EXH. ECK-07
DOCKET TP-25____
2025 PSP GENERAL RATE CASE
WITNESS: CAPTAIN ERIC C. KLAPPERICH

BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, **Complainant,** **v.** **PUGET SOUND PILOTS,** **Respondent.**	**Docket TP-25____**

SIXTH EXHIBIT (NONCONFIDENTIAL) TO THE TESTIMONY OF

CAPTAIN ERIC C. KLAPPERICH

ON BEHALF OF PUGET SOUND PILOTS

JULY 29, 2025

Best Practices for Fatigue Management

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Harvard Medical School
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Brigham Health

December 7, 2017

State of Washington Board of Pilotage Commissioners

Seattle, Washington

PILOTS OFFICE
COLUMBIA RIVER BAR PILOTS

PILOT
COLUMBIA RIVER BAR PILOTS

Captain
Nelson

Acknowledgements/Conflict of Interest Disclosure

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National Institute for Neurological Diseases & Stroke
National Institute of Mental Health (NIMH)
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Collision of Tankship *Eagle Otome* with berthed Cargo Vessel *Gull Arrow* and Subsequent Collision with the Kirby 30406 Barge Pushed by the *Dixie Vengeance Tow* in Sabine-Neches Canal, Port Arthur, Texas, January 23, 2010

NTSB: "Contributing to the accident was the first pilot's fatigue, caused by his untreated obstructive sleep apnea and his work schedule, which did not permit adequate sleep."

462,000 gallons oil spilled

"The NTSB has identified fatigue as a factor in at least two highly visible marine accidents. The NTSB determined that the March 24, 1989, grounding of the vessel *Exxon Valdez* on Bligh Reef, an accident that … was caused, among other factors, by the—failure of the third mate to properly maneuver the vessel **because of [his] fatigue and excessive workload** …."

National Transportation Safety Board. 2011. Collision of Tankship Eagle Otome with Cargo Vessel Gull Arrow and Subsequent Collision with the Dixie Vengeance Tow, Sabine-Neches Canal, Port Arthur, Texas, January 23, 2010. Marine Accident Report NTSB/MAR-11/04. Washington, DC.

"A schedule that alternates **daytime work with nighttime work in the same week** is **detrimental** to optimum **performance** in that it is difficult for someone to compensate for the sleep deprivation that has resulted from working at a time when one is typically sleeping."

National Transportation Safety Board. 2009. Allision of Hong Kong-Registered Containership M/V Cosco Busan with the Delta Tower of the San Francisco–Oakland Bay Bridge, San Francisco, California, November 7, 2007. Marine Accident Report NTSB/MAR-09/01. Washington, DC.

Goals of a Comprehensive Fatigue Risk Management Program

A comprehensive fatigue risk management program should be designed to:

- improve the **long-term health** of the pilots; and
- improve pilot performance and **decrease the risk of pilot errors and consequent accidents.**

Ensure that the NTSB does not again find that:
"Contributing to the accident was the first pilot's fatigue,
caused by his untreated obstructive sleep apnea and his work schedule,
which did not permit adequate sleep."

National Transportation Safety Board

In 2011, the United States National Transportation Safety Board recommended (NTSB Recommendation M-11-20) that governors of states in which pilots operate should "**require local pilot oversight organizations** that have not already done so to implement fatigue mitigation and prevention programs that:

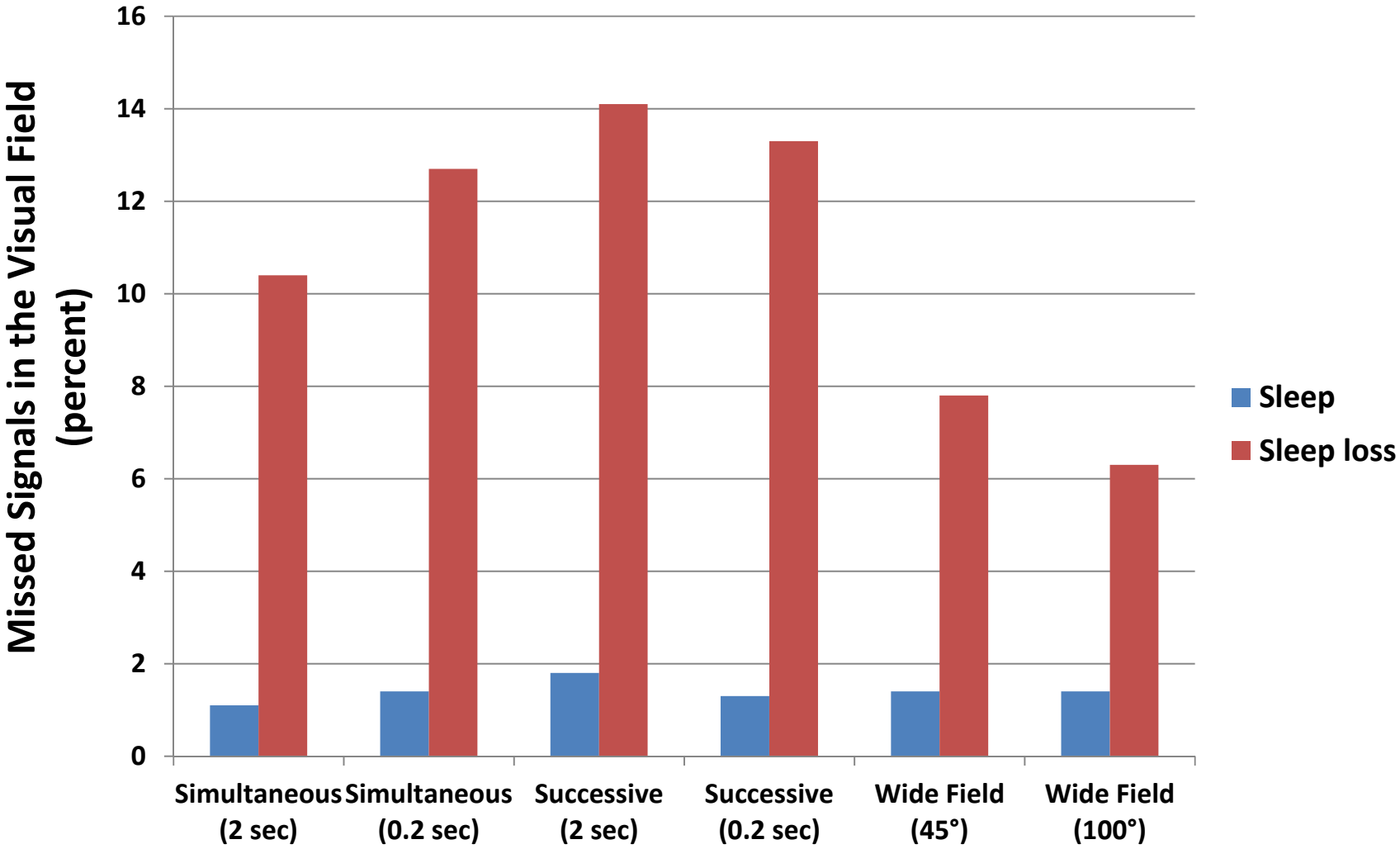
(1) **regularly inform mariners** of the **hazards of fatigue** and effective **strategies to prevent [fatigue]**, and

(2) promulgate **hours of service rules** that **prevent fatigue resulting from**

- **extended hours of service**,
- **insufficient rest within a 24-hour period**, and
- **disruption of circadian rhythms**."

National Transportation Safety Board. 2011. Collision of Tankship Eagle Otome with Cargo Vessel Gull Arrow and Subsequent Collision with the Dixie Vengeance Tow, Sabine-Neches Canal, Port Arthur, Texas, January 23, 2010. Marine Accident Report NTSB/MAR-11/04, p. 70. Washington, D.C.

Impact of One Night of Sleep Loss on Missed Signals in the Visual Field



Sanders, A. F. and W. D. Reitsma (1982). The effect of sleep-loss on processing information in the functional visual field. *Acta Psychologica* 51: 149-162.

Components of a Comprehensive Fatigue Risk Management Program

(1) an **education program**, with annual certification testing, to train pilots, pilot managers and pilot dispatchers on the principles of sleep and circadian science;

Search

Railroaders' Guide to Healthy Sleep

Steps to improve your sleep and make a real difference in your life

Getting Sleep

- Working the Rails
- Sleep Tips A to Zzzz
- Sleep Drive, Naps, & Caffeine
- Listen to Your Body Clock
- How to Avoid Sleep Debt

Read Your Signals

- Stories from the Rails
- TIPS: Stay Safe on the Job
- TOOLS: Sleep-Wake Diary & More
- QUIZ: How Well Do You Sleep?
- GAME: Test Your Reaction Time

Problems? Get on Track

- The Snoring Sickness: Obstructive Sleep Apnea
- Could YOU Have Obstructive Sleep Apnea?
- Other Sleep Problems & Their Treatment
- Why Better Sleep = Better Health
- Find a Sleep Center

A resource from the Division of Sleep Medicine at Harvard Medical School

Sponsored by the Federal Railroad Administration, an operating mode of the U.S. Department of Transportation

http://www.railroadersleep.org/

Produced in partnership with WGBH Educational Foundation and the John A. Volpe National Transportation Systems Center

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http://www.railroadersleep.org/

Railroaders' Guide to Healthy Sleep

Getting Sleep
- Working the Rails
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Listen to Your Body Clock

Everyone has an inner clock that helps organize daily life. This clock directs ups and downs in alertness and sleepiness over the day.

What time is it in your body?

In Sync: Example

If our internal clock matches the external clock time, we are "in sync." This is shown in the example on the right.

Click on the blue play button to the right to start.

When a person awakens at 6 a.m., the internal clock soon supports alertness (shown as yellow turning to green). In daylight the internal clock continue to promote alertness for daytime activities (indicated by green), and this persists into the evening. This continued alertness makes it difficult to fall asleep when the body's internal clock is in the evening mode, even though hours awake have increased.

Eventually the internal clock switches to nighttime mode, promoting sleep (indicated by red). The strongest push for sleep normally occurs in the wee hours of the morning, while it is still dark outside.

