

Sleep, Alertness, and Fatigue Education in Residency (SAFER) Program Speaker's Guide

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Introduction

Acute and chronic sleep loss, whether partial or complete, substantially impair physical, cognitive, and emotional functioning in human beings. In addition, the influence of circadian physiology dictates both that wakefulness and alertness are for the most part at optimal levels during daylight hours, and that sleepiness is maximized during the night. Failure to adhere to this need for both appropriately-timed and adequate amounts of sleep results in an increase in sleepiness and fatigue levels and a decline in waking function that are likely to be particularly relevant to performance of daily tasks in the context of occupational settings.

However, modern society expects performance and productivity on a 24-hour basis. This need for round-the-clock operations in many spheres, including healthcare, often assumes precedence over the basic physiologic principles governing sleep and wakefulness. In particular, the long continuous shifts, reduced opportunities for sleep, and minimal recuperation time traditionally experienced by medical students and house staff during training, and frequently by physicians in practice as well, impact their work, their health and well-being, and the quality of their educational experience.

In response to such concerns, the ACGME in 2001 charged its Work Group on Resident Duty Hours and the Learning Environment with developing a set of recommendations regarding common requirements for resident duty hours across accredited programs in all medical specialties. These recommendations include an 80-hour work week, continuous duty hours limited to 24 hours, and one day in seven free of patient duties. Every residency program in the United States is required to implement these recommendations by July 1, 2003. The overriding goal of these recommendations was to create the opportunity for medical trainees to experience adequate rest, and enable them to perform and learn at their optimal level on a consistent basis.

The Need for Education

However, work hour regulations in and of themselves are necessary but not sufficient to achieve this goal. Education regarding the antecedents and consequences of sleep loss and fatigue and alert management strategies form the necessary foundation for any sleep loss and fatigue management strategies, including work hour regulations, and must be part of any comprehensive and integrated approach to this issue:

- Education is necessary to effect any substantial and sustained behavioral change on the individual level (i.e., the individual needs to understand the rationale for the changes in order to "buy into" them, and also accepts personal responsibility for instituting them).
- Education is often the only vehicle for affecting changes in lifestyle or personal behaviors that impact fatigue and alertness, as these behaviors are not likely to be amenable to external regulation (like amounts of baseline and recovery sleep obtained by residents on non-call nights, and moonlighting practices).
- Education is a critical part of affecting change at the social dynamic level, where one of the most powerful identified barriers to adherence to work hour regulations is the "culture" of the medical workplace. This culture implies that physicians need to "learn" how to manage without sleep.
- Education is necessary at the pragmatic level, where system-wide changes need to support and complement the changes in individuals (i.e., the hospital should provide adequate call room space for napping).

The ACGME work hour guidelines call for "education of faculty and residents in recognizing the signs of fatigue" and "applying operational countermeasures," and mandate the inclusion of sleep education in all residency programs. Unfortunately, medical students and house officers typically receive little or no education about normal sleep and circadian rhythms, or the essential role of sleep in maintaining adequate health and performance. Furthermore, the guidelines clearly state that monitoring of work hours within institutions must not be the only outcome measured, and refers to the need to monitor such parameters as "the physical and emotional well-being of residents the effects of sleep loss and fatigue," and "effect on performance." Many residency programs and program directors do not have expertise in sleep medicine or access to extensive educational resources, and are likely to need assistance on employing these parameters operationally, evaluating or monitoring them, and making "adjustments" or interventions to achieve the required goals. This perceived educational need provided the impetus for the development of the SAFER sleep education curriculum program.

SAFER Educational Goals

The goal of the SAFER program is to increase knowledge and awareness about sleep and fatigue among medical students and residents, and to help create a learning environment that maintains optimal performance and alertness. The first specific objective in achieving that goal was to develop the following educational curriculum module for medical professionals on sleep, fatigue, and alertness management, and to make it available to every residency program in the country. The module was designed to be easily adaptable to a variety of target audiences, including medical students, residents, residency directors, hospital administrators, and "support staff " (other health care professional that work with medical trainees as well as for residents' families). The SAFER curriculum was developed by a task force of individuals with diverse backgrounds and expertise in sleep medicine, medical education/curriculum development, and residency training programs. The task force was headed by members of the AASM Board and **AASM Medical School Education Committee, as well as resident representatives, and representatives from ACGME and the AMA.** The **SAFER program** stresses the importance of supporting balanced, evidence-based, and socially responsible policies regarding sleep, sleep loss and fatigue in medical education settings. The SAFER program also provides standardized and empirically-based information, including strategies that have already been developed in other industries facing similar needs (transportation, aeronautics).

SAFER Curriculum Content

The basic content areas of the SAFER curriculum include:

- Principles of sleep and chronobiology.
- The impact of sleep loss and fatigue on medical trainees (mood, health and safety, work performance, medical education, medical errors).
- Myths and misconceptions about sleep loss and fatigue.
- A framework for developing strategies at the systems levels and at the individual level for addressing and managing sleep loss and fatigue.

The 50-minute PowerPoint presentation is designed to be given by non-sleep as well as sleep medicine faculty to a variety of target audiences, and to present an educational overview of the issues that are accessible and pragmatic. Most of the key educational points are contained in the content of the slides themselves; the accompanying speaker's syllabus was developed to provide users with the empirical basis for the slide presentation content, and to supplement the information contained therein. The syllabus also contains a pre- and post-test evaluation tool for assessment of educational goals and objectives.

Slide Presentation

SLIDE 1: Author Acknowledgement and Contact Information The SAFER program was developed by a task force of the American Academy of Sleep Medicine, Address: One Westbrook Corporate Center, Ste. 920, Westchester, IL 60154 Telephone: (708) 492-0930; Fax: (708) 492-0943; Web site: www.aasmnet.org

SLIDE 2: SAFER Sleep, Fatigue, and Alertness Education in Residency educational module: 50-minute PowerPoint presentation

SLIDE 3: Learning Objectives

At the conclusion of the presentation, participants should be able to: 1) List specific factors relevant to the medical setting that put physicians at risk for sleepiness and fatigue. 2) Describe the impact of sleep loss on residents' personal and professional lives, including performance of work-related tasks, health and safety of medical trainees, medical education, and medical errors 3) Recognize the common (and frequently overlooked) signs of sleepiness and fatigue in themselves and others. 4) Recognize and challenge the most common misconceptions among physicians about sleep and sleep loss, and understand the empirical basis for the counter arguments to these misconceptions. 5) Use and adapt the information presented in the curriculum regarding such fatigue countermeasures as napping and strategic caffeine use, and regarding optimal sleep health behaviors to develop individualized alertness management strategies.

SLIDE 4: **Sleep Loss and Fatigue - Resident Studies Results** The scope of the problem of sleep loss and fatigue in residency training is illustrated in this and other quotes cited later on in the presentation that come from a national focus group study of residents' perspectives on sleep deprivation. The study was conducted at six medical schools across the country, and included 150 residents at all levels of training from a number of specialties (internal medicine, pediatrics, surgery, emergency medicine, family practice, and obstetrics and gynecology) speaking about their own and colleagues' experiences with sleep loss and the impact of sleepiness and fatigue on themselves, their work, and their patients.

References:

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- 2) Papp K, Stoller E, Sage P, Avidan A, Owens J, Aikens J, Strohl K. *Sleep loss and fatigue in graduate medical education: a model. Sleep, Vol 2003*
- 3) Owens JA, Avidon A, Papp KK, Stoller EP, Sage P, Aikens J, Strohl KP. *A qualitative analysis of sleep and caffeine alertness management strategies used by medical trainees. Sleep, Vol 26, 2003; A413*

SLIDE 5: Sleep Loss and Fatigue - Addressing the Issue

There is considerable empirical evidence to support the negative effects of experimental sleep deprivation on neurobehavioral performance (sustained attention, reaction time, vigilance, etc) and on cognitive performance measures (memory, reasoning, etc) in humans (4). Although other occupations (transportation, aviation, military operations) have moved forward in developing and implementing strategies to address work-related fatigue (5,6), the health care profession has been slow to acknowledge and address the substantial impact of sleep loss and fatigue on safety and quality of health care delivery. There are a number of reasons for this relative lack of response, which include concerns about quality of patient care (7, 8), professionalism, and medical education, as well as political and financial considerations (9, 10).

