Strategies for Enhancing Sleep and Reducing Fatigue
Introduction

Residents often are required to work shifts that make it difficult to obtain adequate regular sleep.
It is important for residents to understand:

– The basic regulatory processes of sleep
– The effects of sleep deprivation, including the times of day you are most at risk
– How to use appropriate management techniques
Outline

1. Effects of sleep loss
   - Underlying factors
   - Effects of inadequate sleep
   - Objective and subjective fatigue
   - Individual differences

2. Management Strategies
   - Strategies that maximize sleep opportunities
   - Managing sleep pre and post call
   - Countermeasures
Effects of Sleep Loss
Prospective cohort study with 2,737 medical interns

17,003 monthly Internet surveys

Outcomes:
- Percutaneous injuries
- Motor vehicle crashes
- Near motor vehicle crashes

Comparison:
- Risk between 6:30am and 5:30 pm with and without prior night shift
- Risk at night (11:30pm to 7:30am) compared to daytime risk (7:30 am to 3:30 pm)
Shift Duration and Accident Risk

Motor Vehicle Crashes

Near-Miss Crashes

Percutaneous Injuries

Drawn from Barger et al., 2005, & Ayas et al., 2006
Lack of concentration (64%) and tiredness (31%) were the top 2 reasons for percutaneous injuries.

The risk for percutaneous injuries during the night was doubled compared to the daytime (OR=2.04, 95% CI: 1.98-2.11).

Ayas et al., 2006
Medical Errors **without** Consequences for Patient Care

- Risk after 5 or more 24-hour shifts per month **7.5 times higher** relative to months without 24 hour shifts.

*Drawn from Barger et al., 2005*
Medical Errors with Consequences for Patient Care

- Risk after 5 or more 24-hour shifts per month 7 times higher relative to months without 24 hour shifts.

*Drawn from Barger et al., 2005*
Medical Errors with Lethal Consequences for the Patient

- Risk after 5 or more 24-hour shifts per month 4.1 times higher relative to months without 24 hour shifts.

Drawn from Barger et al., 2005
Two Process Model of Sleep

1. **Process C**
   - Circadian process
   - (wake drive – 24-hour regulation of sleep/wake cycle)

2. **Process S**
   - Homeostatic process
   - (sleep drive – increases as a function of time awake)
Adapted from Borbély, 1982
Effects of Ignoring Your Body’s Sleep-Wake Cycle:

1. Impaired cognitive function and performance
2. Increased fatigue and sleepiness
3. Altered hormonal function
4. Gastrointestinal complaints
Performance Modulated by Time Awake, Circadian Rhythm, and Time on Task

Modified from Wesensten et al., 2004
Sources of Fatigue

- Circadian Rhythms
- Chronic Sleep Restriction
- Reduction in Nightly Sleep
- Sleep Fragmentation
- Sleep Inertia
- Sleep Disorders
Circadian Variation in Alertness

Short-term memory, cognitive performance, and subjective alertness all decrease as the circadian drive wanes.

Johnson et al., 1992
Alcohol Intoxication vs. Sleep Deprivation

Data from Roehrs et al., 2003
Dose-Response Relationship for Chronic Sleep Restriction

Redrawn from Van Dongen, et al., 2003

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Real World Sleep Restriction
A sleep restriction study involved 68 participants who were placed into four groups with varying sleep opportunities:

- **Group One:** 9 hours
- **Group Two:** 7 hours
- **Group Three:** 5 hours
- **Group Four:** 3 hours

_Belenky, et al., 2003_
Performance in Sleep Restriction and Subsequent Recovery

Worse Performance

Psychomotor Vigilance Task (PVT)