Next

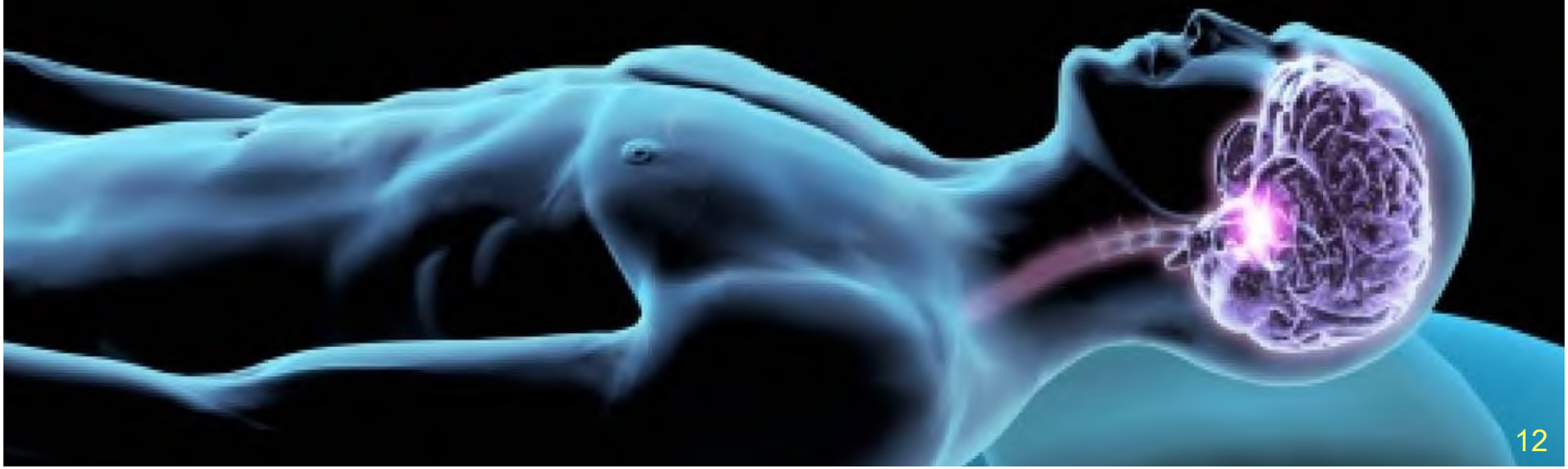
How Your Body Clock Works

Everyone has an internal clock, a clock that organizes daily life. The clock mechanism is a pinhead-sized cluster of nerve cells in the brain. The body clock controls when you sleep and stay awake. It also directs the timing of hundreds of functions in your body. A few examples of functions that cycle over the day include the rise and fall of body temperature and blood

The hard part is getting rest in the middle of the day or the early evening. We know that we should be resting, but we are not tired

Why the Brain Needs Sleep

fulfill basic biological needs **(Deep SWS and REM sleep)**	keep brain cells healthy for life	repair, maintenance of excessive connections **(Deep SWS)**
consolidation of memory **(Deep SWS)**	integration of daily learning with prior experience **(REM sleep)**	restoration of energy stores of cells requires the brain to be offline



Changes in Brain Energy Use

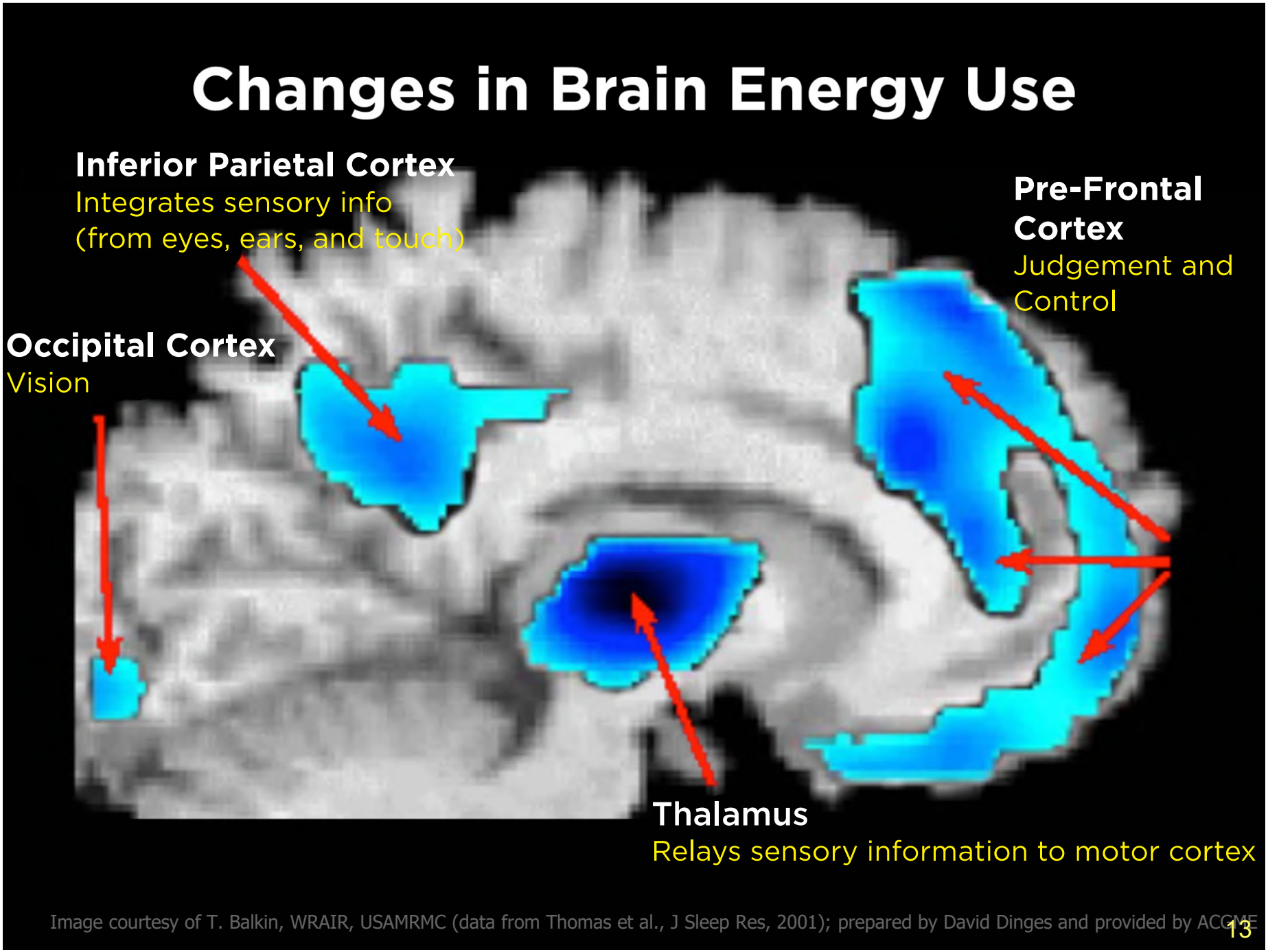


Image courtesy of T. Balkin, WRAIR, USAMRMC (data from Thomas et al., J Sleep Res, 2001); prepared by David Dinges and provided by ACCME

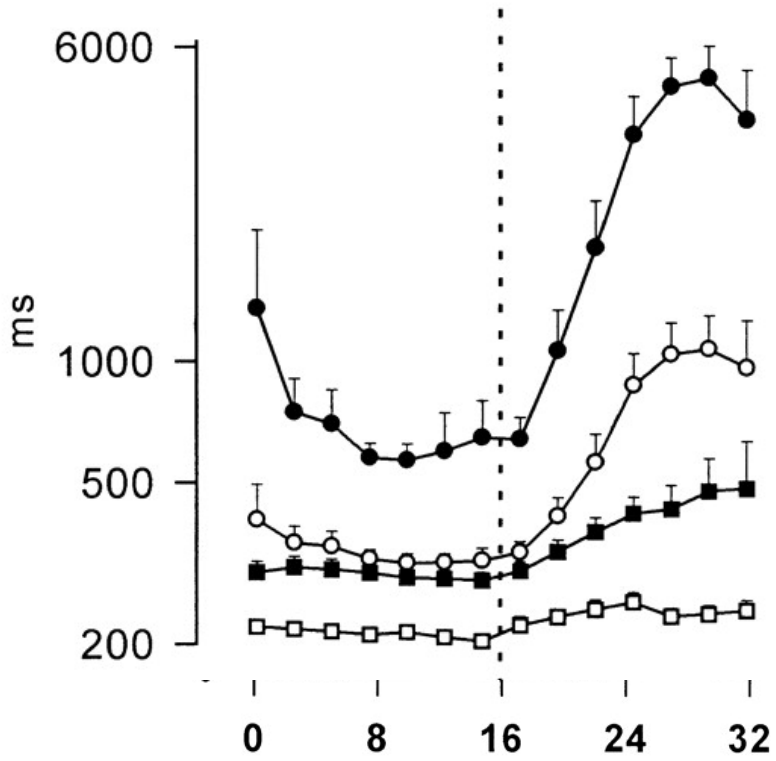
Neurobehavioral performance impact of sleep deficiency/circadian disruption

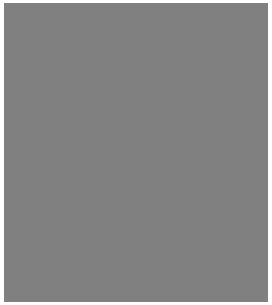
- Slowed **reaction time**
- Increased risk of **lapses of attention**
- Increased risk of **automatic behavior**
- Increased **distractibility**
- Impaired **judgment** (not as risk averse)
- Fast and **sloppy** (speed/accuracy tradeoff)
- Impaired **memory**, insight and creativity
- *Increased risk of **falling asleep***
- *Increased risk of **errors and accidents***

Performance Impairment in Cognitive Psychomotor Performance

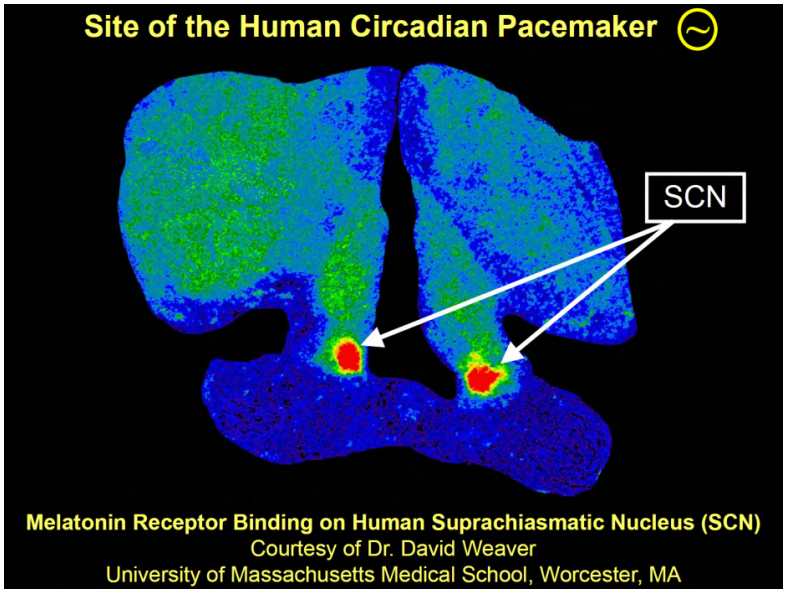
24 hours of wakefulness (at 8 am) induces impairment equivalent to **blood alcohol concentration of 0.10%**