References:

- 4) Pilcher JJ, Huffcutt AL *Effects of sleep deprivation on performance: a meta-analysis. Sleep* 1996; 19: 318-326
- 5) Rosekind MR, Gander PH, Gregory KB, Smith, RM, Miller DL, Oyung R, Webbon LL, Johnson JM. *Managing fatigue in operational settings 1: Physiological considerations and countermeasures. Behavioral Medicine* 1996,-21:157-65
- 6) Rosekind MR, Gander PH, Gregory KB, Smith, RM, Miller DL, Oyung R, Webbon LL, Johnson JM. *Managing fatigue in operational settings 2: An integrated approach. Behavioral Medicine* 1996,-21:166-70
- 7) Laine C, Goldman L, Soukup JR, Hayes JG. *The impact of a regulation restricting medical house staff working hours on the quality of patient care. JAMA* 1993;269(3)3 74-3 78.
- 8) Petersen LA, Brennan TA, O'Neil AC, Cook EF, Lee TH *Does housestaff discontinuity of care increase the risk for preventable adverse events? Ann Int Med* 1994; 121, 866-72.
- 9) Gaba DM, Howard SK. *Fatigue among clinicians and the safety of patients. N Engl J Med* 2002;347(16):1249-1255.
- 10) Howard SK, Gaba DM, Rosekind MR, Zarcone VP. *The risks and implications of excessive daytime sleepiness in resident physicians. Acad Med.* 2002; 77(10):1019-1025.

SLIDE 6: Sleep Loss and Fatigue - Understanding Residents' Sleep

Residents report sleepiness tendencies that are equivalent to those found in some clinical populations of patients with sleep apnea or narcolepsy. Shown are data representing mean values for Epworth Sleepiness Scale (ESS) for nontrial subjects and patients with a variety of sleep disorders (Insomnia, Sleep Apnea, and Narcolepsy) studied at the Louis Stokes DVA Medical Center (11), compared with data reporting ESS values obtained in a multi-center survey of medical residents (1).

The Epworth Sleepiness Scale is an 8-item self report that asks respondents to rate their likelihood of "dozing" under several specified conditions. The individual rates each situation from 0-3, with 3 indicating the highest likelihood. The highest possible score is 24. The generally accepted value for the upper limit of "normal" is 11. Values between 11 and 13 are considered mild, 14 and 17 as moderate and > 17 as severe (12, 13).

References:

- 11) Mustafa, M, Principe K, Ebose I, Erokwu K, Strohl KP. *Risk of Sleep Disorders in the Cleveland VA population. AJRCCM* 2002; 202: A513, 2002.)
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- 13) Johns MW. *Sleep propensity varies with behaviour and the situation in which it is measure& the concept of somnificity. J Sleep Res.* 2002 Mar; 11 (1): 61 - Z

SLIDE 7: Knowledge of Sleep Needs and Physiology

Empirical data from both survey and clinical outcome studies strongly suggest that, in general, physician education regarding basic sleep and circadian biology as well as the recognition, diagnosis, management, and prevention of clinical sleep disorders is inadequate. Substantial knowledge deficits exist at the medical school level, as well as at the post-graduate training and continuing medical education levels (14, 15). The presence of large gaps between scientific

knowledge and clinical teaching and practice has important public health implications. For example, it is known that physicians outside of sleep medicine significantly under-diagnose or misdiagnose sleep disorders--despite the high prevalence of these disorders-leading to increased morbidity and decreased quality of life.

There is no drug test for sleepiness. Despite ongoing investigations regarding the development of practical measures of physiologic sleepiness (analogous to the "breathalyzer" test to assess blood alcohol concentration), the current gold standard remains the Multiple Sleep Latency Test (MSLT), a series of five 20 minute nap opportunities in which the time to onset to EEG- documented sleep is measured.

Most programs do not recognize and address the problem of resident sleepiness. The "culture" of medicine often equates the number of hours on the job and without sleep with professionalism and dedication to patient care (16).

References:

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16) Buysse DJ, Barzansky B, Dinges D, Hogan E, Hunt C, Owens J, Rosekind M, Rosen R, Simon F, Yeasey S, Wiest F. *Sleep, fatigue, and medical training: setting an agenda for optimal learning and patient care. A report from the conference "Sleep, Fatigue, and Medical Training: Optimizing Learning and the Patient Care Environment Vol. 26, No. 2, 2003.*

SLIDE 8: Physiologic Factors that Cause Sleepiness

SLIDE 9: Physiologic Factors that Cause Sleepiness - Myths and Facts

Wakefulness and sleep are highly regulated states. They are primarily governed by a balance of homeostatic drive for sleep and circadian influences on alertness (see also Slide 14), and influenced to a degree by the interaction of external and internal stimuli (17). Optimal mental performance requires a combination of adequate sleep and circadian wakefulness (18). When adults obtain less than 5 hours of sleep per night, the homeostatic drive to sleep raises sharply, which results in an increased propensity to sleep (19) and a decline in cognitive performance. This may be manifested as falling asleep in inappropriate places, such as in noon conference. In other words, it is lack of sleep (not room temperature, a large lunch, a boring lecture, dim light, etc) that causes sleepiness.

References:

17) Borbely AA, Achermann P. *Sleep homeostasis and models of sleep regulation. J Biol Rhythms.* 1999,14:557-568

18) Carrier J, Monk TH. *Circadian rhythms of performance: new trends. Chronobiol Int.* 2000,-17:719-732

19) Jewett ME, Dijk DJ, Kronauer RE, Dinges DF *Dose-response relationship between sleep duration and human psychomotor vigilance and subjective alertness. Sleep.* 1999;22:171-179

SLIDE 10: Excessive Daytime Sleepiness

Excessive daytime sleepiness (EDS) may be due to a variety of factors that may occur independently or in combination. These include insufficient sleep, fragmented sleep, underlying circadian rhythm abnormalities, and primary sleep disorders. An insufficient *quantity* of sleep results from an individual getting less sleep than is needed to be optimally rested, which in most cases is about 8 hours a night. This is probably the most common reason for sleepiness in medical training. Sleep may be of adequate duration, but still result in daytime sleepiness if disrupted or poor *quality* sleep; fragmented sleep in residents during call nights may be caused by interruptions from repeated phone calls, pagers going off, attending to patients on the floor, and emergency room consultations, as well as even the *anticipation* of being interrupted during opportunities to sleep. Circadian rhythm disruptions result from a mismatch between environmental demands on the individual and endogenous circadian sleep wake rhythms (working night shifts). Finally, primary sleep

disorders such as obstructive sleep apnea, narcolepsy, and insomnia are an important cause of excessive daytime sleepiness.

SLIDE 11: Sleep Requirements

Individuals may have differences in their optimal sleep requirements. Most sleep experts agree that the adult sleep requirement is typically between 6 and 10 hours of sleep per 24-hour period, with the majority of individuals requiring approximately 8 hours of sleep per day. When adults get less than 5 hours of sleep over a 24-hour period, peak mental abilities begin to decline. Although in experimental settings adults who get 4 hours of sleep can function reasonably well for short periods of time (2-3 days), performance is still clearly sub-optimal, even in the short run.

If an individual experiences restricted sleep for just a couple of days, the result is significantly slower response times. After one night of missed sleep, cognitive performance may decrease as much as 25% from baseline; after the second night of missed sleep, cognitive performance can fall to nearly 40% of baseline. Furthermore, any discrepancy between the amount of sleep needed by an individual and the amount of sleep actually obtained, even for one night, begins to build up a "sleep debt". This sleep debt continues to accumulate over time until adequate recovery sleep is obtained. Sleep debt leads to slower response times, altered mood and motivation, and reduced morale and initiative.

References:

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21) Koslowsky M, Babkoff H. *Meta-analysis of the relationship between total sleep deprivation and performance.* *Chronobiol Int.* 1992;9:132-136 22) Cox T K, GP, ed. *Stress and Sustained Performance.* 1 ed, 1989. *Work and Stress;* No. 3. Krueger G, ed. *Sustained work, fatigue, sleep loss and performance: A review of the issues.* 1 ed; 1989. *Work and Stress;* No. 3.

SLIDE 12: Sleep Stages

This slide shows two hypnograms, which are a graphic representation of sleep stages as a function of time spent asleep.

