

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

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Headline News

In January 1999, Valentin Barbulescu, MD, a third-year resident at Jacobi Hospital in the Bronx, died when his car ran off the road and hit a tree in rural Pennsylvania. Fellow residents attributed the accident to fatigue brought on by an overnight shift in the CCU just prior to Barbulescu's trip.

Dr Barbulescu was on his way to take a US medical licensing examination in Detroit.

Henican E. *Newsday*. February 3, 1999.

Rubinowitz S. *The New York Post*. February 7, 1999.

Learning Objectives

- At the conclusion of this activity, participants should be able to promote optimal learning, health and safety of residents, as well as safe patient care, by:
 - Describing the impact of sleep loss and fatigue on cognitive function and performance through relevant examples
 - Recognizing the signs of fatigue and sleepiness
 - Applying preventive and operational countermeasures

Outline

- History
- ACGME Standards
- Myths and Facts About Sleep Need
- Sleep Physiology
- Influence of Circadian Rhythm

Outline (continued)

- How Risky Is Driving Postcall?
- Impact and Recognition of Sleep Deprivation
- Obstacles to New ACGME Standards
- Preventive and Operational Countermeasures
- Summary

The History of the Problem

- 1984: Libby Zion—fatigue was a cited cause
- 1987: Bell Commission
- 2001: OSHA petition/AAMC
- 2001: Bills in Congress to impose work-hour limits
- 2002: ACGME proposed standards
- 2003: Standards approved
- July 1, 2003: “We must comply!”

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

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.”

Prevailing Myths (continued)

“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

Wake Up to the Facts

- Sleep deprivation affects cognition and performance demonstrably¹
- 24 hours of being awake = legally drunk²
- Most residents report having had a car accident, or a near miss, due to sleepiness after being on call^{3,4}

1. Veasey S, et al. *JAMA*. 2002.

2. Dawson D, et al. *Nature*. 1997.

3. Marcus CL, et al. *Sleep*. 1996.

4. Steele MT, et al. *Acad Emerg Med*. 1999.

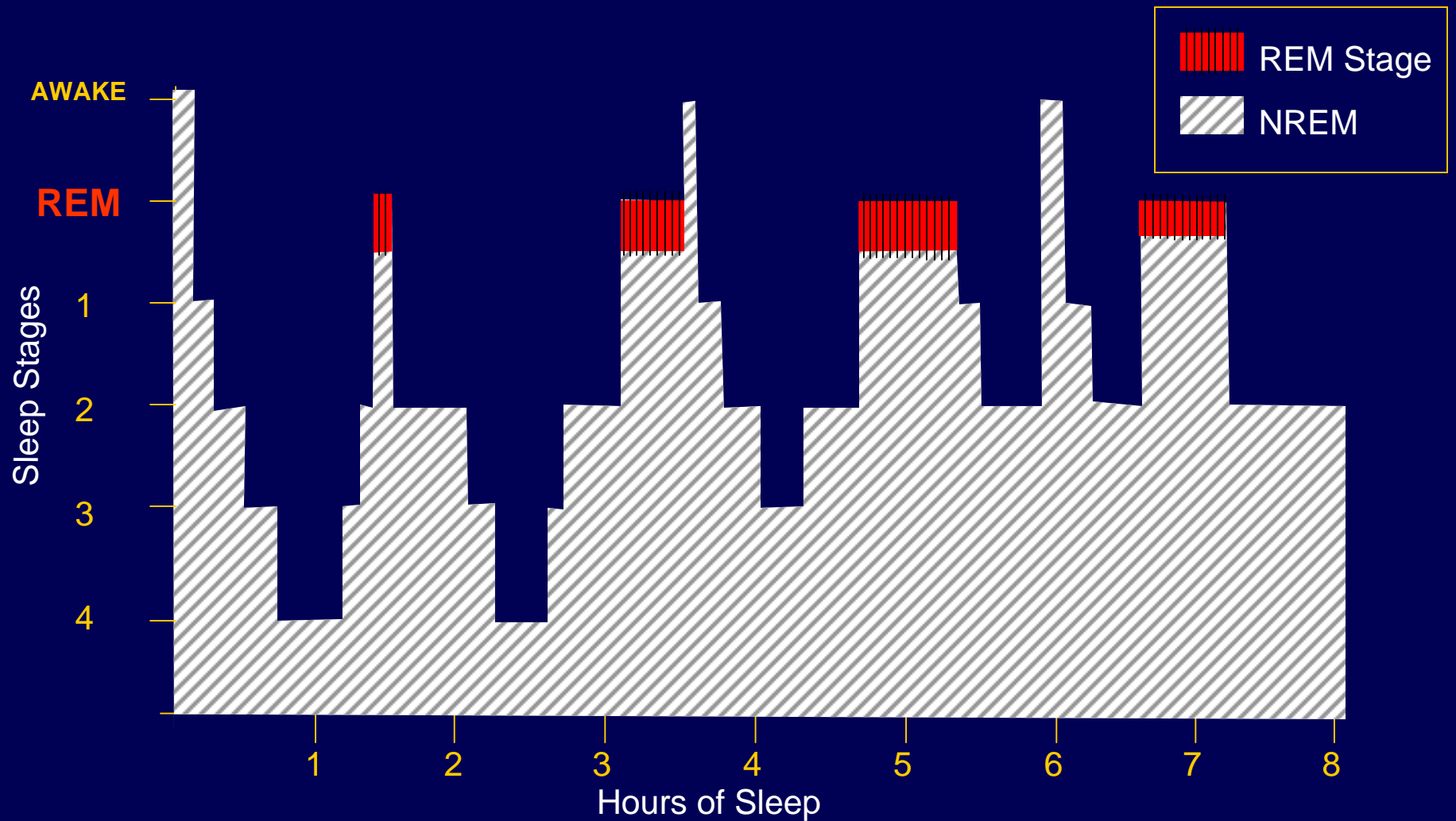
Sleep Facts

- Adults need an average 8.2 hours of sleep per 24 hours¹
- Impairment of performance occurs with as little as 2 hours less sleep than normal per night²
- Sleep debt from restricting sleep to 5 hours a night accumulates with time, and awareness of sleepiness declines²
- The significance of circadian timing is rarely addressed (even in the ACGME guidelines) when considering the effects of shift work

1. National Heart, Lung, and Blood Institute Working Group on Problem Sleepiness. 1997.
2. Carskadon MA, et al. Sleep restriction. In: Monk T, ed. *Sleep, Sleepiness and Performance*. 1991.

