



**National
Transportation
Safety Board**

Managing Fatigue in 24/7 Operations: Lessons from Transportation

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NATIONAL TRANSPORTATION SAFETY BOARD

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



NTSB



All Modes

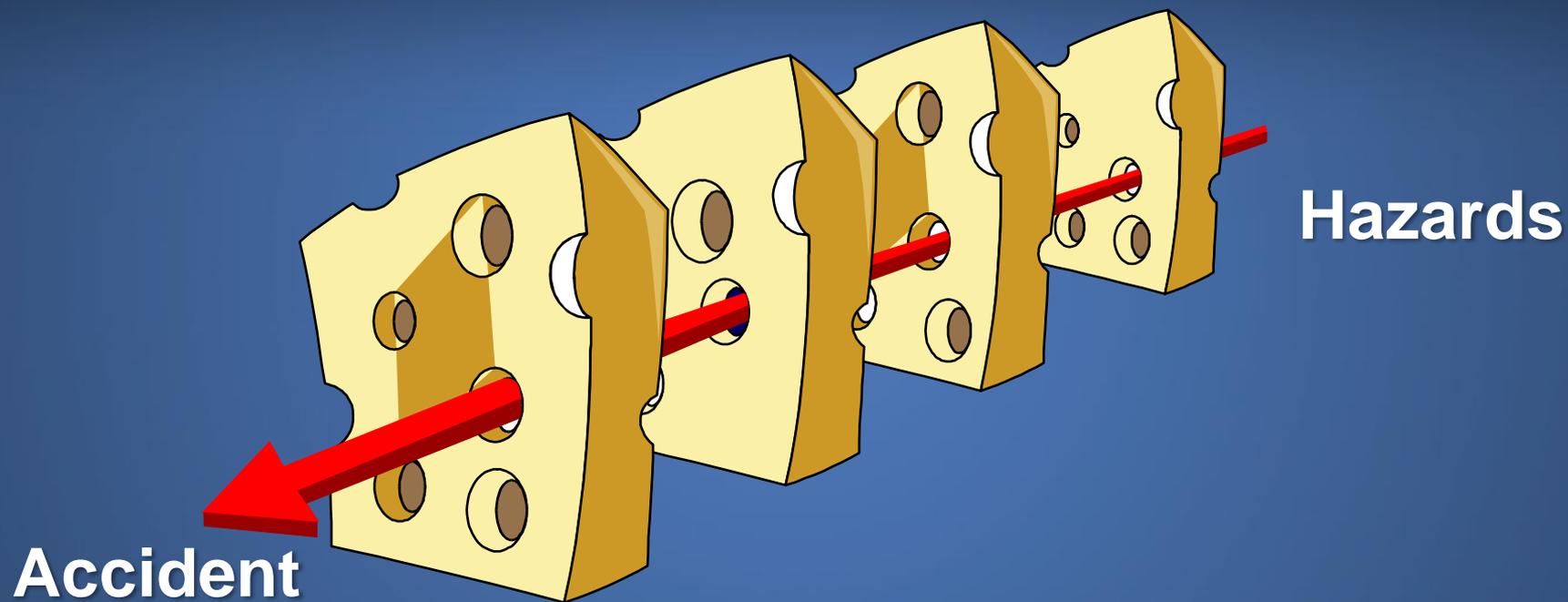


Independent Federal Agency: Created in 1967

- ~ 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



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NTSB Go Team: 24/7/365

- Individual investigator
- Regional/limited team
- Major launch/Board Member



Key On-scene Events



Organizational Meeting

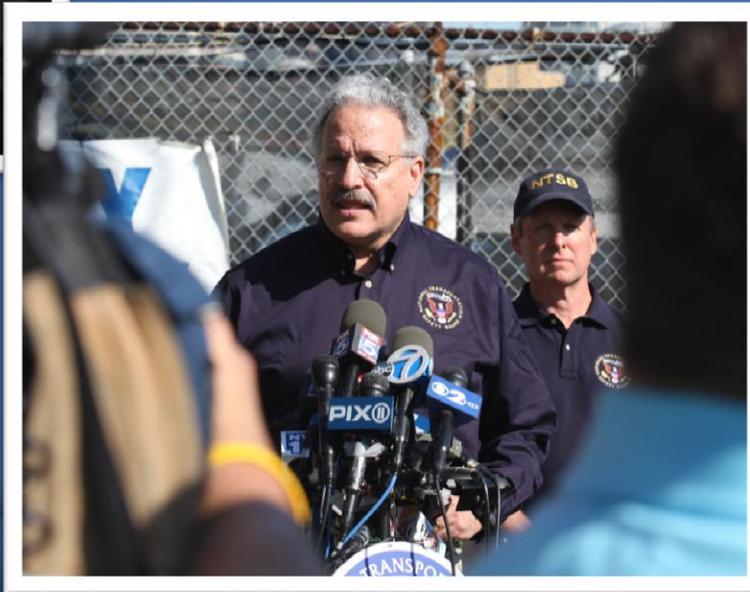
- Designate parties and party coordinators
- Establish and organize groups

Progress Meetings

- Summarize findings
- Info for briefings

Family Briefings

Press Briefings



NTSB Investigative Process



On-scene Investigation

- Organizational Meeting
- Groups and Parties
- Progress meetings
- Media Briefings
- Press Releases



Preliminary Report

Factual information



Public Hearing

- Fact finding
- Depositions
- Witnesses
- Docket



Board Meeting

- Docket
- Findings
- Conclusions
- Probable Cause
- Safety Recommendations



Final Report

Government in the Sunshine Act

NTSB Characterized as:

‘moral compass and industry conscience’

NTSB Chairman Deborah A.P. Hersman



NTSB

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; . . .”



Miami, Oklahoma (June 26, 2009)

Fatigue Factors

- Off work for 3 weeks: day active/night sleep schedule
- 3am to 3pm shift work/drive schedule (since 1997)
- Early bedtime (2 hr phase advance in sleep time)
- Obtained min 3 hrs/max 5 hrs sleep prior to accident
- Subsequently diagnosed with mild sleep apnea



10 fatalities
3 serious injuries
2 minor injuries
5 no injuries

Ford
Windstar



Hyundai
Sonata

Kia
Spectra

Source: Oklahoma State Police

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. . . . ”





