loss. Imagine resident physician wellness as analogous to a wellness bank. Using this analogy, we can consider our wellness as a bank account, so that we should aim for our account to carry a *positive* balance. Thus, we need to reflect on what constitutes bank *deposits* (e.g., what makes us feel well and healthy?), and what leads to bank *withdrawals* (e.g., what causes us to feel distressed?). If nocturnal sleep were a bank account, many of us in medicine would exceed the maximum daily debit transaction limit or be in deep credit card debt. The trouble is that the greater the "sleep debt," the less capable we are of recognizing the sleep deficit. Perhaps we can hardly recall what it is like to be fully rested [33]. Experimental studies on chronic sleep deprivation, which mod-

eled the sleep loss experienced by individuals with sleep fragmentation and sleep limitation due to lifestyle and disorders, demonstrated that cognitive deficits accumulate over time to severe levels and without full awareness by the affected individual [33]. As the sleep debt mounts, the health consequences increase, putting us at increasing risk for weight gain, diabetes mellitus, heart disease, stroke, or cognitive impairment. Therefore, adequate sleep is just as important for health as diet and physical exercise. Some strategies and tips on how to settle our "sleep debt" are illustrated below.

- *Long-term debt.* If you were chronically deprived of sleep for years, it may take several weeks to recuperate from this deficit. For example, some tips may include planning a vacation with fewer or no obligations in your schedule. While away, sleep every night until you awake naturally the following morning (turn off the alarm clock!). By the end, you may be getting about the amount you regularly need to wake feeling refreshed.
  - *Avoid relapsing into a new sleep debt cycle:* Once you have determined how much sleep you need, factor it into your daily schedule. Try to go to bed and get up at the same time every day (at least, when not on call). If need be, use weekends or time off from work to compensate for lost sleep.
- *Short-term debt.* If you missed 10 hours of nocturnal sleep during the week, consider sleeping an additional 3–4 hours on the weekend, and 1–2 hours more per night the following week until you have completely repaid the debt.
  - Think about ways to incorporate naps into your busy life and work schedules, if feasible. As sleep deprivation and fatigue are common in residency training, especially given late and overnight shifts, literature has shown that the most helpful strategies to minimize disruptions to your sleep regimen and circadian rhythm include limiting your sleep after call to noon instead of all day, and "sleep anchoring" where you have naps that aim to overlap with your normal hours of sleep [44]. A study examined the benefits of naps of various lengths (5, 10, 20, and 30 minutes) versus no naps [45]. The

results showed that a 10-minute nap produced the most benefit in terms of reduced sleepiness and fatigue, and improved cognitive performance, with improvements lasting up to 155 minutes after the nap. A 30-minute nap or longer is more likely to be accompanied by sleep inertia (i.e., impaired alertness and performance immediately after napping) [45].

  - Table 13.5 provides a few tips for the resident physician practicing sleep discipline strategies both during and after a call shift [47]. During an active call shift, if workload permits, a limited nap of 10–20 minutes can be restorative and allow more alertness and quicker responsiveness on call than a longer period of sleep and deeper sleep stages, which are associated with disruption and grogginess. Setting the alarm for sleeping up to about 20 minutes may allow better functioning until you can experience a longer, uninterrupted period of sleep on your post-call day. After the call shift, wearing sunglasses outside or using a sleep mask for daytime sleeping minimizes exposure to bright sunlight, which activates alertness. Aim to sleep for up to 4 hours, and as soon as possible after the call is completed. Sleeping longer than 4 hours may impact your next night's sleep.

- *Sleep hygiene.* Use sleep hygiene tactics for rapidly rotating shifts. Some key elements of nonpharmacological approaches to sleep deprivation are provided in Table 13.6 [47, 48].

