Sleep Deprivation and Fatigue In Healthcare

Hospital Wide Grand Rounds
Riverside County Regional Medical Center

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Disclosures

• None of the faculty, planners, speakers, providers nor CME committee has any relevant financial relationships with commercial interest.

• There is no commercial support for this CME activity.
Residents who work traditional schedules with recurrent 24 hour shifts...

- Make **36% more** serious preventable adverse events than individuals who work no more than 16 consecutive hours.

- Make **five times** as many serious diagnostic errors.

- Have **twice** as many on-the-job attentional failures at night.

2007 Joint Commission Journal on Quality and Patient Safety
Residents who work traditional schedules with recurrent 24 hour shifts...

- Experience a **1.5 to 2 SD** deterioration in performance relative to baseline rested performance on both clinical and non-clinical tasks.

- Report making **300% more** fatigue-related preventable adverse events that led to a patient’s death.
Objectives

• Definition of fatigue
• Problems associated with fatigue
• Signs of fatigue
• Risks of fatigue in healthcare

• Assessing the risks
• Overcoming fatigue
  – Controlling the risks
  – Monitoring and Supervision
Definition of Fatigue

• A mental or physical exhaustion that prevents a person from performing work safely and effectively

• Occurs because of prolonged exertion, sleep loss, or disruption of the internal body clock

• Can be caused by factors that are work-related and/or lifestyle-related and can accumulate over time.
Mechanism of Sleepiness

• Sleep
  – Most effective way to prevent and manage fatigue
  – The optimum amount of sleep is variable
    • Most adults required 7-8 hours daily

• Process S: Homeostatic **Sleep Drive**
  – Wake/sleep homeostasis

• Process C: Circadian **Wake Drive**
  – Entrained to a ~24hr cycle
  – Governs most systems in the body
Two Process Model of Sleep
Two Process Model of Sleep

Risk Factors of Fatigue in Healthcare

• Night shifts
• Extended shifts
• On-call nights (sleep fragmentation)
• Rotating shifts
• Seasonal workers
• New employees
• Mentally demanding tasks
• Health-care culture
Sleep Fragmentation

Normal night
High Risk Times of Fatigue

• Midnight to 6 a.m.
• Early hours of the day shift

• First night shift or call night after a break
  – Also near end of call week if accumulating sleep debt
• The first 2-3 hours of a shift or the end of shift

• Early in residency when new to night call
• Right-of-passage at a new job
Signs of Fatigue

• Constant yawning or falling asleep at work
  – “Micro sleeps”
• Short term memory problems
• Inability to concentrate
• Inattention to detail
• Impaired decision-making and judgment
• Reduced hand-eye coordination
• Report of blurred vision
• Difficulty with interpersonal communication
  – “Irritability, depressed mood, flattened affect”
• Report of need for extended sleep during days off
Myths

• “I know when I am too tired to perform”

• “I just need another Red Bull”

• “My program director/attending/supervisor will look down on me if I complain about being tired”

• “I will eventually adapt to less sleep”

• “A short nap will only make me more groggy”

• “I don’t need [the recommended] 6-8 hours of sleep”
Conclusions:

• “Neurobehavioral deficits from sleep loss varied significantly among individuals and were stable within individuals.”

• “…they involved trait-like differential vulnerability to impairment from sleep loss, for which neurobiologic correlates have yet to be discovered.”
Subjective Measure of Sleepiness
Epworth Sleepiness Scale

- Narcolepsy
- Medical Residents
- Sleep Apnea
- Insomnia
- Normal

Epworth Sleepiness Scale Score

Data from: Papp et al. 2004; Mustafa et al. 2003; Johns MW. 1994; Johns MW. 2002

From: AASM “safer” program
Poor Subjective Awareness of Decreased Performance

Human subjects

4 hour sleep restriction

12 continuous nights

Objective performance evaluation
  • Performance Vigilance Test (errors)

Subjective sleepiness evaluation
  • Stanford Sleepiness Scale (0-7)

Van Dongen 2003
• 32 healthy males and females age 21-35 years

• Sleep loss of 0, 2, 4 or 8 hours

• Ethanol consumption of 0.0, 0.3, 0.6 , and 0.9 g/kg (with 80-proof vodka tonic) at 8:30 am

• Measured performance and mean sleep latency
# Table 3—Sleep Loss and Ethanol Dose Equivalence for Sedative Effects