The framework or architecture of sleep is based upon recognition of two distinct sleep stages: REM sleep (rapid eye movement or "dream" sleep) and non-REM sleep (75-80% of sleep in healthy young adults). These stages are defined by distinct polysomnographic features of EEG patterns, eye movement, and muscle tone.

- Non-REM sleep may be viewed as a period of relative low brain activity during which the regulatory capacity of the brain is actively ongoing and in which body movements are preserved. Non-REM sleep is further divided into:
 - *Stage 1* sleep (2-5%) which occurs at the sleep-wake transition and is often referred to as "light sleep"
 - *Stage 2* sleep (45-55%) which is usually considered the initiation of "true" sleep and is characterized by bursts of rhythmic rapid EEG activity called sleep spindles (fluctuating episodes of fast activity) and high amplitude slow wave spikes called K-complexes
 - *Stages 3 and 4* sleep (3 to 23%) which are otherwise known as "deep" sleep, slow wave sleep, or delta sleep and during which the highest arousal threshold (most difficult to awaken) also occurs. Delta sleep is generally considered the most restorative stage of sleep, and one which tends to be preserved if the total amount of sleep is restricted. The relative percentage of delta sleep is also increased during the recovery sleep that follows a period of sleep loss.
- REM sleep (20-25%; 4-6 episodes per night) is characterized by paralysis or nearly absent muscle tone (except for control of breathing), high levels of cortical activity (low-voltage, mixed-frequency) that are associated with dreaming, irregular respiration and heart rate, and episodic bursts of phasic eye movements that are the hallmark of REM sleep.

Non-REM and REM sleep alternate throughout the night in cycles of about 90-110 minutes. Brief arousals normally followed by a rapid return to sleep often occur at the end of each sleep cycle (4 to 6 times per night). The relative proportion of REM and non-REM sleep per cycle changes across the night, such that slow wave sleep predominates in the first third of the night and REM sleep in the last third.

The top panel in this slide shows the sleep hypnogram of "normal sleep." The Y axis depicts stages of sleep as the individual falls into deeper sleep proceeding from "Wake" into Stage I and 2 (light sleep), and Stage 3 and 4 (deep/slow wave sleep). The lower panel shows

the sleep hypnogram of a "resident on call". As is evident, sleep here is very fragmented by frequent interruptions during the night. As a result, the resident does not obtain an adequate period of consolidated sleep, spends very little time the restorative stages of sleep (Stages 3 and 4 and REM), and wakes up very sleepy in time for morning rounds.

SLIDE 13: Sleep Stages - Circadian Rhythms

Circadian rhythms, including the sleep wake rhythm, are intrinsic physiologic processes with a "free-running" cycle length of a little over 24 hours. In normal everyday circumstances, circadian rhythms in the human organism are synchronized with and supported by the external environment, which makes it possible for the organism to better adapt to environmental demands (23).

During residency training and in individuals with a shift-work schedule, the sleep wake rhythm is inverted; thus, the individual has to be alert and functional during the period of intrinsic low circadian alertness, and needs to sleep during the day, when she is usually active and alert. In order to perform adequately, the shift worker has to adapt to such disruptions of the sleep wake pattern.

Because the internal periodicity of the human circadian clock is slightly longer than 24 hours, it is easier to stay up later (delay sleep) than to try to fall asleep earlier (advance sleep time). For the same reason, it is also easier to adapt to shifts that rotate in a forward (clockwise) direction (day/evening/night), just as it is easier to adjust to travel across time zones flying west than flying east (24). "Night owls," who normally have a tendency to fall asleep and wake later ("eveningness"), may also find it easier to adapt to night shifts (25), although most sleep experts agree that human beings in general never fully adjust to working night shifts.

References:

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24) Dogen HP and Dinges DF *Circadian rhythms in fatigue, alertness, and performance in Principles and Practice of Sleep Medicine*, Kryger, Roth, and Dement, ed. WB Saunders Company, Philadelphia, Third edition, 2000, 391-99.

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SLIDE 14: Sleep Stages - Interaction of Circadian Rhythms and Sleep

Sleep and wakefulness are regulated by two basic highly coupled processes operating simultaneously (the "two process" sleep system). These are the *homeostatic process* (26), which primarily regulates the length and depth of sleep, and endogenous *circadian rhythms* ("biological time clocks"), which influence the internal organization of sleep and timing and duration of daily sleep/wake cycles (23).

Circadian sleep rhythm is modulated by the hypothalamus, in particular the suprachiasmatic nucleus (SCN). The SCN sets the biologic body clock to approximately 24 hours, with both light exposure and environmental and scheduling cues entraining or coupling

this clock to the 24-hour cycle. Body temperature cycles are also under this circadian hypothalamic control. An increase in body temperature is seen during the course of the day and a decrease is observed during the night. People who are alert late in the evening (ie, evening types or "night owls") have body temperature peaks late in the evening, while those who find themselves most alert early in the morning (i.e., morning types or "larks") have body temperature peaks early in the evening.

Melatonin has been implicated as a modulator of the effects of light exposure on the circadian sleep-wake cycle. Melatonin is secreted maximally during the night by the pineal gland. Prolactin, testosterone, and growth hormone also demonstrate circadian rhythms, with maximal secretion during the night. Many other physiologic functions such as hormone secretion, urine production, and changes in blood pressure are under circadian control and synchronized with the sleep/wake cycle.

Sleep *homeostatic drive* (sleep load) builds up during wake, reaching a maximum in the late evening (near usual sleep time). The circadian system facilitates awakening and through the day usually acts as a counterbalance to the progressive accumulation of sleep load. This model explains the ability to maintain wakefulness during the day and sleep during the night. Thus, the relative level of sleepiness or alertness existing at any given time during a 24 hour period is determined by the duration and quality of previous sleep, as well as time awake since the last sleep period, interacting with the 24 hour cyclic pattern or rhythm characterized by clockdependent periods of maximum sleepiness ("*circadian troughs*") and maximum alertness ("*circadian nadirs*").

References:

26) Borbely AA, Acherman P. Sleep homeostasis and models of sleep regulation. In: Kryger MH, Roth T, Dement WC, eds. *Principles and Practice of Sleep Medicine, Third Edition*. Philadelphia: WB Saunders; 2000:377-90

SLIDE 15: Sleep Disorders - Primary Disorders and Risks

Like all adults, both residents and physicians in practice may experience a variety of primary sleep disorders, which may compound the effects of work-related inadequate and/or fragmented sleep. These disorders include such as obstructive sleep apnea (OSA), restless legs syndrome, periodic limb movement disorder, learned or "conditioned" insomnia and medication induced insomnia.

Obstructive Sleep Apnea (OSA) OSA is a common condition in which the upper airway closes repeatedly during sleep. Affected patients typically stop breathing for 10 to 30 seconds, and sometimes longer, until a brief arousal allows them to open their airway, resume breathing, and fall back asleep, only to repeat the same cycle. The most important risk factors for OSA in adults are obesity and male gender. Untreated, obstructive sleep apnea may lead to high blood pressure, stroke, heart attack, and shorter life span. However, one of the most common shorter-term effects is to produce excessive daytime sleepiness. **Once identified, obstructive sleep apnea** can be successfully treated in most instances. The most common form of treatment in adults is continuous positive airway pressure, or CPAP.

Restless legs syndrome (RLS) and periodic limb movement disorder (PLMD)

Restless leg syndrome, has four cardinal symptoms: uncomfortable sensation in the legs; motor restlessness; worsening episodes during the night; and improvement of the symptoms with leg movements. These symptoms may cause sleep onset insomnia as well as frequent arousals during the night, leading to significant daytime sleepiness. About 10% of the adult population is thought to have RLS, but most go undiagnosed. Risk factors include pregnancy and iron deficiency anemia (low ferritin). Periodic limb movements (PLM's) are continuous and repetitive leg jerks lasting a few seconds, typically occurring every 20 to 40 seconds and sometimes resulting in arousals or awakenings. Most patients with RLS also have PLM's. Bed partners of patients with restless leg syndrome and periodic limb movements frequently bring this problem to the attention of the clinician.

