Sleepiness and Fatigue in the Medical Profession: Toughing It Out Is Not Dealing With It

Thomas A. Blackwell, M.D

Senior Associate Dean for Austin Initiatives
Associate Dean for Graduate Medical Education
Professor, Department of Internal Medicine
University of Texas Medical Branch
Galveston, Texas
Goals

• Basic understanding of sleep deprivation

• Issues in residency training

• Personal recommendations regarding sleep regulations
House Officer Stress Syndrome

• Episodic Cognitive Impairment
• Chronic Anger
• Pervasive Cynicism
• Family Discord

• Depression
• Suicidal Ideation/Suicide
• Substance Abuse

Small, GW. Psychosomatics 22(10):860-869, 1981
House Officer Stress Syndrome

• Etiology:
  • Sleep Deprivation
  • Excessive Work Load
  • Patient Care Responsibilities
  • Perpetually Changing Work Environment
  • Competition

• Prevention and Management
  • Improved Working Conditions, including Duty Hours
  • Increased Group Responsibility for Patient Care
  • Psychiatric Referral when necessary

Small, GW. Psychosomatics 22(10):860-869, 1981
Regulation of the Sleep Wake Cycle

Suprachiasmatic nucleus (SCN) → SCN Pacemaker

Retina

Light

Non-Photic Input

Hypothalamus → Thalamus

Neocortex

Sleep Wake Cycle

Derived from Moore, Science, 1999; and Dinges, D. ACGME Annual Conference March, 2003
Image from NASA, moonrise.jpg, Apollo 8 Mission
Sleep Deprivation

• Acute Sleep Deprivation
  • Zero to 4 hours sleep in 24 hours
  • “Sleep Debt” (<8 h) must be made up in next sleep cycle to prevent development of Chronic (Partial) Sleep Deprivation

• Chronic (Partial) Sleep Deprivation
  • Repetitive daily sleep cycles of less than 7-8 hours
  • Most obvious at less than 5 hours
  • Results in a “Sleep Debt” that requires sleep in excess of 8 hours to return to baseline function
Acute Sleep Deprivation

• Sustained wakefulness (<4 hours sleep in 24 hours) is associated with progressive impairment of:
  
  • Mood- Anxiety, Irritability, Sadness, Inappropriate Affect
  
  • Attentiveness – diminished vigilance
  
  • Ability to accomplish tasks requiring sustained attention
  
  • Sacrifice of speed for accuracy on manual dexterity related tasks
Chronic (Partial) Sleep Deprivation

• There is significant individual to individual variation in the level of impact/impairment at a given level of sleep deprivation

• Humans are not able to predict their own cognitive impairment due to sleep deprivation

• 5 hours sleep/night for 1 week

• Cognitive impairment equivalent to 2 nights of total sleep deprivation

Effect of Chronic Sleep Reduction on Daytime Alertness

Average sleep latency (min)

Consecutive Days of Sleep Reduction

B: baseline
R: time in bed = 5 hours

Carskadon, 1990; from Doghramji, K. with permission
Neurobehavioral and Cognitive Effects of Chronic Sleep Deprivation

- Slower response time
- Instability of attention (increased number of errors of omission and commission)
- Rapid deterioration of performance ("fatigability" or vigilance decrement)
- Cognitive slowing on subject-paced tasks
- Increased cognitive errors with increased time pressure (in work-paced tasks)
- Decline in both short-term recall and working memory performance
- Reduced learning (acquisition) of cognitive tasks
- Increased "response perseveration" on ineffective solutions
- Neglect of nonessential activities increases (loss of situational awareness)
- Onset of involuntary "microsleep" attacks
- Increased compensatory effort required to maintain behavioral effectiveness

Dinges D, Clin Psychiatry News 2002:5-7 From Doghramji, K, with permission
Only Mood and Cognition, or More?