Table 13.5 Strategies for sleep discipline during on call and post call [47]

On call	Post call
Take limited naps (approximately 20 minutes)	Wear sunglasses outside
	Use a sleep mask and/or room darkening blinds for daytime sleeping
	Use stress reduction techniques to induce daytime sleep (e.g., relaxation tapes, white noise machines, self-hypnosis)
	Sleep as soon as possible after call is completed
	Sleep for up to 4 hours

Table 13.6 Elements of sleep hygiene prior to a sleep period [47, 48]

Use a room that is quiet and comfortable
Avoid having visible time cues in the room
Use an alarm clock
Avoid stimulating activities prior to a sleep period (e.g., screen-based activity)
Decrease daytime napping
Avoid caffeine at least 6 hours prior to a sleep period
Avoid alcohol and nicotine prior to a sleep period
Avoid eating or eat very lightly prior to a sleep period
Prepare for sleep with relaxation techniques (e.g., breathing exercises, meditation, soft music)
Avoid automatic/negative, catastrophizing thoughts prior to a sleep period (e.g., "I'll die if I have another night on call like the last one," "this lifestyle is completely unbearable," "there is nothing I can do to make it better")
Insert positive thoughts prior to a sleep period (e.g., "I'll feel better after I've had some rest," "I have a vacation booked next week and will enjoy more fulsome sleep soon," "even a short bout of sleep will help towards restoring my sleep debt"

In summary, extending, preserving or "banking" sleep, and learning how to achieve adequate sleep recovery after a period of sleep deprivation while on call or a night shift promotes future resilience to psychological, physical, and operational stress.

Skill-Building Exercise: How to Incorporate "Sleep Anchoring" Into Your Busy Schedules

Consider your normal hours of sleep during weekdays and weekends and try to designate 3–4 hours of sleep (or approximately half of your normal sleep duration) after a night shift that is close to the beginning or end of your normal sleep period to maintain your regular circadian rhythm and to minimize disruptions [44, 46].

Adopting Healthy Sleep Habits: Taking Care of Yourself

In an overworked and chronically stressed medical world, there is an increasing desire for physicians to live a healthier and more fulfilling life. Thus, there has been a collective shift in medicine toward more holistic approaches in achieving a positive mindset and healthier lifestyle as well as returning to the basics of self-care, which includes more optimal sleep. Some common strategies to minimize the negative effects of work-related sleep deprivation, promote optimal sleep habits, and prevent burnout are further discussed below. (Also see Table 13.7 for additional tips to manage and mitigate sleep loss.)

Physician Engagement and Collaboration to Manage Sleep Deprivation

- *Get involved:* Always reassess your on-call night schedule and find ways to insert brief periods for short naps even during busy call shifts if you can. It can be protective against burnout if you spend this time optimizing your opportunities for rest as part of your regular job.
- *Collaborate:* If you work on a team, particularly on-call or on shifts, consider ways to split the shift or rotate who is providing patient care to ensure that everyone can get some rest overnight if possible. Working with your attending physician and resident peers to promote a healthy and safe work environment, such as ensuring those who have worked long shifts take post-call days or get an opportunity to rest and recuperate, can also be crucial and help to instill a sense of camaraderie and support. Residents are encouraged to become aware of the regulations by their governing bodies related to maximum duty hours and post-call allowances, and to work with rotation leads and on-call schedulers to ensure that regulations are upheld.