D. Dawson and K. Reid, *Nature* 388: 235, 1997





Christian Cajochen,PhD



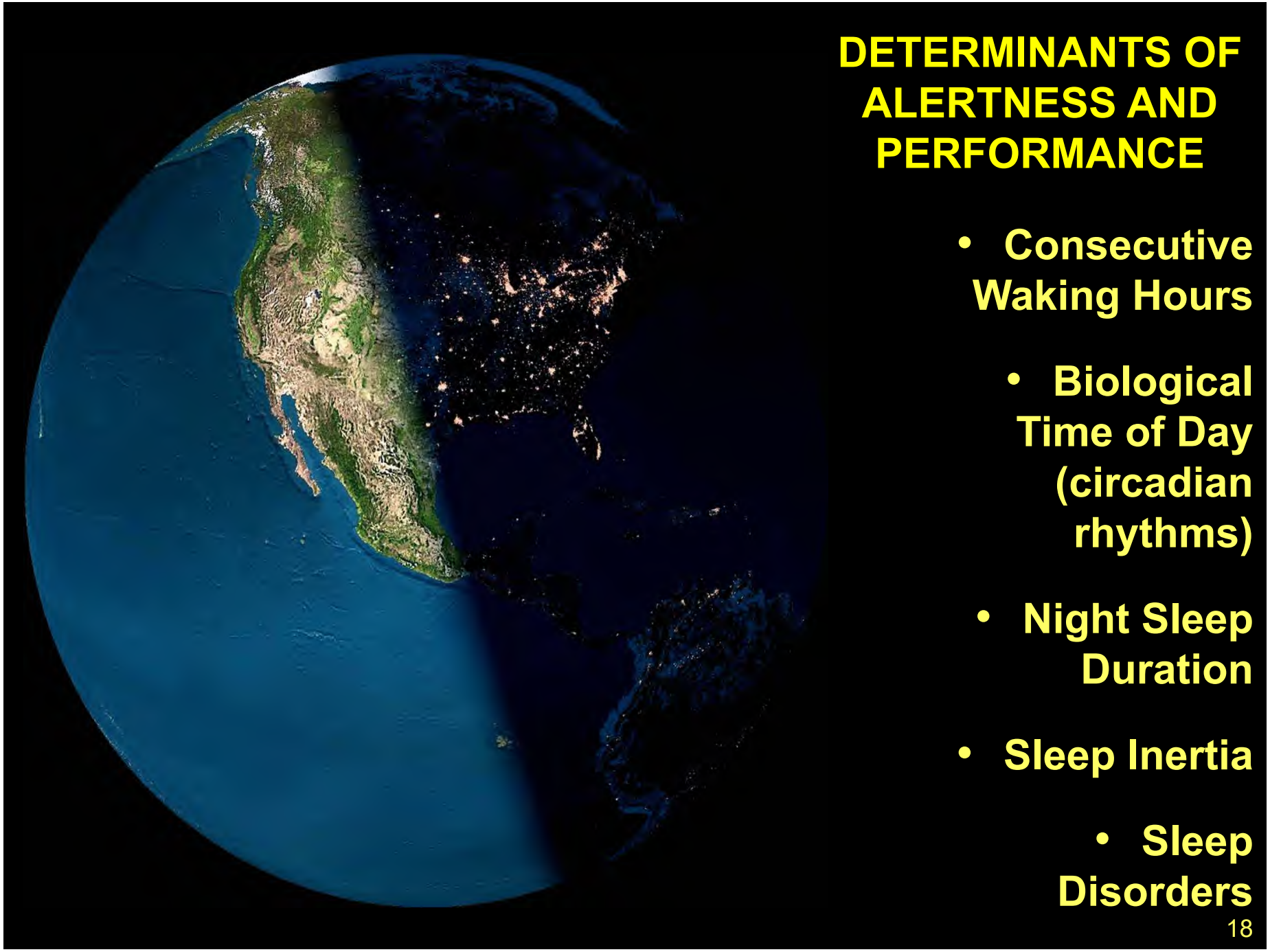
BWH

Cajochen C, Khalsa SBS, Wyatt JK, Czeisler CA, Dijk D-J. *Am J Physiol 277*: R640-R649, 1999

Why the Body Needs Sleep
heart, blood pressure and other functions
insulin secretion
glucose metabolism
regulates appetite
nervous system functioning
liver function
resistance in infection
abdominal fat cells: response to insulin
16

Health Consequences of Sleep Deficiency

Diabetes Risk
Inflammation
Cancer
Weight Gain
Vaccination Response
Burnout
Infection Risk
Cardiovascular Disease
Distractibility
Hormone Regulation
Hyperactivity
Emotional Instability
Depression



DETERMINANTS OF ALERTNESS AND PERFORMANCE

- Consecutive Waking Hours
- Biological Time of Day (circadian rhythms)
- Night Sleep Duration
- Sleep Inertia
- Sleep Disorders

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 OCTOBER 28, 2004 VOL. 351 NO. 18

- **109% more attentional failures at night >16 hours**
- **36% more serious medical errors** working 30-h
- **464% more serious diagnostic errors** in the ICU
- **168% more car crashes** commuting after >24-h shifts
- **468% more near-miss car crashes** after >24-h shifts
- **73% greater risk of needle stick or scalpel lacerations** after >20 consecutive hours at work
- **171% more complications** in patients undergoing elective surgery if attending surgeon had <6 h sleep opportunity during prior night on call

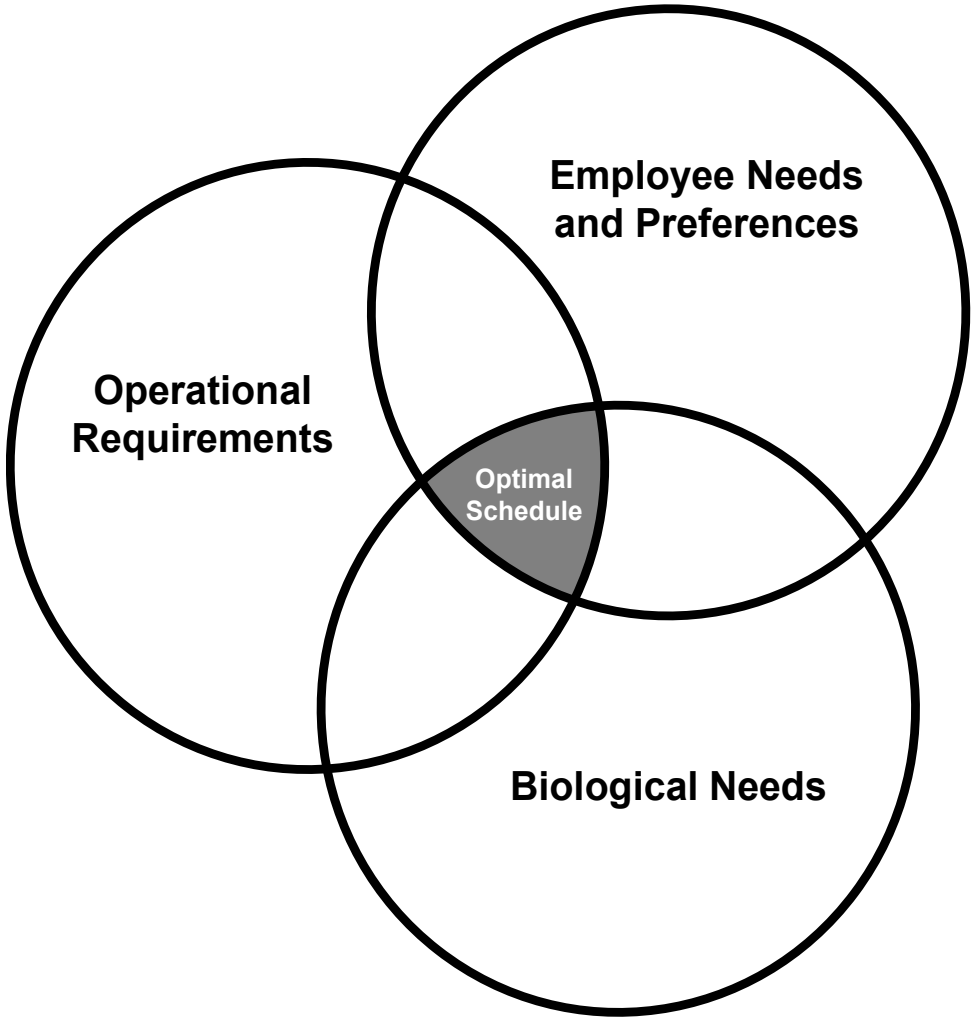
JAMA
The Journal of the American Medical Association

Components of a Comprehensive Fatigue Risk Management Program

(2) **work scheduling policies** grounded on sleep and circadian science, resulting in work schedules that consistently provide adequate time for sleep, with effective disincentives for and required reporting of violations of work-rest policies;

(3) **monitoring of effectiveness** of, **adherence** to and **enforcement** of work-rest policies;

Three major factors that should be considered in schedule design



Work hour regulations in other safety-sensitive industries

Occupation	Limit
US nuclear power plant operators: 1982; 2009	<16 consecutive work hours <72 work hours per week >34 consecutive hours off every 9 days
US railroad operators: 1907, modified 1969 and 1976	<12 work hours per day >8–10 hours rest required per day
US interstate truck and bus drivers: 1938; 1962; 2003; 2005; 2008	<11 driving hours within a 14-hour interval <14 consecutive hours from start to end of work >10 consecutive rest hours <60 work hours per 7 days; <70 work hours per 8 days >34 consecutive hours off between workweeks
EU all occupations (including resident physicians and practicing physicians): 2004; 2009	<13 consecutive work hours <56 work hours per week until 2009; 48 hours thereafter >11 hours rest time per day

From: Czeisler, CA. Chapter 21. Ethical considerations for the scheduling of work in continuous operations: physicians in training as a case study. Oxford University Press, 2010.

Federal Aviation Administration, Part 117

Table A to Part 117—Maximum Flight Time Limits for Unaugmented Operations Table	
Time of report (acclimated)	Maximum flight time (hours)
0000-0459	8
0500-1959	9
2000-2359	8

Table B to Part 117—Flight Duty Period: Unaugmented Operations							
Scheduled time of start (Acclimated time)	**Maximum flight duty period (hours) for lineholders based on number of flight segments**						
	1	**2**	**3**	**4**	**5**	**6**	**7+**
0000-0359	9	9	9	9	9	9	9
0400-0459	10	10	10	10	9	9	9
0500-0559	12	12	12	12	11.5	11	10.5
0600-0659	13	13	12	12	11.5	11	10.5
0700-1159	14	14	13	13	12.5	12	11.5
1200-1259	13	13	13	13	12.5	12	11.5
1300-1659	12	12	12	12	11.5	11	10.5
1700-2159	12	12	11	11	10	9	9
2200-2259	11	11	10	10	9	9	9
2300-2359	10	10	10	9	9	9	9

- WORK DURATION. **60** flight duty period hours in any **168** consecutive hours. OR 190 flight duty period hours in any 672 consecutive hours.
- **100** hours in any **672** consecutive hours or 1,000 hours in any 365 consecutive calendar day period.

Electronic code of Federal Regulations. Title 14: Aeronautics and Space. Part 117- Flight and Duty Limitations and Rest Requirements: Flightcrew and Members. SOURCE: Doc. No. FAA-2009-1093, 77 FR 398, Jan. 4, 2012, unless otherwise noted. e-CFR Data is current as of January 28, 2014

FAA Part 117

REST POLICY…no flightcrew member may accept an assignment for any reserve or flight duty period unless the flightcrew member is given a rest period of at least 10 consecutive hours immediately before beginning the reserve or flight duty period measured from the time the flightcrew member is released from duty. **The 10 hour rest period must provide the flightcrew member with a minimum of 8 uninterrupted hours of sleep opportunity.**

REST POLICY…flightcrew member must be given at least **30 consecutive hours** free from all duty within the **past 168** consecutive hour period.

CONSECUTIVE NIGHT SHIFTS. **Three to five night shifts** are allowed depending on rest opportunities.

