SAFER

SLEEP ALERTNESS & FATIGUE EDUCATION IN RESIDENCY

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Learning Objectives

1. List factors that put you at risk for sleepiness and fatigue.

2. Describe the impact of sleep loss on residents’ personal and professional lives, and on resident and patient safety.

3. Recognize signs of sleepiness and fatigue in yourself and others.

4. Challenge common misconceptions among physicians about sleep and sleep loss.

5. Adapt alertness management tools and strategies for yourself and your program.
The Scope of the Problem

“How do you brainwash someone? You sleep deprive them. You feed them bad food and you repeat things over and over again. It’s like that kind of covers residency.”

Papp et al, Academic Medicine, 2002
Sleepiness in residents is equivalent to that found in patients with serious sleep disorders.

Papp et al, Academic Medicine, 2002
Mustafa et al, Sleep and Breathing, 2005
Sleep Loss and Fatigue – Addressing the Issue

So why is the problem of sleepiness and fatigue in residency underestimated?
Cultural Norms and Sleep Need

The culture of medicine says:

• Sleep is “optional” (and you’re a wimp if you need it)
• Less sleep = more dedicated doctor

Perception that reducing work hours

• Compromises patient care
• Reduces educational opportunity
• Increases “scut” work
What Causes Sleepiness?
Physiologic Factors that Cause Sleepiness

**Myth:** “It’s the really boring noon conferences that put me to sleep.”

**Fact:** Environmental factors (passive learning situation, room temperature, low light level, etc) may unmask but DO NOT CAUSE SLEEPINESS.
Conceptual Framework (in Residency)

- **Insufficient Sleep** (on call sleep loss; inadequate recovery sleep)
- **Circadian Rhythm Disruption** (night float, rotating shifts)
- **Primary Sleep Disorders** (sleep apnea, etc)
- **Fragmented Sleep** (pager, phone calls)

EXCESSIVE DAYTIME SLEEPINESS

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Sleep Needed vs. Sleep Obtained

**Myth:** “Like a lot of residents, I only need five hours of sleep, so none of this applies to us.”

**Fact:** Sleep loss is cumulative; getting less than eight hours of sleep starts to create a “sleep debt” which must be paid off.

**Fact:** The effects of sleep loss on attention and working memory become evident when individuals are limited to six hours of sleep per night*

*Van Dongen et al, Sleep, 2003
Sleep Deprivation Decreases Attention

Van Dongen et al, Sleep, 2003
Reducing the Impact of Sleep Loss

Avoid starting out with a sleep deficit!

– Even during light or no call rotations, residents do not obtain adequate sleep (average 6.38 hrs)*

*Arnedt, JAMA, 2005
Adaptation to Sleep Loss

**Myth:** “I’ve learned not to need as much sleep during my residency.”

**Fact:** Sleep needs are genetically determined and cannot be changed.

**Fact:** Human beings do not “adapt” to getting less sleep than they need.*

**Fact:** Although performance of tasks may improve somewhat with effort, *optimal* performance and *consistency* of performance do not! (e.g., post-call performance on a neurocognitive battery does not differ by training year)

*Arnedt, JAMA, 2005
Sleep Fragmentation Affects Sleep Quality

NORMAL SLEEP

ON CALL SLEEP

Morning Rounds
How the Circadian Clock Impacts You

**Fact:** It is easier to stay up later than to try to fall asleep earlier.

**Fact:** It is easier to adapt to shifts in forward (clockwise) direction (day ⇒ evening ⇒ night).

**Fact:** Night owls may find it easier to adapt to night shifts.
Physiologic Determinants of Sleepiness

Normal Sleepiness

16

Physiologic Determinants of Sleepiness

- Sleep Drive
- Wake Propensity
- Circadian Drive for Wakefulness

Consequences of Sleep Deprivation
Impact on Professionalism

“Your own patients have become the enemy...because they are the one thing that stands between you and a few hours of sleep.”