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Track Path Animation

Collision Between Two BNSF Railway Freight Trains

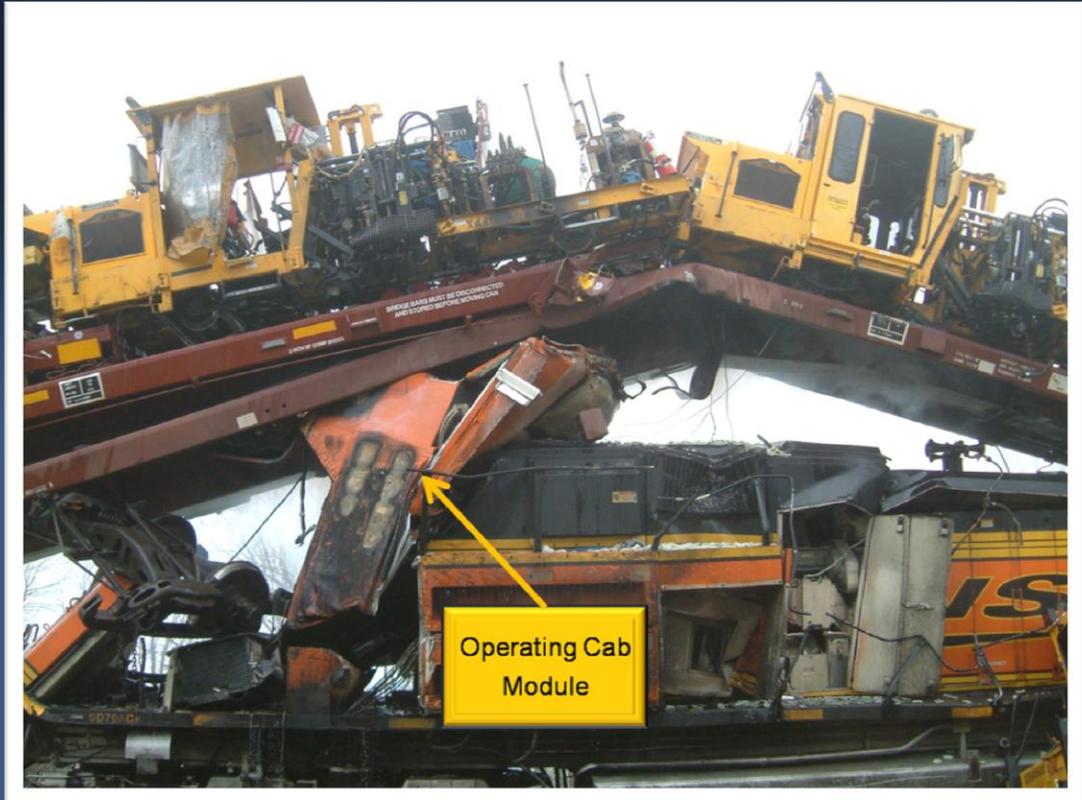
Red Oak, Iowa

April 17, 2011

DCA11FR002



NTSB



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.”





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Animation of Accident Reconstruction

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

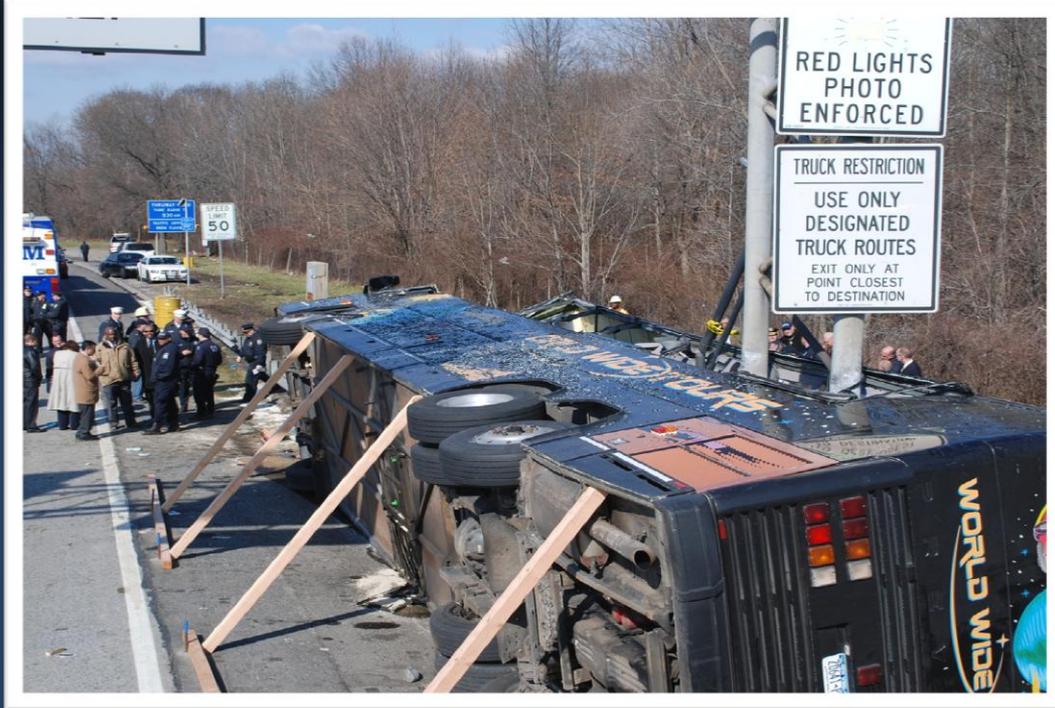
Interstate Highway 95 Southbound
New York, New York
March 12, 2011

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.”



