



## Strategies for Nurses to Prevent Sleep-Related Injuries and Errors

Claire C. Caruso, PhD RN • Edward M. Hitchcock, PhD

### KEY WORDS

*injury prevention  
nurses  
safety issues*

*Rehabilitation nurses work shift schedules or long hours to provide essential patient services around the clock. These demanding hours can lead to sleep difficulties, declines in performance, and increased worker errors. This article gives an overview of selected declines in cognitive performance that are associated with inadequate sleep and several factors that increase risk for fatigue-related errors. Selected strategies for nurses and managers to reduce these risks are discussed, such as better sleep practices, improved work schedule design, naps, caffeine, exposure to light, and rest breaks. Both nurses and managers share responsibility for implementing strategies to reduce risks from inadequate sleep.*

Rehabilitation nurses work shift schedules or long hours to provide essential patient services around the clock. These demanding hours often lead to difficulties with sleep because of the need to sleep at irregular times and at times out of phase with normal circadian rhythms. In addition, the time available for sleep may be reduced because of short periods between work shifts or demands from work and family. A substantial number of studies found that workers on shift work and long hours frequently report short sleep duration and poorer sleep quality (Caruso et al., 2006; Pilcher, Lambert, & Huffcutt, 2000). Not only do people feel tired and sleepy when they do not get sufficient sleep, they also can show declines on a wide variety of cognitive performance tests (Goel, Rao, Durmer, & Dinges, 2009). Declines in performance increase the risks for personal injury to the nurse, patient care errors, and vehicular crashes during commutes, which endanger other people (Rogers, Hwang, Scott, Aiken, & Dinges, 2004; Scott et al., 2007; Trinkoff, Le, Geiger-Brown, & Lipscomb, 2007). The purpose of this article is to provide an overview of the types of declines in cognitive performance that are associated with inadequate sleep and present strategies for nurses and managers to reduce these risks.

### Cognitive Declines

Sleep is a biological need for life and health, similar to the need for food and water (Everson, 2009). Most adults need 7–9 hours of good, quality sleep each day (National Sleep Foundation, n.d.a). Goel and colleagues (2009) reviewed the wide range of cognitive declines associated with sleep deprivation, which are discussed below.

Without adequate sleep, people feel sleepy and can experience microsleeps—short episodes of sleep lasting a few seconds. During microsleeps, the

person may appear to be awake (eyes open), but his or her brain will not process information and lapses in attention occur. A sleep-deprived person cannot control the onset of microsleeps and is often unaware that microsleep is occurring. Microsleeps can be identified on electroencephalograms and can be dangerous if they occur at critical times (Moller, Kayumov, Bul-mash, & Nhan, 2006).

Sleep deprivation impairs performance of tasks that require intense or prolonged attention. Performance is unstable with increased errors of *omission*—failing to respond to a stimulus—and *commission*—responding when a stimulus is not present. Omission and commission errors occur more frequently over time. For example, a nurse may fail to set a machine properly or adequately monitor a patient's condition. Sometimes these deficits will not occur and can falsely reassure a nurse that she or he can perform adequately while sleep deprived. However, in nursing, attention is critical and unstable performances can cause errors.

When the sleep-deprived person can pace activities without time pressure, cognitive slowing will be evident and response time slows, but accuracy can be preserved. Under time pressure, however, cognitive slowing will produce errors. Also, performance may begin well but deteriorate as time-on-task increases and the effort to remain behaviorally effective increases. The cognitive resources to contend with this demand are finite, and performance declines considerably after resources are depleted (Wickens, 1984). Even in the presence of automated monitoring systems designed to off-load the monitoring carried out by people, performance declines can persist (Hitchcock et al., 2003).

Sleep deprivation impairs information processing and learning (Goel et al., 2009). Both short-term recall and working memory performance decline. Tasks that require information to be accurately held

in memory for brief periods (e.g., remembering a drug dose from chart to medication room) will be impaired. There is reduced learning of new information. Everyday nursing tasks require new learning, for example, hearing patient information from a nurse on the previous shift.

Communication skills decrease as sleep deprivation increases (Durmer & Dinges, 2005; Pilcher et al., 2007). A nurse may fumble trying to find the right word, say the wrong word when meaning to use another, or may misinterpret what another person said or wrote.