Papp et al, Academic Medicine, 2002
Residents Averaging Less Than Five Hours of Sleep per Night

<table>
<thead>
<tr>
<th>Were significantly more likely to report:</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involvement in a malpractice suit</td>
<td>2.02</td>
</tr>
<tr>
<td>Use of medication to stay awake</td>
<td>1.91</td>
</tr>
<tr>
<td>Serious conflict with other residents</td>
<td>1.86</td>
</tr>
<tr>
<td>Accidents/injuries</td>
<td>1.84</td>
</tr>
<tr>
<td>Making a serious medical error</td>
<td>1.74</td>
</tr>
<tr>
<td>Noticeable weight change</td>
<td>1.59</td>
</tr>
<tr>
<td>Increased use of alcohol</td>
<td>1.52</td>
</tr>
<tr>
<td>Serious conflict with nursing staff</td>
<td>1.47</td>
</tr>
</tbody>
</table>
Average Hours of Sleep per Night Impacts Residency Experience

As Nightly Sleep Increases:

- Satisfaction with residency increases
- Stress rating decreases
- Sense of being “impaired” decreases
- Reports of feeling “belittled or humiliated” decrease

Baldwin & Daugherty, Sleep, 2004
Impact on Patient and Personal Health and Safety
Resident Performance and Fatigue

- Meta-analysis of 20 studies involving residents
  - 24 hour sleep deprivation associated with significant decline in:
    - Vigilance
    - Memory
    - Cognitive performance
    - Clinical performance
  - Magnitude of performance decline
    - Almost one SD overall
    - More than 1.5 SD on clinical tasks

Philibert I. Sleep, 2005
Resident Self-reported Errors by Average Daily Hours of Sleep

Baldwin & Daugherty, Sleep, 2004
# Sleep Deprivation & Errors in Detection of Cardiac Arrhythmias on ECG

<table>
<thead>
<tr>
<th>Medical Interns</th>
<th>Rested</th>
<th>Sleep Deprived</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep Amount in Prior 32 h</td>
<td>7.0 h (5.5 – 8.5 h)</td>
<td>1.8 h (0 – 3.8 h)*</td>
</tr>
<tr>
<td>Errors on ECG Sustained Attention Task</td>
<td>5.21 ± 0.93</td>
<td>9.64 ± 1.41*</td>
</tr>
</tbody>
</table>

*p<.0001

Friedman et al., N Engl J Med 1971
Impaired Speed and Errors in Performance: Laparoscopic Surgical Simulator

Pre and post 17-hour overnight call duty in a surgical department (median reported sleep time 1.5 h; range 0-3 h)

Grantcharov TP et al, BMJ, 2001
Residency Specific Data

• **Surgery:** 20% more errors and 14% more time required to perform simulated laparoscopy post-call (two studies)
  

• **Internal Medicine:** efficiency and accuracy of ECG interpretation impaired in sleep-deprived interns
  
  Lingenfelser et al, Med Educ, 1994

• **Pediatrics:** time required to place an intra-arterial line increased significantly in sleep-deprived
  
  Storer et al, Acad Med, 19891
Residency Specific Data

- **Emergency Medicine**: significant reductions in comprehensiveness of history & physical exam documentation in second-year residents
  
  Bertram N Y State J Med 1988

- **Family Medicine**: scores achieved on the ABFM practice in-training exam negatively correlated with pre-test sleep amounts
  
  Jacques et al J Fam Pract 1990
Intern Sleep and Patient Safety Study

• Randomized trial comparing interns’ alertness and performance on traditional “q3” schedule with 24-30 hour shifts (ACGME-compliant) vs. 16 hr max schedule

• Results: Twice as many EEG-documented attentional failures at night on traditional schedule

Intern Sleep and Patient Safety Study

Results: 36% more serious errors on traditional schedule, including *five times* as many serious diagnostic errors.