Sleep Physiology

Normal Sleep Patterns in Young Adults



Adapted from Berger RJ. The sleep and dream cycle. In: Kales A, ed. *Sleep Physiology & Pathology: A Symposium*. Philadelphia: J.B. Lippincott; 1969.

Human Sleep Stages

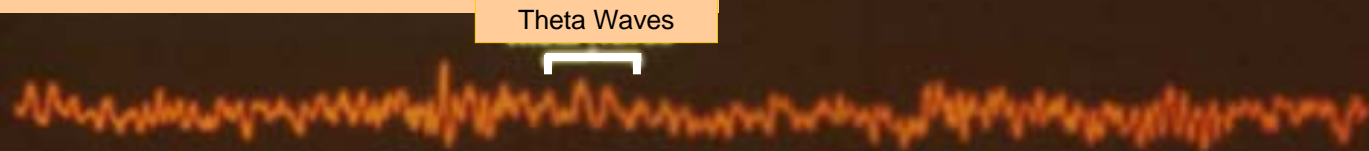
Awake—low voltage-random, fast



Drowsy—8 to 12 cps-alpha waves



Stage 1—3 to 7 cps-theta waves



Human Sleep Stages

Stage 2—12 to 14 cps-sleep spindles and K complexes

sleep spindle

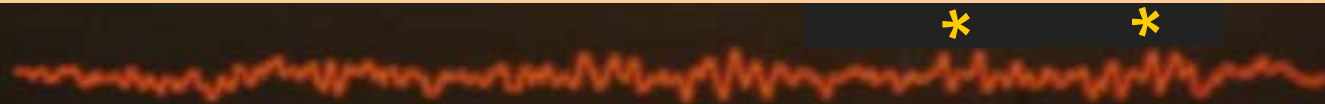
K complex



Stage 3/4—1/2 to 2 cps-delta waves $>75\mu\text{V}$



REM Sleep—low voltage-random, fast with sawtooth waves*

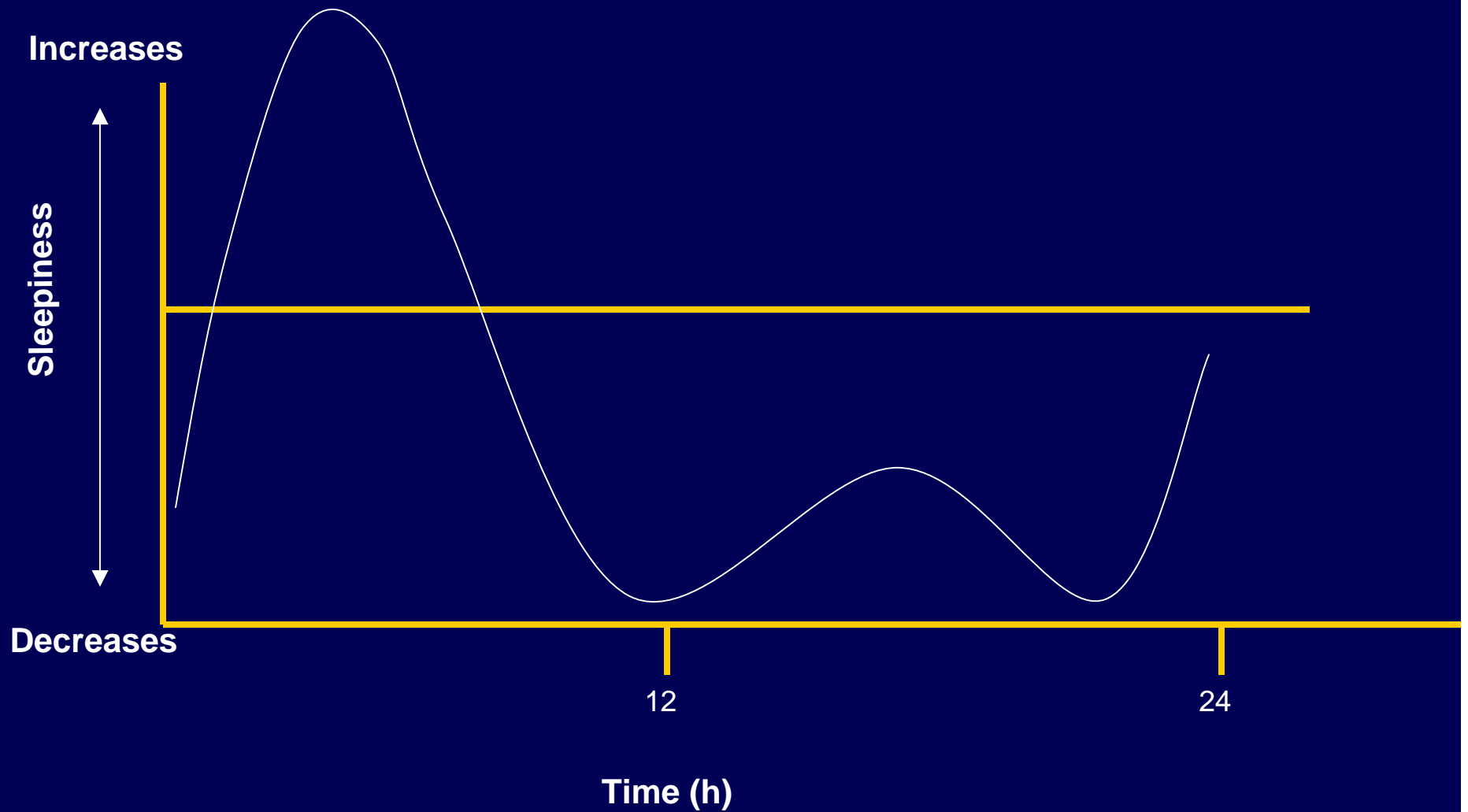


Why Do We Feel Sleepy?

