



**National
Transportation
Safety Board**

Fatigue, Shift Work, and Sleep Disorders: Key Lessons from Transportation Accidents

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Board Member**

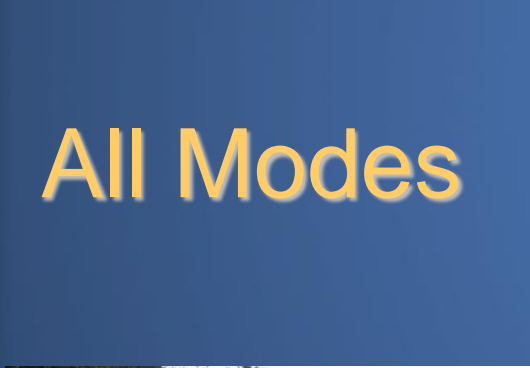
**Harvard Sleep and Shift Work Symposium
September 27, 2012**



NATIONAL TRANSPORTATION SAFETY BOARD

- 1) determining the probable cause of transportation accidents**
- 2) making recommendations to prevent their recurrence**





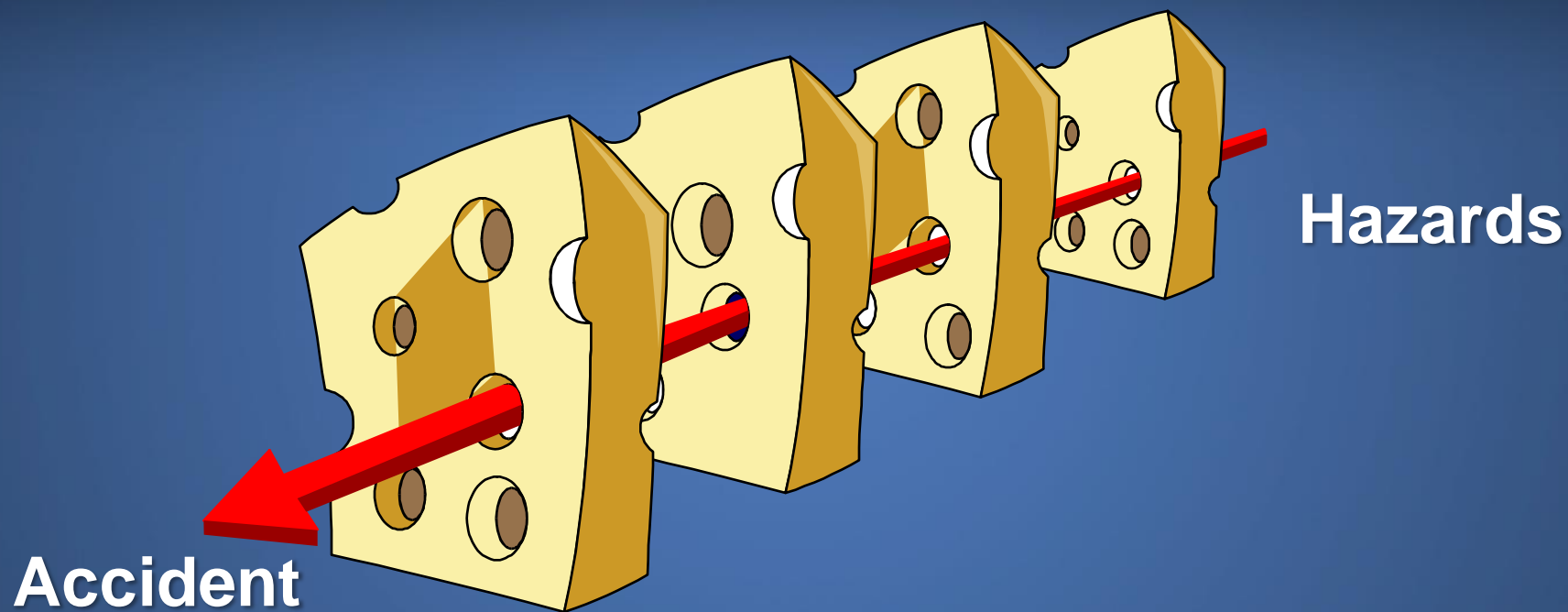
All Modes

Independent Federal Agency: Created in 1967

- ~ 132,000 accident investigations
- 13,500+ safety recommendations
- ~ 2,500 organizations/recipients
- 82% acceptance rate



“Swiss Cheese” Model (Reason)



Successive layers of defenses, barriers, and safeguards



NTSB

NTSB Characterized as:

‘moral compass and industry conscience’