Honorable John K. Lauber:

No Accident \neq
Safe Operation



NTSB



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



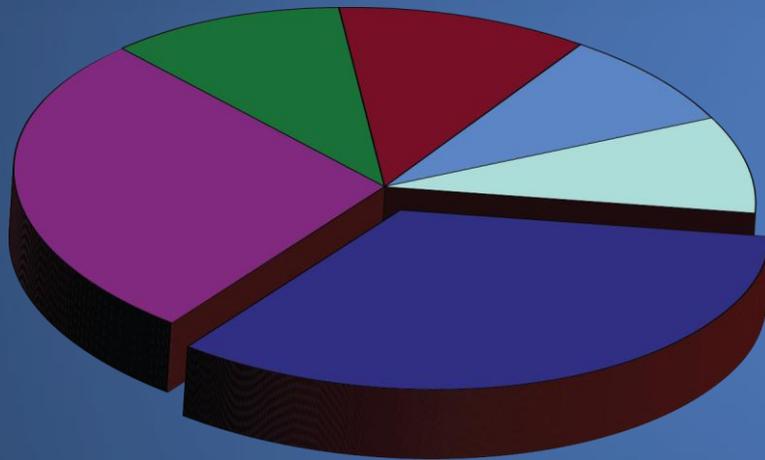
NTSB Recommendations

- MOST WANTED 1990 -2012
- ~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 Fatigue 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



Challenges of a 24/7 Society



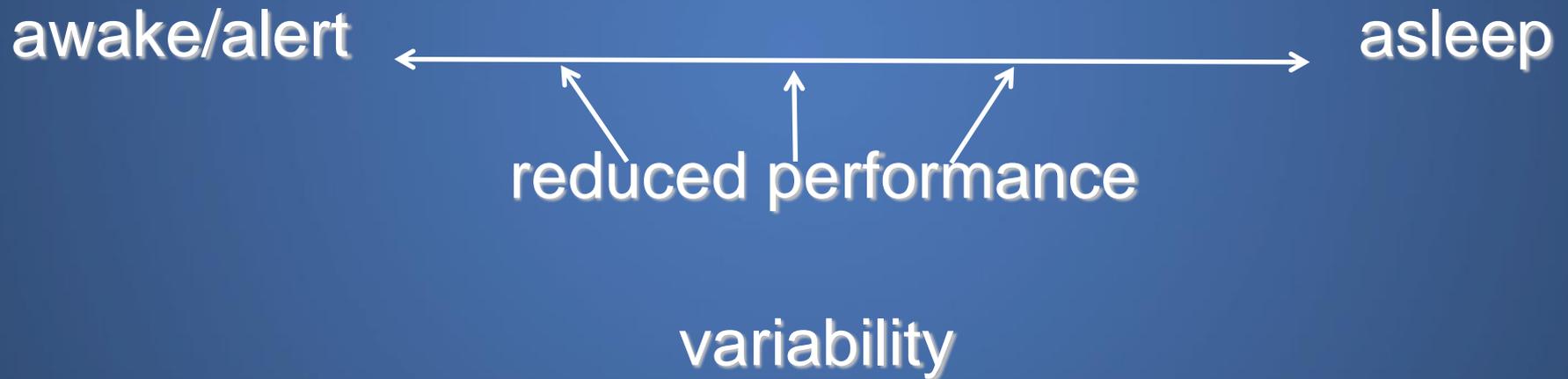
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Fatigue Risks

Fatigue can degrade
every aspect of
human capability.