- Studies mixed, but suggest negative effects in pregnant residents\(^1,2\)
  - Increased number of pregnancy related complications
    - Hypertension
    - Abruptio Placenta
    - Preterm Labor
    - Adverse fetal outcomes

- Large study\(^3\) which failed to show increased complications in comparison to controls, demonstrated association between >100 hours worked per week and preterm delivery

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1. Silva BM. Pregnancy during residency JAMWA 47:71-74
Automobile Accidents and Pediatric Residents and Physicians

• Prevalence Rates\(^1\) for:

  • Falling asleep at the wheel:
    » Residents 49%
    » Faculty 13%

  • Traffic Citations:
    » Residents 25%
    » Faculty 18%

• Motor Vehicle Accidents
  » Residents 20
  » Faculty 11

• Nearly all accidents for residents occurred *post call*

\(^1\) Marcus CL, Effects of sleep deprivation on driving safety in house staff. Sleep 1996, 19:763
## Survey of Pediatric On-Call House Staff and Faculty

<table>
<thead>
<tr>
<th></th>
<th>House Staff (on call every 4th night) N = 70</th>
<th>Faculty Members (sleep undisturbed) N = 85</th>
<th>Statistical significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response rate</td>
<td>87%</td>
<td>87%</td>
<td></td>
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<tr>
<td>Average hours sleep</td>
<td>2.7 ± 0.9</td>
<td>6.5 ± 0.8</td>
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<tr>
<td>Fell asleep at stop light</td>
<td>44%</td>
<td>12.5%</td>
<td>( P &lt; .001 )</td>
</tr>
<tr>
<td>Fell asleep while driving*</td>
<td>23%</td>
<td>8%</td>
<td>NS</td>
</tr>
<tr>
<td>Fell asleep at the wheel†</td>
<td>49%</td>
<td>13%</td>
<td>( P &lt; .001 )</td>
</tr>
</tbody>
</table>

*While car in motion
†While car in motion or at stop light

Marcus CL, Effects of sleep deprivation on driving safety in house staff. Sleep 1996, 19:763
Automobile Accidents and Emergency Medicine Residents and Physicians

• Prevalence Rates\(^1\) for:
  • Collision up to 8% (74% post night shift)
  • Near misses up to 58% (80% post night shift)

• Correlated with:
  – numbers of night shifts worked
  – resident’s self reported tolerance of shift work
  – self reported adaptation to drowsiness

\(^1\) Steele MT, The occupational risk of motor vehicle collisions for emergency medicine residents. Acad Emer Med 1999, 6:1050
National Survey of 963 Emergency Medicine Residents

Motor Vehicle Accidents (MVA)

- 8% had \( \geq 1 \) MVAs (mean = 1.3 accidents)
- 74% of MVAs were related to night shift
- n = 963 (1554 polled, 62% response rate)

From Doghramji, K., with permission
Extended Work Shifts and the Risk of Motor Vehicle Crashes among Interns

Barger, Laura K.; Cade, Brian E.; Ayas, Najib T.; Cronin, John W.; Rosner, Bernard; Speizer, Frank E.; Czeisler, Charles A.
Survey
2002-2003 Academic Year
18,447 offered participation
3,429 volunteered
2,737 completed initial survey
2,554 completed 1 monthly survey
2,232 completed ≥ 2 surveys
1,550 3-11 ; 682 12 months

Diary validation study as
Subcomponent of 12 month group

From: Barger, L, et al: Extended Work Shifts
and the Risk of
Motor Vehicle Crashes among Interns.
NEJM, 352(2).125-134, 2005
~67% <3hrs/night

# Motor Vehicle Accidents During Commute Home from Work

<table>
<thead>
<tr>
<th>Table 1. Risk of Motor Vehicle Crashes and Near-Miss Incidents after Extended Shifts.*</th>
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<tbody>
<tr>
<td><strong>Variable</strong></td>
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<tr>
<td>Crashes</td>
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<tr>
<td>No. reported</td>
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<tr>
<td>No. of commutes</td>
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<tr>
<td>Rate (per 1000 commutes)</td>
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<tr>
<td>Odds ratio (95% CI)</td>
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<tr>
<td>Near-miss incidents</td>
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<tr>
<td>No. reported</td>
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<tr>
<td>No. of commutes</td>
</tr>
<tr>
<td>Rate (per 1000 commutes)</td>
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<tr>
<td>Odds ratio (95% CI)</td>
</tr>
</tbody>
</table>

Odds Ratio for Having Motor Vehicle Accident or Near Miss Event During Commute Home from Work