Electronic code of Federal Regulations. Title 14: Aeronautics and Space. Part 117- Flight and Duty Limitations and Rest Requirements: Flightcrew and Members. SOURCE: Doc. No. FAA-2009-1093, 77 FR 398, Jan. 4, 2012, unless otherwise noted. e-CFR Data is current as of January 28, 2014

Maritime

- Deep Sea Industry
  - Even time off (e.g., 2 months on/2 months off)
  - Watch system: 4 hours on/8 hours off
  - No breaks/resets during time aboard ship
- Tug Boat Industry
  - Even time off (e.g., 1 week on/1 week off, 2 weeks on/2 weeks off)
  - Watch system: 6 hours on/6 hours off
  - No breaks/resets during time aboard tug boat

Institute of Medicine, 2009[1]

- No more than 16 consecutive hours
- No more than 4 consecutive night shifts
- At least 10 hours off after a day shift; 12 hours after a night shift; 14 hours off after a 16-hour shift
- One day off per week; two consecutive days off per month
- All work included (e.g., moonlighting)

[1]Institute of Medicine. Resident Duty Hours: Enhancing Sleep, Supervision, and Safety. Ulmer C, Wolman DM, Johns MME, eds. Washington, DC: National Academies Press; 2009.

State of Washington, Board of Pilotage Commissioners Current Rest Rules

RCW 88.16.103

Mandatory rest periods for pilots and pilot trainees—Rules—Assignment refusal—Penalty.

(1) Pilots and pilot trainees, after completion of an assignment or assignments which are seven hours or longer in duration, shall receive a mandatory rest period of seven hours.

(2) A pilot or pilot trainee shall refuse a pilotage assignment if the pilot or pilot trainee is physically or mentally fatigued or if the pilot or pilot trainee has a reasonable belief that the assignment cannot be carried out in a competent and safe manner. Upon refusing an assignment under this subsection, a pilot or pilot trainee shall submit a written explanation to the board within forty-eight hours. If the board finds that the pilot's or pilot trainee's written explanation is without merit, or reasonable cause did not exist for the assignment refusal, such pilot or pilot trainee may be subject to the provisions of RCW 88.16.100.

(3) The board shall quarterly review the dispatch records of pilot organizations or pilot's quarterly reports to ensure the provisions of this section are enforced. The board may prescribe rules for rest periods pursuant to chapter 34.05 RCW. [2008 c 128 § 7; 1986 c 122 § 2; 1977 ex.s. c 337 § 9.]

Rest period. **WAC 363-116-081**

(1) Pilots shall observe rest period requirements as set out in RCW 88.16.103 as now or hereafter amended. For purposes of applying this rule an assignment shall begin at the pilot's dispatched departure time if the pilot is on board, regardless of when the ship actually sails. The assignment ends when the pilot leaves the vessel. Travel time shall not be included in an assignment.

[WSR 97-08-042, recodified as § 363-116-081, filed 3/28/97, effective 3/28/97. Statutory Authority: RCW 88.16.035. WSR 79-05-023 (Order 79-2, Resolution No. 79-2), § 296-116-081, filed 4/17/79; Order 73-6, § 296-116-081, filed 5/11/73.]

National Transportation Safety Board

In 2011, the United States National Transportation Safety Board recommended (NTSB Recommendation M-11-20) that governors of states in which pilots operate should "**require local pilot oversight organizations** that have not already done so to implement fatigue mitigation and prevention programs that:

(1) **regularly inform mariners** of the **hazards of fatigue** and effective **strategies to prevent [fatigue]**, and

(2) promulgate **hours of service rules** that **prevent fatigue resulting from**

- **extended hours of service**,
- **insufficient rest within a 24-hour period**, and
- **disruption of circadian rhythms**."

National Transportation Safety Board. 2011. Collision of Tankship Eagle Otome with Cargo Vessel Gull Arrow and Subsequent Collision with the Dixie Vengeance Tow, Sabine-Neches Canal, Port Arthur, Texas, January 23, 2010. Marine Accident Report NTSB/MAR-11/04, p. 70. Washington, D.C.

Critique of Agency's Current Rest Rules

- **Current rule excludes travel time in hours of service, potentially allowing unsafe, extended duration work shifts**
  - **Bridge time is an inadequate proxy for required duty time**
  - **Duty hours should explicitly include travel time, as pilots are required to service vessels traveling to, from and within 12 ports covering 7,000 square miles of territory within the Puget Sound Pilotage District**
  - **Current rule is not compliant with the NTSB recommendation that "local pilot oversight organizations … implement fatigue mitigation and prevention programs that promulgate hours of service rules that prevent fatigue resulting from … extended hours of service…."**

Critique of Agency's Current Rest Rules

- **Current rule does not limit duration of work shifts, and therefore allows unsafe, extended duration work shifts**
  - **As written, a 6.9-hour pilotage assignment could be followed by an assignment of 22 or more hours, resulting in a 29-hour work shift, including travel time**
  - **Current rule is not compliant with the NTSB recommendation that "local pilot oversight organizations … implement fatigue mitigation and prevention programs that promulgate hours of service rules that prevent fatigue resulting from … extended hours of service…."**

Critique of Agency's Current Rest Rules

- **Current rule provides inadequate time for rest between work shifts, creating an unsafe condition**
  - **Seven (7) hours of off-duty time is inadequate for pilots to fulfill their daily sleep need, inducing sleep deficiency that causes fatigue;**
  - **11 hours of off-duty time is required each day to ensure that pilots can obtain an adequate amount of sleep**
  - **Current rule is not compliant with the NTSB recommendation that "local pilot oversight organizations … implement fatigue mitigation and prevention programs that promulgate hours of service rules that prevent fatigue resulting from … insufficient rest within a 24-hour period…."**

Critique of Agency's Current Rest Rules

- **Current rule fails to ensure that pilots are provided with 34 consecutive hours of uninterrupted rest, including two nights between midnight and 6 am, within every running 7-day interval**
  - **Pilots currently work for 14 consecutive days and are allowed to trade assignments**
  - **Allowing pilots to work for 14, 28 or 42 consecutive days and nights can induce chronic sleep deficiency and fatigue**
  - **Current rule is not compliant with the NTSB recommendation that "local pilot oversight organizations implement fatigue mitigation and prevention programs that promulgate hours of service rules that prevent fatigue…."**

Critique of Agency's Current Rest Rules

- **Current rule requires pilots who refuse a pilotage assignment because of physical or mental fatigue to submit a written explanation to the Board within 48 hours, and that if the Board finds the pilot's explanation to be "without merit," the pilot may be subject to Pilot License revocation or suspension, reprimand, fine or other disciplinary actions**
  - **NTSB recommends pilots be required to decline pilotage assignments when they are impaired by fatigue without fearing disciplinary action**
  - **Pilots who have slept less than 5 hours in the prior 24 hours should be required to refuse a pilotage assignment**

Critique of Agency's Current Rest Rules

- **Current rule provides the State of Washington Board of Pilotage Commissioners with the authority to enhance the guidance that the legislature has provided. "The board may prescribe rules for rest periods pursuant to chapter 34.05 RCW."**
  - **Given the limited scope of the current rest rules mandated by the legislature, the advances in sleep and circadian science that have been made since the legislation was enacted, and the NTSB Recommendations that were issued by the NTSB, the Commission has the responsibility to use the authority granted to the Commission by the legislature to provide further regulatory guidance.**

Summary of Rest Rules of Puget Sound Pilots

- **Two hours of advance notice required for assignment**
- **Travel time is included in work hours, for example:**
  - **2 hours before and 1 hour after is allotted for travel to/from vessel assignments in Seattle Harbor;**
  - **3 hours before and 3 hours after is allotted for travel to and from vessel assignments in Olympia, Manchester, Bangor, Port Townsend;**
  - **4 hours before and 3 hours after is allotted for travel to and from vessel assignments in Anacortes, March Point;**
  - **7 hours before and 7 hours after is allotted for travel to and from vessel assignments in Vancouver, New Westminster, Delta Port or Port Moody;**

Summary of Rest Rules of Puget Sound Pilots

- **At Seattle, a minimum off-duty time "before and after an inter-port or sea-trial assignment, and before the first of multiple harbor shift assignments is eight hours."**
- **Pilots who work three consecutive nights (between 0100 and 0459) shall [not work the next night]**

Critique of Rest Rules of Puget Sound Pilots

- **Inclusion of travel time in work hours is a great improvement over the Agency rule**
- **Voluntary inclusion of travel time in work hours restrictions by the Puget Sound Pilots is not sufficient to substitute for regulatory action by the Commission**

Critique of Rest Rules of Puget Sound Pilots

- **Current rules do not limit duration of work shifts, and therefore allows unsafe, extended duration work shifts**
  - **Current rules are not compliant with the NTSB recommendation that "local pilot oversight organizations … implement fatigue mitigation and prevention programs that promulgate hours of service rules that prevent fatigue resulting from … extended hours of service…."**

Critique of Rest Rules of Puget Sound Pilots

- **Current rule provides inadequate time for rest between work shifts, creating an unsafe condition**
  - **Eight (8) hours of off-duty time is inadequate for pilots to fulfill their daily sleep need, inducing sleep deficiency that causes fatigue;**
  - **11 hours of off-duty time is required each day to ensure that pilots can obtain an adequate amount of sleep**
  - **Current rule is not compliant with the NTSB recommendation that "local pilot oversight organizations … implement fatigue mitigation and prevention programs that promulgate hours of service rules that prevent fatigue resulting from … insufficient rest within a 24-hour period…."**

Critique of Rest Rules of Puget Sound Pilots

- **Current rules fail to ensure that pilots are provided with 34 consecutive hours of uninterrupted rest, including two nights between midnight and 6 am, within every running 7-day interval**
  - **Pilots currently work for 14 consecutive days and are allowed to trade assignments**
  - **Allowing pilots to work for 14, 28 or 42 consecutive days and nights can induce chronic sleep deficiency and fatigue**
  - **Current rule is not compliant with the NTSB recommendation that "local pilot oversight organizations implement fatigue mitigation and prevention programs that promulgate hours of service rules that prevent fatigue…."**

Policy Recommendation 1 (a)

- ***Personal responsibility.*** **Work-rest requirements should include a provision requiring pilots to take personal responsibility for coming to work rested and fit for duty. If a pilot were to report that he or she is fatigued and unfit for duty, the pilot must be removed from the assignment immediately, without penalty for reporting that he or she is fatigued and unfit for duty.**