Insomnia (Learned/Conditioned and Medication-induced)

Although most residents complain that they fall asleep *too* easily and at inopportune times, insomnia can also be a problem. Insomnia, which is a symptom and not a diagnosis, is defined as difficulty initiating sleep, difficulty maintaining sleep (frequent awakenings during the night), awakening too early, and/or unsatisfactory sleep quality. Duration and time course of insomnia can range from transient (a few days) and situational (stress-related) to continuous and chronic (weeks to months to years). Some of the wide ranges of causal factors that may be involved include poor sleep hygiene, stress, anxiety, depression, and use of certain medications. Effective treatment strategies may include addressing any underlying psychiatric or medical problems, sleep hygiene measures (good sleep habits; see Slide 42 and 43), cognitive-behavioral therapy, psychotherapy, and short-term or intermittent use of short-acting hypnotic medications.

SLIDE 16: Sleep Disorders - Adaptation to Sleep Loss

Many studies, including those cited above (4, 19) and below (27-29), have clearly demonstrated that human beings do not simply adapt to a state of chronic sleep loss by "learning to function" on less than adequate amounts of sleep. The need for sleep is a biological imperative that must be obeyed at the risk of compromising cognitive functioning, memory, and efficiency and accuracy in performing tasks. Performance can be maintained under certain conditions of sleep loss but only for short periods of time and at sub-optimal levels, on certain types of tasks (shorter, less complex), and under the right circumstances (high level of motivation, powerful reinforcement).

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28) Dinges DF, Pack F, Williams K, Gillen K, Powell JW, Ott GE, Aptowicz C, Pack AI. Cumulative sleepiness, mood disturbance, and psychomotor vigilance performance decrements during a week of sleep restricted to 4-5 hours per night. *Sleep*. 1997; 20:267-277.

29) Van Dongen HP, Maislin G, Mullington J, Dinges DF. The cumulative cost of additional wakefulness: Dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep* Vol. 26, No. 6. 2003; 117-126

SLIDE 17: Consequences of Sleep Deprivation

There is considerable evidence to support the link between acute and chronic, partial and complete sleep deprivation and a host of devastating consequences, ranging from effects on the cardiovascular and immune systems, to impairment in neurobehavioral domains, to functional impairment on the job and behind the wheel.

References:

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SLIDE 18: Consequences of Sleep Deprivation - Shift Work

The consequences related to sleep loss and shift work in physicians in training, like those in any occupational setting, are potentially broad in scope and are likely to occur in a number of domains. They include: personal and family consequences (mood disturbances, increased stress, adverse health consequences, negative effects on personal relationships, increased potential for alcohol and substance abuse, and increased risk of motor vehicle crashes) negative effects on cognitive and neurobehavioral functioning (attention, reaction time, vigilance, memory, as well as motivation) impact on the performance of professional duties (including procedures such as intravenous insertion, cognitive tasks such as electrocardiogram (EKG) interpretation, and patient-related behavior such as communication skills) implications for the quality of medical education (decreased retention of information, impaired information processing, and decreased motivation to learn) impact on the quality of patient care and on commission of errors in the hospital setting, a particular concern in this era of increasing accountability in health care.

To date, there are over fifty studies in the literature on sleep loss and fatigue in medical training, including about thirty performance studies that have examined specific effects on a variety of different performance and performance-related measures. Outcome variables in these studies include: effects on neuro-cognitive and psychomotor functioning in the laboratory setting, effects on performance of simulated work-related tasks and of occupational tasks in actual work settings, and effects on mood and psychological state.

However, there are methodologic flaws in many of the studies, including small sample size, lack of objective or reliable recording of actual sleep amounts, and use of performance outcome measures which may not be sensitive enough or may not be of adequate duration to detect more subtle levels of impairment. Furthermore, the design of most of these studies involves comparisons between pre-call ("rested") and post-call performance in groups of residents. Because the "rested" comparison residents were often in reality chronically sleep deprived, this can obscure any actual difference between baseline and post-call performance.

Although it is difficult to compare studies because of the wide variation in methodology, several reviews have attempted to summarize the available data (33-37). The following slides will illustrate some specific findings in various fields and across tasks.

References:

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- 34) Leung L, Becker CE. Sleep deprivation and house staff performance. *J Occup Med.* 1992;-34:1153-1160.
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SLIDE 19: Consequences of Sleep Deprivation - Resident Studies Results

A number of studies have included outcome variables with "real world" medical task components, either simulated or actual work performance measures. The following studies illustrate that impairment in performance in residents occurs across specialties, settings, and tasks.

Surgery

For example, two recent simulated laparoscopy studies found significantly more errors and more time to perform procedures such as tissue electrocoagulation with increasing sleep loss and on mornings post-call, even in experienced surgeons. There were 20% more errors and 14% more time was required to perform a simulated laparoscopy post call (38); Grantcharov's group found a 2-fold increase in errors, and a 38% increase in time required (39).

Internal Medicine

In another study that looked at the effect of training experience (first/second year residents vs. third/fourth), Lingenfelser examined the performance on a number of psychomotor tasks of residents in the "off-duty" state (at least 6 hours of sleep the previous night) and after 24 hours on call (40). Efficiency and accuracy of performance on a simulated ECG task deteriorated post-call; there was no significant difference in performance between junior and senior residents, suggesting a lack of "adaptation" over time to the sleep-deprived state.

Pediatrics

In a study of pediatric residents that included measurement of performance on both board-type questions and several simulated tasks including intubation, vein catheterization, and arterial catheterization, significant differences were found after 24 and 36 hours of continued wakefulness on efficiency of task performance (41).

References:

- 38) Taffinder NJ, McManus IC, Gul Y, Russell RC, Darzi A. *Effect of sleep deprivation on surgeons' dexterity on laparoscopy simulator. Lancet. 1998; 352: 1191.*
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- 41) Storer JS, Floyd HH, Gill, Giusti CW, Ginsberg H. *Effects of sleep deprivation on cognitive ability and skills of pediatrics residents. Acad Med. 1989; 64:29-32.*

SLIDE 20: Consequences of Sleep Deprivation - Resident Studies Results, cont.

Emergency Medicine

Residents in emergency medicine are particularly vulnerable to the additional effects on performance of circadian rhythm disruption. For example, one study of ten randomly selected second-year residents demonstrated significant reductions in comprehensiveness of the clinical encounter as measured by the number of items documented on history and physical exam (42).

Family Medicine

A retrospective study of 353 family medicine residents found that scores achieved on the ABFM practice in-training exam were significantly negatively correlated with pre-test sleep amounts (43).

In summary, similar to what has been found with performance on neurobehavioral tasks in the laboratory setting, simulated tasks dependent upon high and/or sustained levels of vigilance, those of longer duration, and those which involve newly learned procedural skills appear to be more vulnerable to the effects of short-term sleep loss in medical trainees. In addition, efficiency of performance on "real world" tasks is often sacrificed in favor of preserving accuracy, a factor which could have significant impact in situations that require both speed and precision (intubation of a critically-ill patient, for example). There is little evidence in these studies to support "adaptation" to or the development of increased tolerance for the effects of sleep loss over time in medical trainees.

References:

- 42) Bertram DA. *Characteristics of shifts and second-year resident performance in an emergency department. NY State J Med. 1988,88:10-15.*
- 43) Jacques CH, Lynch JC, Samkoff JS. *The effects of sleep loss on cognitive performance of resident physicians. J Fam Pract. 1990, 30:223-229.*

SLIDE 21: Consequences of Sleep Deprivation - Impact on Professionalism In the focus group study cited above (1), a surprising number of residents identified professionalism and task performance as problems related to sleep loss and fatigue. Professionalism included residents' attitudes toward and interactions with patients and their families, objectification of patients, interactions with staff, loss of empathy, role resistance, and negative attitudes towards the profession. In the focus group study, residents described

themselves as inattentive and emotionally unavailable in their relationships with patients, having difficulty listening to patients, and being much more 'directed' in their discussions with patients when sleep-deprived, as well as having less patience with families. Residents also noted that their compassion level decreased during post call clinic, when they were seeing less acutely ill but nevertheless demanding patients. Sleep loss appeared to contribute significantly to residents' resentment of and disenchantment with the profession of medicine.

SLIDE 22: Consequences of Sleep Deprivation - Impact on Professionalism, cont.