Data From Table 1: Barger, L, et al: Extended Work Shifts and the Risk of Motor Vehicle Crashes among Interns. NEJM, 352(2).125-134, 2005
Proportion of Months with One or More Episodes of Falling Asleep While Driving

Odds Ratio for Falling Asleep While Driving or While Stopped in Traffic

(Proportion of months with one or more episodes of falling asleep, regardless of number of incidents)


* 95% CI
CHAPTER 143

AN ACT concerning vehicular homicide and amending N.J.S.2C:11-5.
BE IT ENACTED by the Senate and General Assembly of the State of New Jersey:

1. N.J.S.2C:11-5 is amended to read as follows:

   a. Criminal homicide constitutes vehicular homicide when it is caused by driving a vehicle or vessel recklessly. Proof that the defendant fell asleep while driving or was driving after having been without sleep for a period in excess of 24 consecutive hours may give rise to an inference that the defendant was driving recklessly.

This act shall take effect immediately.


http://www.njleg.state.nj.us/2002/Bills/PL03/143_.PDF
Performance versus Hours of Wakefulness

- 40 subjects studied in paired experiments
- Experiment 1: Subjects kept awake for 28 hours (8 AM Day 1 to Noon Day 2)
- Experiment 2: Rested Subjects given 10-15 grams EtOH at 30 minute intervals from 8 AM until mean [EtOH] reached 0.10%
- Cognitive psychomotor performance measured at half hour intervals using computer-administered test of hand-eye coordination (unpredictable tracking task)
- Results expressed as % of performance at 8 AM

Performance versus Hours of Wakefulness

**Figure 1.** Scatter plot and linear regression of mean relative performance levels against:

- **a**, time, between the tenth and twenty-sixth hour of sustained wakefulness ($F_{1, 24} = 132.9, P < 0.05$, $R^2 = 0.92$)

Performance versus Blood Alcohol Level

Figure 1. Scatter plot and linear regression of mean relative performance levels against:

**b,** blood alcohol concentrations up to 0.13%, ($F_{1,24} = 54.4, P < 0.05, R^2=0.69$).

Comparison of Deterioration in Performance: Hours of Wakefulness versus Comparable Blood Alcohol Concentration

Figure 2
Performance in the sustained wakefulness condition expressed as mean relative performance and the percentage blood alcohol concentration equivalent. Error bars ± s.e.m.

Effect of Reducing Interns’ Weekly Work Hours on Sleep and Attentional Failures

Steven W. Lockley, Ph.D., John W. Cronin, M.D., Erin E. Evans, B.S., R.P.S.G.T., Brian E. Cade, M.S., Clark J. Lee, A.B., Christopher P. Landrigan, M.D., M.P.H., Jeffrey M. Rothschild, M.D., M.P.H., Joel T. Katz, M.D., Craig M. Lilly, M.D., Peter H. Stone, M.D., Daniel Aeschbach, Ph.D., and Charles A. Czeisler, Ph.D., M.D., for the Harvard Work Hours, Health and Safety Group
A  Traditional Schedule

<table>
<thead>
<tr>
<th></th>
<th>Wednesday</th>
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<td>Intern A</td>
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Clock Time

B  Intervention Schedule

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<td>Intern 1</td>
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Clock Time

Lockley, SW, et. al. Effect of Reducing Interns’ Weekly Work Hours on Sleep and Attentional Failures NEJM 2004;351:1829-37
Duty Hours Decreased

Sleep Increased for all but 2 residents

Lockley, SW, et. al. Effect of Reducing Interns' Weekly Work Hours on Sleep and Attentional Failures NEJM 2004;351:1829-37
Inverse Correlation between Mean Duration of Work and Sleep

![Graph showing the inverse correlation between Mean Duration of Work and Mean Duration of Sleep. The graph includes data points for Traditional schedule and Intervention schedule, with a linear regression line indicating the inverse correlation (r = -0.57).](image)

Nighttime Attentional Failures

Figure 5. Mean (+SE) Number of Attentional Failures among the 20 Interns as a Group and Individually while Working Overnight (11 p.m. to 7 a.m.) during the Traditional Schedule and the Intervention Schedule.