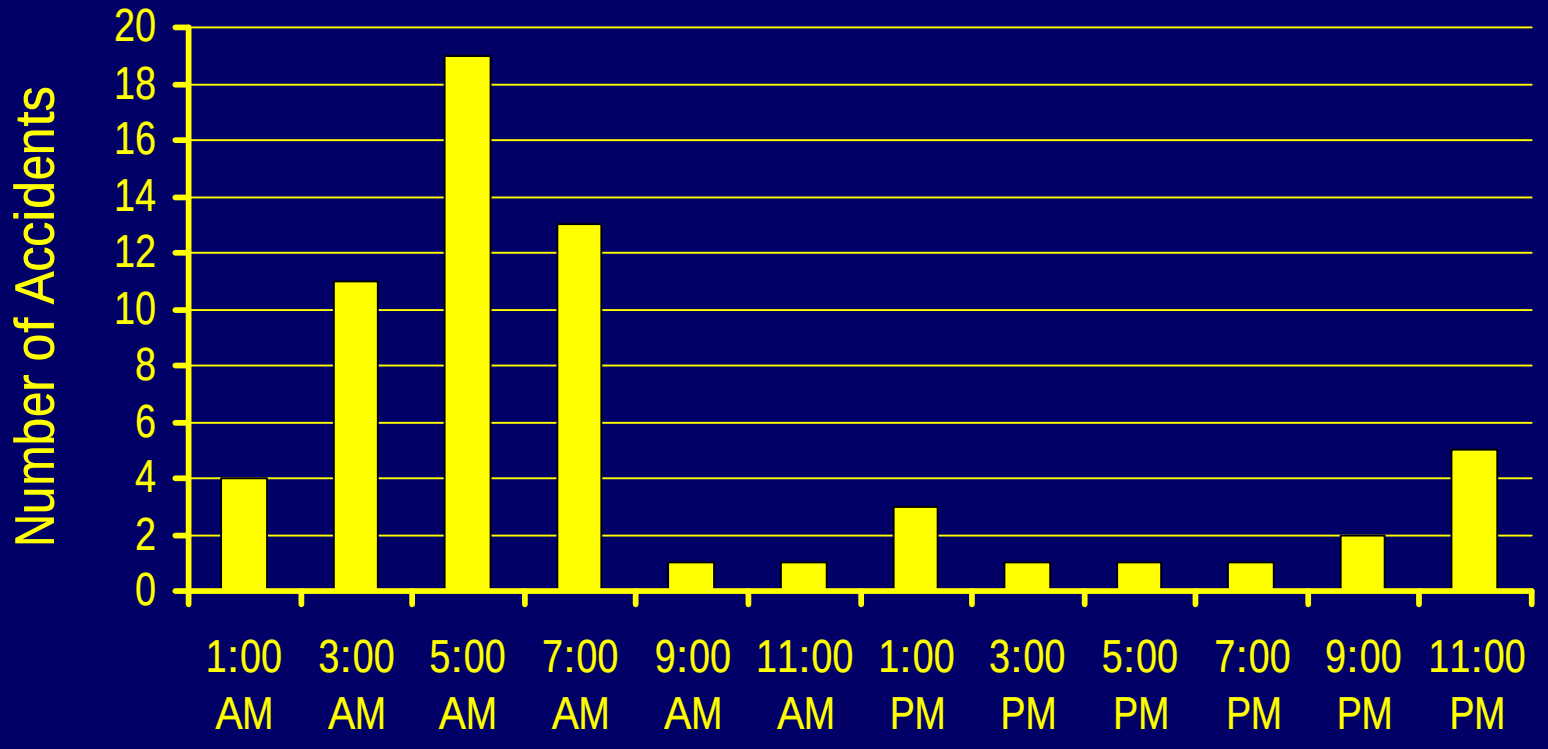
Policy Recommendation 1 (b)

- ***Promoting and fostering a safety culture that recognizes fatigue as a primary safety concern.*** **The Commission should be responsible to provide an annual mandatory education program on sleep, health and safety, with annual certification testing, to train all Puget Sound Pilots, pilot managers and pilot dispatchers on the principles of sleep and circadian science, highlighting the hazards of fatigue and effective strategies to prevent fatigue.**

Policy Recommendation 2

- ***Maximum consecutive work hours.*** **Each work episode of a Puget Sound Pilot should be limited to no more than 12 consecutive hours during the daytime (all work hours between 6 am to midnight) [maximum extended day work duration] and should be limited to no more than 8 consecutive hours if more than one of the work hours occurs between midnight to 6 am [maximum night work duration] before a mandatory rest break is started.**

Temporal Distribution of Fatigue-related Single Vehicle Truck Accidents

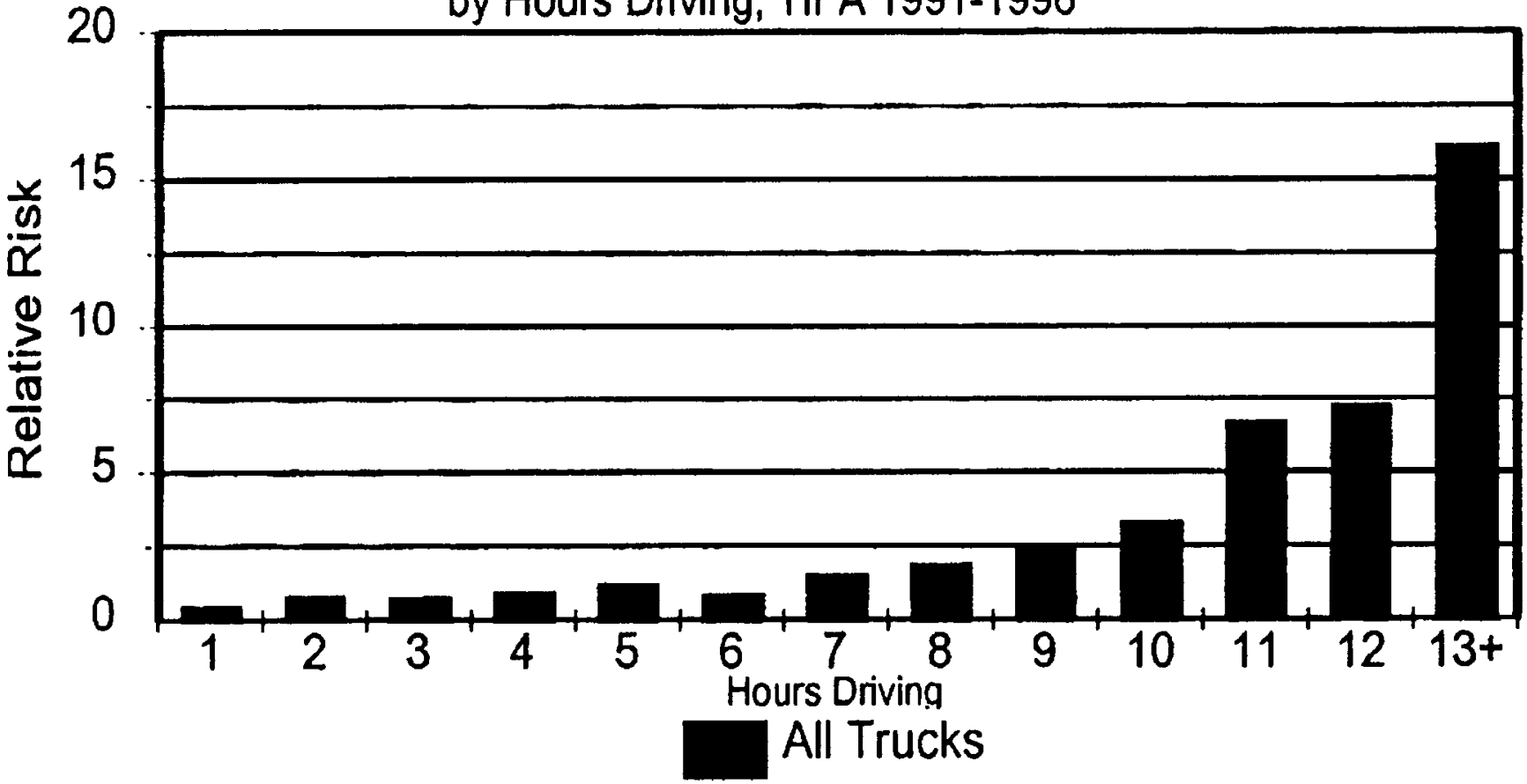


National Transportation Safety Board Safety Study (SS-1995/01)

Chart 5

Relative Risk of Fatigue Crash

by Hours Driving, TIFA 1991-1996



To Promote the Science and Art of Medicine and the Betterment of the Public Health
September 6, 2006, Vol 296, No. 9 Pages 1021-1192
JAMA
The Journal of the American Medical Association

Artist Unknown, *Jar With Both a Plumed Serpent and a Macaw-Headed Serpent*, 1280-1450 CE, Casas Grandes.

September 6, 2006

ORIGINAL CONTRIBUTIONS

Extended Work Duration and the Risk of Self-reported Percutaneous Injuries in Interns 1055
N. T. Ayas, L. K. Barger, B. E. Cade, D. M. Hashimoto, B. Rosner, J. W. Cronin, F. E. Speizer, C. A. Czeisler

Occupational Injuries

73% greater rate of needle stick or scalpel lacerations after > 20 consecutive hours at work

Ayas NT, Barger LK, Cade BE, Hashimoto DM, Rosner B, Cronin JW, Speizer FE, Czeisler CA. *JAMA* 2006;296:1055-1062.

Policy Recommendation 2 (continued)

- ***Exceptions.*** **Each work episode of a Puget Sound Pilot should be limited to no more than 13 consecutive hours during the daytime, if all work hours occur between 8 am to 10 pm) [maximum day work duration] and should be limited to no more than 9 consecutive hours if more than one but less than 3 of the work hours occurs between midnight to 6 am [maximum night work duration] before a mandatory rest break is started.**

Policy Recommendation 2 (continued)

- **Each work episode should, by definition, begin from the time that a pilot is ordered by and assigned to a vessel and will include preparation time, transit time to and from the vessel, time between pilotage assignments and any other compensated work performed by the pilot, whether or not it is related to pilotage, until such time as a mandatory rest break is begun.**

Policy Recommendation 2 (continued)

- **No pilot should begin a pilotage assignment or board a vessel if the expected time of completion of the assignment, including return travel, would cause the pilot's work episode to exceed the maximum allowed work durations.**

Policy Recommendation 2 (continued)

- **If a pilot's work episode duration has exceeded the maximum work durations due to unforeseen adverse weather conditions, traffic conditions or unplanned detention aboard a vessel, then: (1) the reason, duration and time of day of the work-hour exception should be recorded by the Puget Sound Pilots; and (2) all such work-hour exceptions should be compiled by the Puget Sound Pilots.**

Policy Recommendation 2 (continued)

- **The Puget Sound Pilots should report all such scheduling exceptions to the State of Washington Board of Pilotage Commissioners. In case of emergency, a waiver to allow a pilot to exceed the Maximum Work Durations could be issued; the reason, duration and time of day of all such waivers should be reported by a representative of the State of Washington Board of Pilotage Commissioners.**

Policy Recommendation 3

- ***Minimum consecutive hours between shifts*. A mandatory off-duty rest break of a minimum of 12 consecutive hours, when the pilot is not on duty or available to accept pilotage assignments, and is free from transportation to or from a vessel, and is not performing any other compensated work, whether or not it is related to pilotage, should be taken before a pilot can be assigned to a vessel.**
  - **Free of all paid work and required travel time**
  - **Free of administrative pilotage work**

Policy Recommendation 3 (continued)

- **The mandatory rest break may be shortened to a minimum of 11 hours if the rest break includes six consecutive hours between 2200 and 0800. All 11-hour rest breaks should include a pilot-chosen, eight consecutive hour interval, excluding travel time, that is free from calls from dispatch.**

[Consistent with European Working Time Directive]

Policy Recommendation 3 (continued)