Specialties Most Likely to Report Experiences of Sleep Deprivation

1. Neurosurgery 4.06
2. General Surgery 3.65
3. Orthopedic Surgery 3.17
4. Neurology 3.16
5. OB/Gyn 3.10
6. Pediatrics 3.01

Sleep deprivation scale:
1=“Never”; 5=“Almost daily”

Baldwin & Daugherty, Sleep, 2004
Drowsy Driving:
Effects of Sleep Deprivation on Physician Safety
Harvard Work Hours, Health, and Safety Study – Methods

- **National survey**: To objectively quantify the work schedules experienced by house staff, and determine if increased hours are associated with increased risk of house staff injury
  - Study of a national sample of house staff
    - 1,417 person-years monthly survey data collected from 2,737 interns nationwide in 2002-2003
  - Monthly surveys
  - Work hours, crashes, and injuries
  - Correlation of work hours and motor vehicle crashes

Harvard Work Hours, Health, and Safety Study – Results

• For each extended duration work shift scheduled per month interns had:
  – 8.8% (3.2%-14.4%) increased monthly risk of any motor vehicle crash
  – 16% (7.6%, 24.4%) increased monthly risk of a motor vehicle crash on the commute from work
Harvard Work Hours, Health, and Safety Study: Motor Vehicle Crash Risk in Interns on Commute Home from Hospital

Extended shifts (>24 hours) vs. Non-extended shifts (<24 hours)

Crashes per 1000 commutes from the hospital

OR: 2.3, p<0.001

Driving Simulator

Condition effects:
P < 0.001

No effect of sex or training year

Arnedt et al. JAMA 2005
Potential Legal Implications for House Staff and Hospitals

- In New Jersey, “driving after having been without sleep for a period in excess of 24 consecutive hours” now explicitly considered reckless
- Laws pending in several other states to make drowsy driving a felony
- Several “high profile” cases in courts accuse hospitals responsible for fatigue-related crashes even after staff have left
Recognize Signs of Driving While Drowsy

- Trouble focusing on the road
- Difficulty keeping your eyes open
- Nodding
- Yawning repeatedly
- Drifting from your lane, missing signs or exits
- Not remembering driving the last few miles
- Closing your eyes at stoplights
Risk Factors for Drowsy Driving

- Driving long distances without breaks
- Driving alone or on a boring road
- Driving at high risk times of day
Drowsy Driving: What Does and Does Not Work

• What works:
  – AVOID driving if drowsy.
  – If you are really sleepy, get a ride home, take a taxi, or use public transportation.
  – Take a 20 minute nap and/or drink a cup of coffee before going home post-call 20 minute recovery time.
  – Stop driving if you notice the warning signs of sleepiness.
  – Pull off the road at a safe place, take a short nap.

• What doesn’t work:
  – Turning up the radio
  – Opening the car window
  – Chewing gum
  – Blowing cold air (water) on your face
  – Slapping (pinching) yourself hard
  – Promising yourself a reward for staying awake
Impact on Medical Education

“We all know that you stop learning after 12 or 13 or 14 hours. You don’t learn anything except how to cut corners and how to survive.”

Papp et al, Academic Medicine, 2002
Increasing Sleep Time Improves Learning during Residency

As Nightly Sleep Increases:

- Satisfaction with learning increases
- Satisfaction with time with attending increases
- Satisfaction with quality of time with attending increases
- Working without adequate supervision decreases

Baldwin & Daugherty, Sleep, 2004
Impact on Medical Education

**Myth:** “If I’m not on call as much, I’ll learn less.”

**Fact:** Study of surgical residents showed more frequent call is associated with less participation in operative procedures*

**Fact:** Satisfaction with learning in residency is negatively correlated with average hours of sleep**

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*Sawyer et al, Surgery 1999
**Baldwin et al, Soc Sci Med, 1997*
Bottom Line

You need to be alert to take the best possible care of your patients and yourself.
Recognizing Sleepiness in Yourself and Others
Estimating Sleepiness

**Myth:** “I can tell how tired I am and I know when I’m not functioning up to par.”

**Fact:** Almost 50% of the time they had actually fallen asleep, anesthesia residents did not perceive themselves to be asleep*. 