Lockley, SW, et. al. Effect of Reducing Interns' Weekly Work Hours on Sleep and Attentional Failures NEJM 2004;351:1829-37
Effect of Reducing Interns’ Work Hours on Serious Medical Errors in Intensive Care Units

Christopher P. Landrigan, M.D., M.P.H., Jeffrey M. Rothschild, M.D., M.P.H., John W. Cronin, M.D., Rainu Kaushal, M.D., M.P.H., Elisabeth Burdick, M.S., Joel T. Katz, M.D., Craig M. Lilly, M.D., Peter H. Stone, M.D., Steven W. Lockley, Ph.D., David W. Bates, M.D., and Charles A. Czeisler, Ph.D., M.D., for the Harvard Work Hours, Health and Safety Group
Effect of Reducing Interns’ Work Hours on Serious Medical Errors in Intensive Care Units Landrigan, CP, et.al. NEJM 2004;351:1838-48

A  Traditional Schedule

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<td>Intern 3</td>
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<tr>
<td>Intern 4</td>
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</tbody>
</table>

Clock Time
Table 3. Incidence of Serious Medical Errors.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Traditional Schedule</th>
<th>Intervention Schedule</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serious medical errors made by interns</td>
<td>no. of errors (rate/1000 patient-days)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serious medical errors</td>
<td>176 (136.0)</td>
<td>91 (100.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Preventable adverse events</td>
<td>27 (20.9)</td>
<td>15 (16.5)</td>
<td>0.21</td>
</tr>
<tr>
<td>Intercepted serious errors</td>
<td>91 (70.3)</td>
<td>50 (55.0)</td>
<td>0.02</td>
</tr>
<tr>
<td>Nonintercepted serious errors</td>
<td>58 (44.8)</td>
<td>26 (28.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Types of serious medical errors made by interns</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medication</td>
<td>129 (99.7)</td>
<td>75 (82.5)</td>
<td>0.03</td>
</tr>
<tr>
<td>Procedural</td>
<td>11 (8.5)</td>
<td>6 (6.6)</td>
<td>0.34</td>
</tr>
<tr>
<td>Diagnostic</td>
<td>24 (18.6)</td>
<td>3 (3.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Other</td>
<td>12 (9.3)</td>
<td>7 (7.7)</td>
<td>0.47</td>
</tr>
<tr>
<td>All serious medical errors, unit-wide</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Serious medical errors</td>
<td>250 (193.2)</td>
<td>144 (158.4)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Preventable adverse events</td>
<td>50 (38.6)</td>
<td>35 (38.5)</td>
<td>0.91</td>
</tr>
<tr>
<td>Intercepted serious errors</td>
<td>123 (95.1)</td>
<td>63 (69.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Nonintercepted serious errors</td>
<td>77 (59.5)</td>
<td>46 (50.6)</td>
<td>0.14</td>
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<tr>
<td>Types of serious medical errors, unit-wide</td>
<td></td>
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</tr>
<tr>
<td>Medication</td>
<td>175 (135.2)</td>
<td>105 (115.5)</td>
<td>0.03</td>
</tr>
<tr>
<td>Procedural</td>
<td>18 (13.9)</td>
<td>11 (12.1)</td>
<td>0.48</td>
</tr>
<tr>
<td>Diagnostic</td>
<td>28 (21.6)</td>
<td>10 (11.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Other</td>
<td>29 (22.4)</td>
<td>18 (19.8)</td>
<td>0.45</td>
</tr>
</tbody>
</table>
Effect of Reducing Interns’ Work Hours on Serious Medical Errors in Intensive Care Units Landrigan, CP, et.al. NEJM 2004;351:1838-48
Medical Errors by Interns

Effect of Reducing Interns’ Work Hours on Serious Medical Errors in Intensive Care Units
Landrigan, CP, et.al. NEJM 2004;351:1838-48
Sleep Inspires Insight

- 22 subjects in each group
- Repetitive problem, with pattern
- Pattern Recognition (insight) permits “shortcut” to solution
- Measure solution rate, “shortcutting” as a manifestation of insight
- Studied with Prime experience at 11PM, then 8 hours later after either 8 hours sleep or 8 additional hours of waking
- Third group studied at 11 AM, then 8 hours of additional waking (to exclude acute sleep deprivation as cause of observed differences)
- Additional group studied without prime, after sleep or waking