Fatigue Risks

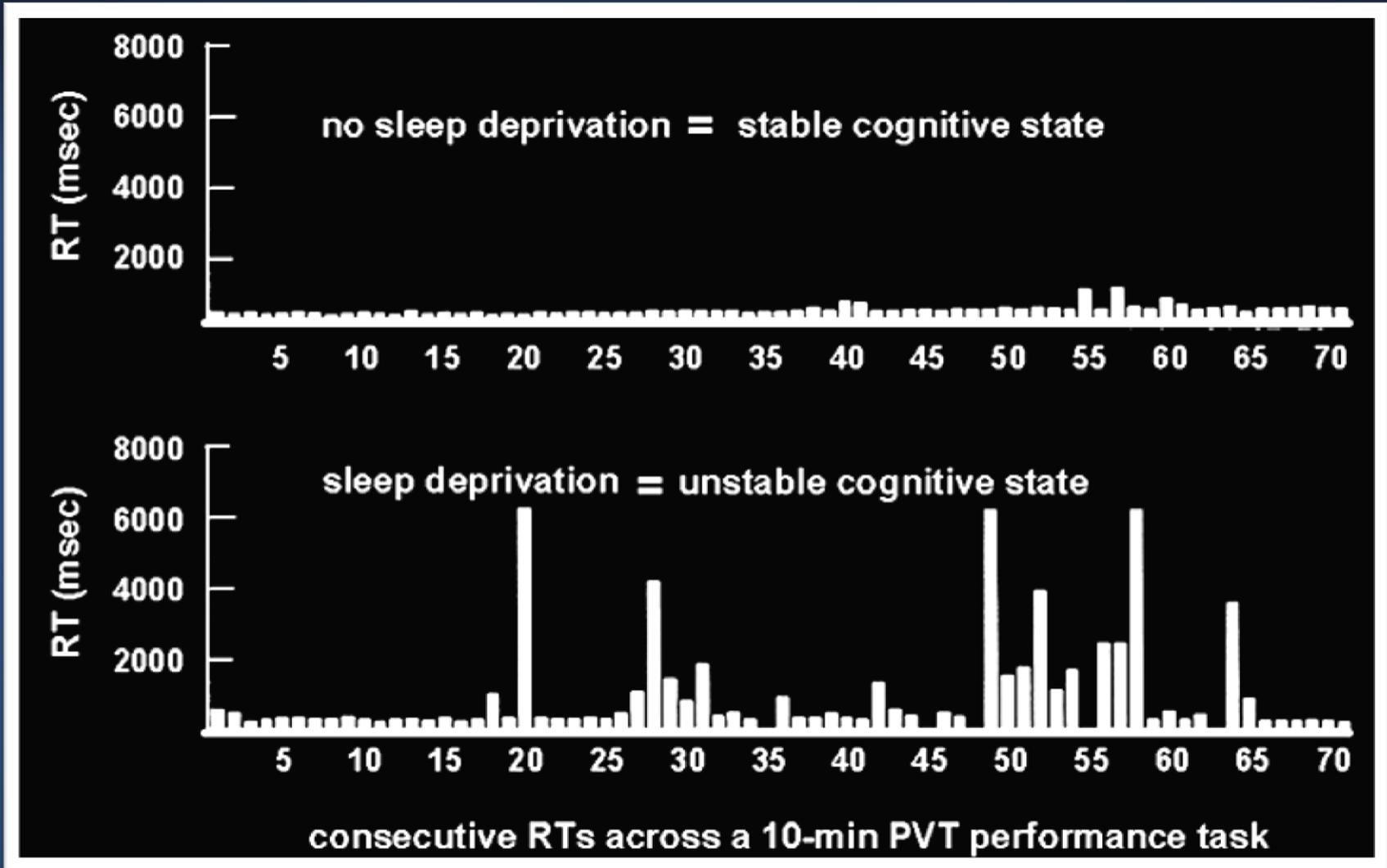


Fatigue Risks

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



Fatigue and Reaction Times

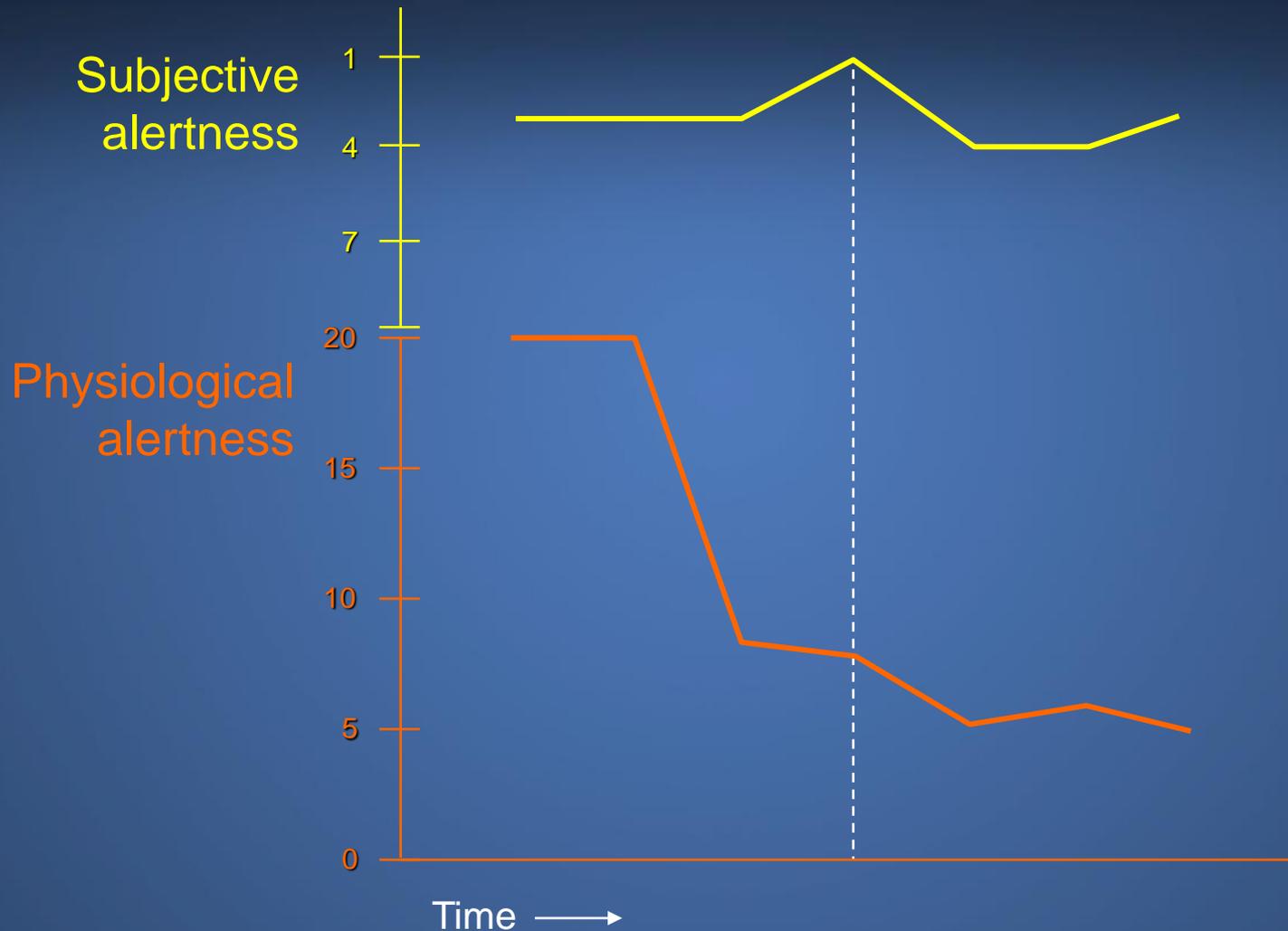


Doran SM, Van Dongen HP, Dinges DF. Sustained attention performance during sleep deprivation: evidence of state instability. *Archives of Italian Biology: Neuroscience* 2001;139:253-267.