Sleep deprivation leads to impaired cognitive flexibility, negatively affects innovation, and decreases insight (Goel et al., 2009). In situations during which “thinking outside of the box” is needed, sleep-deprived nurses will tend to use routine solutions. They may fixate on an ineffective solution and may not be able to recognize better alternatives, even if these are clearly available.

Sleep deprivation leads to an inferior ability to assess risks and risk-taking behaviors increase (Venkatraman, Chuah, Huettel, & Chee, 2007). In addition, the person is less able to learn from the negative consequences of risky decisions. Activities judged to be nonessential are increasingly neglected because situational awareness is lost. For example, a nurse may misjudge how much time has passed.

Sleep deprivation also leads to impaired mood including irritability, anxiety, and depression. The sleep-deprived nurse may avoid communicating or exhibit rude or hostile behavior because he or she views the situation in a more negative light. Sleep deprivation may lead to inappropriate behavior such as giggling or laughing in serious situations. When nurses are in a significantly sleep-deprived state, they may have difficulty making quick decisions in ambiguous situations where there is a high emotional charge (Killgore et al., 2007).

Several studies showed evidence of similarities between fatigue-related impairment in mental and physiological functioning and impairments because of alcohol intoxication (Arnedt, Owens, Crouch, Stahl, & Carskadon, 2005; Dawson & Reid, 1997; Williamson & Feyer, 2000). In these studies, participants’ performances were tested and compared after staying awake for extended periods of time and after drinking alcohol to a certain blood alcohol concentration (BAC). Participants staying awake for 17 hours showed performance deficits similar to a BAC of 0.05%, and after 24 hours awake, the deficits were similar to having a BAC of 0.10%. The United States defines legal intoxication for purposes of driving as having a BAC of 0.08% or greater. However, driving impairments are seen at lower levels and some countries use a 0.05% or lower cutoff (National Highway Traffic Safety Administration, 2000).

A common misconception is that the effects of sleep deprivation can be overcome through motivation, professionalism, training, or experience. Recent research provided evidence to the contrary (Arnedt et al., 2005; Van Dongen, Maislin, Mullington, & Dinges, 2003). A study of medical residents did not provide evidence that they adapted to sleep deprivation better as their training years progressed. Researchers pointed out that a sleep-deprived person may not recognize the extent of his or her decline in performance. Performance declines vary for individuals when they are sleep deprived (Goel et al., 2009). Testing the same person over time showed consistent patterns in his or her response to sleep loss. Some people showed an increased decline in performance as compared to others, which may reflect an individual trait or sensitivity.

Fatigue-related impairments can lead to reduced performance on the job. Errors in the delivery of patient care are a serious concern for the nursing profession and the public. Rogers and colleagues (2004) reported that the odds for a nurse making an error at work increased by three times when work shifts lasted 12.5 hours or longer, compared with 8.5-hour shifts. Interns working long hours made more serious medical errors in intensive care units (Landrigan et al., 2004). Because of concern for patient safety, the report, “Keeping Patients Safe” (Page, Committee on the Work Environment for Nurses, & Patient Safety Board on Health Care Services, 2004), recommended that work hours for nurses be limited to no more than 60 hours per week, and no more than 12 hours per day.

Nurse fatigue is a problem not only in the workplace but also in the community. Experts who examined drowsy driving crashes listed shift work and long work hours in the top five factors that increase risk (National Sleep Foundation, n.d.b). Nurses who have these demanding work schedules are at increased risk for vehicle crashes during commutes and could endanger others on the road.

### Strategies to Reduce Risks

Nurses, managers, and employers share the responsibility of implementing strategies to reduce sleep-related risks. Strategies for nurses include adopting good sleep practices and behaviors and allowing sufficient time to get enough sleep. Strategies for managers include instituting policies and systems in the workplace to reduce fatigue. Below are several factors that increase fatigue and strategies to reduce these risks.