NTSB Chairman Deborah A.P. Hersman



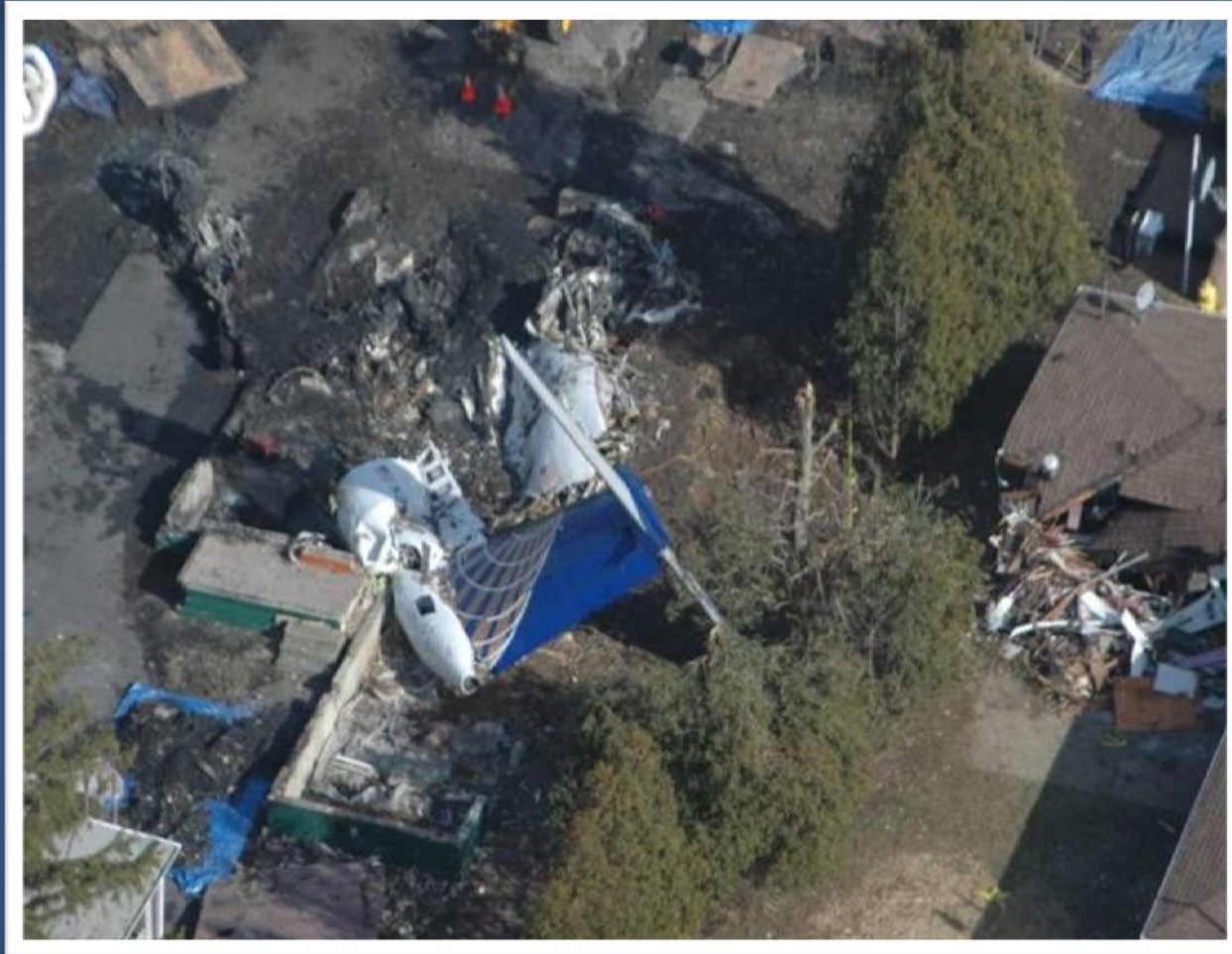
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#1: Fatigue is a safety risk.



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Continental Connection (Colgan Air) Buffalo, NY (February 12, 2009)



- 50 fatalities; commuting, acute sleep loss



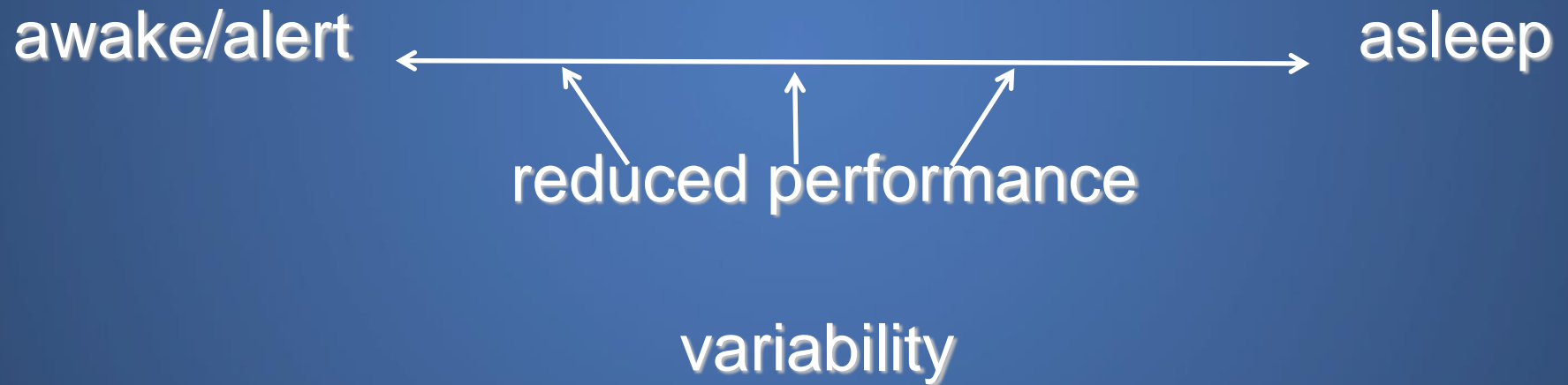
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Fatigue Risks

Fatigue can degrade
every aspect of
human capability.