In a national random survey of PGY1 and PGY2 residents conducted in 1998-9, the 3,604 respondents (64.2% response rate) reported working an average of 79.4 hours per week and sleeping less than 6 hours per night during their 1998-99 training year. While there were significant differences in both figures by year of training and by specialty, residents who worked longer hours and averaged fewer hours of sleep reported committing significantly more serious medical errors and conflicts with attendings, nurses, and other residents than did their colleagues.

Reference: 44) Baldwin D and Daugherty S, personal communication

SLIDE 23: Consequences of Sleep Deprivation - Impact on Professionalism, cont.

Self-perceived negative effects on mood, motivation, and life satisfaction as a result of chronic sleep loss are almost universally reported in medical trainees. Negative effects of sleep loss on mood in medical trainees is one of the most consistent findings in the literature on this topic, paralleling what is known about the effects of sleep deprivation in general. In one study of six emergency physicians which assessed sleep amounts (sleep logs and ambulatory EEG), mood states, and performance on two simulated tasks (patient triage and intubation) as a function of day and night shift work, night-shift physicians rated themselves as more sleepy, less happy, and less clear-thinking (45). Residents also report that the negative psychological effects of sleep loss frequently take a toll on family life, and on their professional and personal relationships.

Reference:

45) Smith-Coggins R, Rosekind MR, Hurd S, Buccino KR. Relationship of day versus night sleep to physician performance and mood Ann Emer Med. 1994; 24:928-934.

SLIDE 24: Consequences of Sleep Deprivation - Impact on Professionalism, cont.

In a national survey of PGY1 and PGY2 residents cited in Slide 22, respondents (N=3,604) who reported averaging fewer hours of sleep per night than their colleagues, also reported significantly higher rates of adverse personal health variables, including weight change, alcohol use, and using medications to stay awake during their training year.

SLIDE 25: Sleep Loss and Fatigue - Safety Issues

Several retrospective self-report studies have examined the relationship between sleep loss and fatigue and traffic citations, motor vehicle crashes (MVC, and "near-miss" driving accidents. Studies which have looked at the issue have found prevalence rates for collisions as high as 8% and near-crashes up to 58% in emergency room physicians (46). In this study, 74% and 80% of the collisions and near-miss crashes, respectively, occurred on the drive home following the night shift. Furthermore, driving incidents were correlated with both the number

of night shifts worked, and residents' self-reported tolerance of shift work and adaptation to drowsiness. Marcus and Loughlin's survey of pediatric house officers found a significantly increased prevalence compared to faculty of falling asleep at the wheel either while driving or stopped at a traffic light (49% of the residents vs. 13% of the faculty), traffic citations (25% vs. 18%), and motor vehicle accidents (20 vs. 11 MVA's), with the vast majority of these incidents occurring post-call (47). Finally, a recent retrospective survey of 697 emergency medicine residents found that they were 6.7 times more likely to have a fall-asleep MVC during compared to prior to residency; furthermore, these collisions were associated with rotations with more frequent call and during which less sleep was routinely obtained (48).

A study which looked at the day-night pattern of occurrence of accidental blood-borne pathogen exposure incidents in medical students and residents, found that reported exposures were 50% greater at night (60 incidents per 1000 trainees), indirectly suggesting additional potential effects of fatigue on occupational safety (49).

References:

- 46) Steele MT, John O, Watson WA, Thomas HA, Muelleman RL. The occupational risk of motor vehicle collisions for emergency medicine residents. *Academic Emergency Medicine*. 6(10):1050-1053, 1999.
- 47) Marcus CL, Loughlin GM. Effect of sleep deprivation on driving safety in housestaff. *Sleep*. 1996;19(10):763-766.
- 48) Kowalenko T, Hass-Kowalenko J, Rabinovich A, Grzybowski M. Emergency medicine residency related MVCs - is sleep deprivation a risk factor? *Acad Emerg Med*. 2000; 7(5):451.
- 49) Parks DK. Day-night pattern in accidental exposures to blood-borne pathogens among medical students and residents. *Chronobiol Int*, 2000, 17(1): 61- 70.

SLIDE 26: Sleep Loss and Fatigue: Impact on Medical Education

The quote is from the focus group study cited in Slide 4 (1). An argument that has been traditionally made in defense of the long hours of continuous duty demanded by the current system of medical training is that increased exposure to patients and disease states resulting in enhanced learning. Thus, the results of those few studies which have examined the impact of sleep loss on outcomes potentially related to medical education (decreased retention of information, impaired information processing, and decreased motivation to learn) are important to consider. Decreased satisfaction with the learning environment was reported to be a consequence of sleep loss, and learning satisfaction was negatively correlated with reported average sleep hours in a dose-dependent fashion in Baldwin's survey study cited in Slides 22 and 24.

SLIDE 27: Sleep Loss and Fatigue - Impact on Medical Education, cont.

Both medical students (50) and residents (51) themselves have reported a negative correlation between long work hours and effective learning and use of skills. In those studies that have examined trainees' actual performance on educational tasks, the results are mixed in terms of finding differences in factual knowledge test scores pre- and post-call.

In a study of 34 surgery residents which utilized sleep logs and monthly surveys of operative participation, every other night call was associated not only with increased levels of

fatigue and stress and decreased overall satisfaction, but also with participation *in fewer* operative cases per month, compared to every third and every fourth night call schedules (52).

In summary, generally studies suggest that residents may be able to compensate on tests of factual knowledge for the negative effects of sleep loss and fatigue and that they are appropriately confident about their performance. However, trainees' motivation to learn appears to be significantly impacted by inadequate sleep.

References:

50) Daugherty SR, Baldwin DC Sleep deprivation in senior medical students and first-year residents. *Academic Medicine*. 1996,71(1):S93-S95.,

51) Baldwin PJ, Dodd M, Wrate R W. Young doctors' health - I How do working conditions affect attitudes, health and performance? *Soc Sci Med*. 45(1):35-40, 1997.

52) Saer RG, Dibble CG, Newberg DS, Pruett TL, Minasi JS. Intern call schedules and their relationship to sleep, operating room participation, stress, and satisfaction. *Surgery*. 1999,-126.-337-342.

SLIDE 28: Sleep Loss and Fatigue: Medical Errors

Medical errors may occur at any of multiple different steps in the diagnostic and treatment process, and often involve human factors in their genesis, such as inattention, poor communication, and fatigue. Given the fact that most of the studies cited above show some adverse affects of sleep loss and fatigue in medical trainees on neuro-cognitive function and performance of occupational tasks, it is logical to postulate that sleep loss in medical trainees has significant potential to compromise the margin of safety in the delivery of patient care. However, to date no study has conclusively demonstrated a direct causal relationship between fatigue and medical errors in the healthcare setting.

Attempts to examine the association between sleep loss and fatigue in medical trainees and adverse clinical outcomes have included both survey studies of provider-identified risk factors for medical errors, and studies which have examined antecedents of actual reported errors. For example, surveys of health care providers have documented that, over 60% of anesthesiologists surveyed in the U.S. (53) and almost 90% of those in Australia (54) report having made fatigue-related errors. In a recent survey of 254 internal medicine residents, 41% of the respondents cited fatigue as a cause of their most significant medical mistake (55).

Several other studies, in attempting to unravel the relationship between fatigue and medical errors, have employed a number of different methodologies to assess prevalence, type, and risk factors for medical errors. For example, in one study of anesthetic incidents in Australia, fatigue-related events constituted 2.7% of the 5600 reported errors occurring over a ten-year period, (56) and in another Australian study, fatigue was considered a contributing factor in ten percent of medication errors (57).

Finally, a large study compared the frequency of significant surgical complications (discussed at morbidity and mortality report) for three different call schedules (58). Although no differences were found overall among call schedules, complication rates were 45% higher when the resident had been on call the previous night.

References:

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- 55) Wu A W, Folkman S, McPh ee V, Lo, B. *Do house officers learn from their mistakes? JAMA.* 1991;265(16):2089-2094.
- 56) Morris GP, Morris RW. *Anaesthesia and fatigue: an analysis of the first 10 years of the Australian incident monitoring study 1987-1997. Anaesth Intensive Care.* 2000,-28:300-304.
- 57) Williamson JA, Webb RK, Sellen A, Runciman WB, Van der Walt JH. *Human failure. an analysis of 2000 incident reports. Anesth Intensive Care.* 1993;21:678-683
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SLIDE 29: Signs of Sleep Loss and Fatigue

What are the recognizable signs of sleepiness and fatigue? (Warning: this question is harder than you think!)