The 2-Process Model

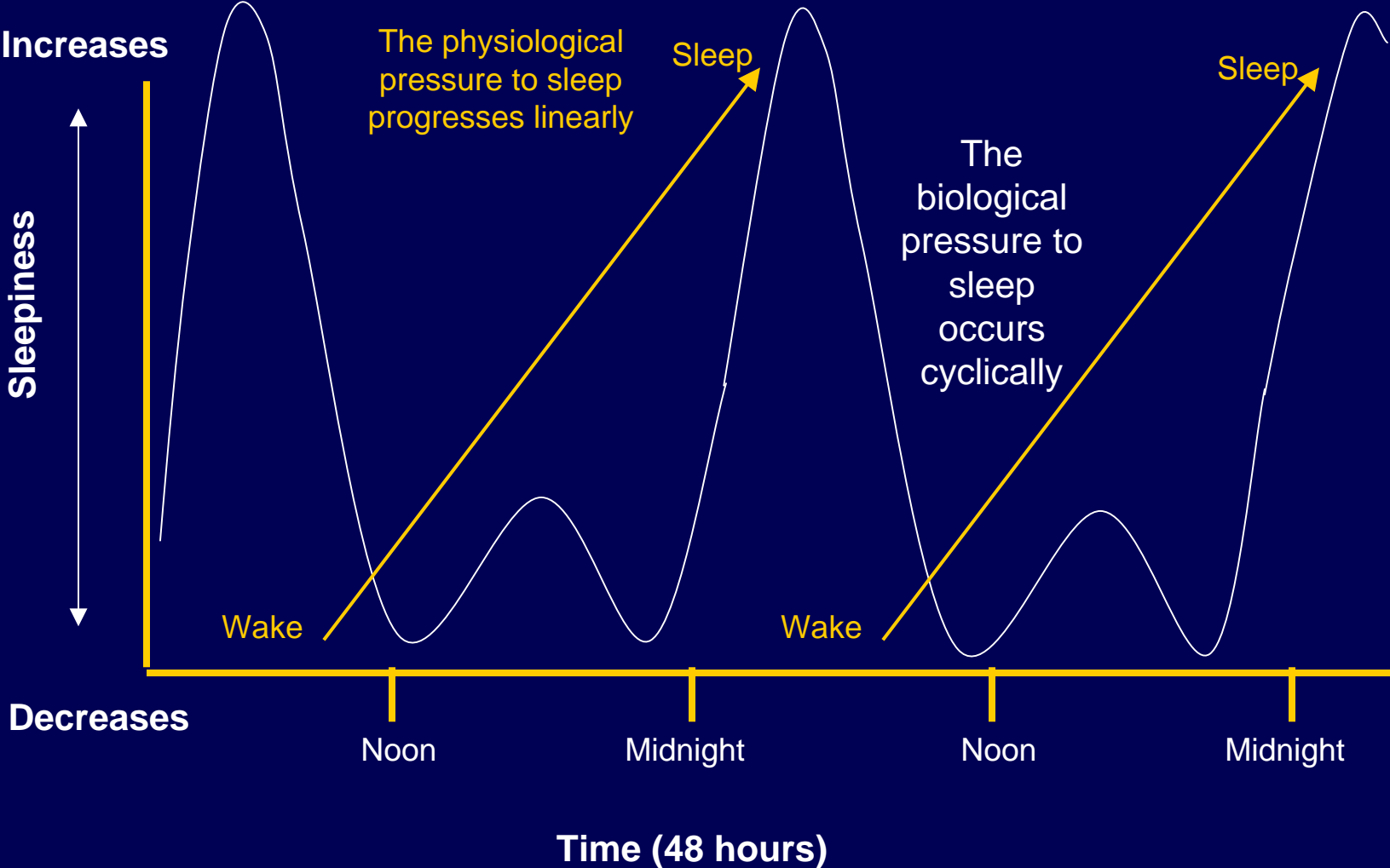
- 2 processes combined determine sleep propensity and the duration of sleep
 - Homeostatic sleep drive:
 - Process driven by amount of time awake
 - Linear and cumulative—one gets progressively more tired with each passing hour (“sleep load” increases)
 - Circadian rhythm:
 - Process driven by biological clock (time of day)
 - Cyclical—periods of sleepiness occur at roughly the same times each day