Fatigue Risks

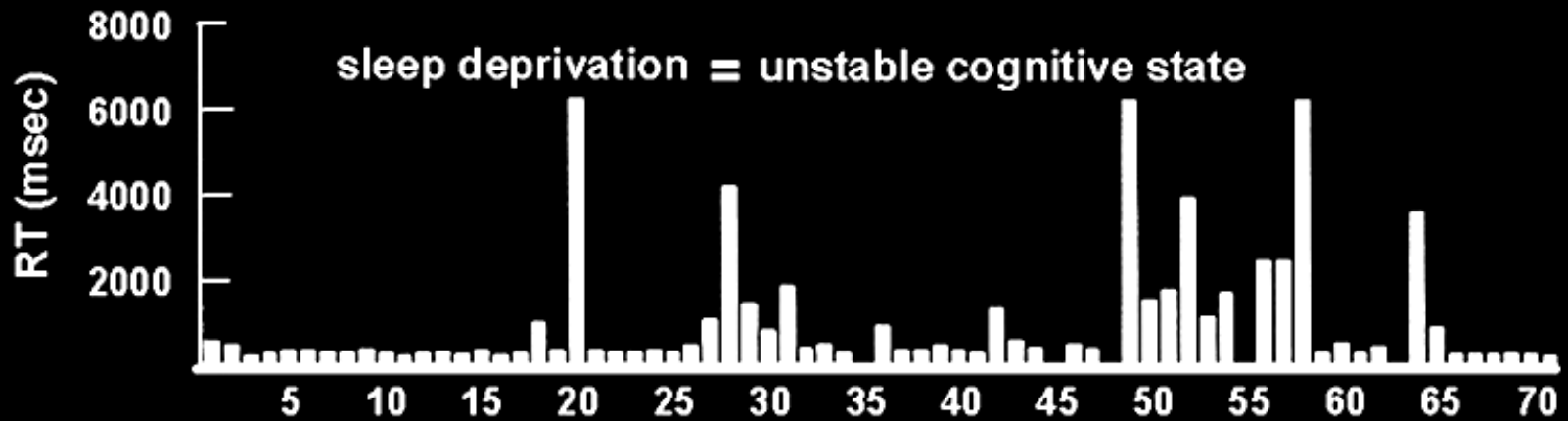
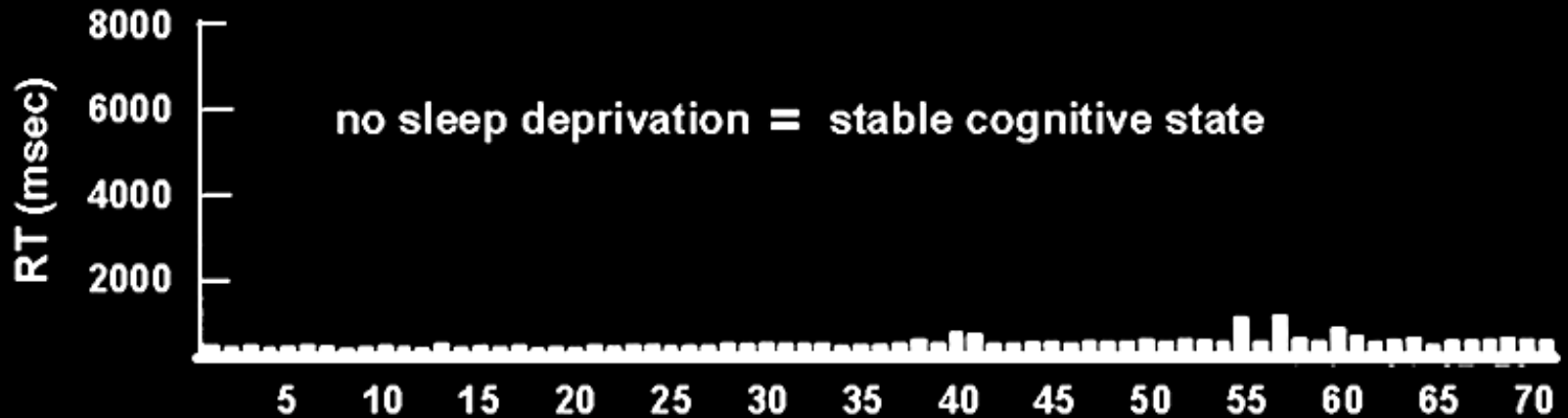


Fatigue Risks

- degraded 20 – 50%+:
 - reaction time
 - memory
 - communication
 - situational awareness
 - judgment
 - attention
 - mood
- increased:
 - irritability
 - apathy
 - attentional lapses
 - microsleeps



Fatigue and Reaction Times



consecutive RTs across a 10-min PVT performance task

Uncontrolled In-Flight Collision with Terrain AIA Flight 808, Douglas DC-8-61, N814CK U.S. NAS, Guantanamo Bay, Cuba, August 18, 1993

First NTSB aviation accident investigation
to cite fatigue as probable cause



- acute sleep loss, sleep debt, circadian disruption



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Observed Performance Effects

- Degraded decision-making
- Visual/cognitive fixation
- Poor communication/coordination
- Slowed reaction time





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Uncontrolled In-Flight Collision with Terrain
AIA Flight 808, Douglas DC-8-61, N814CK
U.S. NAS, Guantanamo Bay, Cuba, August 18, 1993

“The National Transportation Safety Board determines that the probable causes of this accident were the impaired judgment, decision making, and flying abilities of the captain and flight crew due to the effects of fatigue...”