**Fact:** The sleepier you are, the *less accurate* your perception of degree of impairment.

**Fact:** You can fall asleep briefly (“microsleeps”) without knowing it!

*Howard et al  Academic Med, 2002
Microsleeps

• Unintentional episodes of sleep, typically between 5-to-14 seconds in duration

• **Cause:** Sleep debt, sleep deprivation.

• **Behavioral Correlates:** Head nods, drooping eyelids.

• Subjective “unawareness” or “spacing out” sensation

• Extremely dangerous in situations when continual alertness is demanded (driving, operating).

Risser, M. R., Ware, J. C., and Freeman, F. G. Sleep, 2000
The Effects of Sleep Loss are Cumulative

Psychomotor vigilance task (PVT) performance during baseline (B), sleep restriction (P) and recovery (R)

Dinges et al, SLEEP, 1997
Impact of Continued Wakefulness

Myth: “If I can just get through the night (on call), I’m fine in the morning.”

Fact: Performance declines rapidly after about 15-16 hours of continued wakefulness.

Fact: The period of lowest alertness after being up all night is between 6 a.m. and 11 a.m. (e.g., morning rounds).
Recognize the Warning Signs of Sleepiness

- Falling asleep in conferences or on rounds
- Feeling restless and irritable with staff, colleagues, family, and friends
- Having to check your work repeatedly
- Having difficulty focusing on the care of your patients
- Feeling like you really just don’t care
Alertness Management Strategies
Napping Strategies

**Myth:** “I’d rather just “power through” when I’m tired besides, even when I can nap, it just makes me feel worse.”

**Fact:** Some sleep is always better than no sleep.

**Fact:** At *what time* and for *how long* you sleep are key to getting the most out of napping.
Sleep Inertia

• State of impaired cognition, grogginess, disorientation experienced upon waking from sleep
  – Increased if awakened from slow wave sleep
• Studies suggest severe cognitive impairments lasting up to 10 minutes after awakening*
  – Worse than performance after 26 hr sleep deprivation
  – Residual effects up to two hours

*Wertz, JAMA, 2006
Tassi and Muzet, Sleep Med Rev, 2000
Cognitive Performance on Awakening From Sleep Compared with Subsequent Sleep Deprivation

Wertz et al, JAMA, 2006
Napping

**Pros:** Temporarily improve alertness.

**Types:** Preventative (pre-call), operational (on the job)

**Length:** Short naps should be no longer than 30 minutes to avoid sleep inertia*

**Timing:** Take advantage of circadian “windows of opportunity” (2-5 am and 2-5 pm)

*Note: individuals who are sleep-deprived may go into deep sleep sooner and thus may be more likely to experience sleep inertia

*Tietzel A, Lack L. SLEEP 2001
Recovery from Sleep Loss

**Myth:** “All I need is my usual five to six hours the night after call and I’m fine.”

**Fact:** Recovery from on-call sleep loss generally takes at least two nights of extended sleep to restore baseline alertness.
Recovery Sleep and Attention

Belenky et al, J. Sleep Research, 2003
Caffeine

- Reduces some sleep-related deficits at doses of 75-150 mg
- *Strategic* consumption is key
- Effects within 15 – 30 minutes; half-life 3 to 7 hours
- Use for temporary relief of sleepiness
- Cons:
  - Can disrupt subsequent sleep (more arousals)
  - Tolerance may develop
  - Diuretic effects

*Bonnet et al SLEEP 2005*
## Caffeine Content

<table>
<thead>
<tr>
<th>Product</th>
<th>Serving Size</th>
<th>Caffeine (mg)</th>
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<tbody>
<tr>
<td>Cola</td>
<td>8 oz</td>
<td>30 -- 45</td>
</tr>
<tr>
<td>Tea</td>
<td>8 oz</td>
<td>10 -- 70</td>
</tr>
<tr>
<td>Orange soda</td>
<td>8 oz</td>
<td>0 -- 40</td>
</tr>
<tr>
<td>Mountain Dew</td>
<td>8 oz</td>
<td>57</td>
</tr>
<tr>
<td>Red Bull</td>
<td>330 ml</td>
<td>80</td>
</tr>
<tr>
<td>Drip Coffee</td>
<td>7 oz</td>
<td>110 -- 175</td>
</tr>
<tr>
<td>Starbucks Grande</td>
<td>16 oz</td>
<td>260</td>
</tr>
<tr>
<td>No-Doze</td>
<td>1 tab</td>
<td>100</td>
</tr>
<tr>
<td>Vivarin</td>
<td>1 tab</td>
<td>200</td>
</tr>
</tbody>
</table>
Healthy Sleep Habits