Circadian Rhythm

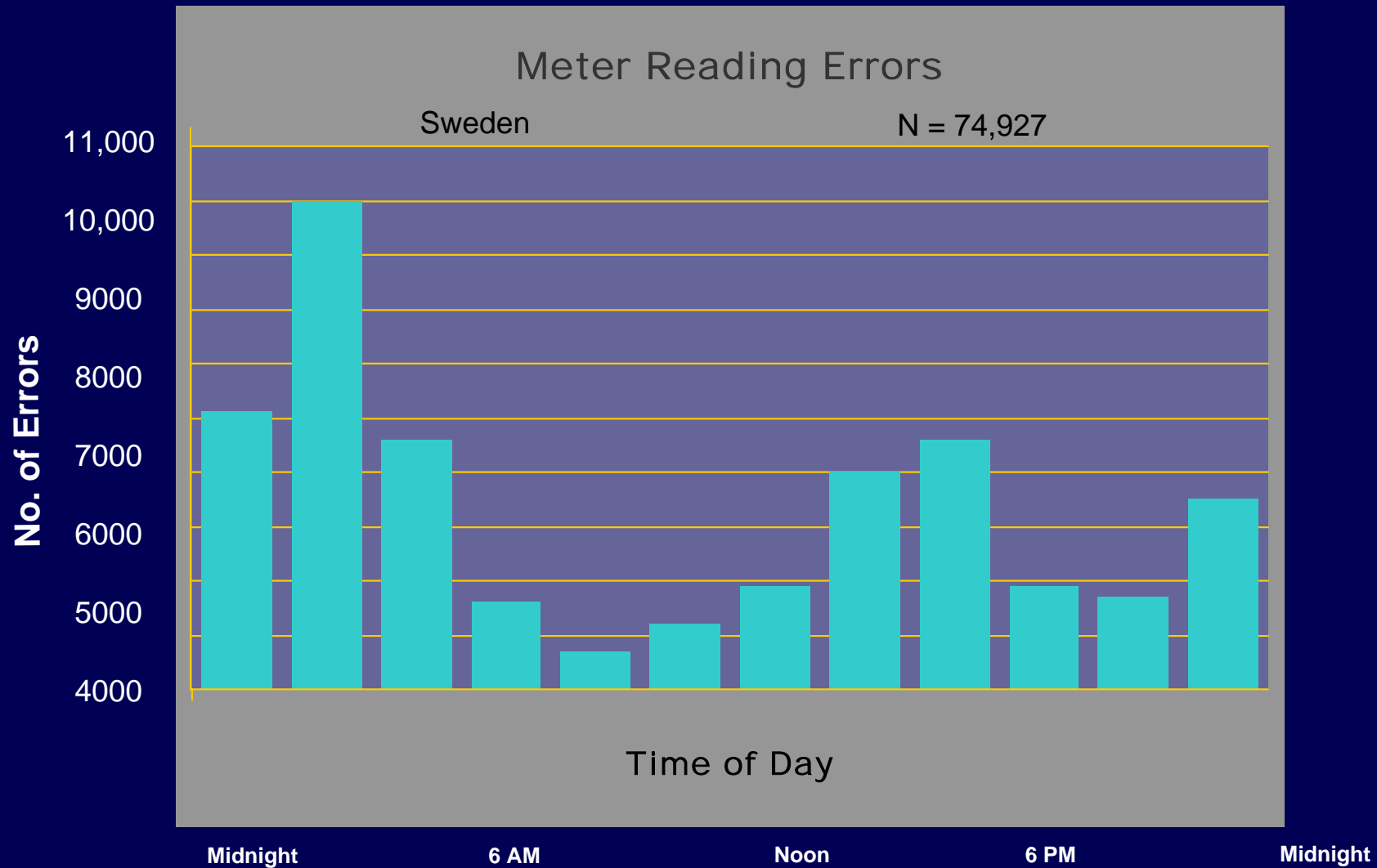


University of Virginia Center for Biological Timing.
Available at: <http://www.cbt.virginia.edu/tutorial/HUMANCLOCK.html>.