- **In case of emergency, a waiver to allow a pilot to accept a pilotage assignment with fewer than 11 or 12 consecutive hours of off-duty time between work episodes may be issued; the reason, duration and time of day of all such waivers should be reported to the Washington Board of Pilotage Commissioners.**

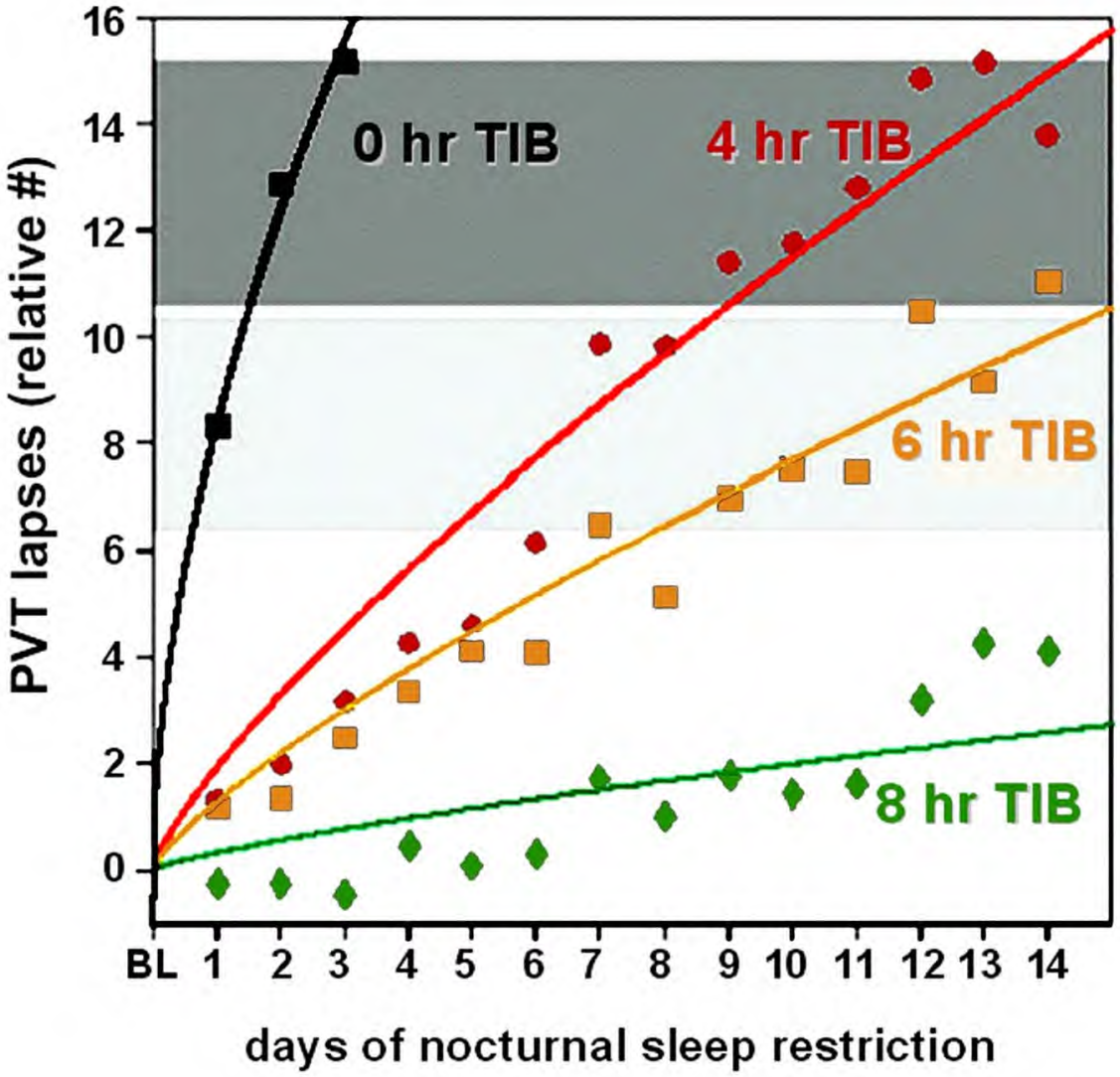
Policy Recommendation 4

- ***Weekly work limit.*** **The maximum cumulative duration of all of the pilotage work episodes and all other compensated work performed by each pilot within any running 7-day interval should not exceed 60 hours. In case of emergency, a waiver to allow a pilot to accept a pilotage assignment that would result in the cumulative duration of the work episodes of that pilot to exceed 60 hours within a 7-day interval may be issued; the reason, duration and time of day of all such waivers should be reported to the State of Washington Board of Pilotage Commissioners.**

Policy Recommendation 5

- ***Consecutive night shifts.*** **The maximum number of consecutive night shifts (defined as involving more than one work hour between midnight and 6 am) worked by Puget Sound Pilots should not exceed three (3). In case of emergency, a waiver to allow a pilot to accept a pilotage assignment that would result in the pilot working up to four (4) consecutive night shifts, but no more, may be issued; the reason, duration and time of day of all such waivers should be reported to the State of Washington Board of Pilotage Commissioners.**

Cumulative Impact of Daily Sleep Curtailment on Risk of Vigilance Lapses



poor performance

Vigilance lapses

Differences <u>among conditions</u>
p = 0.036

<u>Curvature (SEM)</u>

θ = 0.78 (0.04)

<u>Effect sizes</u>

4 hr vs 8 hr: 1.45

6 hr vs 8 hr: 0.71

4 hr vs 6 hr: 0.43

Van Dongen et al. <u>Sleep</u> (2003)

Policy Recommendation 6

- ***Weekly rest*. A mandatory off-duty rest break of a minimum of 24 consecutive hours should be obtained within every running 7-day interval by each Puget Sound Pilot. This Policy Recommendation should not be eligible for waiver. For each pilot working more than 7 consecutive days: a mandatory off-duty rest break of a minimum of 34 consecutive hours, including 2 nights between midnight and 0600, should be obtained within every running 7-day interval. This Policy Recommendation should not be eligible for waiver.**

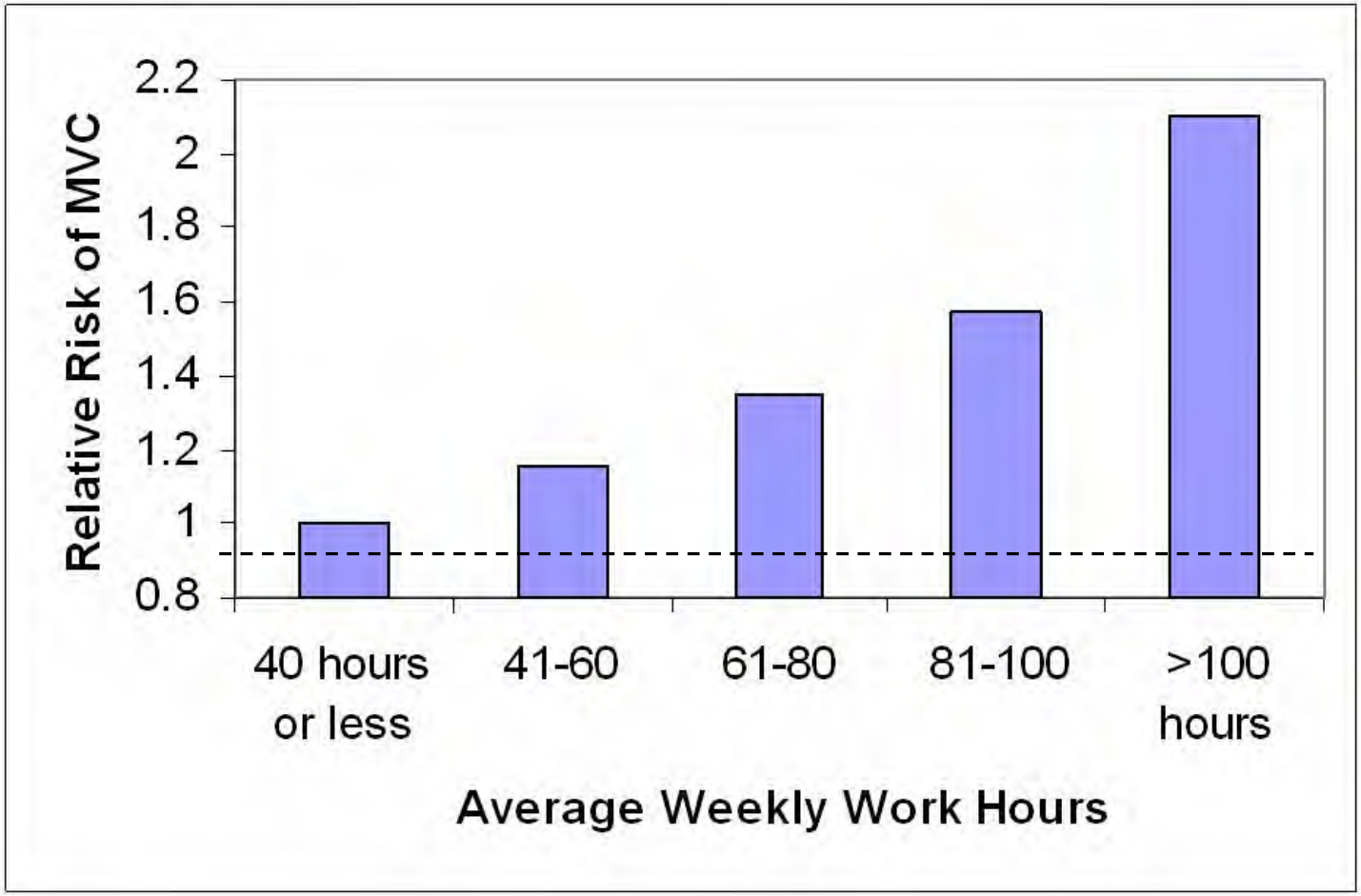
Policy Recommendation 7

- ***Maximum number of days on the duty*. The maximum number of scheduled days on the board should not exceed 15. As stated in Recommendation 6, a minimum of 34 consecutive hours, including 2 nights between midnight and 0600, should be obtained within every running 7-day interval of these 15 scheduled days on the board, such that no pilot will work more than 6 consecutive days. This Policy Recommendation should not be eligible for waiver.**

Policy Recommendation 8

- ***Monthly rest*. A mandatory off-duty rest break of a minimum of 60 consecutive hours, including three (3) nights between midnight and 0600, should be obtained within every running 30-day interval by each Puget Sound Pilot. In case of emergency, a waiver to allow a pilot to reduce the duration of this mandatory monthly off-duty break from 60 to 36 hours, but no shorter may be issued; the reason, duration and time of day of all such waivers will be reported to the State of Washington Board of Pilotage Commissioners.**

Dose Response Relationship Between Resident Work Hours and Risk of an MVC



Barger LK, Cade BE, Ayas N, Cronin JW, Rosner B, Speizer FE, Czeisler CA.
***N Engl J Med* 2005;352:125-134.**

Policy Recommendation 9

- ***Schedule design*. The Puget Sound Pilots should move to stabilize work hours to minimize uncertainty and maximize consistency, particular during the vulnerable nighttime hours (0000-0600). Every effort should be made to increase the regularity and predictability of scheduled work times.**
  - "A schedule that **alternates daytime work with nighttime work in the same week is detrimental to optimum performance** in that it is difficult for someone to compensate for the sleep deprivation that has resulted from working at a time when one is typically sleeping."