SLIDE 30-31: Signs of Sleep Loss and Fatigue - Myths and Facts

To put this very simply, there are two major influences on the physiologic tendencies towards sleepiness: time from last sleep period and the time of day. Circadian variations occur in the levels of alertness (see Slide 14), but both sleep deprivation and sleep restriction contribute towards sleepiness and alertness at any given time of the day. Partial sleep loss results in a cumulative increase in sleepiness by *objective* measurements. Ironically, *subjective* perception of sleepiness correlates much less reliably with these objective measures. Thus, over time, a mismatch develops between the increasing degree of sleepiness and the individual's perception of being sleepy, resulting in a tendency to underestimate subjective sleepiness.

SLIDE 32: Signs of Sleep Loss and Fatigue - Resident Studies

As noted above, subjective self-evaluation of sleepiness in general is poor, as is the ability to detect actual sleep onset. The anesthesia residents in this study (10) were asked whether or not they had fallen asleep or remained awake during formal testing in a sleep laboratory. Self perception of whether they had remained awake or had fallen asleep was no better than a random flip of the coin. This is important in considering the operational consequences of "feeling fit for duty" (or driving home) when the opposite might be true.

SLIDES 33-34: Signs of Sleep Loss and Fatigue - Recognizing Warning Signs

As noted above (Slide 9), sleepiness is physiologically dependent upon previous quantity or quality of sleep, but may be unmasked by reductions in environmental noise, light, and social engagement. A person with a moderate to severe sleep debt may fall asleep even while rating themselves quite alert. Other neurophysiologic phenomena accompanying sleep loss includes *microsleeps* (brief intrusions of EEG indications of sleep into the awake state) and inattention, resulting in forgetfulness and difficulty in staying on-task. These events may not be perceived by the individual as being asleep or recognized as resulting from sleepiness.

References:

59) Chugh DK, Weaver TE, Dinges DF Neurobehavioral consequences of arousals. *Sleep* 1996 Dec;19(10 Suppl):S.198-201.

60) Roehrs T, Carskadon MA, Dement WC, Roth T, Daytime sleepiness and alertness in *Principles and Practice of Sleep Medicine*, Kryger, Roth, and Dement, ed. " Saunders Company, Philadelphia, Third edition,43-52.

SLIDE 35: Alertness Management - Myths, Facts and Strategies

Given the inevitability of some degree of sleep loss and fatigue in the course of medical training, work hour regulations notwithstanding, developing strategies to combat the effects of sleepiness is paramount. There is both anecdotal and empirical evidence to suggest that, operational or system changes such as limits on work hours in and of themselves do not guarantee well-rested and optimally-functioning residents. There are likely to be a number of reasons for this observation (61). First, it is clear from the experience with instituting work hour regulations in New York State, that system changes may be very difficult to implement and maintain. Second, work hour regulations and other system changes cannot by definition govern residents' behavior outside of the workplace (e.g., "moonlighting" activities) or establish their personal priorities regarding adequate sleep, and thus cannot ensure that residents are adequately rested. Finally, it should be pointed out that many of the proposed operational changes themselves have limited or no empirical support. For example, there are no studies in any occupational settings which suggest that an 80-hour work week provides adequate opportunity for rest and recovery; furthermore, this number is well above that stipulated in federal regulations for the aviation industry where much of the research on work hours and fatigue has been conducted (62).

In summary, operational changes such as limitations on resident work hours, scheduling adjustments, and provision of "protected time" for sleep are necessary but unlikely to be sufficient to assure optimal levels of alertness in medical trainees, partially because of difficulties in implementation of and adherence to systems-based measures.

The use of personal strategies or countermeasures (such as napping and strategic caffeine consumption) to address sleep loss and fatigue has been extensively studied in other occupational settings, although only a handful of studies have addressed the issue of countermeasure strategies in medical trainees. One review article (63) examining the impact of shift work in emergency medicine proposed the use of both operational and personal strategies to optimize alertness, including rotation schedule designs based on chronobiologic principles, use of regular exercise and exposure to light on and off the job, and sleep strategies such as anchor sleep, split sleep periods, planned napping.

References:

61) Lamberg L. Long hours, little sleep: Bad medicine for physicians-in-training? *JAMA*. 2002;287(3):303-306.

62) Code of Federal Regulations Aviation (14 CFR Part 121; 14 CFR Part 135). 63) Nitehead DC, Thomas H, Slapper DR. A rational approach to shift work in emergency medicine. *Ann Emerg Med* 1992;21:1250-58.

SLIDES 36-38: Alertness Management - Myths, Facts and Strategies

Since the most effective countermeasure for sleepiness is clearly sleep, the efficacy of napping in combating the effects of fatigue has been an active area of research in the laboratory as well as in other occupational settings. For example, "prophylactic" brief naps prior to 24 hours of sleep loss have been shown to improve alertness during 24 hours of sustained wakefulness (64), and frequent (every 2-3 hours) brief (fifteen-minute) "therapeutic" naps can significantly mitigate performance decrements during periods of prolonged sleep deprivation (65). "Maintenance" or on the job naps may also improve performance in shift workers (66). A 2-8 hour nap prior to 24 hours of sleep loss improves vigilance and minimizes sleepiness for 24 hours (67). According to research, naps as short as 15 minutes can significantly ameliorate the performance decrements of residents if they are provided at 2-3 hour intervals during 24 hours of sleep deprivation (68). The time of the day most refractory to counter-measures is the circadian nadir, 2 to 9 a.m. (69).

In all of these situations, however, consideration must be given to the timing and duration of naps in order to minimize the effects of *sleep inertia* on performance. Sleep inertia, is defined as a clouded sensorium or incomplete arousal from sleep (70). Behaviorally, sleep inertia manifests as slowed speech, substantial performance deficits, poor memory and impaired decision making (71). Sleep inertia is most likely to occur upon an elicited arousal from deep sleep; therefore, brief naps should be timed to end before the first period of deep sleep is likely to occur. With either time or sufficient stimulation, e.g., physical activity or caffeine, sleep inertia is reversed. Although sleep inertia may result in profound impairments, very little is known about the effects of sleep inertia in residents answering pages in the middle of the night.

References:

- 64) Gillberg M, Kecklund G, Axelsson J, Akerstedt T. The effects of a short daytime nap after restricted night sleep. *Sleep*. 1996,-19:570-575.
- 65) Lumley M, Roehrs T, Zorick F, Lamphere J, Roth T The alerting effects of naps in sleepdeprived subjects. *Psychophysiology*. 1986,-23:403-408. 66) Rosa RR, Bonnet MH, Bootzin RR, et al. Intervention factors for promoting adjustment to nightwork and shiftwork. *Occup Med*. 1990,-5:391-415.
- 67) Bonnet MH, Arand DL. Impact of naps and caffeine on extended nocturnal performance. *PhysiolBehav*. 1994,56:103-109.
- 68) Gillberg M, Kecklund G, Axelsson J, Akerstedt T Counteracting sleepiness with a short nap. *J Sleep Res*. 1994,3:90.
- 69) Wright KP, Badia P, Myers BL, Plenler SC. Combination of bright light and caffeine as a countermeasure for impaired alertness and performance during extended sleep deprivation. *J Sleep Res*. 1997,6:26-35.
- 70) Acherman P, Werth E, Dijk D, Borbely AA. Time course of sleep inertia after nighttime and daytime sleep episodes. *Arch Ital Bio*. 1995; 134:109-119.
- 71) Bruck D, Pisani DL. The effects of sleep inertia on decision-making performance. *J Sleep Res*. 1999,8:95-103.

SLIDE 39: Healthy Sleep Habits

Sleeping less than 7 hours per day can result in a sleep deficit. It has been shown that chronic partial restriction of sleep of 6 hours or less per night produces cognitive performance

deficits similar to that seen following total sleep deprivation (72). Chronic loss of sleep has also been shown to have adverse effects on metabolic and endocrine function (31). Therefore, it is important to get an adequate amount of sleep (7-9 hours) per night several days prior to anticipated sleep loss.

References:

72) Hans, PA VD, Maislin, G, Mullington, JM, Dinges, DF. *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, 2003.