Combined Sleep Processes

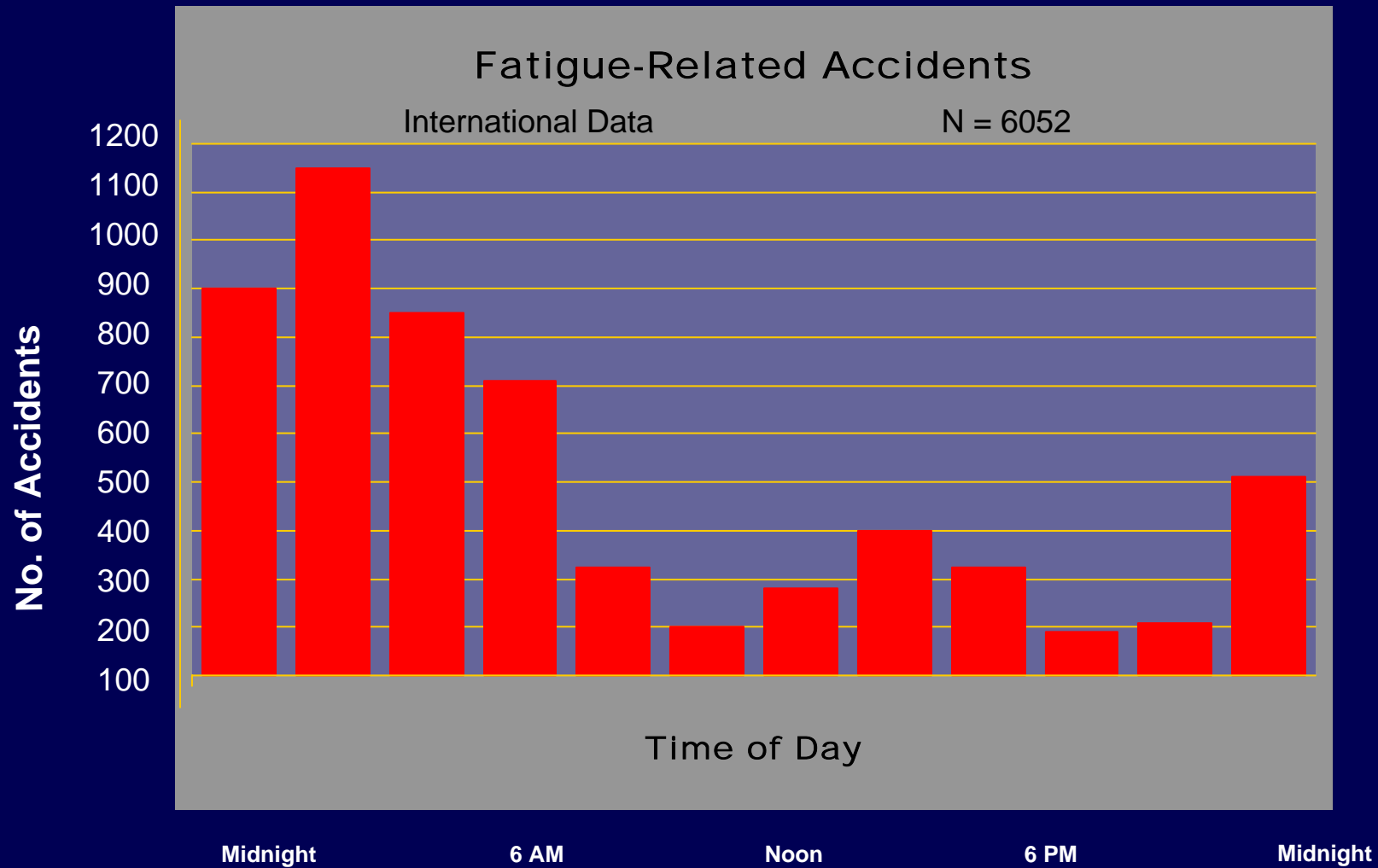


Performance Errors



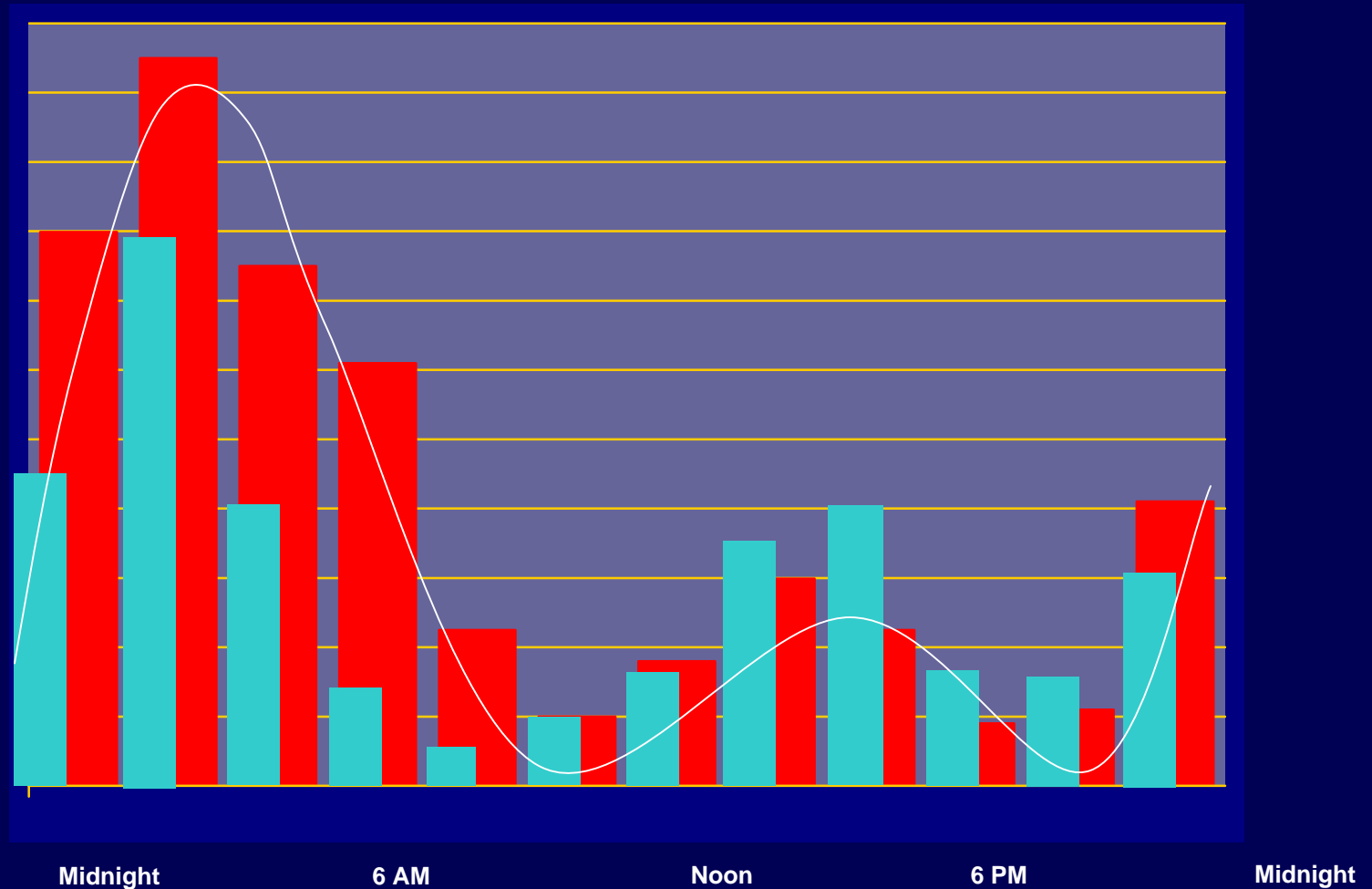
Mitler MM, et al. *Sleep*. 1988.

Vehicle Accident Data



Mitler MM, et al. *Sleep*. 1988.