<table>
<thead>
<tr>
<th>Sleep loss (time in bed), h</th>
<th>Dose</th>
<th>Beer. no.*</th>
<th>BrEC%†</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 (0)</td>
<td>2.16 g/kg</td>
<td>10-11</td>
<td>0.190%</td>
</tr>
<tr>
<td>6 (2)</td>
<td>1.07 g/kg</td>
<td>7-8</td>
<td>0.102%</td>
</tr>
<tr>
<td>4 (4)</td>
<td>1.0 g/kg</td>
<td>5-6</td>
<td>0.095%</td>
</tr>
<tr>
<td>2 (6)</td>
<td>0.5 g/kg</td>
<td>2-3</td>
<td>0.045%</td>
</tr>
</tbody>
</table>

*Number of 12-oz beers in the United States
†Approximate breath ethanol concentration (BrEC) at peak
Acute Effects of Sleep Debt

Being awake 17 hrs = BAC of 0.05
Being awake 20 hrs = BAC of 0.1
Chronic Sleep Restriction Affects Performance

van Dongen 2003
From: AASM “safer” program
Chronic Sleep Restriction Affects Cognitive Speed

Van Dongen 2003
From: AASM “safer” program
Cognitive Effects of Sleep Loss

• Involuntary **microsleeps** occur.
• Attention-intensive performance becomes unstable.
  – Both **errors of commission and omission**
• Task performance **deteriorates with task duration**.
• **Response preservation** on ineffective solutions.

• **Cognitive slowing** in subject-paced tasks whereas time pressure increases **cognitive errors**.
• **Reduced learning** (acquisition).

• **Loss of situational awareness** (e.g. neglecting essential tasks).

Chronic Effects of Sleep Loss

- Irritability
- Cognitive impairment
- Memory lapses or loss
- Impaired moral judgement
- Severe yawning
- Hallucinations
- Symptoms similar to ADHD
- Impaired immune system
- Increased heart rate variability
- Risk of heart disease
- Increased reaction time
- Decreased accuracy
- Tremors
- Aches

Other:
- Growth suppression
- Risk of obesity
- Decreased temperature
Healthcare Workers are Human Too
Healthcare Workers are Human Too

- Acceptance
  - Limited Acceptance and Awareness of Fatigue
  - Pilots acknowledge effects of fatigue more than healthcare workers
  - Sexton et al  *BMJ* 2000;320:745–9

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Anaesthetic</th>
<th>Surgical</th>
<th>Intensive care</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nurse (162)</td>
<td>Resident (60)</td>
<td>Consultant (104)</td>
</tr>
<tr>
<td>Even when fatigued, I perform effectively during critical phases of operations/patient care</td>
<td>Agree 89 (55) 34 (57) 49 (47)</td>
<td>105 (60) 29 (56) 117 (70)</td>
<td>70 (64) 20 (64) 1965 (26)</td>
</tr>
<tr>
<td>A truly professional team member can leave personal problems behind when working in the operating room/Intensive care unit</td>
<td>Agree 96 (59) 33 (55) 55 (53)</td>
<td>122 (70) 33 (63) 137 (82)</td>
<td>76 (70) 21 (68) 4005 (53)</td>
</tr>
<tr>
<td>My decision making ability is as good in medical emergencies as in routine situations</td>
<td>Agree 91 (56) 37 (61) 70 (67)</td>
<td>126 (72) 30 (58) 127 (76)</td>
<td>91 (84) 28 (90) 4837 (64)</td>
</tr>
<tr>
<td>Junior team members should not question the decisions made by senior team members</td>
<td>Agree 21 (13) 9 (15) 17 (16)</td>
<td>24 (14) 11 (21) 40 (24)</td>
<td>2 (2) 1 (3) 151 (2)</td>
</tr>
</tbody>
</table>
Monitoring & Supervision

• Who is responsible for managing fatigue in the workplace?
Monitoring & Supervision

• Individuals
  – Lifestyle
    • Health (insomnia, alcohol or drug use)
    • Family responsibilities
    • Extended travel to work
    • Accepting additional work commitments

• Colleagues
  – Be aware of signs of fatigue and encourage coworkers to devote time for rest
Monitoring & Supervision

• Managers & Supervisors
  – Be aware of signs of fatigue
  – Assure resources are available
  – Work scheduling
  – Monitoring for excessive job demands
  – Promoting safe environmental conditions
  – Reviewing workplace incident data
  – Staffing policies
ACGME Policy
Accreditation Counsel for Graduate Medical Education

• House staff are required to adhere to ACGME Duty Hours requirements.