SLIDE 40: Healthy Sleep Habits: Recovery from Sleep Loss

There is substantial evidence that getting less than 6 hours of sleep on a chronic basis leads to decreased neuropsychological performance. Following sleep loss, such as night on call, 5-6 hours of sleep is not enough to pay back the sleep debt. In a recent National Sleep Foundation poll, of those interviewed who slept 7 hours or less on weekdays, most reporting having to sleep longer on weekends and about a quarter slept 9 or more hours during the 2 weekend days to recover their sleep (73). Following sleep deprivation, recovery sleep is characterized by an increase in the amount of slow wave sleep or deep sleep (74).

References:

73) National Sleep Foundation: 2001 "Sleep in America " Poll. Press Release, March 2001.

74) Dement WC, Greenberg S. *Changes in total amount of stage four sleep as a function of partial sleep deprivation.* *Electroencephalogr Clin Neurophysiol* 20:523-526, 1966.

SLIDE 41: Healthy Sleep Habits - Resident Studies

In this study of anesthesia residents (10), daytime sleepiness was measured using the Multiple Sleep Latency Test (MSLT) in three conditions. The MSLT is a standardized, validated physiological measure of sleepiness that assesses the time to fall asleep while lying in a quiet, dark bedroom at repeated 2 hour intervals throughout the day. In the baseline condition subjects had no call period with 48 hours and were rotating on general operating room rotations. In the post-call condition, the subjects were rotating on difficult rotations (ICU or obstetric anesthesia) and were studied the day after call. In the sleep extended condition, subjects had four consecutive days and reported to work at 1000 AM. While in this condition, subjects in this group averaged 2 hours more sleep than they did in the baseline condition.

Sleepiness levels in the baseline and post-call condition were not statistically different and were at the level of pathologic daytime sleepiness seen in patients with sleep apnea or narcolepsy. Allowing for 4 days of sleep extension normalized levels of daytime sleepiness supporting sleep as the ultimate countermeasure.

SLIDES 42-43: Healthy Sleep Habits - Strategies

Conditions that disrupt the normal sleep wake rhythm and behaviors that increase physiologic and cognitive arousal may weaken the circadian sleep rhythm and decrease sleep quality. Good sleep habits to improve the strength of the circadian rhythm, relaxing pre-sleep rituals and a comfortable sleep environment will lead to improved sleep quality and quantity. Some simple good sleep habits include: 1) regular bed time and wake times; 2) relaxation before

sleep, 3) a comfortable sleeping environment (cooler temperature, darkness and minimizing noises); 4) avoiding eating large meals; 5) avoiding strenuous physical and mental activities within 3 hours of sleep.

Reference:

75) Zarcone, VP: *Sleep Hygiene*. In Kryger MH, Roth T, Dement WC(eds) *Principles and practice of Sleep Medicine, 3rd ed.* Philadelphia, WB Saunders Company, pp 657-661, 2000.

SLIDE 44-48: Drowsy Driving

One of the more dangerous consequences of sleep loss is a significant decrement in attention and reaction time that has been shown to have a measurable impact on operating a motor vehicle. Fall-asleep car crashes are a predictable consequence of sleep loss. Compared to sleeping eight hours or more, sleeping less than five hours increases the risk of involvement in a sleep-related versus a non sleep-related crash by four and a half times. Furthermore, such crashes are more likely to result in serious injury or death than alcohol-related crashes, perhaps because there are less behavioral attempts made by the driver to avoid the imminent event (32, 76).

Typically, drowsy driving crashes involve a single occupant driving off the road. The highest risk group for drowsy driving crashes is young (less than 25 years old) males. The risk of a drowsy driving crash is also significantly higher under conditions that increase drowsiness (medication, alcohol), or minimize environmental stimuli (highway driving for long periods). The relationship among circadian rhythms, homeostatic drive related to sleep loss, and driving performance also impact the timing of drowsy driving crashes; the graph on Slide 43 demonstrates that the most common periods for fall asleep crashes are in the morning and in the mid afternoon, times when residents are most likely to be driving home post-call.

There are a number of warning signs that indicate an increased risk for a drowsy driving accident, as listed in Slide 44. By the time these behaviors occur, however, the individual may have already been experiencing "microsleeps", the brief intrusions of the sleep state into wakefulness. These microsleeps, which often occur without any subjective awareness of the individual experiencing them, can have tragic consequences under certain circumstances, like driving or monitoring anesthesia (Slide 48).

Specific countermeasure to mitigate (not eliminate!) the risks of driving home after a period of sleep loss are listed on Slide 46 (those that have not been shown to be effective but which are common behavioral reactions are on Slide 47). The best countermeasure for sleep loss remains sleep. Many of these strategies require a cooperative effort among residents, program directors, and hospital administrators. For example, napping before driving home post-call can be greatly facilitated by both a stated endorsement from the residency director, and the provision of appropriate sleeping quarters by the hospital. Some programs have instituted operational measures such as an optional taxi service for residents who feel unsafe to drive home after work.

References:

76) Lyznicki JM, Doege TC, Davis RM, Williams MA. Sleepiness, driving, and motor vehicle crashes. Council on Scientific Affairs, American Medical Association. *JAMA* 1998 Jun 17,-279(23):1908-13. 77)

<http://www.nhtsa.dot.gov/people/performlhumanldrows-drivinglindex.html>

78) <http://www.nhtsa.dot.gov/people/performlhumanIDrowsy.html>

SLIDE 49: Pharmacologic Interventions

Although oral administration of exogenous melatonin has been investigated in other occupational settings as a means of mitigating the effects of circadian disruption (shift work), several studies which have examined the effectiveness of oral melatonin use in emergency medicine physicians working night shifts have failed to document a significant effect (79-81).

Short-term use of short-acting hypnotics such as zolpidem (Ambien) and zaleplon (Sonata), in combination with behavioral treatment and sleep hygiene measures, may occasionally be warranted for transient, situational sleep initiation insomnia in residents. However, chronic use of these or any hypnotic medications should be avoided.

Central nervous system stimulants have been tested for effectiveness in improving performance following sleep loss. High-dose caffeine, modafinil and d-amphetamine are effective in reducing sleepiness as measured with polysomnography and enhancing vigilance **performance in individuals following** short-term (reduced sleep for < 2 days) sleep loss (82-83). However, potential health risks with regular use of any of these drugs should prompt caution in considering them as counter-measures for chronic sleep loss in physicians in training.

Although often used to initiate sleep, alcohol causes greater sleep fragmentation during the night. Alcohol also suppresses REM sleep in the first half of the night, leading to REM rebound (intense dreaming) in the latter part of the night. Following consumption of alcohol in close proximity to bedtime, there is also a net increase in sympathetic arousal during the night that accompanies the decline in blood alcohol level. Increased alcohol consumption also makes night wakings as a result of nocturia more likely (84).

References:

79) Jorgensen KM, Witting MD. Does exogenous melatonin improve day sleep or night alertness in emergency physicians working night shifts? *Ann Emerg Med.* 1998,-31:699- 704.

80) Wrenn K, Wright S. Melatonin after night shift work *Ann Emerg Med.* 1999,-33:479.

81) Wright SW Lawrence LM, Wrenn KD, Haynes ML, Welch LA, Schlack HM. Randomized clinical trial of melatonin after night-shift work. efficacy and neuropsychologic effects. *Ann EmergMed.* 1998;32:334-340.

82) Newhouse PA, Belenky G, Thomas M, Yhorne A Sing HC, Fertig J The effects of d-amphetamine on arousal, cognition, and mood after prolonged total sleep deprivation. *Neuropsychopharm.* 1989,-2:153-164.

83) Bensimon J, Benoit O, Lacomblez L, Weiler E, Warot D, Weil JS, Peuch AJ Antagonism of modafinil of the psychomotor and cognitive impairment induced by sleep deprivation in 12 healthy volunteers. *Psychiatr Psychobio.* 1989,-9:193-254.

84) Zarcone VP *Sleep Hygiene in Principles and Practice of Sleep Medicine*, Kryger, Roth, and Dement, ed. WB Saunders Company, Philadelphia, Third edition, 657-61.

SLIDE 50: Caffeine

Caffeine is a central nervous stimulant that takes effect within 15 to 45 minutes on consumption and remains active for three to five hours, thus *strategically timed* consumption is key. Caffeine effects also depend on body mass, previous usage, and food intake; regular use tends to produce relative tolerance to its' stimulatory effects. Caffeine use may also result in more fragmented sleep and decreased total sleep time.