Owatonna, MN (July 31, 2008)



8 fatalities



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Probable Cause/Contributing Factors

“Contributing to the accident were . . .
(2) fatigue, which likely impaired both
pilots’ performance; . . .”

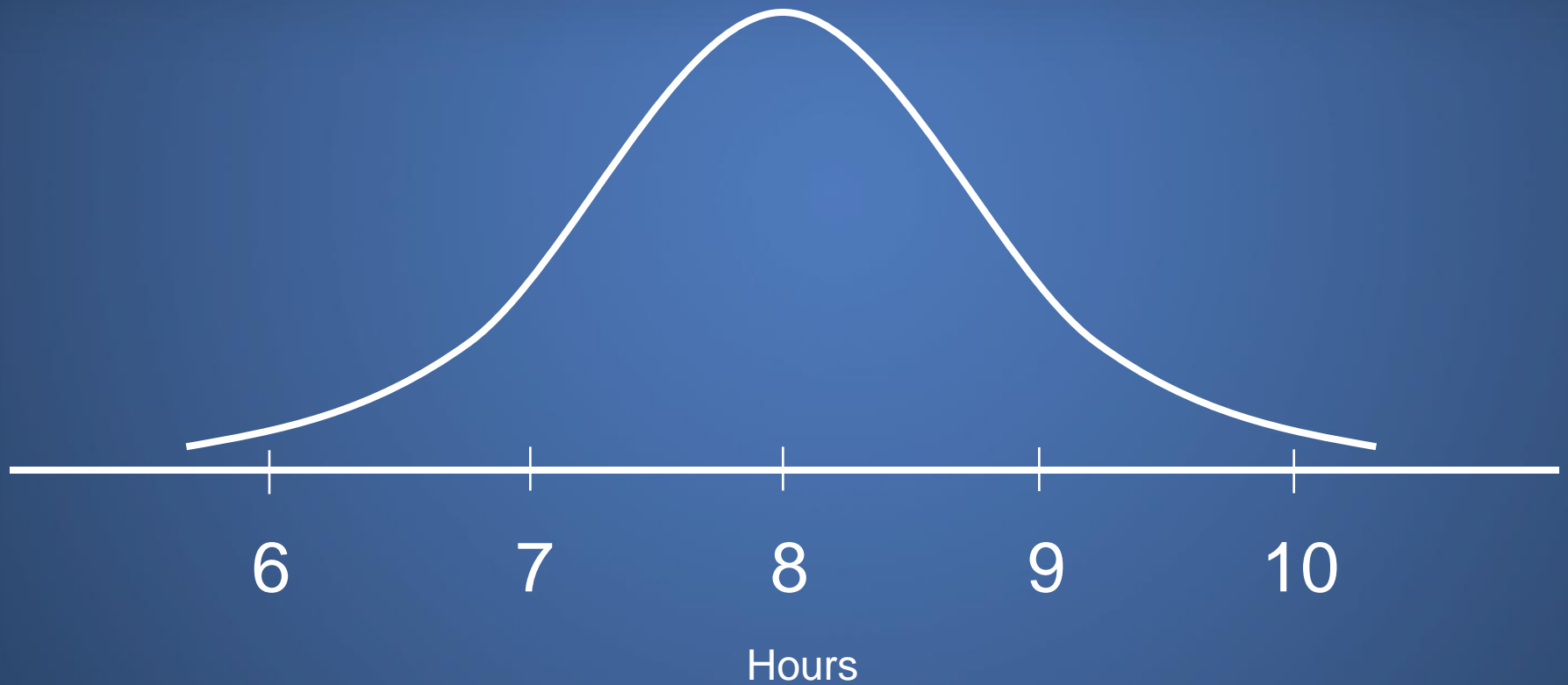


**#2: Shift work disrupts
sleep and circadian rhythms.**

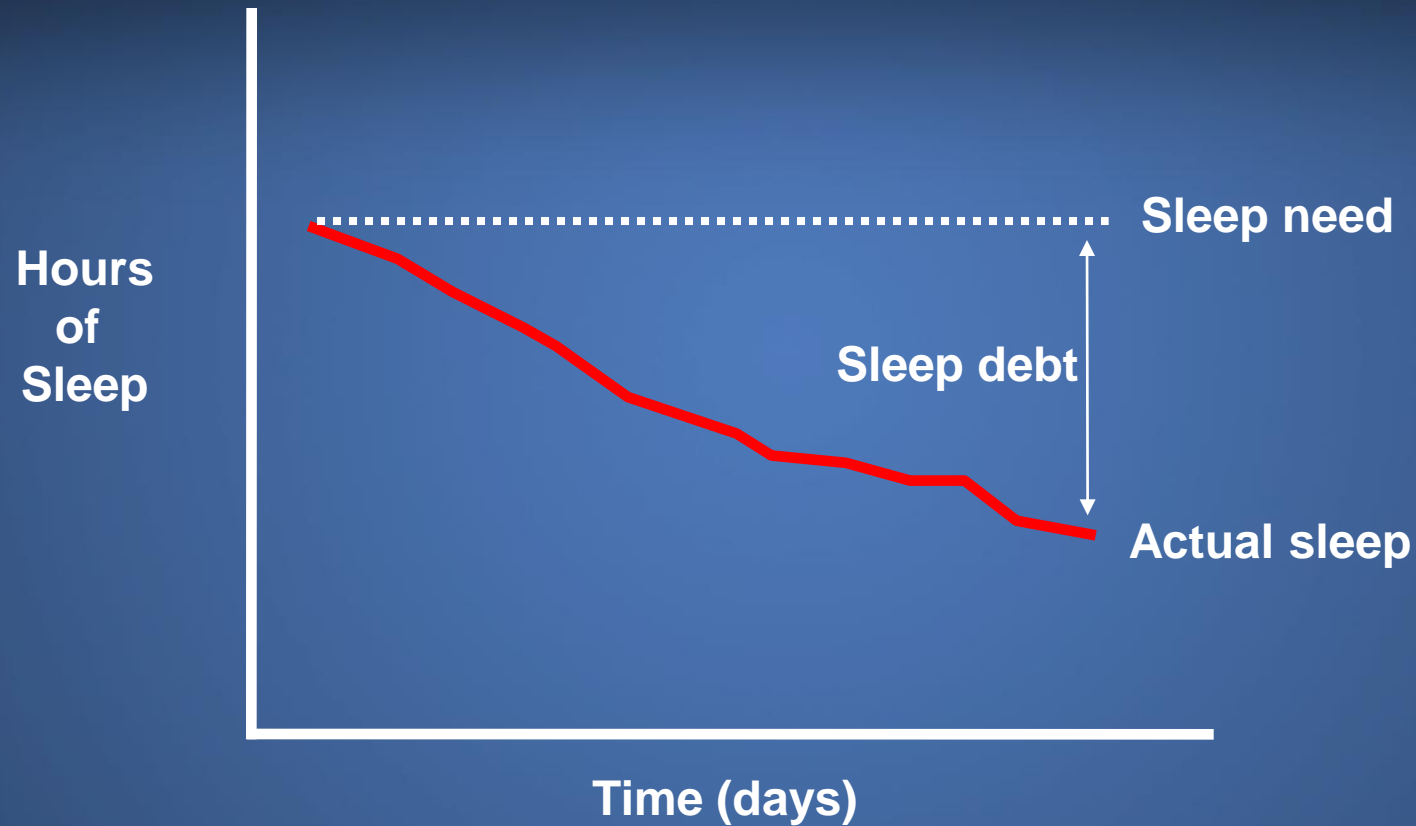


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Sleep Requirement



Cumulative Sleep Debt

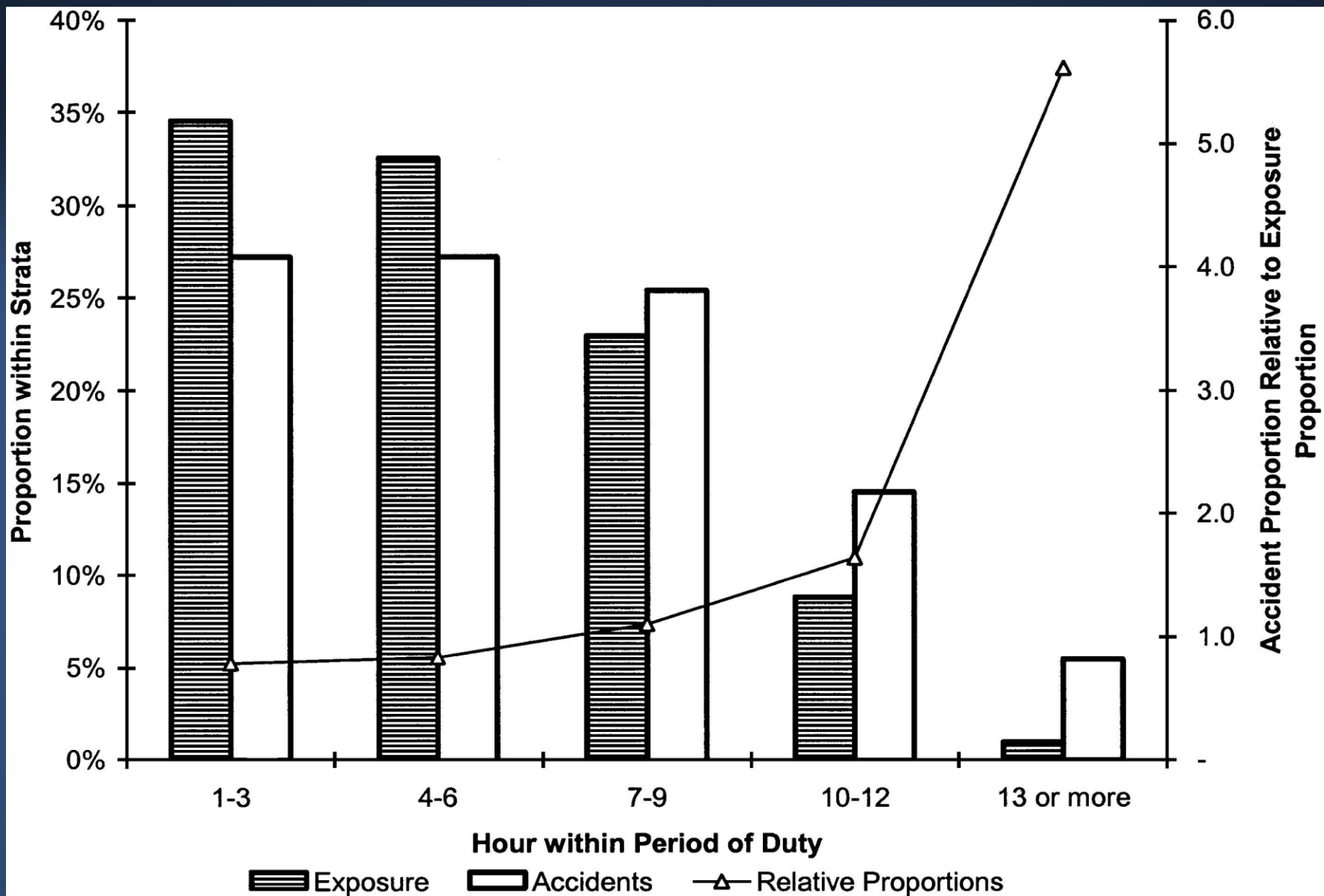


Sleep Need – Actual Sleep = Sleep Debt