Sleep Inspires Insight

with labeling modification¹, from:

![Graph showing subjects gaining insight during different periods: Wake-day, Wake-night, Sleep, After sleep, After wake.](image-url)
Obstacles to Implementation of the New ACGME Standards
Obstacles to Implementation of the ACGME Standards

- Economic burden on the system
- Concerns about continuity of care
  - Educational fallout: will residents see complete cases?
  - Errors in communication: patients cared for by a physician other than their primary resident were 6 times more likely to suffer a preventable adverse event
- Resident financial pressures promote moonlighting
- Historic cultural environment
- Change is difficult!

The Cultural Environment

• “We believe that long hours are an inherent part of our profession, and if we don’t train in the way we will work in the future, we will not be able to function adequately. This is analogous to pilots; if they don’t practice flying at night, how can we expect them to fly at night?”

• “Who are we? The answer is that we are physicians, a highly selected group, and we are not representative of the population as a whole.”
Prevailing Myths

• “The more I work the smarter I get.”
• “Coffee and determination will help me fight sleep.”
• “As long as I’m awake, I’m okay to work.”
• “Napping makes it harder to wake up and function.”
• “After 36 hours on call, I can still drive home to bed.”
• “A couple good nights’ sleep and I’ll be rested.”
• “I can learn to get by on less sleep.”
• “I can tell when I’m getting too tired to work.”
“Limiting on-call duty to every other night is a mistake because I will miss half of the good cases.”

— Overheard from a surgery resident
ACGME Standards

• Limits on duty hours
  – 80 hours maximum per week
  – 24 hours maximum per shift; additional 6 hours allowed for transfer of care
  – 1 day in 7 free of patient care responsibilities
  – In-house call only every 3 nights
  – 10-hour minimum rest period should be provided between daily duty periods and after in-house call
ACGME Standards (continued)

- High-quality education and effective patient care
  - Recognize and monitor residents for signs of fatigue
  - Apply preventive and operational countermeasures
  - Duty hour assignments that recognize collective responsibility to patient care
- Institutional oversight
  - Sponsoring institution to establish policies and procedures to monitor program’s policies
  - Required justification for increases above 80-hour limit
  - Increased patient care support services to reduce resident time spent on routine activities
<table>
<thead>
<tr>
<th>Country(s)</th>
<th>Weekly Hour Limit</th>
<th>Frequency of Night Call Interval</th>
<th>Consecutive Hour Limit</th>
<th>“Sign Out” Interval</th>
<th>Duty Free Interval Minimum</th>
<th>Minimum 24 h Duty Free Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>USA (ACGME)</strong></td>
<td>80 h/wk avg over 4 wk</td>
<td>≥ q 3rd (≈ 9 calls in 28 d)</td>
<td>24 h (6) (12 h ER)</td>
<td>6 h</td>
<td>10 h</td>
<td>1 d/7 avg over 4 wk (4/mo)</td>
</tr>
<tr>
<td><strong>USA New York</strong></td>
<td>80 h/wk</td>
<td>≥ q 3rd (≈ 9 calls in 28 d)</td>
<td>24 h</td>
<td>0 h</td>
<td>8 h</td>
<td>1 d/7 avg over 4 wk (4/mo)</td>
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<td><strong>Canada</strong></td>
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<td><em>example: Ontario</em></td>
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<tr>
<td><strong>European Union</strong></td>
<td>58 h (56 h in 2007)</td>
<td>n/a</td>
<td>13 h (8 h for nights)</td>
<td>n/a</td>
<td>11 h</td>
<td>1 d/7 or 2 d/14 (4/mo)</td>
</tr>
<tr>
<td><strong>Australia</strong></td>
<td>70 h avg; max 75/wk; ≤ 38-40 “ordinary hrs” (6a-6p,M-F)</td>
<td>≤ 7 calls in 28 d; ≤ 10 home call in 30 d</td>
<td>≤ 16 h continuous duty; ≤ 24 h on call</td>
<td></td>
<td>8 h</td>
<td>6 d in each 4 wk period (6/mo)</td>
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<tr>
<td><strong>New Zealand</strong></td>
<td>≤ 72 h any 7 days; ≤ 60 h/ wk; ≤50 h/wk ER</td>
<td>≤ 2 long days/wk (LD&gt;10h)</td>
<td></td>
<td></td>
<td>8 h</td>
<td>Every second weekend completely free of duty</td>
</tr>
</tbody>
</table>