    National Transportation Safety Board. 2009. Allision of Hong Kong-Registered Containership M/V Cosco Busan with the Delta Tower of the San Francisco–Oakland Bay Bridge, San Francisco, California, November 7, 2007. Marine Accident Report NTSB/MAR-09/01. Washington, DC.
  - Pilots consistently rate **irregular night work schedule** as most difficult aspect of schedule

"The NTSB also found that the June 23, 1995, grounding of the passenger vessel *Star Princess* in Alaskan waters was fatigue related. It determined that the probable cause of that accident was the pilot's—poor performance, which may have been exacerbated by **chronic fatigue caused by sleep apnea**."

"The NTSB has recommended that the Coast Guard implement a program to:

- Identify licensed mariners … who are at high risk for OSA, and require that those mariners provide evidence through the medical certification process of having been appropriately evaluated and, if treatment is needed, effectively treated for that disorder before being granted unrestricted medical certification. (M-09-15)
- Develop and disseminate guidance for mariners, employers, and physicians regarding the identification and treatment of individuals at high risk of OSA, emphasizing that mariners who have OSA that is effectively treated are routinely approved for continued medical certification. (M-09-16)"

National Transportation Safety Board. 2011. Collision of Tankship Eagle Otome with Cargo Vessel Gull Arrow and Subsequent Collision with the Dixie Vengeance Tow, Sabine-Neches Canal, Port Arthur, Texas, January 23, 2010. Marine Accident Report NTSB/MAR-11/04. Washington, DC.

50-70 million Americans suffer from sleep disorders

- Excessive daytime sleepiness
- Difficulty initiating or maintaining sleep
- Early morning awakening
- Abnormal movements, behaviors or sensations during sleep

Source: IOM Report on Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem, April, 2006

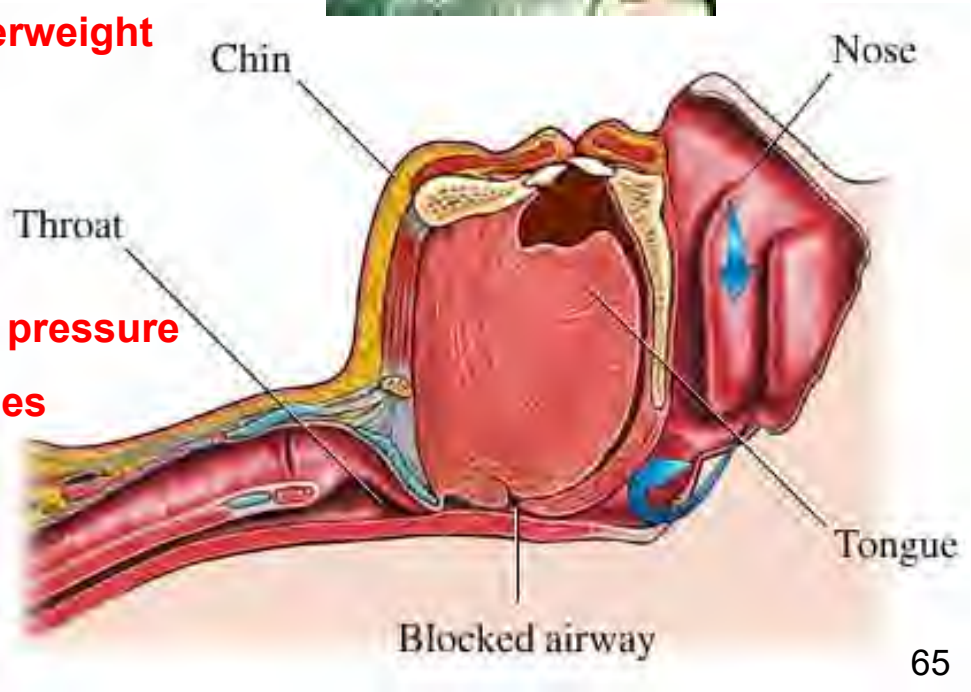
Obstructive Sleep Apnea (OSA)

Temporarily stopping breathing during sleep

- Caused by narrowing of airway during sleep
- Reduces oxygen to the lungs

Symptoms

- **Snoring plus 'gasping' or stopping breathing**
- **Tired during the dayime**
- **High prevalence in men who are overweight or have a collar size >17 inches**
- **Higher risk of CV disease, high blood pressure, and stroke**
- **Leading known cause of high blood pressure**
- **Higher rate of 'fall asleep' car crashes**
- **Most people are undiagnosed**



http://understandingsleep.org

Apnea

Understanding and treating obstructive sleep apnea

What Is OSA
- Understanding OSA
- What Happens During OSA
- Symptoms
- Risk Factors

Living with OSA
- How Does OSA Affect Me
- Physical Characteristics
- Health Consequences
- Personal & Societal Consequences
- Associated Medical Conditions

Diagnosing OSA
- Getting a Diagnosis
- Self-Evaluation
- Testing
- Understanding the Results

Treating OSA
- Treating OSA
- Nonsurgical Treatments
- Understanding PAP
- Surgical Treatments
- Impact of Treatment