Sleep debt grows cumulatively over time



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Lubbock, TX (January 27, 2009)



2 injuries



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Probable Cause/Contributing Factors

“Contributing to the accident were . . .

4) fatigue due to the time of day in which the accident occurred and a cumulative sleep debt, which likely impaired the captain’s performance.”





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Animation of Accident Reconstruction

**Motorcoach Run Off Road-Collision with
Bridge Signpost**

Interstate Highway 95 Southbound
New York, New York
March 12, 2011

HWY11MH005

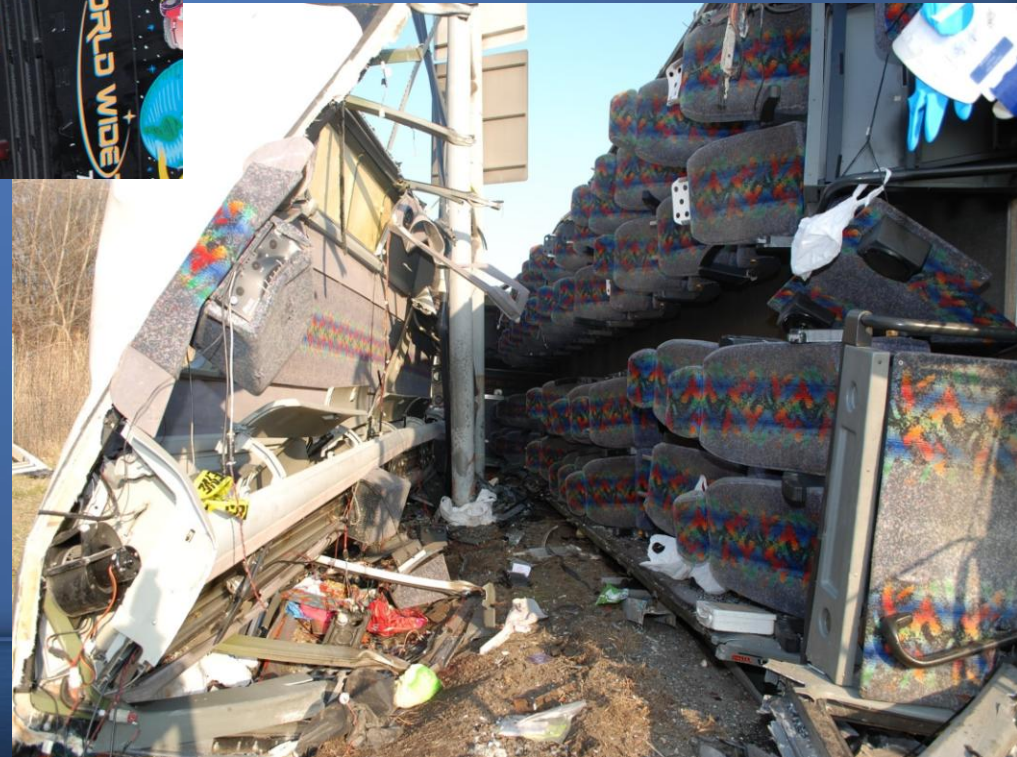


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'Bronx Bus', New York, NY (March 12, 2011)



15 fatalities
17 injuries



Probable Cause

“The National Transportation Safety Board determines that the probable cause of the accident was the motorcoach driver's failure to control the motorcoach due to fatigue resulting from failure to obtain adequate sleep, poor sleep quality, and the time of day at which the accident occurred.”