• House staff are obligated to report excessive fatigue to their supervisor (senior/attending)
  – This includes looking out for themselves and their colleagues.

• The supervisor will devise a contingency plan for transition in care of patients and the excessively fatigued resident will be relieved of duties until the effects of fatigue subside.

• Residents have a responsibility to maximize sleep during off duty hours and to be proactive in anticipating possible sleep deprivation
Evaluate and Treat Medical Conditions

• Anemia
• Endocrine disorders
  – Hypothyroidism
  – Hormonal imbalance
• Psychological disorders
  – Depression
  – Anxiety
  – Substance use
    • Alcohol, tobacco
Evaluate and Treat Medical Conditions

• Sleep disorders
  – Obstructive sleep apnea
  – Insomnia
  – Limb movement disorders
  – Narcolepsy
  – Look for sleep difficulties in family members
    • Elderly and children

• Prescription medication effects
  – Sedating effects after awakening
    • sedatives, narcotics
  – Alerting affects prior to sleep
    • beta-blockers, corticosteroids, antidepressants,
      \(2^{\text{nd}}\) gen- antihistamines, statins, cholinesterase inhibitors
Good Sleep Hygiene

• Maintain regular sleep schedule (as much as possible)
  – Allow enough time for sleep

• Ensure adequate exposure to natural light in the morning
  – Light exposure helps maintain a healthy sleep-wake cycle

• Avoid napping during the day
  – It can disturb the normal pattern of sleep and wakefulness

• Maintain a comfortable sleep environment
  – Adjust noise level, temperature, bed comfort
  – White Noise may be beneficial

• Associate your bed with sleep
  – It's not a good idea to use your bed to watch TV or read
  – Avoid tablets, smart phones
Good Sleep Hygiene

• Exercise
  – Vigorous exercise should be taken in the morning or late afternoon. Avoid vigorous exercise 2-3 hours before bed
  – A relaxing exercise, like yoga, can promote sleep

• Avoid stimulants such as caffeine, nicotine, and alcohol close to bedtime
  – While alcohol is well known to speed the onset of sleep, it disrupts sleep in the second half as the body begins to metabolize the alcohol, causing arousal.

• Food can be disruptive right before sleep
  – Stay away from large or spicy meals close to bedtime

• Establish a regular relaxing bedtime routine
  – Review plans for the following day after dinner
  – Schedule down-time (electronic off, dim lights, relaxing music)
  – Pen and paper next to bed
Mitigating Fatigue
Day-shift Workers

• Planned Naps
  – Can be beneficial when sleep deprived
  – Quite, dark, cool room
  – 15-30 minutes duration
  – Best to plan during time when Process C is low
    • For standard sleep cycle: Between 1-3pm
  – Allow wake up time (up to 15 minutes)
    • To overcome “sleep inertia” (ex: nonsensical response given on phone when middle of night page)

• Pay back sleep dept
  – Allow enough time for sleep the following several nights
Night-shift & On-call

- Night-work disturbs the critical temporal relationship between circadian (process C) and homeostatic (process S) factors.
Night-shift & On-call

- Night-workers do not have the advantage of the circadian alerting system while working.
- Plus, the circadian system process interferes with sleep attempts during the daytime.
  - Truncated sleep in the last few hours as circadian alerting strengthens
Word for the Day: “Zeitgeber”

• A zeitgeber is any external or environmental cue that synchronizes an organism's biological clock (SCN)
• German for “Time-giver” or “Synchronizer”
• Common zeitgeber’s
  – Light !!!!!
  – Temperature
  – Social interactions
  – Exercise
  – Eating/drinking patterns
  – Pharmacological manipulation
Night-shift & On-call

• In even full-time night-workers, only minimal adaptations of circadian rhythms occur

• Adjustment of circadian rhythms is opposed by:
  – Natural light-dark cycle
  – Family and social contacts during the day
  – Reversion of a pattern of wakefulness during the day and sleep at night on non-work days.