Overlay of Vehicle Accident Data, Performance Errors, and Circadian Rhythm



Survey of Pediatric On-Call House Staff and Faculty

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

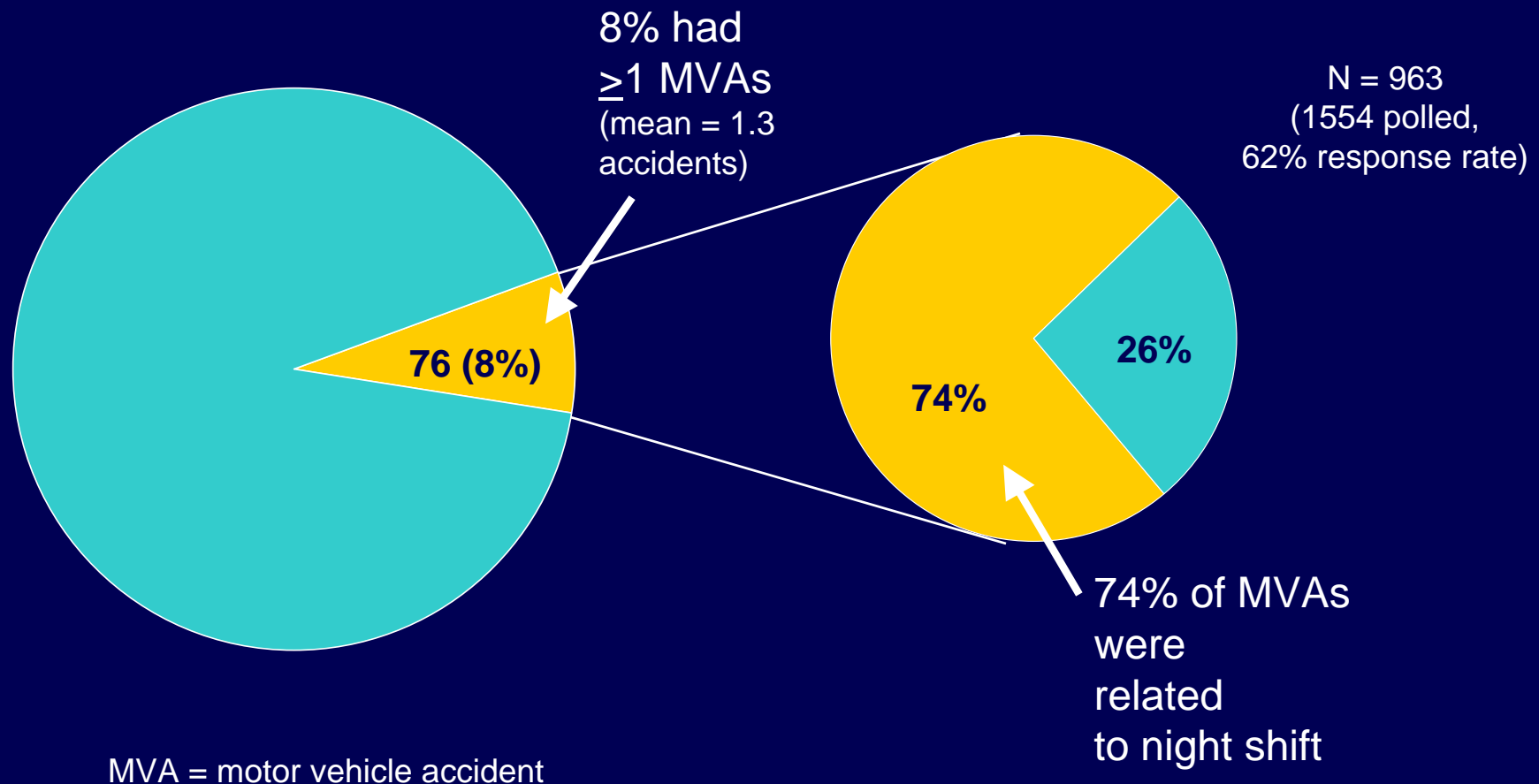
*While car in motion

†While car in motion or at stop light

Marcus CL, et al. *Sleep*. 1996.

National Survey of 963 Emergency Medicine Residents

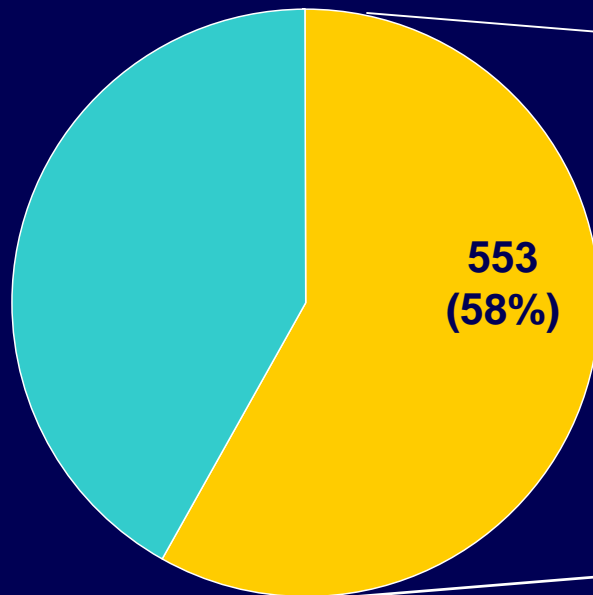
Motor Vehicle Accidents



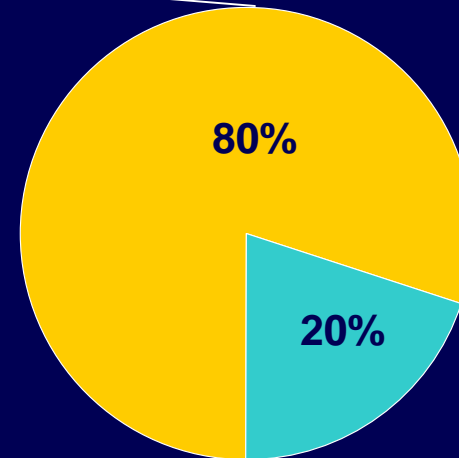
National Survey of 963 Emergency Medicine Residents (continued)

Near-Crashes

N = 963
(62% response rate)



58% had ≥ 1 near-crashes
(mean = 2.6 near-crashes)



80% of near-crashes were related to night shift

Impact and Recognition of Sleep Deprivation

What Is Good Performance?

- Motivation
- Ability to see the “big picture”
- Memory for details
- Prompt decision making
- Accurate and consistent motor performance
- Good communication
- Contingency planning
- Professionalism