Table 13.7 Tips to manage and mitigate sleep loss

Take a "power nap"
Napping can be refreshing but also can disrupt your circadian rhythm (the body's natural sleep-wake cycle).
Try to nap for only 10–20 minutes. This keeps you within the early, lighter stages of sleep.
If really sleep-deprived, nap for a full sleep cycle of 90 minutes.
If sleep problems persist for more than 2 weeks, contact a clinician.
Get the best quality sleep
Get sunlight in the early part of the day.
Practicing a relaxation technique during the day can improve sleep efficiency.
Download a good wellness app and learn to practice letting go of stress.
Although this is discussed elsewhere in this book, getting the minimum recommended amount of physical activity per week improves sleep quality and reduces daytime sleepiness (See Chap. 11).
Ensure optimal environment for sleep
Keep your bedroom cool, dark, and quiet; the body needs time to settle down to initiate sleep. Download free apps for white noise or use a white noise machine or ear plugs.
Stop productive activity at least 30 minutes before sleeping; the brain needs time to downshift from the faster brainwaves of alertness and wakefulness to the slower brainwave pattern of restful sleep.
Unless you are on irregular on-call shifts, aim to go to bed and wake up at around the same time each day.
If you have not slept all night, go to bed extra early the next night to pay down your sleep debt without further disrupting your sleep-wake cycle.
Restrict oral intake before sleep
Hunger or feeling too full can make it difficult to fall asleep. High-fat and high-protein foods take longer to digest and are typically not recommended close to bed.
Excessive intake of liquids within 90 minutes of bedtime can interrupt sleep with bathroom trips.
Alcohol can increase the stress hormone, cortisol, which makes sleep more fragmented.
Caffeine affects the sleep cycle, as caffeine can cause lighter, more fragmented sleep. Sleep experts recommend limiting caffeine to the morning, or avoiding it if sensitive to it (feel jittery) or have sleep disturbance.

Pre-Sleep Routine

- This involves avoiding use of caffeine, nicotine, and alcohol before sleep, as well as avoiding exposure to bright light before sleep.
- After night shifts, retire to a room that is dark (consider eye mask), cool, free from interruptions, and quiet (consider ear plugs or white noise machine).
- Do not use screens for 1–2 hours before sleep; the blue light from smartphones, tablets, and laptops signals your brain to stay alert.
- Silence your phone when off-call and getting ready to go to bed.
- Use guided mindfulness sleep exercises; body scan, mindfulness of breathing, or mindful yoga can help you to relax after a busy shift (See Chap. 14).

Sleep Routine

- *Napping*: Consider napping in mid-afternoon either a 20-minute power nap or 90 minutes, allowing 1 hour to "wake up." Try to nap during the anchor period of your on-duty night shift, if feasible. The off-duty sleep in combination with brief on-duty naps can be effective for sustaining vigilance, learning, and memory when working on-call night shifts.

Sleep Tips for Physician Parents with Young Children

In addition to the sleep strategies listed previously, the following additional tips may address some issues of interest to parents with young children.

- *Split duties*. Work out a schedule with your partner that allows each of you alternately to rest and care for your child. When

friends and family visit, ask if they could watch your child while you take a "power nap." Tasks, chores, and calls can wait so that you can prioritize sleep when your child is asleep.

- *"Bed sharing" during sleep.* Bring your child into your bed for nursing or comforting, if you wish, but return your child to the crib when you plan to resume sleep.
- *"On the alert" waiting.* There are many parenting approaches about how to get children to fall asleep and stay asleep; an expert opinion in this area should be sought if parents need further support and expertise. For example, some believe that it may be reasonable to let your child cry herself or himself to sleep and to encourage self-soothing, unless you suspect that your child is hungry or uncomfortable. If the crying continues, check on your child; your reassuring presence might be all your child needs to fall asleep.

Skill-Building Exercise: How to Mitigate Sleep Deprivation

- Before you can begin to address and work to actively mitigate sleep deprivation, you need to determine what may be contributing to your sleep disruptions and difficulties, as well as understand the impact this may be having on your daily life and functioning.
- To better assess your current routines and sleep patterns, consider trying out a sleep diary or tracker, which helps you to monitor your sleep and energy over time, as well as get insight into factors that could be impacting this either positively or negatively.
- Options for sleep trackers include apps such as Sleeplife, SleepScore, or Sleep Cycle, technology including Fitbit or Apple Watch, while sleep diaries can be found online including this comprehensive one from the National Sleep Foundation: https://www.sleepfoundation.org/sites/default/files/inline-files/SleepDiaryv6.pdf.