Derived from data in Bhananker, SM, Cullen, BF. Curr Opin Anesthesiol 16:603-609, 2003
Preventive and Operational Countermeasures

• Scheduling
• Napping
• Pharmacotherapy
• Monitoring
Preventive and Operational Countermeasures

Scheduling

- Where possible develop scheduling that promotes flexibility
- Develop and formalize patient handoff system
- No shifts should end in early morning hours (2a.m. – 7a.m.)
Preventive and Operational Countermeasures

Scheduling

- Limit continuous performance schedule to 12-16hrs
  
  (i.e.) ED Shifts no longer than 12 hrs.
Preventive and Operational Countermeasures

Scheduling

Night Float Systems

1. Night coverage team – begins @ 9 - 11p.m.

2. One-two week duration to allow circadian shifting

3. Night shifts no longer than 10 hrs

4. Evening Call team out of hospital by midnight.
Napping

Night shift workers after 2-hour nap prior to shift

• Prevented sleepiness

• Longer naps produced a deeper sleep, but workers awakened with grogginess due to sleep inertia

Preventive and Operational Countermeasures

Napping

ER residents after 1-hour nap prior to a night shift

- EEGs show clearly enhanced awake activity
- Reduced stress
- Workload perceived as less onerous

Pharmacologic Countermeasures

• Caffeine
• Modafinil
• Alcohol
• Hypnotics
Slow release caffeine and prolonged (64-h) continuous wakefulness: effects on vigilance and cognitive performance.

- Study of healthy volunteers, with 64 hour acute sleep deprivation, randomized to receive placebo (PBO) or sustained release caffeine 300 mg (SRC) every 12 hours
- Measures of alertness, visual and motor function, and cognitive function and attention tracked
Number of Microsleeps

Slow release caffeine and prolonged (64-h) continuous wakefulness: effects on vigilance and cognitive performance.

- Especially in hours 16-30, SRC enhanced maintained performance, and was superior to placebo in mitigating the impact of acute sleep loss.

- 64 Navy Seal Trainees
- Extreme environmental stress for 72 hours
- Received Placebo, 100, 200 or 300 mg SR Caffeine

- Even in the most adverse circumstances, moderate doses of caffeine can improve cognitive function, including vigilance, learning, memory, and mood state.
- When cognitive performance is critical and must be maintained during exposure to severe stress, administration of caffeine may provide a significant advantage.
- 200 mg appears to be optimal under such conditions

Pharmacokinetics of Sustained Release Caffeine versus Caffeinated Coffee

Preventive and Operational Countermeasures

Pharmacology

• Caffeine—widely available, widely accepted
  – Boosts alertness
  – Tolerance to benefits develops quickly
  – Erodes sleep quality
  – Undesirable side effects on mood
  – Less-predictable GI absorption; active longer than half-life suggests
Preventive and Operational Countermeasures

Modafinil
Preventive and Operational Countermeasures

720-degree turn

Time

% Change

Placebo
Modafinil

Aviation, Space, and Environmental Medicine – Vol 75 9/2004
Preventive and Operational Countermeasures

Depression-Dejection Ratings

% Change

Time

Aviation, Space, and Environmental Medicine – Vol 75 9/2004
Preventive and Operational Countermeasures

Pharmacology

Modafinil—schedule IV wake-promoting agent
  - Tolerance does not develop
  - No erosion sleep quality
Preventive and Operational Countermeasures

Pharmacology

• Dextroamphetamine—schedule II stimulant
  – Palpitations
  – Tachycardia
  – Elevation of blood pressure
  – Overstimulation

• Methylphenidate—schedule II stimulant
  – Nervousness
  – Insomnia
  – Anorexia