n = 16-18/group

Drawn from Belenky, et al., 2003
# Prevalence of Sleep Restriction

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<tbody>
<tr>
<td>5 hours or less</td>
<td>3%</td>
<td>14%</td>
<td>16%</td>
<td>14%</td>
<td>14%</td>
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<tr>
<td>6 hours</td>
<td>8%</td>
<td>28%</td>
<td>27%</td>
<td>26%</td>
<td>26%</td>
</tr>
<tr>
<td>7 hours</td>
<td>25%</td>
<td>30%</td>
<td>28%</td>
<td>28%</td>
<td>25%</td>
</tr>
<tr>
<td>8 hours</td>
<td>45%</td>
<td>22%</td>
<td>24%</td>
<td>25%</td>
<td>29%</td>
</tr>
<tr>
<td>9 hours or more</td>
<td>14%</td>
<td>5%</td>
<td>4%</td>
<td>6%</td>
<td>5%</td>
</tr>
<tr>
<td><strong>NET: 6 hours or less</strong></td>
<td><strong>11%</strong></td>
<td><strong>42%</strong></td>
<td><strong>43%</strong></td>
<td><strong>40%</strong></td>
<td><strong>40%</strong></td>
</tr>
<tr>
<td><strong>NET: 7 hours or more</strong></td>
<td><strong>84%</strong></td>
<td><strong>57%</strong></td>
<td><strong>56%</strong></td>
<td><strong>59%</strong></td>
<td><strong>59%</strong></td>
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<tr>
<td><strong>Avg. hours per night</strong></td>
<td><strong>7.9</strong></td>
<td><strong>6.7</strong></td>
<td><strong>6.7</strong></td>
<td><strong>6.8</strong></td>
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40% reported sleeping **6 hours or less** per night in 2013.

Gallup, 2013

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Prevalence of Sleep Restriction

NOTES: Estimates are age-adjusted using the projected 2000 U.S. population as the standard population. Estimates are based on household interviews of a sample of the civilian noninstitutionalized population. Totals may not add to 100% due to rounding. SOURCE: CDC/NCHS, National Health Interview Survey, 2008–2010.

CDC, National Center for Health Statistics, 2013
Effects of Sleep Loss
Impairments in Executive Functioning

Sleep loss decreases brain activity within the prefrontal cortex and thalamus (among other areas).

Results have implications for:
- Decision making
- Risk taking
- Judgment
- Perseveration

Thomas, et al., 2000
Subjective Sleepiness Versus Objective Performance Score

Subjects allowed 4 hours of sleep per night

Redrawn from Van Dongen, et al., 2003
You May Fail to Recognize Excessive Sleepiness

- Sleep restriction and sleep fragmentation impair your performance more than they make you feel sleepy.

- Whenever you average less than 6 hours of sleep per night, are awake for more than 16 hours, or have frequent awakenings, be aware that your performance may be impaired.
Can You Adjust to Chronic Sleep Deprivation?

The answer is **NO**.
Individual Differences

- There are substantial inter-individual differences between responses to sleep deprivation.

- Individual (intra-individual) responses to sleep deprivation are relatively stable between two exposures to sleep deprivation.

Van Dongen et al., 2004
Fatigue Management Strategies

1. Sleep
2. Alertness
STRATEGY 1: SLEEP
# Seek Treatment for Sleep Disorders

<table>
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<tr>
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<th>Typical presentation includes</th>
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| **Obstructive Sleep Apnea** | • Bedpartner reports occasional cessation of breathing during sleep, sometimes accompanied by loud snoring.  
• Bouts of insurmountable sleepiness during daytime |
| **Restless Legs Syndrome**   | • Irresistible urge to move extremities when at rest, associated with difficulty falling/staying asleep |
| **Insomnia**              | • Endogenous difficulty falling asleep, or staying asleep, at normal bedtimes                   |
| **Narcolepsy**            | • Irresistible bouts of daytime sleepiness                                                   |

• The sleep disruption that is secondary to these disorders can result in excessive daytime sleepiness.  
• Treatment of sleep disorders that cause excessive daytime sleepiness restores sleep quality and daytime alertness.
Managing Sleep Pre/Post Call

• Increase sleep duration pre-call
  – Never presume you will have a nap opportunity during call.

• Protect recovery sleep post-call
  – Sleep immediately post-call.
  – If you are not able to stay asleep, get out of bed and then take advantage of circadian low points to obtain more sleep.

• In general, maximize sleep periods; sleep is the most effective way to reverse sleepiness.
Plan your sleep periods

Lower sleep propensity

Higher sleep propensity

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Optimizing Sleep Environment
Optimizing Your Sleep Environment

- Minimize light
- Keep a cool temperature
- Minimize interruptions by turning off cell phones and electronic devices, when possible
- Allow extra time to relax prior to trying to fall asleep
- Use bedroom only for sleep; avoid work, worry or other stressors
Avoid Sleep Altering Substances
Common Sleep Altering Substances