- You can also create your own sleep diary, recording over several days pertinent points including bedtime, waketime, disturbances in sleep, and other factors such as mood/anxiety, bedtime activities/routine, or caffeine intake. Be sure, however, to keep the diary or tracker near to your bed so you are reminded to use it and record information both at night and in the morning upon waking.
- After monitoring your sleep patterns for a few days, reflect on the findings and try to identify some of the potential problems that may be contributing to sleep loss or disrupted sleep. *Utilizing this information, you can then review the recommendations and strategies discussed in this chapter* to try and promote healthier routines and sleep practices.

Check Your Learning

Case Study: Still Awake?

Case Part I

Amanda is a 28-year-old second-year internal medicine resident. A lifelong high-achiever, she did well in medical school and was thrilled to be matched to an internal medicine program near her family. She is keen to pursue cardiology. The initial transition from medical school into residency was more challenging than she had expected leading to times where she felt run down and questioned whether she was good enough. However, she found reassurance in the positive feedback from her preceptors, as well as patients and families with whom she was able to develop a strong rapport. To do so, she relied on her ability to deeply empathize and explore each case from a humanistic perspective. Over the last few months she finally found her footing, got into the swing of residency, and generally felt at home among her group of

co-residents. Upon starting the new academic year, Amanda felt a mix of both excitement and nervousness as she was now considered a senior resident, which brings on new and heightened responsibilities within this role.

A few months later, Amanda is well into her second year. She has been working for 3 months on Clinical Teaching Unit (CTU) at a tertiary care hospital. Not only is she helping to run a busy team overseeing the care of more than 20 patients, but she is also responsible for leading codes should they occur, supervising and teaching both junior residents and medical students on her service, and is required to complete frequent overnight call shifts.

Given all of her clinical and academic duties, Amanda's days are long and often extend into the evening as she finishes up her notes and debriefs the day with her supervisor. She feels exhausted upon returning home. Self-criticism is now constant for her, while perfectionism and mounting pressures to perform also continue. She feels that there is more she needs to do to prepare for and to study in order to provide optimal patient care and educational experiences for the learners she is responsible to. Amanda struggles to find the time to accomplish everything she needs to in a way that meets her own internal expectations. As such, she begins sacrificing her leisure time, including visits to the gym and outings with friends, and also stays up later, now going to bed past midnight. Once in bed, Amanda finds that her sleep is disrupted as she struggles to fall asleep. She finds herself thinking about all the devastating pain, disease, and death she has witnessed during the rotation. She also frequently has dreams about making an error or something going wrong at work.

When her alarm goes off at 6:00 AM, after only 5 hours of sleep, Amanda struggles to get out of bed and feels like she barely slept. She makes a promise with herself to go to bed early the next night to catch up on some much-needed sleep. However, Amanda continually finds herself staying up late and having difficulties falling asleep as the pressures never seem to lessen and her to-do list never seems to shorten.

***Question*. In considering Amanda's case, what type of sleep deprivation is she experiencing?**

A. **Acute sleep loss**
B. **Chronic partial sleep loss**
C. **Sleep inertia**

Answer: B ✓

If Amanda were to have pulled an all-nighter or stayed up one night on call, this would be an example of acute sleep loss, which refers to either a significant reduction in one's sleep or no sleep at all, usually accumulated over 1–2 days.

In the case described above, however, we learn that Amanda's sleep has been disrupted over the last few months, leading to gradually increasing sleep debt. Not only has the quantity of her sleep been impaired, but the quality of her sleep with regard to restfulness has also been inadequate, likely due to work demands as well as an initial insomnia possibly stemming from anxiety, rumination, and difficulties processing and coping with the grief and psychological stress of her work as a physician. As Amanda's sleep debt accumulates, this can not only contribute to the experience of burnout, but can possibly lead to other negative sequalae.