One Third of Adults Reported Insomnia

Self-reported 1-year prevalence

Nonserious insomnia: 18%
Serious* insomnia (85% untreated): 17%
No insomnia: 64%

*(Serious defined as "a lot of trouble" by respondents.
Adapted from Mellinger GD, et al Arch Gen Psychiatry 1985)
Preventive and Operational Countermeasures

Pharmacology

- Alcohol
  - Induces sleep initially
  - Increases fragmentation
  - Overall, a bad choice for sleep
Preventive and Operational Countermeasures

Pharmacology

- Zolpidem, zaleplon—schedule IV short-acting sedative hypnotics
  - Headache
  - Drowsiness
  - Dizziness
  - Nausea

Selective Benzodiazepine Receptor Agonists

- Zolpidem (Ambien) and Zaleplon (Sonata)
- Bind Bzl Receptor
- Lack Anxiolytic, Myorelaxant, Antiseizure Activity at Normal Doses
- Rapid Onset of Action
- Minimal Side Effects/Effect on Sleep Stages
- Both Indicated for Sleep Latency
Zaleplon (Sonata)

- 1 Hour Half-Life
- May be used if 4 Hours of Sleep Remains
- Reduced Period of Performance Loss if Sleep interrupted
- Usual Dosage 10-20 mg
- 5 mg in elderly
- Released in US 1999
Zolpidem (Ambien)

- 2.5 Hour Half Life
- Indicated for Total Sleep Time and Night Time Awakening
- Performance Effect Longer
- Usual Dosage 5-10 mg
- Metabolized Liver
- Reduces Sleep Loss International Travel
- Released Europe 1988 and US 1992
# Pharmacologic Management of Insomnia

<table>
<thead>
<tr>
<th>Drug</th>
<th>Onset of Action</th>
<th>Half Life (hr)</th>
<th>Duration (hr)</th>
<th>Action Metabolites</th>
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<tr>
<td><strong>Benzodiazepines</strong></td>
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<tr>
<td>Estazolam (2mg)</td>
<td>Rapid</td>
<td>10 - 24</td>
<td>6 - 8</td>
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<tr>
<td>Flurazepam (30mg)</td>
<td>Rapid</td>
<td>47 - 100</td>
<td>8 - 10</td>
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<td>Quazepam (15mg)</td>
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<td>39 - 73</td>
<td>8 - 10</td>
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<td>Temazepam (15mg)</td>
<td>Slow-Intermediate</td>
<td>9.5 - 12.4</td>
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<td>Triazolam (0.25mg)</td>
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<td><em>Imidazopyridine:</em></td>
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<tr>
<td>Zolpidem (10mg)</td>
<td>Rapid</td>
<td>mean 2.5</td>
<td>~6</td>
<td>No</td>
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<tr>
<td><em>Pyrazolopyrimidine:</em></td>
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<td></td>
<td></td>
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<tr>
<td>Zaleplon (10mg)</td>
<td>Rapid</td>
<td>~1</td>
<td>~1</td>
<td>No</td>
</tr>
</tbody>
</table>

Preventive and Operational Countermeasures

Monitoring

Clinical Signs of Excessive Sleepiness

• Irritability, moodiness, and disinhibition
• Frontal lobe signs
  – Apathy, impoverished speech, flattened affect
  – Impaired memory
  – Inflexible thinking and impaired planning skills—an inability to be novel or to multitask

Preventive and Operational Countermeasures

Monitoring

*Clinical Signs of Excessive Sleepiness*

- Intrusive sleepiness
  - Microsleeps (5 to 10 seconds) cause lapses in attention
  - Nodding off when sedentary
  - REM phenomena (hypnagogic hallucinations)

Preventive and Operational Countermeasures

Monitoring: Self-Assessment Tools

• Epworth Sleepiness Scale (ESS)\(^1\)
• Pittsburgh Sleep Quality Index (PSQI)\(^2\)
• Beck Depression Inventory (BDI)\(^3\) and Zung Self-Rating Depression Scale (SDS/ZDS)\(^4\)
• Maslach Burnout Inventory (MBI)\(^5\)