### Improving Sleep Habits and Routines

The key strategy for reducing risks from fatigue is getting enough good, quality sleep every day. Good sleep habits and routines, such as making the

### Key Practice Points

1. Inadequate sleep leads to a wide range of cognitive deficits including impaired learning ability, poor mood and feelings, risky decisions, slower reaction time, inattention, cognitive slowing, decreased communication skills, impaired cognitive flexibility, and the danger of involuntarily falling asleep during critical times.
2. Nurses who work or drive when sleep deprived are at risk for making an error that can endanger themselves, a patient, or another person on the road.
3. Sleep is a biological need similar to water and food, and the effects of sleep deprivation are not overcome by motivation, professionalism, training, or experience.
4. Both workers and managers share the responsibility of adopting strategies to promote adequate sleep.

sleep environment more conducive to sleep and preparing oneself for sleep, improve sleep quality. Information on sleep hygiene, sleep disorders, and strategies for shift workers is available from several sources (Caldwell et al., 2009; Morgenthaler et al., 2007; Patlak, 2005; Sack et al., 2007; National Sleep Foundation, n.d.c). There is widespread lack of knowledge about sleep, which contributes to the growing prevalence of short sleep duration because of personal choice. Scientific groups recommend the development of education programs to disseminate knowledge about sleep and encourage the public and workplaces to adopt better sleep practices (Caruso et al., 2006; Colten & Altevogt, 2006).

Without adequate sleep, people commonly experience excessive daytime sleepiness. Nurses can use the Epworth Sleepiness Scale to estimate how their usual level of daytime sleepiness compares to sleepiness that warrants attention (Johns, 1993). A score greater than 10 raises concern that a person may need to sleep more, improve sleep hygiene, or receive medical attention to determine why he or she is so sleepy.

#### Correcting Other Causes of Sleepiness

Another strategy for reducing risks from fatigue is to identify and manage other factors that increase daytime sleepiness, including sleep disorders and a wide range of other chronic disorders that disturb sleep. Sleepiness is a common side effect of several medications, such as antidepressants, cold tablets, and antihistamines. Sleep-related problems are common, afflicting 50–70 million Americans, but

are often undiagnosed and, therefore, not treated (Colten & Altevogt, 2006). Sleep deprivation from shift work or long hours can exacerbate underlying sleep disorders (Sharifian et al., 2009). Because nurses with fatigue who work these demanding schedules will be particularly vulnerable to fatigue-related risks, they should consider seeking an evaluation from a sleep disorders specialist.

#### Being Aware of the Potential for Error and Injury

Sleep deprivation increases pressure for the brain to fall asleep. The transition from wakefulness to sleep is abrupt and rapid and occurs in an on-off-type switch in the brain stem (Schwartz & Roth, 2008). The warning signs that the brain is close to falling asleep include difficulty focusing, frequent blinking, or heavy eyelids; daydreaming or wandering and disconnected thoughts; yawning repeatedly or rubbing eyes; difficulty keeping head up; and feeling restless and irritable (National Sleep Foundation, n.d.d). When driving, the following symptoms indicate sleep may be imminent: trouble remembering the last few miles driven, missing exits or traffic signs, drifting from a lane, tailgating, or hitting a shoulder rumble strip. If these symptoms occur, stop driving as soon as possible and take action quickly to protect yourself and others from the dangers of drowsy driving.

Wesensten, Belenky, Thorne, Kautz, and Balkin (2004) discussed three key factors that promote fatigue-related errors: time of day, time awake, and time on task. The time of day or the circadian factor predicts that the strongest dip in wakefulness occurs during the early morning hours (2–6 am). Other vulnerable times are in the middle of the afternoon (2–5 pm) and from Midnight to 2 am. The time-awake factor predicts the longer a person has been awake—or the poorer the quality and shorter the amount of sleep he or she had recently—the greater the risk he or she has for fatigue. Last, the time-on-task factor predicts the longer the time spent on a task, particularly one that is monotonous, the more likely a person will feel fatigue. If two or three factors occur at the same time, risk for fatigue is increased.

#### Using Naps

The Standards Practice Committee for sleep medicine recommends planned naps before or during night shifts because research reflects a high degree of clinical certainty for their effectiveness (Morgenthaler et al., 2007). Takahashi's (2003) findings support the positive effects of naps during work shifts. Research indicates that a brief period of sleep (15–20 minutes), not just a quiet period, has an alerting

effect (Takahashi, Fukuda, & Arito, 1998). If time is available, longer naps of 1.5 hours or more can reduce sleep debt and provide further gains. However, after naps of greater than 45 minutes, there will be a period of grogginess, so it is important to allow time for this to pass before resuming dangerous or critical tasks (Wertz, Wright, Ronda, & Czeisler, 2006). When workers are sleepy after the work shift, a short nap may help restore alertness before the drive home.