**#3: Sleep disorders
cause/contribute to accidents.**



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Sleep Apnea is a Safety Risk

- > 6 times increased risk for car crash
- SA performance = .06 - .08 BAC



Fatigue Factors

- sleep
- circadian clock
- hours awake
- sleep disorders





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Track Path Animation

Collision Between Two BNSF Railway Freight Trains

Red Oak, Iowa

April 17, 2011

DCA11FR002



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Probable Cause (fatigue)

“ . . . failure of the crew of the striking train to comply with the signal indication requiring them to operate in accordance with restricted speed requirements and stop short of the standing train because they had fallen asleep due to fatigue resulting from their irregular work schedules and their medical conditions.”



Miami, OK (June 26, 2009)

10 fatalities
3 serious injuries
2 minor injuries
5 no injuries

Ford
Windstar



Hyundai
Sonata

Kia
Spectra

Probable Cause (fatigue)

“ . . . driver’s fatigue, caused by the combined effects of acute sleep loss, circadian disruption associated with his shift work schedule, and mild sleep apnea, which resulted in the driver’s failure to react to slowing and stopped traffic ahead by applying the brakes or performing any evasive maneuver to avoid colliding with the traffic queue. . . . ”



NTSB Safety Recommendations: Fatigue

- 40 years ago: May 10, 1972
- “Revise FAR 135 to provide adequate flight and duty time limitations.” (A-72-55)
- Classified “Closed-Unacceptable”





Home > Transportation Safety > Most Wanted List

SHARE   

MOST WANTED LIST

A program to increase the public's awareness of, and support for, action to adopt safety steps that can help prevent accidents and save lives. The following are ten of the current issues.



Addressing Human Fatigue



General Aviation Safety



Safety Management Systems



Runway Safety



Bus Occupant Safety



Pilot & Air Traffic Controller Professionalism



Recorders



Teen Driver Safety



Addressing Alcohol-Impaired Driving



Motorcycle Safety



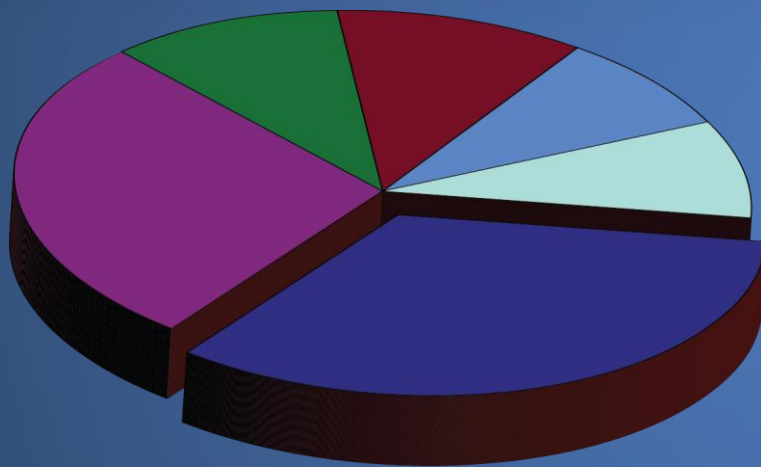
NTSB Recommendations

- MOST WANTED since 1990
- ~200 fatigue recommendations



Complex Issue:

Requires Multiple Solutions



- Scheduling Policies and Practices
- Education/Awareness
- Organizational Strategies
- Healthy Sleep
- Vehicle and Environmental Strategies
- Research and Evaluation