There is no information in the case vignette to suggest that she has experienced sleep inertia, which is a state of sleepiness and impaired cognition commonly experienced upon awakening from deep sleep [17].

Case Part II

Given her limited sleep, when Amanda returns to the inpatient unit each day she finds herself feeling groggy. She feels as though she is dragging herself from room to room to see her patients, and each day she hopes that there are no codes, as she is not sure she has the energy to tackle the task of providing emergency care.

During the few spare moments she has to write notes or review bloodwork in the learner lounge, she finds herself nodding off.

She is embarrassed about this and worries that this may get her into trouble if others notice or if this were to occur in front of a patient. Amanda admits to feeling slow and unfocused, and has trouble answering students' and patients' questions efficiently and meaningfully.

To cope, Amanda has started consuming more caffeinated coffee. She finds this helps her to feel more alert during the day and more energized. Before she knows it, she has gone from one coffee per morning, to four large cups throughout the day. She has also recently started to consume a caffeinated energy drink to help her avoid the inevitable crash and get through her work. Despite continuing to feel exhausted by the end of the night, Amanda has ongoing and worsening difficulties falling asleep, which continues the cycle of fatigue. She also finds that during the course of the day she is increasingly anxious, leading her to doubt herself more, recheck the work she has already done, and become irritable with her patients and learners.

Question. **True or False: Caffeine could be contributing to Amanda's current difficulties including her sleep deprivation.**

A. **True**
B. **False**

Answer: A ✓

Caffeine is one of the most popular and commonly used substances, which is found in several foods and beverages, including tea, coffee, soft drinks, and energy drinks. Caffeine can act as a stimulant and can provide a transient increase in one's wakefulness and level of alertness and has been considered a performance-enhancing drug as it can improve one's attention, processing speed, and reaction time [49].

The problem however is that these effects are temporary and only are positive or helpful up to a certain point, after which higher doses can be detrimental leading to restlessness, irritability, anxiety, tremulousness, headache, nausea/vomiting, and tachycardia.

In addition, the effects of caffeine on the body can last for an average of 6 hours, which depending on when it is consumed and the quantities consumed can interfere with sleep onset latency and, subsequently, total sleep time, which appears to be occurring for Amanda whose caffeine intake has significantly increased with evening doses.

To avoid the negative effects of caffeine, besides being mindful of the amount of caffeine you consume, strategies such as avoiding caffeine at least 6 hours before bedtime has been recommended.

BONUS Question. **What is the recommended maximum caffeine intake per day?**

A. **200 mg per day**
B. **300 mg per day**
C. **400 mg per day**
D. **600 mg per day**

Answer: C ✓
Health Canada and the US Food and Drug Administration both recommend, for adults, a maximum of 400 mg of caffeine per day (which is considered the equivalent of about 3 regular cups of coffee).

Case Part III

Amanda continues to struggle with her sleep and energy. While she recognizes this is having a negative impact on her functioning at work and mental health, she is not quite sure how to address this. She is also dismayed to receive the next call schedule in which she learns that she is on call at least 1 in 7 days, including three shifts occurring in short-order over 2 weeks, given that some of her colleagues are away on vacation.

By the third call shift, Amanda feels drained and as if she is running on empty. Overnight she almost made an error in writing orders in one of her patient's electronic medical records, which

she fortunately noticed in time to rectify. This is her second near-miss medical error in the last week. This is unsettling for her, and has prompted even more checking and self-scrutiny, which slows down her performance while on call even more.

At 8:00 AM, after a 24-hour work shift, Amanda hands over her cases to the incoming day staff. She can barely keep her eyes open, let alone formulate her own thoughts. Handover seems to go on and on, and she is stopped by the attending physician repeatedly as she continues to miss pertinent points about each case. She experiences a sense of shame when her attending staff provides some strong constructive criticism, witnessed by several of her colleagues and learners.