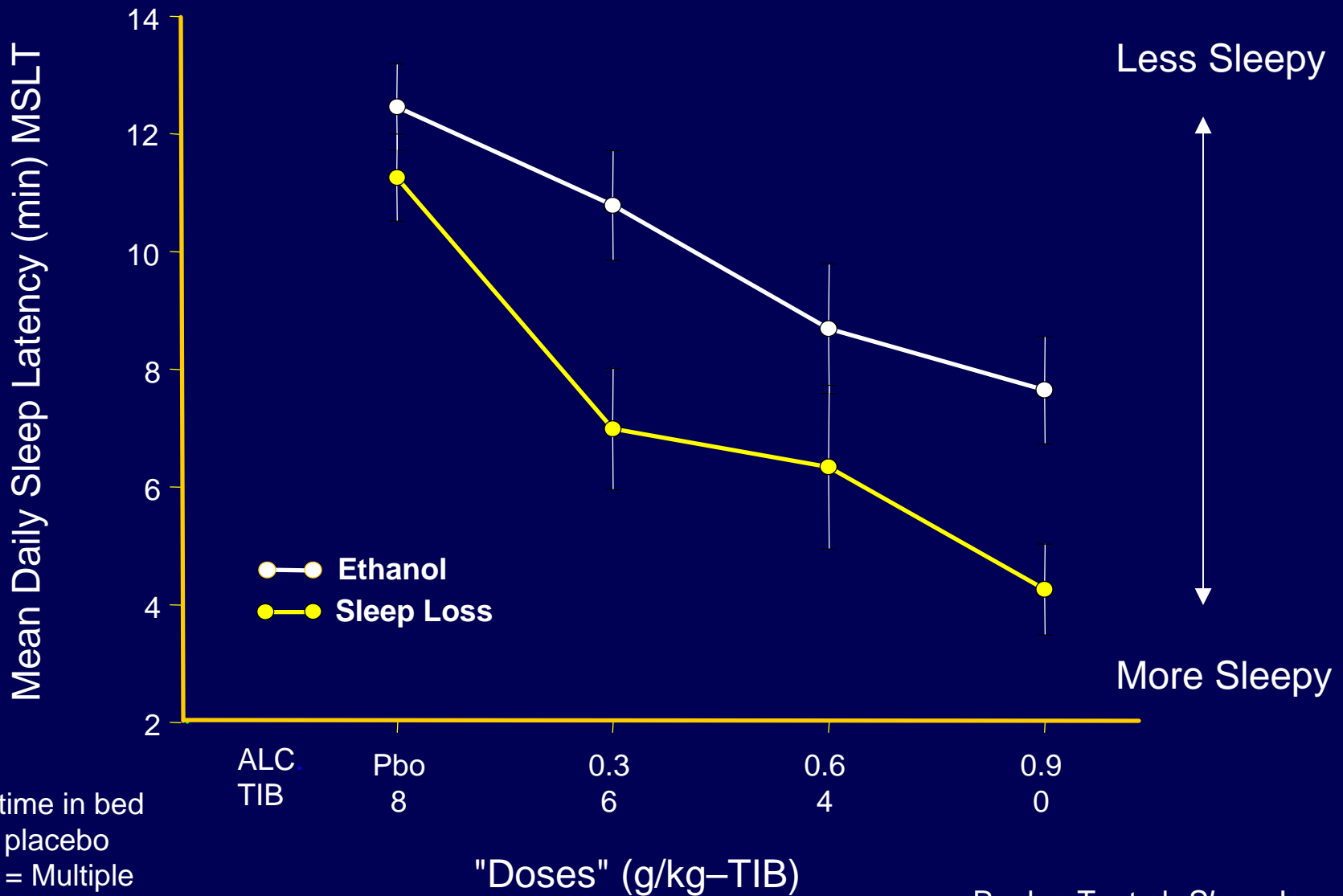
Clinical Signs of Excessive Sleepiness

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

Dinges D, et al. In: Monk T, ed. *Sleep, Sleepiness and Performance*. 1991.

Rosekind MR, et al. *Behav Med*. 1996.

Alcohol and Sleep Loss Equivalence

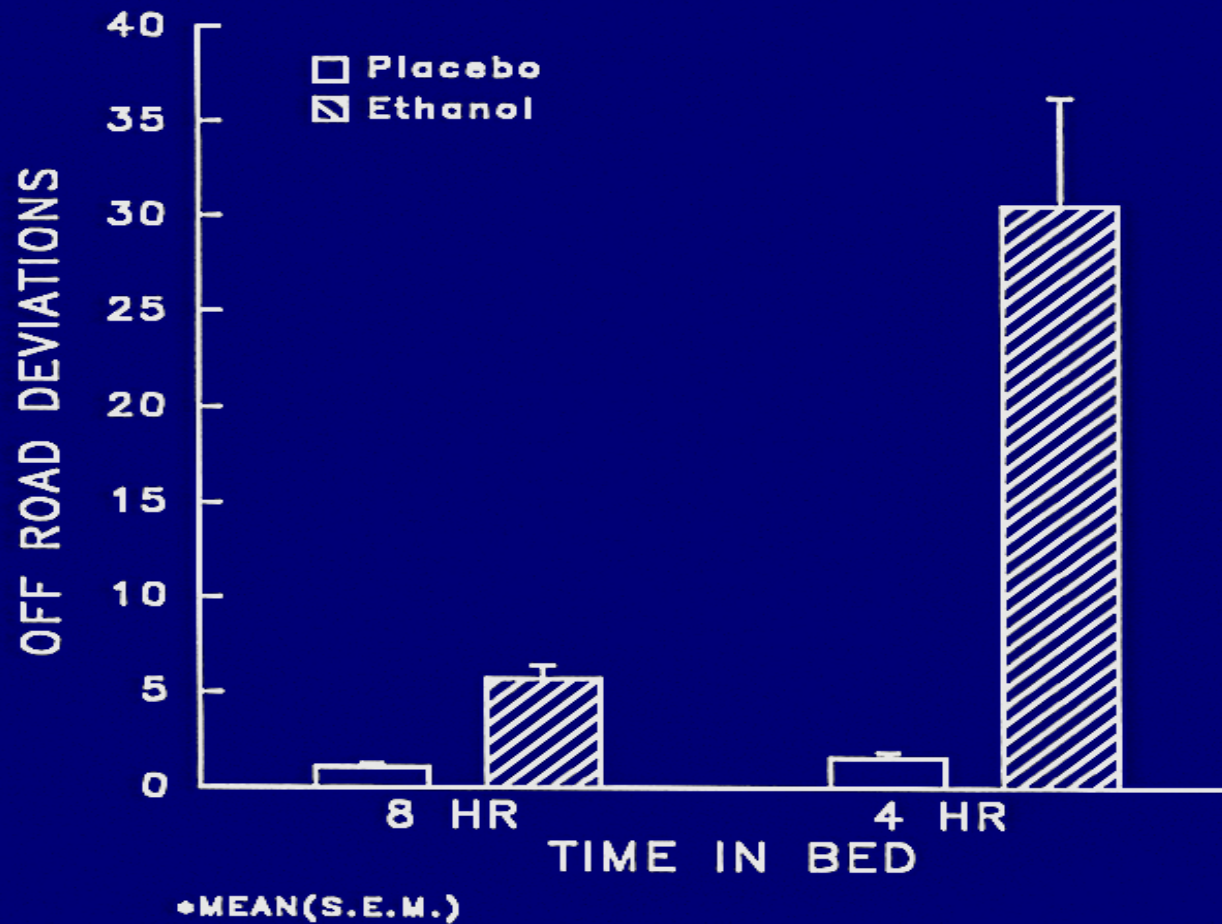


TIB = time in bed
Pbo = placebo
MSLT = Multiple
Sleep Latency Test

Roehrs T, et al. *Sleep*. In press.