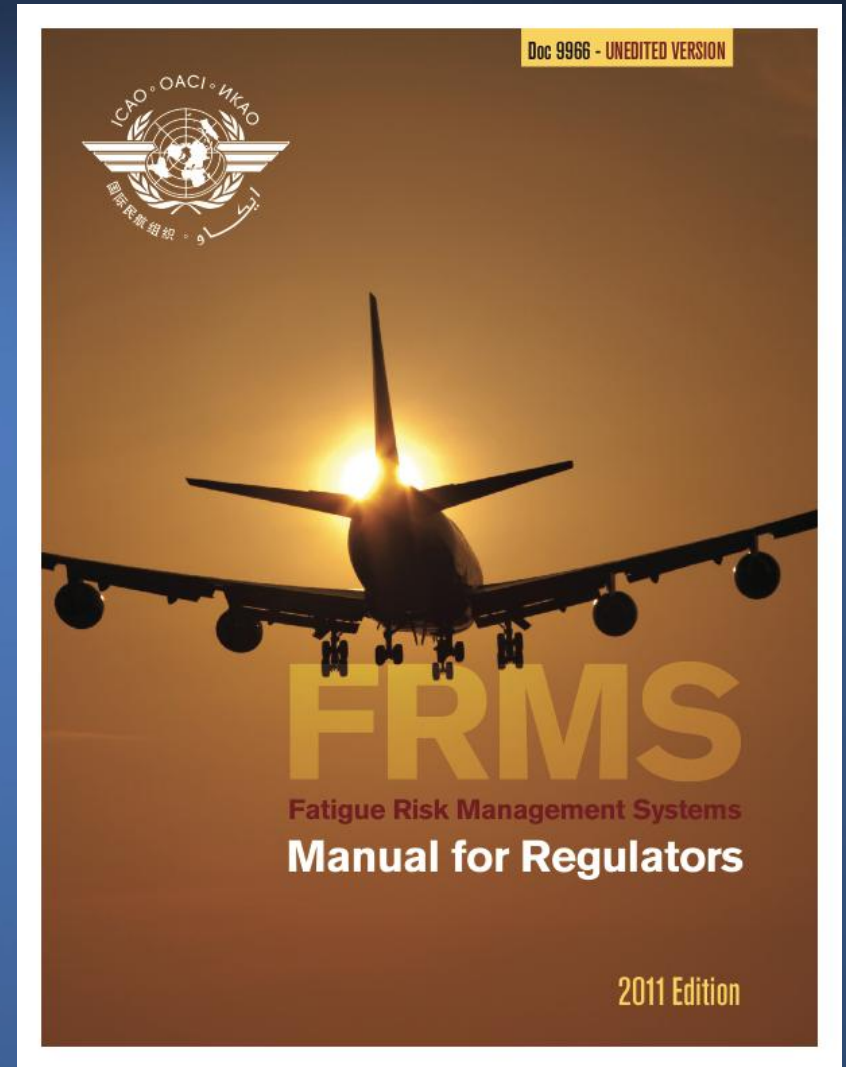
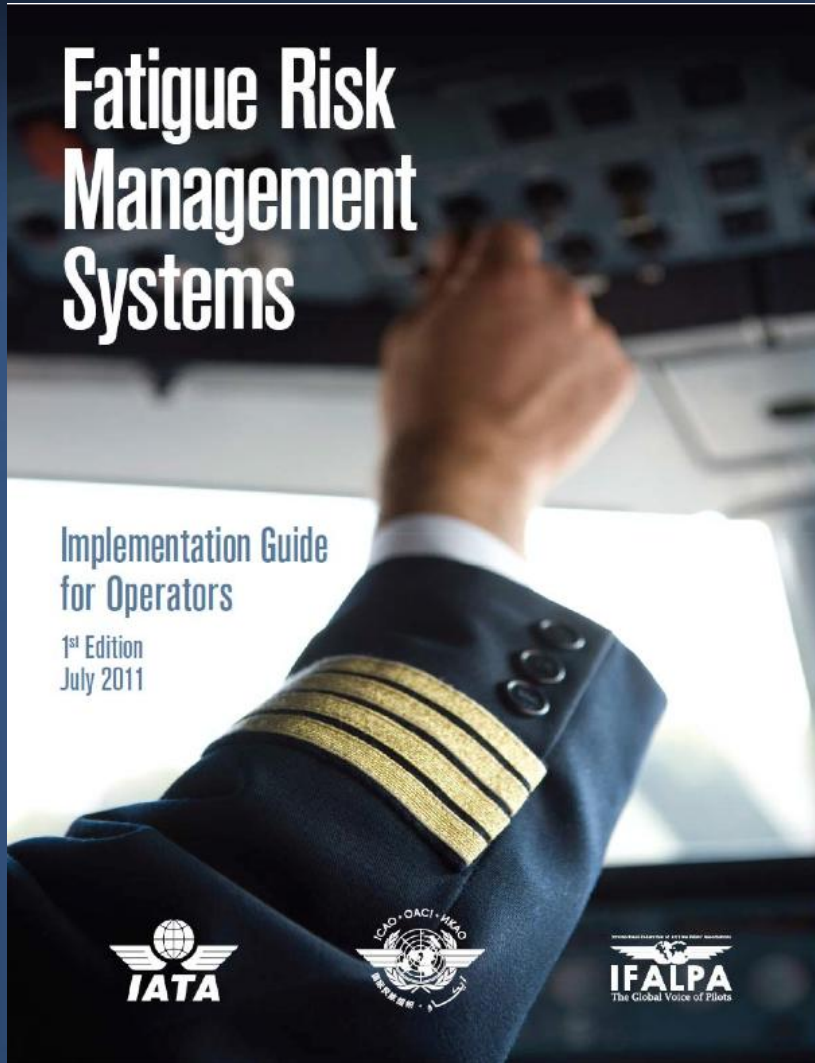


NTSB Recommendations: Fatigue Management Systems

- Develop guidance based on empirical and scientific evidence for operators to establish fatigue management systems
- Develop and use a methodology that will continually assess the effectiveness of fatigue management systems



Fatigue Risk Management Systems



NTSB Recommendations: Education/Strategies

- Develop a fatigue education and countermeasures training program
- Educate operators and schedulers
- Include information on use of strategies: naps, caffeine, etc.
- Review and update materials



NTSB Recommendations: Education/Strategies

- Include information on use of strategies: naps, caffeine, etc.
- No recommendations on specific personal strategies



Example: NASA Planned Rest Study



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Challenges of a 24/7 Society



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Manage Fatigue = Enhance Safety

- Culture change
- Get educated
- Acknowledge
- Act!





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