### Using Caffeine

Caffeine is a commonly used stimulant that takes approximately 30 minutes to reach peak plasma levels (Roehrs & Roth, 2008). The equivalent of two cups of coffee can increase alertness for a few hours (National Sleep Foundation, n.d.e). However, heavy daily use of caffeine may reduce its effectiveness. Instead, consider using it strategically only when its stimulant effect is needed.

### Using a Combination of a Nap and Caffeine

If experiencing drowsiness while driving, experts suggest stopping driving, consuming caffeine, and then quickly taking a short nap (National Sleep Foundation, n.d.d). On awakening, the person will gain the benefits from both. The combination of a 2.5-hour nap before a night shift and caffeine at the beginning of the shift had positive effects on alertness (Sack et al., 2007; Schweitzer, Randazzo, Stone, Erman, & Walsh, 2006).

### Using Light

Light increases alertness and is a strong signal for circadian rhythms (Cajochen, 2007; Caldwell et al., 2009). Many questions remain about the optimum color of light, intensities, and length of time for exposure to light (Terman, 2009). Sunlight is most effective, but common levels of artificial room level light (100 lux or more) also increase alertness (Caldwell et al.). For night workers, some researchers suggest intermittently going into well-lit areas during the first several hours of the shift and reducing light exposure a few hours before bedtime to help prepare the body for sleep when home (Morgenthaler et al., 2007; Sack et al., 2007).

### Using Other Strategies

More research is needed to examine the effects of diet. However, a few studies suggest simple sugars may increase sleepiness, so it is best to avoid sugar-rich beverages and foods when prone to sleepiness and there is a need to stay alert (Anderson & Horne, 2006; Burdakov et al., 2006; Lowden et al., 2004). Caldwell and colleagues (2009) concluded that short

periods of moderate exercise can increase alertness for brief periods (30 minutes), while longer periods of intense exercise may increase sleepiness.

### Avoiding Ineffective Strategies

Researchers cautioned that several common strategies people use when feeling sleepy while driving actually do not help, such as putting down the window, turning the air conditioner on full blast, and playing the radio loudly (Vanlaar, Simpson, Mayhew, & Robertson, 2008). Resorting to these strategies indicates that someone is struggling to stay awake and is too sleepy to continue driving safely (National Sleep Foundation, n.d.d).

### Cautioning About Substances to Promote Sleep or Alertness

Many people can be helped by good sleep habits and routines, so it is best to use these behavioral strategies fully. Stimulants and sleep medications can help people who have difficulty with sleep or daytime sleepiness, but these substances can have side effects, can become addictive, and are generally just for short-term use (Caldwell & Caldwell, 2005; Caldwell et al., 2009). In addition, they do not completely remedy the effects of inadequate sleep and questions remain about their long-term use (Morgenthaler et al., 2007). Given that caution, it is advisable to see a sleep disorders specialist if experiencing frequent sleep disturbances or excessive daytime sleepiness.

### Improving the Workplace

Certain work scheduling patterns are associated with higher risks for fatigue-related accidents and errors. When compared with the day shift, risks were 15% higher for evening shifts, and 28% higher for night shifts (Folkard & Lombardi, 2006). When compared with 8-hour shifts, 10-hour shifts increased the risk for accidents and errors by 13%, and 12-hour shifts increased this risk by 28% (Folkard & Lombardi). As the number of successive night shifts increased, risk increased by 17% for the third night shift, and 36% for the fourth. Dembe, Erickson, Delbos, and Banks (2005) reported a possible “dose response”—as weekly work hours increased, injury rates to workers increased. Work schedule researchers recommended avoiding backward rotations, which change from evening shift to day shift (Caruso et al., 2006). They recommended avoiding a weekly rotation, and suggested using rotations that change shifts several times per week, or every 2 weeks or more.

Managers can work toward moving their organizations to make use of naps during work shifts. This

# Strategies for Nurses to Prevent Sleep-Related Injuries and Errors

includes policies to allow naps during the work shift, good nap environments, systems to schedule naps and awaken napping workers, and adequate staffing to cover the work.

Managers can schedule employees to work with others rather than working alone. Consider the timing of demanding tasks and try to schedule these at times when there is less chance for fatigue. Long periods working on monotonous tasks increase risk for fatigue, so it is useful to break up time on these tasks with other activities.

Frequent rest breaks during the work shift help reduce risks. By pooling findings from several studies, Folkard and Lombardi (2006) estimated that rest breaks every 2 hours reduced risks more than 4- or 6-hour rest breaks did. Managers can improve their workplace approach for taking work breaks.