Sleep-Alcohol Interaction

DRIVING SIMULATOR—A.M.



Sleep Deprivation and Medical Performance

Patient Care Is Jeopardized

- During laparoscopic surgery after a night on call with an average sleep time of 1.5 hours¹:
 - Fine motor control degrades
 - More time taken to complete surgery
 - More complications postop
- Prescribing errors made connected with physical and mental well being²:
 - Tired
 - Hungry
 - Unwell

1. Grantcharov TP, et al. *BMJ*. 2001.

2. Dean B, et al. *Lancet*. 2002.

Studies on Impact of Sleep Deprivation

- Why do studies in the clinical setting produce mixed results when laboratory studies clearly show the impact of sleep deprivation on performance?
 - Lack of well-rested residents for control groups
 - Studies essentially compare effects of chronic partial sleep restriction (residents not on call) versus chronic partial sleep restriction plus short-term sleep loss (residents on call or immediately post call)
 - Differences in general health status and sleep/wake habits
 - Failure to control for caffeine and food intake, recent physical activity, and ambient temperatures
 - Effects on specific tasks may be overcome by motivation and focused attention; more difficult to measure continuous performance

Impact of Sleep Deprivation on Resident Health

- Increased risk of obstetrical complications for pregnant residents versus other working women¹
 - Premature labor is twice as common
 - Preeclampsia is twice as likely
- High rates of depression occur among residents²
 - 30% of first-year residents report depressive symptoms for an average of 5 months
 - Some reported to have suicidal ideation with plan
 - Among married residents, 46% in depressed group versus 7% in the nondepressed group had marital problems (none of the depressed individuals had ever had marital problems prior to depression onset)

1. Osborn LM, et al. *J Fam Pract.* 1990.

2. Valko RJ, et al. *Dis Nerv Syst.* 1975.

Impact of Sleep Deprivation on Resident Health (continued)

- Resident burnout, identified as **house officer stress syndrome**, is caused by:
 - **Sleep deprivation**
 - Excessive workload
 - Patient care responsibilities
 - Perpetually changing working conditions
 - Peer competition
- Severely affected residents may suffer from major depression, suicidal ideation, and substance abuse

Impact of Sleep Deprivation on Resident Health and Patient Care

- Of 115 residents surveyed, 76% met criteria for burnout
- Compared with non-burned-out residents, burned-out residents were more likely to self-report at least 1 type of suboptimal patient care at least monthly ($P = .0004$)
- Symptoms are characteristic of a relationship with work and do not include all life domains, as seen in major depression

How Much Sleep Is Enough?

- The amount that allows you to feel alert when rested and relaxed (eg, grand rounds)
- There is little variation of sleep need (8.2 hours) among individuals
- 1 night with 2 hours less than your usual sleep is sufficient to produce significant decrements in waking performance
- After several nights of 5-hour sleep, most adults do not realize they are pathologically sleepy

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.”

Preventive and Operational Countermeasures

Preventive and Operational Countermeasures

Scheduling

- Limit continuous performance schedules to 12-16 hours
- Time off duty to protect sleep and sanity

Working With Circadian Rhythm

- Know the times of greatest impairment and maximum alertness

Avoid Alcohol

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

Does Napping Help?

Night shift workers after 2-hour nap prior to shift

- Prevented sleepiness
- Later naps produced a deeper sleep, but workers awakened with grogginess due to sleep inertia

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

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

Dinges DF, et al. *Sleep*. 1997.
Rosekind MR, et al. *Behav Med*. 1996.
Frey R, et al. *Crit Care Med*. 2002.

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

1. Johns MW. *Sleep*. 1991.

2. Buysse DJ, et al. *J Psychiatric Res*. 1989.

3. Beck AT, et al. *Manual for the Beck Depression Inventory*. 2nd ed. 1996.

4. Zung WW. *Arch Gen Psychiatry*. 1965.

5. Maslach C, et al. *The Maslach Burnout Inventory*. 3rd ed. 1996.

Epworth Sleepiness Scale

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

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

Johns MW. *Sleep*. 1991.

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

Pharmacology

- Modafinil—schedule IV wake-promoting agent
 - Headache
 - Nausea
 - Rhinitis
- Pemoline—schedule IV stimulant
 - Insomnia
 - Hepatic dysfunction
 - Anorexia/weight loss

Preventive and Operational Countermeasures

Pharmacology

- Dextroamphetamine—schedule II stimulant
 - Palpitations
 - Tachycardia
 - Elevation of blood pressure
 - Overstimulation
- Methylphenidate—schedule II stimulant
 - Nervousness
 - Insomnia
 - Anorexia

Preventive and Operational Countermeasures

Pharmacology

- Alcohol
 - Induces sleep initially
 - Increases fragmentation
 - Overall, a bad choice for sleep

Preventive and Operational Countermeasures

Pharmacology

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

Summary

- In response to the new ACGME standards, this presentation has:
 - Reviewed the impact of sleep loss and fatigue on cognitive function and performance
 - Described the signs of fatigue and sleepiness from sleep deprivation
 - Outlined preventive and operational countermeasures
- While there are short-term countermeasures available, ultimately, the only cure for sleep deprivation is sleep.