## Epworth Sleepiness Scale

<table>
<thead>
<tr>
<th>Situation</th>
<th>Chance of dozing (0-3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting and reading</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Watching television</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Sitting inactive in a public place—for example, a theater or meeting</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>As a passenger in a car for an hour without a break</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Lying down to rest in the afternoon</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Sitting and talking to someone</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Sitting quietly after lunch (when you’ve had no alcohol)</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>In a car, while stopped in traffic</td>
<td>0 1 2 3</td>
</tr>
</tbody>
</table>

### Total Score

- **0** = would never doze
- **1** = slight chance of dozing
- **2** = moderate chance of dozing
- **3** = high chance of dozing

Quantitative Reporting

• **Kronos** is a comprehensive Web-based solution managing every phase of the employee relationship including staffing, developing, deploying, tracking, and rewarding the workforce.

• **Radio frequency identification (RFID)** is a method of remotely storing and retrieving data using devices called RFID tags. An RFID tag is a small object, such as an adhesive sticker, that can be attached to or incorporated into a product. RFID tags contain antennas to enable them to receive and respond to radio-frequency queries from an RFID transceiver.
RFID Takes Attendance and Heat

A California startup developed an RFID system to help teachers take roll call, but called off an in-school pilot after it incited protests from parents and advocacy groups.

By Mary Catherine O'Connor

Feb. 16, 2005—A small California startup called InCom has developed a radio frequency identification (RFID) system called InClass to automate attendance-taking in elementary and secondary schools. The system uses ultra-high frequency (UHF) readers mounted in classroom doorways and passive RFID tags attached to student ID card holders. InClass was being tested at Brittan Elementary School in Sutter, the small town northeast of Sacramento where InCom is based. After a number of parents of Brittan students protested the use of RFID in the school, InCom announced on Feb. 15 at a school board meeting that it had ended the pilot test.

Article taken from RFID Journal
# Qualitative Reporting

**Rotation Specific:**

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
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</thead>
<tbody>
<tr>
<td>Did you work more than 80 hours per week averaged over a four-week period?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>Did you receive 24 hours off in each seven days during this rotation averaged over a four-week period?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>Are you on call more often than every third night averaged over 4 weeks?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>Were you provided a 10-hour period between all daily duty periods and after in-house call?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>Were supervision and teaching adequately provided in all your patient care activities?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>Were the overall Goals and Objectives for this rotation met and appropriate, as defined, for your level of training?</td>
<td>Yes / No</td>
</tr>
</tbody>
</table>

*Data taken from UTMB Evaluation System*
## Qualitative Reporting

**The University of Texas Medical Branch at Galveston**

**House Staff**

Rotation Summary of YES Answers - House Staff Evaluating Faculty and Rotation Between 11/3/2004 and 2/1/2005

<table>
<thead>
<tr>
<th>Program Description</th>
<th>Evaluations (Please note # below reflects adjusted count for each HS answering Work Hour Questions 1 time during a rotation. HS may evaluate more than 1 faculty during a rotation.)</th>
<th>Did you work more than 80 hours per week averaged over a four week period?</th>
<th>Did you receive 24 hours off in each seven days during this rotation averaged over a four week period?</th>
<th>Are you on in house call more often than every third night averaged over 4 weeks?</th>
<th>Were you provided a 10-hour period between all daily duty periods and after in-house call?</th>
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</thead>
<tbody>
<tr>
<td>Allergy &amp; Immunology / Internal</td>
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<td>Medicine/Pediatrics</td>
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<td>Anesthesiology</td>
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<tr>
<td>Anesthesiology-Cardiac</td>
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<td>Anesthesiology-Pain Medicine</td>
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<td>Dermatology-Dermatopathology</td>
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</tbody>
</table>
Qualitative Summary of Self Reporting

The University of Texas Medical Branch at Galveston
House Staff
Rotation Summary of YES Answers - House Staff Evaluating Faculty and Rotation Between 11/3/2004 and 2/1/2005

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<tr>
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<td>Surgery-Urology</td>
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<td>0%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Data taken from UTMB Evaluation System
Preventive and Operational Countermeasures

Education

• No substitute for sleep
• Avoid driving between 2 AM and 9 AM
• Behavioral changes may indicate dangerous levels of fatigue
• Need for performance backups during times of impairment
• Interaction between alcohol and sleep loss can be deadly
• Benefits of prophylactic naps