## Conclusion

Nurses, managers, and employers often lack an appreciation and knowledge about the risks linked to worker fatigue, and often do not have systems to address these risks. The consequences for nurses of fatigue-related errors can be severe, including personal injury or death. In addition, there can be serious legal consequences for the nurse, manager, or employer if an error causes a patient death or if falling asleep on the commute kills another person on the road. Nurses, managers, and employers share the responsibility of adopting strategies to reduce these risks. A key strategy is making sleep a priority in the nurse's personal life and in the workplace's systems for organizing work. Although many research questions remain, current scientific data provide many evidence-based strategies to help reduce these risks.

## Acknowledgment

The findings and conclusions in this report are those of the author and do not necessarily represent the views of NIOSH.

## About the Authors

Claire C. Caruso, PhD RN, is a research health scientist at the National Institute for Occupational Safety and Health (NIOSH), Centers for Disease Control and Prevention, in Cincinnati, OH. Address correspondence to her at ccaruso@cdc.gov.

Edward Hitchcock, PhD, is a deputy branch chief at NIOSH in Cincinnati, OH.

## References

Anderson, C., & Horne, J. A. (2006). A high sugar content, low caffeine drink does not alleviate sleepiness but may worsen it. *Human Psychopharmacology*, 21(5), 299–303.

- Aredt, J. T., Owens, J., Crouch, M., Stahl, J., & Carskadon, M. A. (2005). Neurobehavioral performance of residents after heavy night call vs after alcohol ingestion. *Journal of the American Medical Association*, 294(9), 1025–1033.
- Burdakov, D., Jensen, L. T., Alexopoulos, H., Williams, R. H., Fearon, I. M., O'Kelly, I., et al. (2006). Tandem-pore K<sup>+</sup> channels mediate inhibition of orexin neurons by glucose. *Neuron*, 50(5), 711–722.
- Cajochen, C. (2007). Alerting effects of light. *Sleep Medicine Reviews*, 11(6), 453–464.
- Caldwell, J. A., & Caldwell, J. L. (2005). Fatigue in military aviation: An overview of U.S. military-approved pharmacological countermeasures. *Aviation, Space, and Environmental Medicine*, 76(7 Suppl.), C39–C51.
- Caldwell, J. A., Mallis, M. M., Caldwell, J. L., Paul, M. A., Miller, J. C., Neri, D. F., et al. (2009). Fatigue countermeasures in aviation. *Aviation, Space, and Environmental Medicine*, 80(1), 29–59.
- Caruso, C. C., Bushnell, T., Eggerth, D., Heitmann, A., Kojola, B., Newman, K., et al. (2006). Long working hours, safety, and health: Toward a National Research Agenda. *American Journal of Industrial Medicine*, 49(11), 930–942.
- Colten, H. R., & Altevogt, B. M. (2006). *Sleep disorders and sleep deprivation an unmet public health problem*. Washington, DC: National Academies.
- Dawson, D., & Reid, K. (1997). Fatigue, alcohol and performance impairment. *Nature*, 388(6639), 235.
- Dembe, A. E., Erickson, J. B., Delbos, R. G., & Banks, S. M. (2005). The impact of overtime and long work hours on occupational injuries and illnesses: New evidence from the United States. *Occupational and Environmental Medicine*, 62(9), 588–597.
- Durmer, J. S., & Dinges, D. F. (2005). Neurocognitive consequences of sleep deprivation. *Seminars in Neurology*, 25, 117–129.
- Everson, C. A. (2009). Comparative research approaches to discovering the biomedical implications of sleep loss and sleep recovery. In C. J. Amlaner, D. Phil, & P. M. Fuller (Eds.), *Basics of sleep guide* (2nd ed.). Westchester, IL: Sleep Research Society.
- Folkard, S., & Lombardi, D. A. (2006). Modeling the impact of the components of long work hours on injuries and "accidents." *American Journal of Industrial Medicine*, 49(11), 953–963.
- Goel, N., Rao, H., Durmer, J. S., & Dinges, D. F. (2009). Neurocognitive consequences of sleep deprivation. *Seminars in Neurology*, 29(4), 320–339.
- Hitchcock, E. M., Warm, J. S., Matthews, G., Dember, W. N., Shear, P. K., Tripp, L. D., et al. (2003). Automation cueing modulates cerebral blood flow and vigilance in a simulated air traffic control task. *Theoretical Issues in Ergonomic Sciences*, 4(1–2), 89–112.
- Johns, M. W. (1993). Daytime sleepiness, snoring, and obstructive sleep apnea. The Epworth Sleepiness Scale. *Chest*, 103, 30–36.
- Killgore, W. D., Killgore, D. B., Day, L. M., Li, C., Kamimori, G. H., & Balkin, T. J. (2007). The effects of 53 hours of sleep deprivation on moral judgment. *Sleep*, 30(3), 345–352.
- Landrigan, C. P., Rothschild, J. M., Cronin, J. W., Kauschal, R., Burdick, E., Katz, J. T., et al. (2004). Effect of reducing interns' work hours on serious medical errors in intensive care units. *New England Journal of Medicine*, 351(18), 1838–1848.
- Lowden, A., Holmbäck, U., Åkerstedt, T., Forslund, J., Lennernäs, M., & Forslund, A. (2004). Performance and sleepiness during a 24 h wake in constant conditions are affected by diet. *Biological Psychology*, 65(3), 251–263.
- Moller, H. J., Kayumov, L., Bulmash, E. L., Nhan, J., & Shapiro, C. M. (2006). Simulator performance, microsleep episodes, and subjective sleepiness: Normative data using convergent methodologies to assess driver drowsiness. *Journal of Psychosomatic Research*, 61(3), 335–342.
- Morgenthaler, T. I., Lee-Chiong, T., Alessi, C., Friedman, L., Aurora, R. N., Boehlecke, B., et al. (2007). Practice parameters for the clinical evaluation and treatment of circadian rhythm sleep disorders. An American Academy of Sleep Medicine report. *Sleep*, 30(11), 1445–1459.