• Studies show that night-sift workers only receive 5-6 hours of sleep

• The ability to adapt decreases as the individual becomes older
Night-shift & On-call
Strategies to Avoid Sleep Deprivation

- Consider “banking” sleep if possible
- Napping before work
- Caffeine prior to shift
- Bright light exposure
- Exercise / Activity during duty
  - Avoid prolonged sedentary positions (Q1 hour)
  - Consider brief activity breaks
- Wake promoting agents
  - Modafinil, Armodafinil
Night-shift & On-call
Strategies to Avoid Sleep Deprivation

• Caffeine (300 mg) nightly prior to start of shift for 4 nights plus an evening 2-hour nap taken prior to the night shift on the first 2 nights produced greater alertness and performance during night work.
  — Sleep 2006;29:39-50

• Bright light and caffeine have been shown to be more effective than either countermeasure alone in enhancing alertness and performance at night.
Night-shift & On-call
Strategies to Avoid Sleep Deprivation

- Sunglasses on way home in the morning
- Allow time for recovery sleep
- Establish “Do Not Disturb” policy with friends and family
- Smart phone “Do Not Disturb” feature
- Black-out curtains
- Melatonin in the evening to help reset cycle if needed following periodic shift
Sentinel Event Alert #48
Joint Commission

• Assess the organization for fatigue-related risks
• Review policies that address extended work shifts and hours
• Assess the handoff process since it is a time of high risk
• Create and implement a fatigue management plan
• Provide opportunities for staff to express concerns about fatigue
• Consider fatigue as a potentially contributing factor when reviewing adverse events
Summary & Future Goals

• Accept that you are not superhuman
• Be aware of signs of fatigue in self and others
• Seek evaluation for suspected medical conditions
• Remember the tools to mitigate fatigue
• Hospital policy on impairment
• Continued focus on this issue as we improve healthcare at our institution
  – Staff fatigue
  – Patient sleep quality
THANK YOU
Night-shift & On-call

- Human performance is lowest in the early morning hours.
- Night shift workers are 1.6x more likely to experience unintentional sleep at work.
Night-shift & On-call
Strategies to Avoid Sleep Deprivation

INTERVENTIONS:
(1) Laboratory Study: an evening nap opportunity before the first 2 of 4 consecutive simulated night shifts plus placebo taken all 4 nights, caffeine taken nightly, the combination of the nap and caffeine conditions, or placebo.
(2) Field Study: an evening nap on the first 2 of 4 consecutive night shifts plus caffeine taken nightly versus placebo taken nightly without naps.

MEASUREMENTS AND RESULTS:
(1) Laboratory Study: Napping, caffeine, and their combination all improved alertness and performance as measured by Maintenance of Wakefulness Test and Psychomotor Vigilance Task, but the combination of napping and caffeine was best in improving alertness.
(2) Field Study: Napping plus caffeine improved performance as measured by Psychomotor Vigilance Test and decreased subjective sleepiness in individuals working the night shift.

CONCLUSIONS: Napping plus caffeine helps improve performance and alertness of night-shift workers.
QUESTION

Which ONE of the following is a CORRECT statement:

• A) Medical schools attract people who need less sleep
• B) The stress of the medical environment can counteract sleepiness.
• C) Healthcare staff can learn over time to perform at a high level even when sleep deprived.
• D) None of the above.
Problems Associated With Fatigue

• Impacts on workplace and public safety
  – Decreased ability to perform high level tasks
  – Decreased concentration
  – Interpersonal relationships

• Impacts on personal health
  – Heart disease
  – Diabetes
  – Hypertension
  – Gastrointestinal disorders
  – Anxiety and depression
  – Headaches
  – Obesity
  – Lower fertility
  – Interpersonal relationships
Cognitive Effects of Sleep Loss

Involuntary microsleeps occur.

Attention-intensive performance is unstable with increased errors of omission (lapses) and commission (wrong responses).

Cognitive slowing occurs in subject-paced tasks, whereas time pressure increases cognitive errors.

Psychomotor response time slows.

Both short-term recall and working memory performances decline.

Reduced learning (acquisition) of cognitive tasks occurs.

Performance requiring divergent thinking deteriorates.

Response suppression errors increase in tasks primarily subserved by the prefrontal cortex.

Response perseveration on ineffective solutions is more likely to occur.

Increased compensatory effort is required to remain behaviorally effective.

Tasks may begin well, but performance deteriorates as task duration increases.

Growing neglect of activities judged to be nonessential (loss of situational awareness) occurs.