Though Amanda is holding back tears and cannot wait to get home to her bed, she stays behind another hour and a half to finish up some of her notes and tie up some loose ends, which her attending staff requested as she had not followed up on all of her patients' treatment plans. It is close to 11:00 AM when she finally gets in her car to head home.

Amanda leaves 15 minutes away from the hospital. It seems close enough, but to be safe she turns up the radio and ensures the air conditioning is on to keep her awake. Despite this, Amanda dozes off while stopped at a red light, waking only when another frustrated driver honks at her to drive. About 5 minutes from home, Amanda again dozes off, this time while driving down a busy road. She swerves into the other lane and is jolted to her senses by loud honking. She swerves back into her lane just in time.

When Amanda pulls into her driveway her heart is pounding. She realizes that she narrowly avoided an accident. She also realizes that she could have caused a serious accident putting herself or others at significant risk. She recognizes the urgency to do something to address the current situation.

Question. **Which of the following are negative effects possibly associated with sleep deprivation?**

A. **Medical errors**
B. **Handover errors**
C. **Motor vehicle accidents**
D. **All of the above**

Answer: D ✓

As we see from the case vignette, Amanda is experiencing the compounding effects of persistent and multiple stressors, and in particular, acute-on-chronic sleep deprivation.

With ongoing and worsening sleep deprivation, Amanda's cognitive abilities are likely compromised, resulting in difficulties with attention, processing speed, memory, and judgment, leading to making errors at work. Though Amanda catches some of these errors or near misses herself and is made aware of handover concerns by her team, her sleep-deprived performance has the potential to significantly impact patient care, particularly if she were to be working more in isolation or if there were fewer safeguards in place.

Not only have we learned that sleep deprivation can impact our cognitive processes and thereby impact our occupational or academic performance and functioning, but lack of sleep can also put a physician's own well-being and safety in jeopardy. Most concerningly, some studies have shown that driving while sleep deprived is similar to driving while intoxicated, an association which could suggest an increased risk of motor vehicle accidents [31].

Case Part IV

After taking a much-needed nap upon returning home, Amanda wakes with a raging headache likely resulting from a perfect storm of sleep loss, dehydration, and caffeine withdrawal. She feels terrible and though she had been hoping to get caught up on some reading, she spends the remainder of the day in bed resting.

Amanda feels exhausted and depleted and knows her current routine is not sustainable for much longer. She feels a sense of profound guilt given what transpired on call and post call as she realizes she put both herself and her patients at risk. Motivated to make a serious change, she requests a professional day leave to give herself a long weekend off, which she plans to spend with her boyfriend reconnecting and to catch up on some of her sleep. She may not even set her alarm those days!

Amanda, however, realizes that change will also need to extend into her daily routine. She begins to work on setting some goals for herself around going to bed earlier so that she can achieve closer to 8 hours a night, which leads her to feel more rested, and to begin cutting down on her caffeine intake beginning with eliminating her nightly energy drinks, which also helps her to fall asleep a little more easily.

Though she experiences some improvements with these initial changes, Amanda continues to find that she has a difficult time relaxing at night and slowing down her thoughts which include never-ending to-do lists once she stops work for the night. While at a social retreat with her co-residents, the topic of wellness and self-care arises. Amanda shares some of her recent challenges and is relieved to hear that others in her training program have gone through similar experiences. Through their group discussion, Amanda learns of some helpful tips and strategies such as avoiding use of the computer, TV, or cellphone close to bedtime. Her peers introduce her to some mindfulness smartphone apps and to the concept of "sleep anchoring" which will aid her in ensuring restorative sleep post call or shiftwork without upsetting her regular sleep schedule.

Slowly Amanda begins to change her nighttime routine to one in which she reads for fun about an hour before bed and then listens to a mindful body scan before going to sleep. Not only has this helped to restore some of her work-life balance by engaging in these self-care practices, but it has also helped to relax and quiet her mind, in addition to falling asleep more quickly. It is a work in progress, but already Amanda begins to feel better physically, mentally, and emotionally, helping to restore her confidence in herself and in her role as a physician caring for others.