- National Highway Traffic Safety Administration. (2000). *On DWI laws in other countries*. Retrieved July 7, 2010, from [www.nhtsa.gov/people/injury/research/pub/DWlOthercountries/dwiothercountries.html](http://www.nhtsa.gov/people/injury/research/pub/DWlOthercountries/dwiothercountries.html).
- National Sleep Foundation. (n.d.d). *Detection and prevention*. Retrieved July 7, 2010, from <http://drowsydriving.org/about/detection-and-prevention/>.
- National Sleep Foundation. (n.d.e). *Getting enough sleep can save your life on the roads*. Retrieved July 10, 2010, from <http://drowsydriving.org/2010/05/getting-enough-sleep-can-save-your-life-on-the-roads/>.
- National Sleep Foundation. (n.d.c). Homepage. Retrieved July 7, 2010, from [www.sleepfoundation.org](http://www.sleepfoundation.org).
- National Sleep Foundation. (n.d.a). *How much sleep do we really need?* Retrieved June 7, 2010, from [www.sleepfoundation.org/how-much-sleep-do-we-really-need](http://www.sleepfoundation.org/how-much-sleep-do-we-really-need).
- National Sleep Foundation. (n.d.b). *Who is at risk?* Retrieved July 7, 2010, from <http://drowsydriving.org/about/whos-at-risk/>.
- Page, A. (Ed.), Committee on the Work Environment for Nurses, & Patient Safety Board on Health Care Services. (2004). *Keeping patients safe: Transforming the work environment of nurses*. Washington, DC: National Academies Press.
- Patlak, M. (2005). *Your guide to healthy sleep*. NIH Publication No. 06-5271. U.S. Department of Health and Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute.
- Pilcher, J. J., Lambert, B. J., & Huffcutt, A. I. (2000). Differential effects of permanent and rotating shifts on self-report sleep length: A meta-analytic review. *Sleep, 23*(2), 155–163.
- Pilcher, J. J., McClelland, L. E., Moore, D. D., Haarmann, H., Baron, J., Wallsten, T. S., et al. (2007). Language performance under sustained work and sleep deprivation conditions. *Aviation Space and Environmental Medicine, 78*(5 Suppl), B25–B38.
- Roehrs, T., & Roth, T. (2008). Caffeine: sleep and daytime sleepiness. *Sleep Medicine Reviews, 12*(2), 153–162.
- Rogers, A. E., Hwang, W. T., Scott, L. D., Aiken, L. H., & Dinges, D. F. (2004). The working hours of hospital staff nurses and patient safety. *Health Affairs, 23*(4), 202–212.
- Sack, R. L., Auckley, D., Auger, R. R., Carskadon, M. A., Wright, K. P. Jr., Vitiello, M. V., et al. (2007). Circadian rhythm sleep disorders: Part 1, basic principles, shift work and jet lag disorders. An American Academy of Sleep Medicine review. *Sleep, 30*(11), 1460–1483.
- Schwartz, J. R., & Roth, T. (2008). Neurophysiology of sleep and wakefulness: Basic science and clinical implications. *Current Neuropharmacology, 6*(4), 367–378.
- Schweitzer, P. K., Randazzo, A. C., Stone, K., Erman, M., & Walsh, J. K. (2006). Laboratory and field studies of naps and caffeine as practical countermeasures for sleep-wake problems associated with night work. *Sleep, 29*(1), 39–50.
- Scott, L. D., Hwang, W., Rogers, A. E., Nysse, T., Dean, G. E., & Dinges, D. F. (2007). The relationship between nurse work schedules, sleep duration, and drowsy driving. *Sleep, 30*(12), 1801–1807.