- Caffeine
- Other Stimulants
- Alcohol
Manage Naps
Nap Timing and Placement

– Naps = 10 – 120 minutes, typically secondary to “night’s rest”
– The longer the nap, the better. However, brief naps are better than nothing!
– Morning or later afternoon is the best time to nap
– Allow for “wake-up” period
Strategy 2: **Alertness**
Alertness management: Caffeine
• Caffeine can help manage sleepiness while significantly improving alertness and performance.
• Can take 15–20 minutes to take effect
• Effects last 4 - 5 hours on average.
• Doses ranging from 200 - 600 mg are particularly effective in people who do not normally use caffeine.
• Regular use may lead to tolerance and various undesirable side effects, including elevated blood pressure, stomach problems, and insomnia, so it is best to use only when needed.
• Can be effective when used in combination with a short nap

<table>
<thead>
<tr>
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<th>Caffeine (mg)</th>
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<tr>
<td>Café brewed coffee, 20 oz.</td>
<td>415 - 436</td>
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<tr>
<td>Brewed coffee, 12 oz.</td>
<td>100 - 160</td>
</tr>
<tr>
<td>Iced coffee, 8 oz.</td>
<td>75 - 90</td>
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<tr>
<td>Brewed tea, 8 oz.</td>
<td>30 - 80</td>
</tr>
<tr>
<td>Cola, 12 oz</td>
<td>35 - 47</td>
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<tr>
<td>Energy drink, 16 oz</td>
<td>160 - 200</td>
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Alertness management: Light Exposure
• Indoor bright light exposure can limit the degradation of alertness.

• Study of permanent night shift workers
  – Melatonin secretion adapted with specific light patterns.

• Bright light exposure at night will help with alertness, but may shift circadian clocks undesirably.

_Dumont et al., 2001_
Short Activity Breaks

Redrawn from Bonnet and Arand, 2000
Prescription Stimulants

• Documented to reduce or eliminate subjective and objective measures of sleepiness

• Side effects may include tolerance, anxiety, trouble sleeping and stomach or head aches

• Do not self-prescribe
Be aware of when you are most at risk for fatigue-related performance impairment

<table>
<thead>
<tr>
<th>Time of Day:</th>
<th>between midnight and 0600 hrs</th>
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<tbody>
<tr>
<td>Continuous Hours</td>
<td>when more than 16 hrs have</td>
</tr>
<tr>
<td>Awake:</td>
<td>elapsed since last major</td>
</tr>
<tr>
<td></td>
<td>sleep period</td>
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<tr>
<td>Cumulative Sleep</td>
<td>missing as little as an hour a</td>
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<tr>
<td>Debt:</td>
<td>night can have a significant</td>
</tr>
<tr>
<td></td>
<td>effect</td>
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</table>

Physiological and subjective sleepiness are independent: It can be difficult to recognize that you are dangerously sleepy.
Plan to manage your fatigue

Combine strategies for optimizing your sleep and sustaining your alertness:

- Optimize your sleep environment by reducing noise, light and interruptions.
- Caffeine can significantly reduce the effects of fatigue and improve performance.
- Napping is an effective countermeasure, whether before, during or after call.
- Brief activity breaks can provide short-term relief.
A Public Health Epidemic?

The CDC has called insufficient sleep a public health epidemic due to the 70 million Americans who suffer from sleep problems.

Join the field of Sleep Medicine to tackle this epidemic head on.
Board certified sleep medicine physicians specialize in the clinical assessment, physiologic testing, diagnosis, management and prevention of sleep disorders, including:

- Insomnia
- Sleep Related Breathing Disorders
- Central Disorders of Hypersomnolence
- Circadian Rhythm Sleep-Wake Disorders
- Parasomnias
- Sleep Related Movement Disorders

Becoming a Sleep Specialist

1. Completion of medical school
2. Residency in a sleep-related specialty:
   - Internal Medicine
   - Psychiatry
   - Neurology
   - Family Medicine
   - Otolaryngology
   - Pediatrics
   - Anesthesiology
3. One-year Sleep Medicine Fellowship
Questions?

For more information contact:

American Academy of Sleep Medicine
(630) 737-9700
www.aasmnet.org
References


Johns MW. Sleepiness in different situations measured by the Epworth Sleepiness Scale. Sleep 1994;17(8):703-10.


Schweitzer PK, Randazzo AC, Stone K et al. Laboratory and field studies of naps and caffeine as practical countermeasures for sleep-wake problems associated with night work. Sleep 2006;29:39-50.


Van Dongen HP, 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 2003;26:117-26