- Realize that circadian rhythms and sleep needs are non-negotiable
- Go to bed and get up at about the same time every day.
- Develop a pre-sleep routine.
- Use relaxation to help you fall asleep.
- Protect your sleep time; enlist your family and friends!
- Get 7 - 9 hours before anticipated sleep loss
Healthy Sleep Habits

• Sleeping environment:
  – Cooler temperature
  – Dark (eye shades, room darkening shades)
  – Quiet (unplug phone, turn off pager, use ear plugs, white noise machine)

• Avoid going to bed hungry, but no heavy meals within three hours of sleep.

• Get regular exercise, but avoid heavy exercise within three hours of sleep.

• Avoid using alcohol to help you fall asleep; it induces sleep onset but disrupts sleep later on
Residents Report Using:

**Melatonin**: minimal effect in ER resident studies

**Amphetamines/MPH***: can improve psychomotor performance and promote subjective alertness at 10-20 mg; adverse effects sleep, CV and metabolic/ neuroendocrine measures, high abuse potential

**Modafinil (Provigil)***: Variable improvement performance, alertness, mood at doses 100-400mg; may result in subjective “overconfidence,” disrupted sleep

*Bonnet et al SLEEP 2005
Operational Measures to Reduce Fatigue
ACGME Common Standards for Resident Duty Hours (2003)

- 80 hour limit/week, averaged over four weeks
- One day in seven off
- Adequate rest (10 hours) between duty periods
- In-house call no more than every 3rd night
- 24 hour limit on continuous duty (+ up to six hours) for transfer of care
- Moonlighting must be approved by the program director
Work Hour Limits for Physicians in Other Countries

• **European Working Time Directive** (law which applies to practicing physicians & residents in all EU countries)
  – Maximum of **48-56 hours per week** and **13 consecutive hours**

• **New Zealand Employer - Resident Contract**
  – Maximum **72 hours weekly** and **16 consecutive hours**
Work Hour Limits for Other Occupations in the U.S.

- Truckers: maximum 11h continuous driving
- Pilots: maximum 8h per 24 flying domestic routes
- Nuclear Power plant workers: maximum 12h shift
- Train engineers: maximum 12h shift
Adapting to Night Shifts

**Myth:** “I get used to night shifts right away; no problem.”

**Fact:** It takes at least a week for circadian rhythms and sleep patterns to adjust.

**Fact:** Adjustment often includes physical and mental symptoms (think jet lag).

**Fact:** Direction of shift rotation affects adaptation (forward/clockwise easier to adapt).
How to Survive Night Float

• Protect your sleep.
• Nap before work.
• Consider “splitting” sleep into two four hour periods.
• Have as much exposure to bright light as possible when you need to be alert.
• If you want to go home and sleep, avoid light exposure in the morning after night shift (be cool and wear dark glasses driving home from work).
Morning Shifts

• Reduction in nocturnal sleep by two to four hours

• Anticipation of difficulty in morning waking results in reduced SWS

• Day shifts starting before 7 a.m. more problematic (coincides with circadian nadir of alertness)
Aviation Standards to Reduce Shift Work Fatigue

- Allow adequate rest time between shifts (not < 12 hrs; preferably > 16 hrs).

- Avoid more than three successive shifts in rotating systems, rotate clockwise.

- Night shifts should be placed at the end of a shift cycle; duration not more than eight hours.

- Allow planned “cockpit” nap (30 min) during first night float shift.
“The Best Laid Plans...”