- Sharifian, A., Firoozeh, M., Pouryaghoub, G., Shahryari, M., Rahimi, M., Hesamian, M., et al. (2009). Restless Legs Syndrome in shift workers: A cross sectional study on male assembly workers. *Journal of Circadian Rhythms, 7*, 12.
- Takahashi, M. (2003). The role of prescribed napping in sleep medicine. *Sleep Medicine Reviews, 7*(3), 227–235.
- Takahashi, M., Fukuda, H., & Arito, H. (1998). Brief naps during post-lunch rest: Effects on alertness, performance, and autonomic balance. *European Journal of Applied Physiology and Occupational Physiology, 78*(2), 93–98.
- Terman, M. (2009). Blue in the face. *Sleep Medicine, 10*(3), 277–278.
- Trinkoff, A. M., Le, R., Geiger-Brown, J., & Lipscomb, J. (2007). Work schedule, needle use, and needlestick injuries among registered nurses. *Infection Control and Hospital Epidemiology, 28*(2), 156–164.
- Van Dongen, H. P., Maislin, G., Mullington, J. M., & Dinges, D. F. (2003). The cumulative cost of additional wakefulness: Dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep, 26*(2), 117–126.
- Vanlaar, W., Simpson, H., Mayhew, D., & Robertson, R. (2008). Fatigued and drowsy driving: A survey of attitudes, opinions and behaviors. *Journal of Safety Research, 39*(3), 303–309.
- Venkatraman, V., Chuah, Y. M. L., Huettel, S. A., & Chee, M. W. L. (2007). Sleep deprivation elevates expectation of gains and attenuates response to losses following risky decisions. *Sleep, 30*(5), 603–609.
- Wertz, A. T., Ronda, J. M., Czeisler, C. A., & Wright, K. P. Jr. (2006). Effects of sleep inertia on cognition. *Journal of the American Medical Association, 295*, 163–164.
- Wesensten, N. J., Belenky, G., Thorne, D. R., Kautz, M. A., & Balkin, T. J. (2004). Modafinil vs. caffeine: Effects on fatigue during sleep deprivation. *Aviation Space Environmental Medicine, 75*(6), 520–525.
- Wickens, C. D. (1984). Processing resources in attention. In R. Parasuraman & D. R. Davies (Eds.), *Varieties of attention* (pp. 63–102). Orlando, FL: Academic Press.
- Williamson, A. M., & Feyer, A. M. (2000). Moderate sleep deprivation produces impairments in cognitive and motor performance equivalent to legally prescribed levels of alcohol intoxication. *Occupational and Environmental Medicine, 57*, 649–655.

### Earn nursing contact hours

Rehabilitation Nursing is pleased to offer readers the opportunity to earn nursing contact hours for its continuing education articles by taking a posttest through the ARN website. The posttest consists of questions based on this article, plus several assessment questions (e.g., how long did it take you to read the article and complete the posttest?). A passing score on the posttest and completion of the assessment questions yield one nursing contact hour for each article.

To earn contact hours, go to [www.rehabnurse.org](http://www.rehabnurse.org) and select the "Education" page. There you can read the article again, or go directly to the posttest assessment by selecting "RNJ online CE." The cost for credit is \$10 per article. You will be asked for a credit card or online payment service number.

Contact hours for this activity will not be available after October 31, 2012.

The Association of Rehabilitation Nurses is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation (ANCC-COA).