Question. **Which of the following are evidence-based strategies to manage and prevent sleep loss?**

A. **Sleep hygiene**
B. **Sleep anchoring**
C. **Relaxation and mindfulness**
D. **All of the above**

Answer: D ✓

As we have learned through this chapter, there are several strategies that can be helpful in restoring one's sleep as well as preventing significant sleep debt. The efficacy of each practice or approach may vary based on the individual as well as the factors contributing to their disrupted sleep. As such, a helpful first step may be to reflect on your current sleep patterns and assess for possible contributing factors including caffeine, activities prior to bed, and stress, as discussed in the skill-building activity above.

In any case, some of the core recommendations for optimizing one's sleep, in which Amanda begins to engage, include sleep hygiene, sleep anchoring, and relaxation training. These have all been supported by research, and though may take some practice and time can be quite efficacious.

Despite best efforts, individuals may experience ongoing sleep difficulties. This may signal other problems at play, such as a sleep disorder or other mental health conditions. Seeking help from a physician may be important to further investigate and treat if needed.

Key Takeaways

- Sleep is a vital component supporting physician wellness and optimal functioning.
- Sleep loss can be accrued through different means including the following:
- An acute reduction in sleep, such as from on call shifts
- Gradual and chronic reductions in sleep quantity and quality related to work or personal demands
- Sleep disorders including insomnia
- Sleep deprivation among physicians can be associated with compromised personal health and well-being, as well as occupational performance and functioning. These factors can negatively impact patient care.
- Caffeine can promote alertness and enhance performance; however, it should be used judiciously and in moderation so as not to contribute to the cycle of disrupted sleep, subsequent fatigue, and impaired performance. Consuming caffeine in high amounts can be

detrimental and lead to an overdose manifesting as restlessness, tremors, headache, tachycardia, gastrointestinal disturbances, dehydration, irritability, and anxiety.
- There are many different approaches to restoring sleep that can be personalized based on an individual's needs. Sleep hygiene, sleep anchoring, and relaxation training, or other lifestyle changes such as optimal exercise, have however shown to be effective. (See Chaps. 11 and 14)

Selected Resources

Additional resources about sleep are illustrated in Table 13.8.

Table 13.8 Selected resources about sleep

Resources	Description
World Sleep Society www.worldsleepsociety.org	Membership provides access to international best practices, current research in the field of sleep medicine, and a global directory of sleep medicine professionals.
Centers for Disease Control and Prevention: Sleep and Sleep Disorders www.cdc.gov/sleep/index.html	US organization which provides basic information and statistics about sleep, as well as podcasts, publications, and other resources to help promote healthy sleep.
Canadian Sleep Society www.css-scs.ca	Canadian organization which provides a directory of sleep centers within Canada, as well as helpful links, publications, books, and podcasts.
American Academy of Sleep Medicine www.aasmnet.org	US organization which has resources for both patients and providers, including guidelines and papers regarding the diagnosis and treatment of several sleep disorders.
National Sleep Foundation www.sleepfoundation.org	A visually pleasing site filled with short and easy-to-read articles about various sleep topics, sleep disorders, and tips and tools to aid with disrupted sleep. There are also quizzes and apps to help assess your sleep!

Table 13.8 (continued)

Resources	Description
American Sleep Apnea Association www.sleepapnea.org	A website devoted to sleep apnea, providing education, research, recommendations regarding treatment and related services, as well as peer-support forums.
Better Sleep Council www.bettersleep.org	A comprehensive website exploring the various factors that contribute to good night's sleep.
Harvard University: Healthy Sleep http://healthysleep.med.harvard.edu/healthy/	An interactive website filled with videos and information to help understand why sleep matters, the science behind sleep, and how to achieve restorative and healthy sleep.

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