**Study:** Impact of night float coverage (2 a.m. to 6 a.m.)

**Results:** “protected” interns slept less than controls; used time to catch up on work, not sleep; thus there was no improvement in performance

**Bottom line:** Sleep when you can!

Richardson et al, SLEEP, 1996
Schedule Design Principles

Provide relief for residents:

• Reduce hours and/or workload
  – Limit consecutive work hours to < 16 when possible
• Minimize risk-prone situations
• Maintain opportunities for education
• Support resident well-being
• Create shared responsibility for fatigue management and a “culture of support” in the training program.
• Focus on making things better rather than amplifying past problems.
Reducing Hours or Workload - Examples

- **Floats**: not limited to nighttime; should include explicit educational component
- **Shifts**: can stagger team or team member start times or admission times; can provide for designated sleep breaks
- **Caps**: call in float when it appears recommended cap will be exceeded
- **Physician extenders**: spread the workload to maintain resident education and morale and provide sleep breaks
- **Rethinking the care of the patient**: not “my patient” or “your patient,” but the team’s patients. Integrating all of the work, learning, and caring minimizes the impact of any one resident’s day off
### Some Potential Pitfalls Regarding Mistakes, Education, and Morale

<table>
<thead>
<tr>
<th>Common Complaints</th>
<th>Sensible Solutions</th>
<th>Overall Benefits</th>
</tr>
</thead>
</table>
| Hand-offs lead to mistakes; cross-coverage means no one knows the patient | Improve communication                                                             | • More minds understand patient’s problems  
• All hand-offs and coverage will improve, a needed skill for practice |
| Night shifts have no educational value                  | Attending can round one on one with the night float before the rest of the team; night float can be structured to allow float to stay for rounds with one team and conferences at least every other day | • Float gets individualized educational opportunity  
• Float gets to know a team’s patients in depth, aiding with future cross-coverage  
• Float has social interaction with other residents on team and in conferences |
| Night float causes poor morale                          | Structure floats so that people can see their families and friends                | • Float time may increase overall (e.g. q2 schedule for two weeks instead of q1 for one week) but be more pleasant, especially when combined with greater education opportunity (just remember to maintain a consistent sleep routine) |
Minimizing Risk-prone Situations

- **High-risk procedures** (e.g. central lines): Done by incoming team. Residents’ procedure logs should fill at same rate over the course of the rotation

- **Drowsy driving**: Provide cab vouchers or reimbursements
Maintaining Opportunities for Education

- **Conferences:**
  - Schedule at times where floats can attend also
  - Videotape so residents can watch when more alert
  - Distribute handouts; reinforce messages on rounds

- **Achieving competency: education is about learning how to do something right; not the number of times it is done.**
  - Maintain a curriculum to ensure all material is covered and available in multiple learning formats (formal didactic conferences, rounds, journal reading, etc.)
  - Use simulators and computerized resources

- **Attending time:**
  - Incorporate into every rotation, including floats
  - Provide advisors as resource to oversee resident progress and facilitate getting any needed experiences
Supporting Resident Well-being

• Schedule rotations so that residents have adequate time to sleep and see family/friends
• Check-in with residents through advisors, surveys, and attending interaction to assess adequacy of schedules and any associations with mood and morale
• Monitor depression and burnout rates
  – Resident depression has been associated with chronic sleep deprivation and increased from 4% to 30% over one year (Rosen, et al, Acad Med, 2006)
  – Up to ¾ of residents report burnout symptoms, with positive associations with increased workload and work hours (Thomas, JAMA, 2004)
In Summary...

• Fatigue is an impairment like alcohol or drugs.

• Drowsiness, sleepiness, and fatigue cannot be eliminated in residency, but can be managed.

• Recognition of sleepiness and fatigue and use of alertness management strategies are simple ways to help combat sleepiness in residency.

• When sleepiness interferes with your performance or health, talk to your supervisors and program director.
“Patients have a right to expect a healthy, alert, responsible, and responsive physician.”

January 1994 statement by American College of Surgeons
Re-approved and re-issued June 2002