References:

85) Rosenthal L, Roehrs T, Zwyghuizen-Doorenbos A, Plath D, Roth T *Alerting effects of caffeine after normal and restricted sleep. Neuropsychopharm . 1991;4:103-108.*

86) Reyner LA, Horne JA. *Early morning driver sleepiness: effectiveness of 200 mg caffeine. Psychophys. 2000;37:251-256.*

SLIDE 51-52: Shift Work - Myths, Facts and Strategies

Because different physiologic systems in the body adjust at different rates, the disruption in endogenous circadian rhythms associated with adaptation to night shift work may result in a whole host of psychological (i.e., cognitive dullness, irritability) and somatic complaints (eg, gastrointestinal symptoms), similar to those experienced in jet lag. Adjustment to working night shift, although probably never complete in most individuals, generally takes at least a week. Due to the intrinsic periodicity of the human circadian clock of slightly longer than 24 hours described earlier (Slide 13), it is easier to adapt to shifts that rotate in a forward (clockwise) direction (day/evening/night) and "night owls" may be more successful "night floats."

Strategies to assist in adapting to working the night shift include assuring adequate sleep during off-work hours (5,6). Studies suggest that workers tend to lose one to four hours of sleep each night for approximately three days after a rotation to a new shift (87). Shift workers are also more vulnerable to sleep interruptions from family, social pressures, and other responsibilities. Thus, enlisting the cooperation of others is a key factor in ensuring adequate sleep. Napping strategies include "prophylactic" naps before work. If it is not possible to obtain adequate sleep on work days (equivalent to a normal night's sleep on non-work days) in a single **sleep period, splitting sleep into two periods may be** a viable alternative for some. Sleep periods should be timed if possible to take advantage of those times in the circadian cycle that are most sleep-conducive ("sleep when you are sleepy"). Finally, because light has such a powerful influence on circadian rhythms of alertness and sleepiness, light exposure should be maximized when alertness is desired (i.e., at work) and minimized when a sleep period is planned (driving home after the night shift).

Reference:

87) Vidacek S, Kaliterna L, Radosevik- Vidacek B, Folkard F, *Productivity on a weekly rotating shift system: circadian adjustment and sleep deprivation effects. Ergonomics. 1986: 29:1583-90.*

SLIDE 53: Shift Work - Myths, Facts and Strategies, cont.

There have been a handful of studies which have examined the effects of other operational changes in medical settings. In one example of the use of operational strategies, institution of a team day/night shift on-call system resulted anecdotally in improved morale and resident learning in one obstetrics and gynecology residency program (88). A more recent study which examined the impact of a "night stalker" (night float) radiology resident in the emergency room on quality of care reported fewer "missed" radiologic findings and less clinically significant discordant findings in the post-intervention cases reviewed (89).

However, in the striking illustration of the complexity and challenges involved in implementing system changes to address sleep and fatigue outlined in this slide, one study which examined the impact of a "night float" on-call coverage system on resident performance found that, counter to expectations, the "covered" residents who had protected time for sleep actually obtained *less* sleep overall than the residents who were relieved by the night float (90). The authors concluded that the covered residents used their protected time to catch up on work, not sleep.

References:

88) Carey JC, Fishburne JJ. A method to limit working hours and reduce sleep deprivation in an obstetrics and gynecology residency program. *Obstetrics & Gynecology* 1989; 74:668-672

89) Mann FA, Danz PL. The night stalker effect: quality improvements with a dedicated nightcall rotation. *Investigative Radiology* 1993;28:92-96

90) Richardson GS, Wyatt JK, Sullivan JP, Grav EJ, Ward AE, Wolf MA, Czeisler CA. Objective assessment of sleep and alertness in medical house staff and the impact of protected time for sleep. *Sleep*. 1996; 19:718-726.

SLIDE 54: Alertness Management Strategies Summary

There are several key concepts to keep in mind regarding the development of individual strategies to manage fatigue in the medical setting. All strategies should be evidence-based and include a range of options as outlined in the previous slides; there is neither a "one-size-fits-all" approach nor a single "magic bullet" solution that works for everyone. Because sleep needs, tolerance to sleep loss, and non work-related demands varies across individuals, residents need to develop a sense both of their own personal vulnerability to fatigue (with the caveat that selfassessment of that vulnerability is not always accurate!) and the approaches that work best for them and their lifestyle.

There is also clearly a need for shared responsibility among trainees, medical school faculty and administration, hospital administration, and medical education regulatory bodies for developing and incorporating effective and creative solutions for the problem of sleep loss and fatigue in medical training. Ongoing mechanisms must be developed to insure accountability from residency program and hospital administrators in implementing and assessing the efficacy of given interventions. Because of the unique nature of the combined student and physician role of trainees, working conditions must be structured not only to ensure the safety of both patients and of trainees, but they should also provide an optimal learning environment that allows residents to learn in a well-rested state.

SLIDE 55: Summary

It should be evident from this presentation that the problem of sleep loss and fatigue in medical training is one that impacts significantly on the professional and personal lives of residents and of their patients. Because health care delivery in teaching hospitals must operate 24 hours a day, 7 days a week, *management* rather than *elimination* of fatigue should be the driving concept. Alertness management strategies should be informed by the growing body of research and policy experience from other occupational settings; however, because there are fundamental differences in the nature of the tasks which medical personnel are required to perform in the course of their workday, fatigue management strategies that have been successful in other occupational settings may not be uniformly applicable to medical training; therefore, strategies which are unique to the hospital setting and which incorporate the process of medical education and patient care needs must continue to be developed and tested. Recognition that work hour regulations alone are unlikely to be sufficient to ensure residents who are functioning at an optimal level should prompt ongoing evaluation of the effects of sleep loss and fatigue on key outcomes such as patient health and safety, education effectiveness, resident health and professionalism, and health care economics.

SLIDE 56: Resources

Additional information and assistance with developing and implementing sleep education programs in residency training programs may be obtained through the American Academy of Sleep Medicine. The MED Sleep section of the AASM Web site's (aasmnet.org) has free downloadable educational resources developed by the National Center on Sleep Disorders Research Sleep Academic Award program, and includes PowerPoint slide presentations, case studies, screening tools, model curricula, and sleep knowledge assessment tools. The Medical School Education Committee of the AASM has also developed a list of "sleep education advocates," a network of sleep medicine faculty members at medical schools across the country who have volunteered to act as educational resources at their institution, to continue development and dissemination of educational materials, and to provide feedback and evaluation. There are currently established sleep education advocates in more than 100 of the 141 medical schools in US/PR/Canada committed to further expanding sleep medicine education at their institutions (www.aasmnet.org/MEDSleepprogram.htm).

SAFER Evaluation

Because SAFER is an educational intervention, the expectation is that it will primarily affect knowledge and attitudes of the target audience (residents, faculty, hospital administrators, etc) regarding alertness management. Therefore, the primary emphasis should be on evaluation of these parameters. In addition, specific feedback regarding the SAFER program should be obtained. The following evaluation package includes a pre and post-test, consisting of several components:

Pre-Test:

- Basic demographic information about the respondent
- Assessment of respondent's sleepiness level (Epworth Sleepiness Scale with additional resident-specific items; 12 items)
- Assessment of respondent's current sleep-related behaviors (Sleep Behavior; 8 items)
- Assessment of respondent's current attitudes regarding the impact of sleep loss and fatigue (Sleep Attitudes; 12 items)
- Evaluation of respondent's knowledge regarding basic concepts of sleep and circadian rhythms covered in the SAFER curriculum (Sleep Knowledge; 15 items)

The pre-test evaluation package takes about 10 minutes to complete.

Post-Test:

- Assessment of respondent's feedback regarding SAFER program content, format, and success in meeting stated objectives (Overall Program Evaluation; 10 items)
- Specific suggestions for improving the SAFER program
- Assessment of respondent's intended behavioral changes regarding personal sleep habits in response to the SAFER program
- Assessment of changes in respondent's knowledge regarding basic concepts of sleep and circadian rhythms as a result of the SAFER program (Sleep Knowledge post-test)

The post-test evaluation takes about 5 minutes to complete.