DIVISION OF
SLEEP MEDICINE
HARVARD MEDICAL SCHOOL

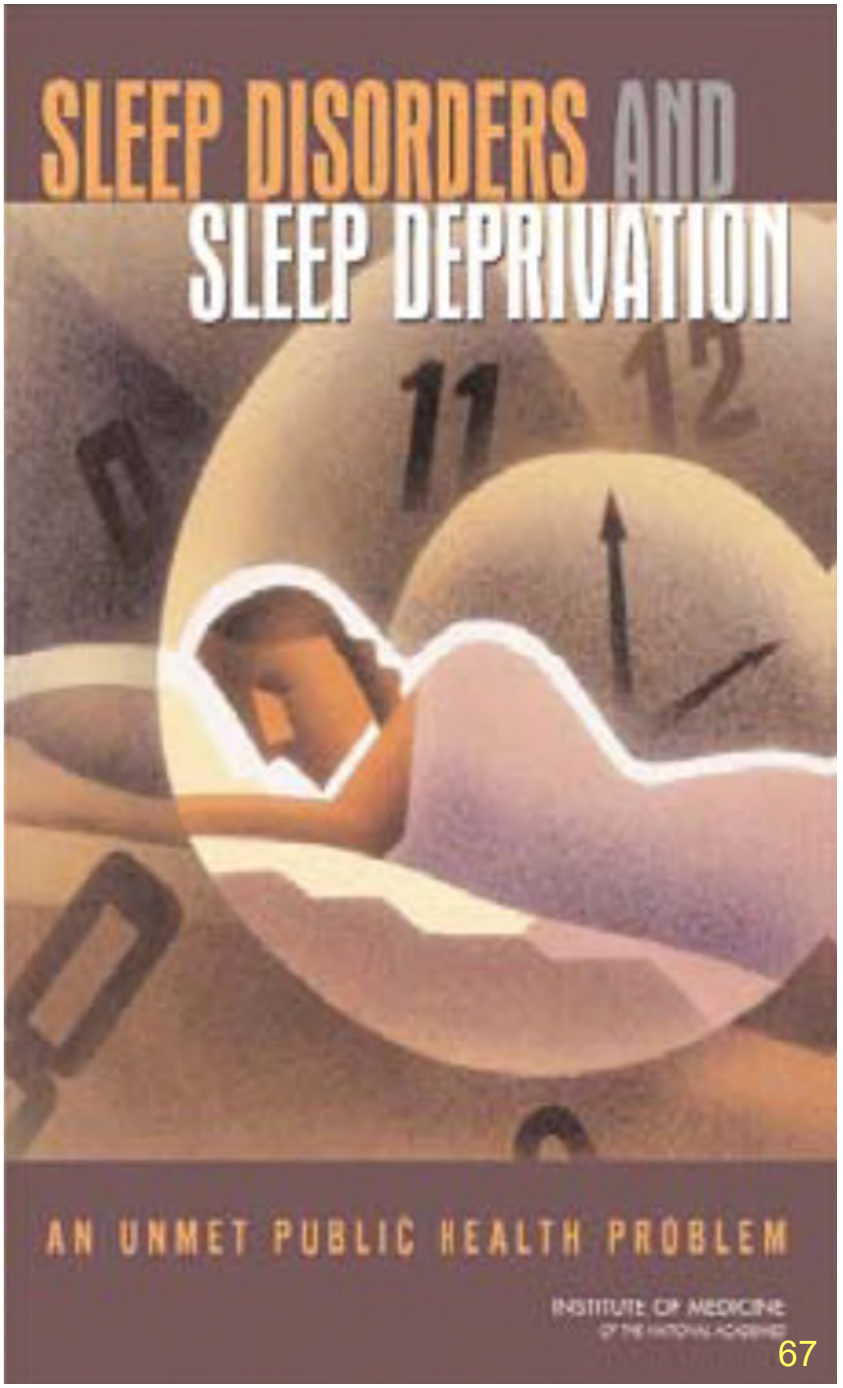
REPORT BRIEF • APRIL 2006

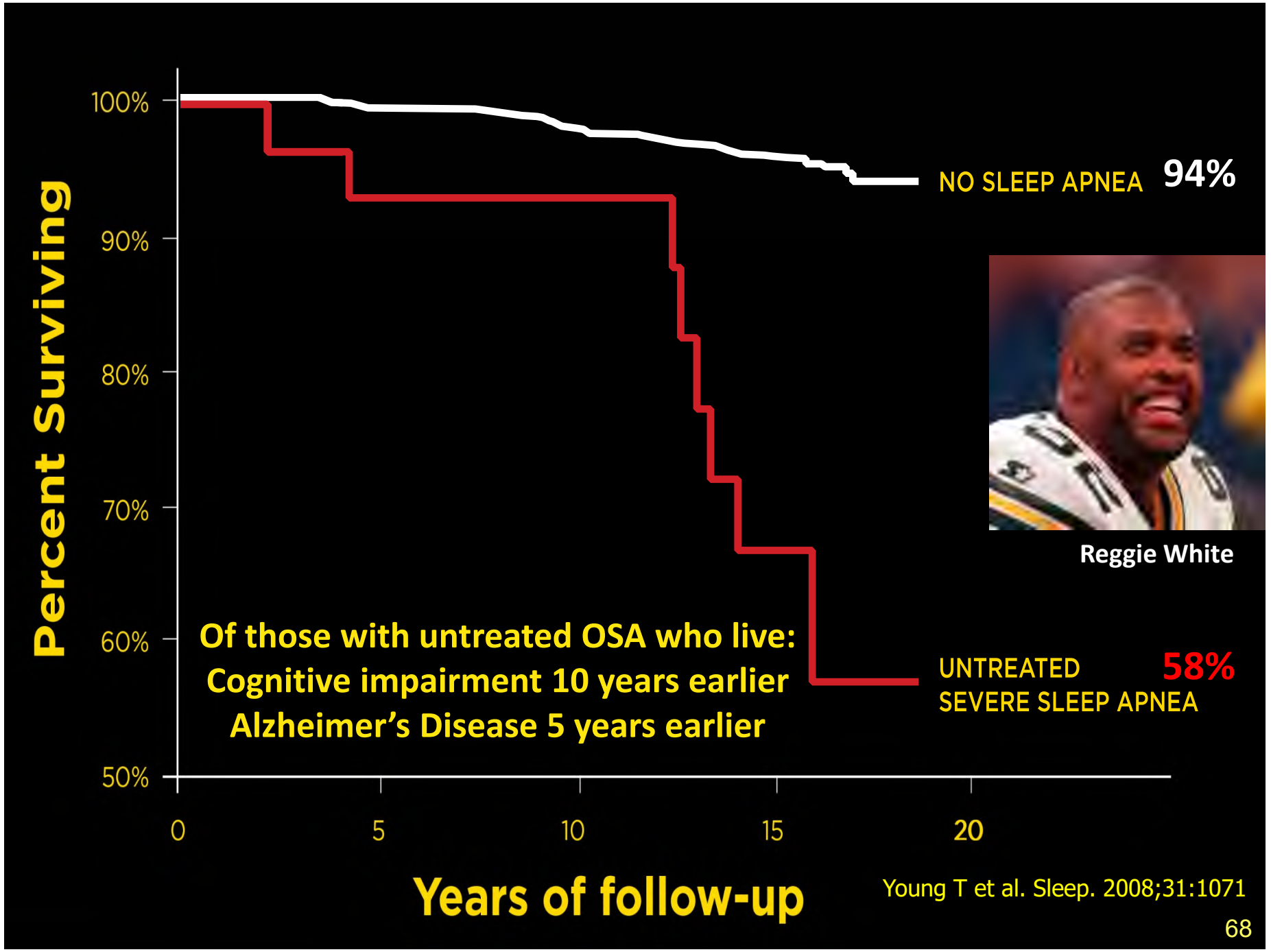
SLEEP DISORDERS AND SLEEP DEPRIVATION: AN UNMET PUBLIC HEALTH PROBLEM

The cumulative effects of sleep loss and sleep disorders represent an under-recognized public health problem and have been associated with a wide range of health consequences, including an increased risk of hypertension, diabetes, obesity, depression, heart attack, and stroke.

INSTITUTE OF MEDICINE
OF THE NATIONAL ACADEMIES

Advising the Nation. Improving Health.




Percent Surviving
100%
90%
80%
70%
60%
50%
0
5
10
15
20
Years of follow-up
NO SLEEP APNEA 94%
UNTREATED SEVERE SLEEP APNEA 58%
Of those with untreated OSA who live:
Cognitive impairment 10 years earlier
Alzheimer's Disease 5 years earlier
Reggie White
Young T et al. Sleep. 2008;31:1071
68

Policy Recommendation 10

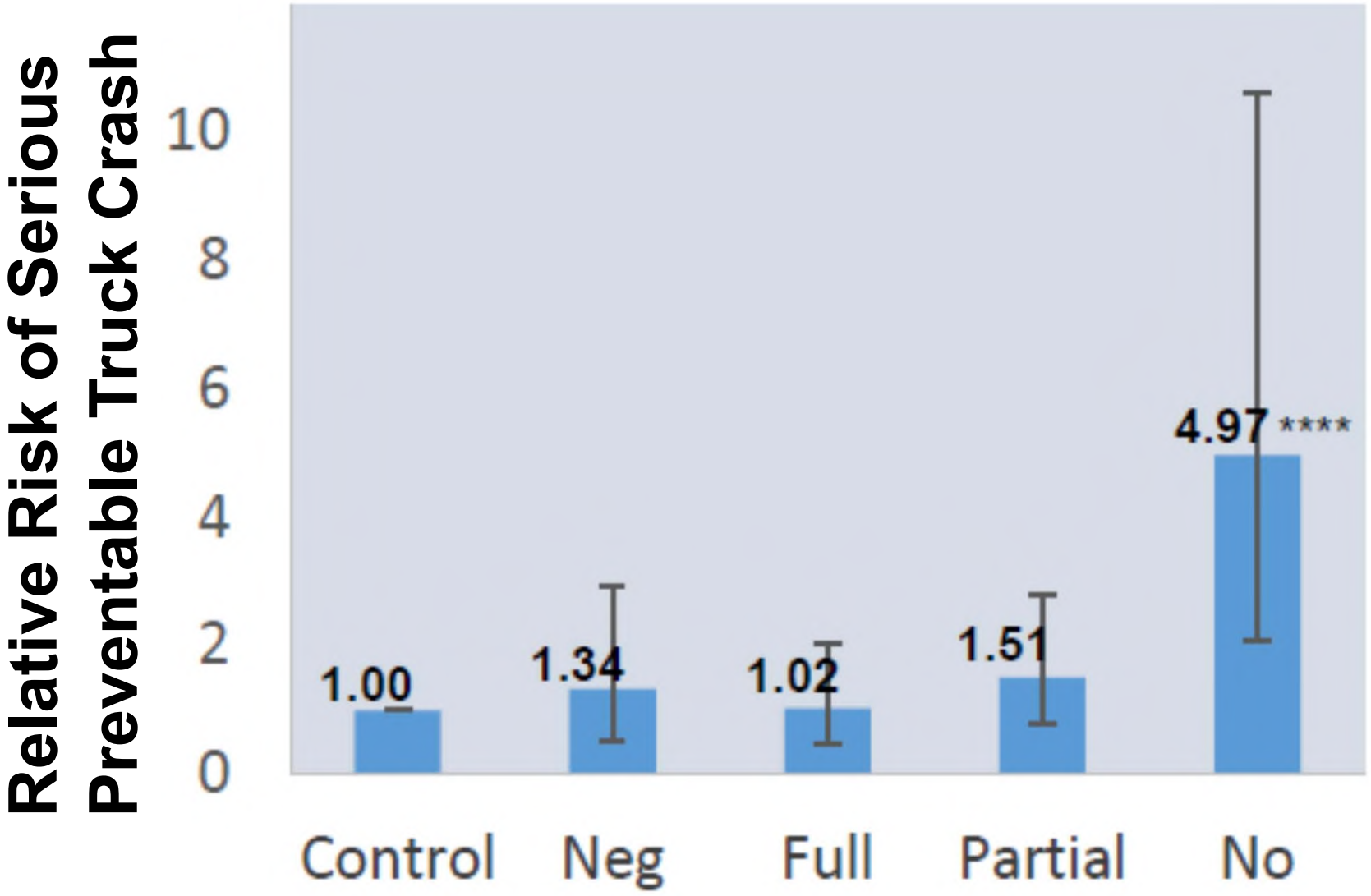
Incorporate Vital Components of a Comprehensive Fatigue Risk Management Program into Regulations

(4) **mandatory screening**, using validated questionnaires, of all employees for sleep disorders, **specifically including obstructive sleep apnea**, with follow-up mandatory objective at-home or in-lab diagnostic testing for obstructive sleep apnea in those who screen positive on a validated obstructive sleep apnea screening questionnaire;

(5) **mandatory objective at-home** or in-lab diagnostic testing for obstructive sleep apnea in all employees with a body mass index greater than 30 kg/m^2;

(6) in pilots diagnosed with obstructive sleep apnea or another sleep disorder, **mandatory demonstration of the effectiveness of, and ongoing compliance with, treatment** of obstructive sleep apnea or another sleep disorder prior to resumption of pilotage duties.

Non-Compliance with Employer-Mandated Sleep Apnea Treatment and Increased Risk of Serious Truck Crashes



Burks SV, Anderson JE, Bombyk M, Haider R, Ganzhorn D, Jiao X, Lewis C, Lexvold A, Liu H, Ning J, Toll A, Hickman JS, Mabry E, Berger M, Malhotra A, Czeisler CA, Kales SN: ***Sleep In press, 2016.***

Benefits of Fatigue Management

- Improve health and safety of pilots
- Fewer environmental catastrophes
- Increase productivity
- Reduce absenteeism
- Reduce motor vehicle crashes
- Improved on-the-job performance
- Reduce liability for sleep-related incidents

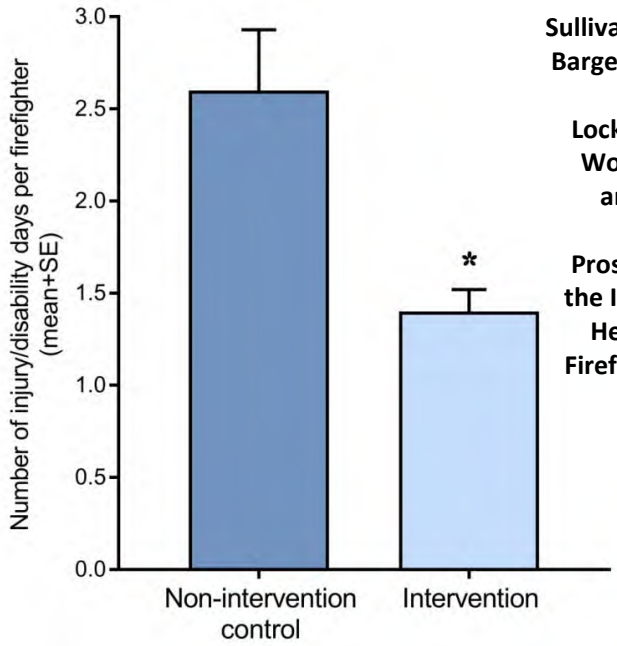
Sleep Disorders, Health, and Safety in Police Officers: Harvard Work Hours, Health and Safety Group

	All partici-pants	Subgroups			Participant with current sleep disorder diagnosis
		Online	State Police	Municipal Police	
Obstructive sleep apnea, *%*	33.6 %	36.0 %	20.3 %	32.2 %	15.1 %
Insomnia (moderate to severe) , *%*	6.5 %	7.0 %	3.8 %	-	21.7 %
Shift work disorder, *%*	14.5 %	15.3 %	7.0 %	-	7.6 %
Restless legs syndrome, *%*	1.6 %	1.7 %	1.0 %	-	34.3 %
Narcolepsy with cataplexy, *%*	0.4 %	0.4 %	0	-	0

Rajaratnam SMW, Barger LK, Lockley SW, Shea SA, Wang W, Landrigan CP, O'Brien C, Qadri S, Sullivan JP, Cade BE, Epstein LJ, White DP, Czeisler CA. JAMA 2011 306: 2567-78

Improved Health and Safety following Sleep Health Education and Screening

- 24% Fewer Injuries among fire-fighters during year-long follow up
- 46% reduction in disability day usage ($2.2M annual savings)
- 5-fold higher rate of serious preventable crashes among truck drivers diagnosed with OSA who were not compliant with treatment
- ~$3,000 per year savings in health care costs for each truck driver compliant with OSA treatment



Sullivan JP, O'Brien CS, Barger LK, Rajaratnam SM, Czeisler CA, Lockley SW; Harvard Work Hours, Health and Safety Group. Randomized, Prospective Study of the Impact of a Sleep Health Program on Firefighter Injury and Disability. Sleep. 2017;40:1-10.

Burks SV … Czeisler CA, Kales SN. Nonadherence with Employer-Mandated Sleep Apnea Treatment and Increased Risk of Serious Truck Crashes. Sleep. 2016 May 1;39(5):967-75