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Alertness Reports Often Inaccurate



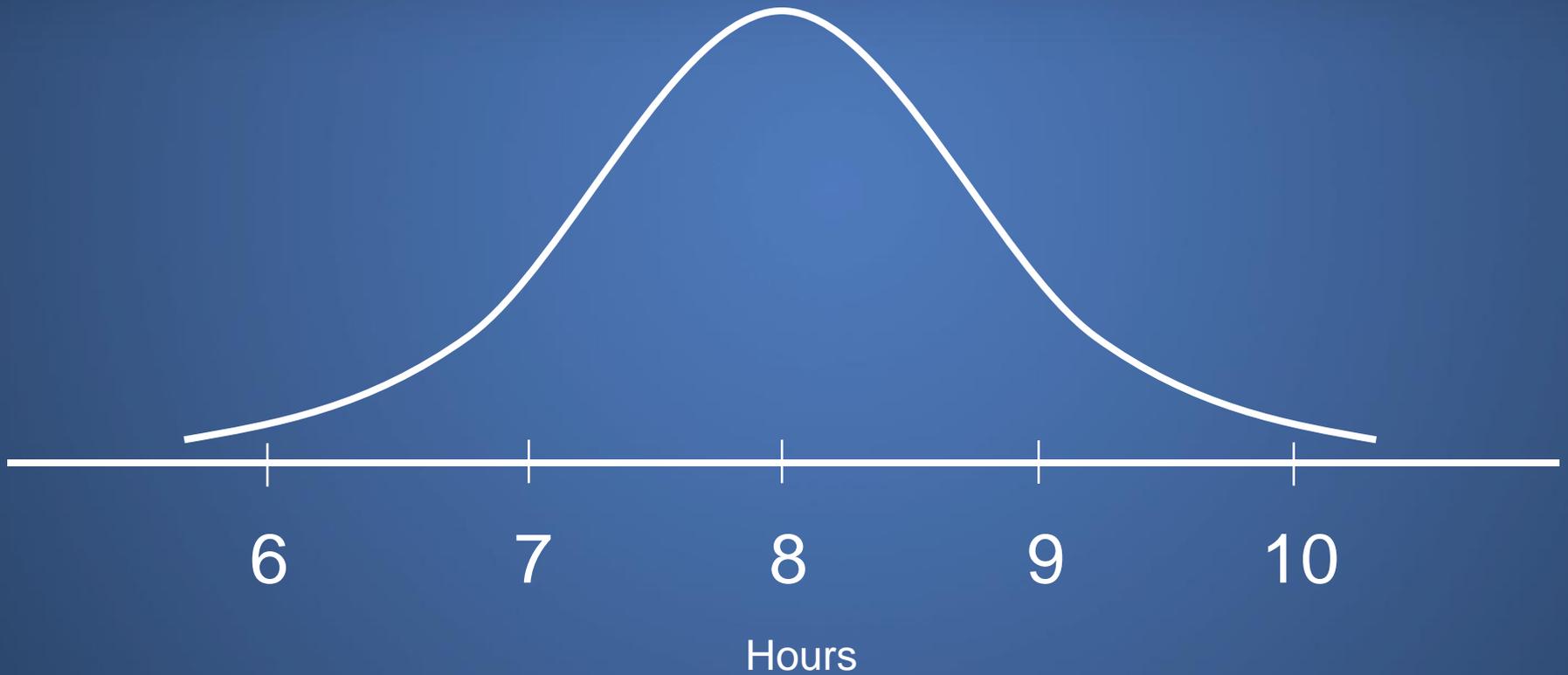
Adapted from Sasaki et al., 1986

Fatigue Factors

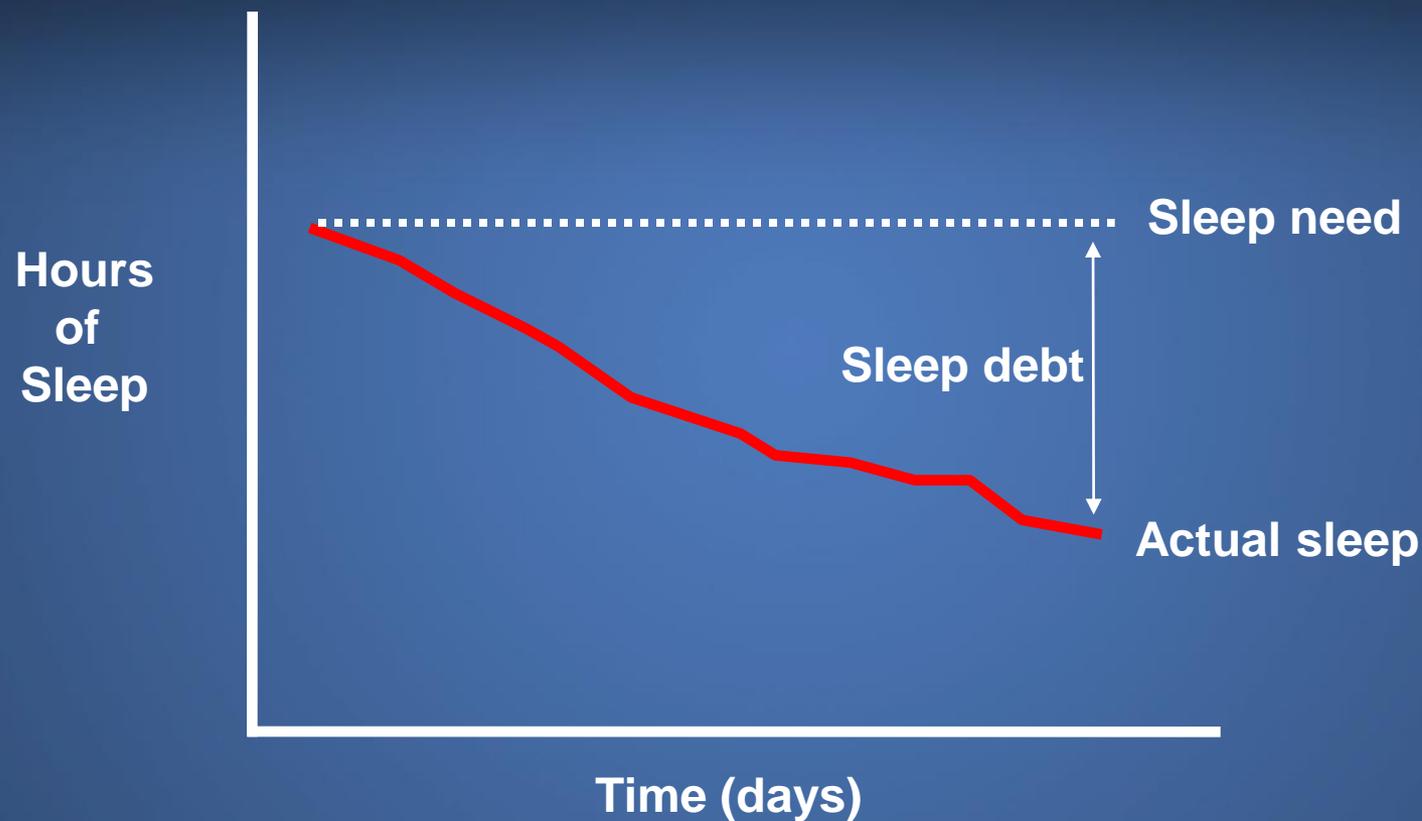
- sleep
 - acute sleep loss
 - cumulative sleep debt
- circadian clock
- hours awake
- sleep disorders



Sleep Requirement



Cumulative Sleep Debt



Sleep Need – Actual Sleep = Sleep Debt

Sleep debt grows cumulatively over time



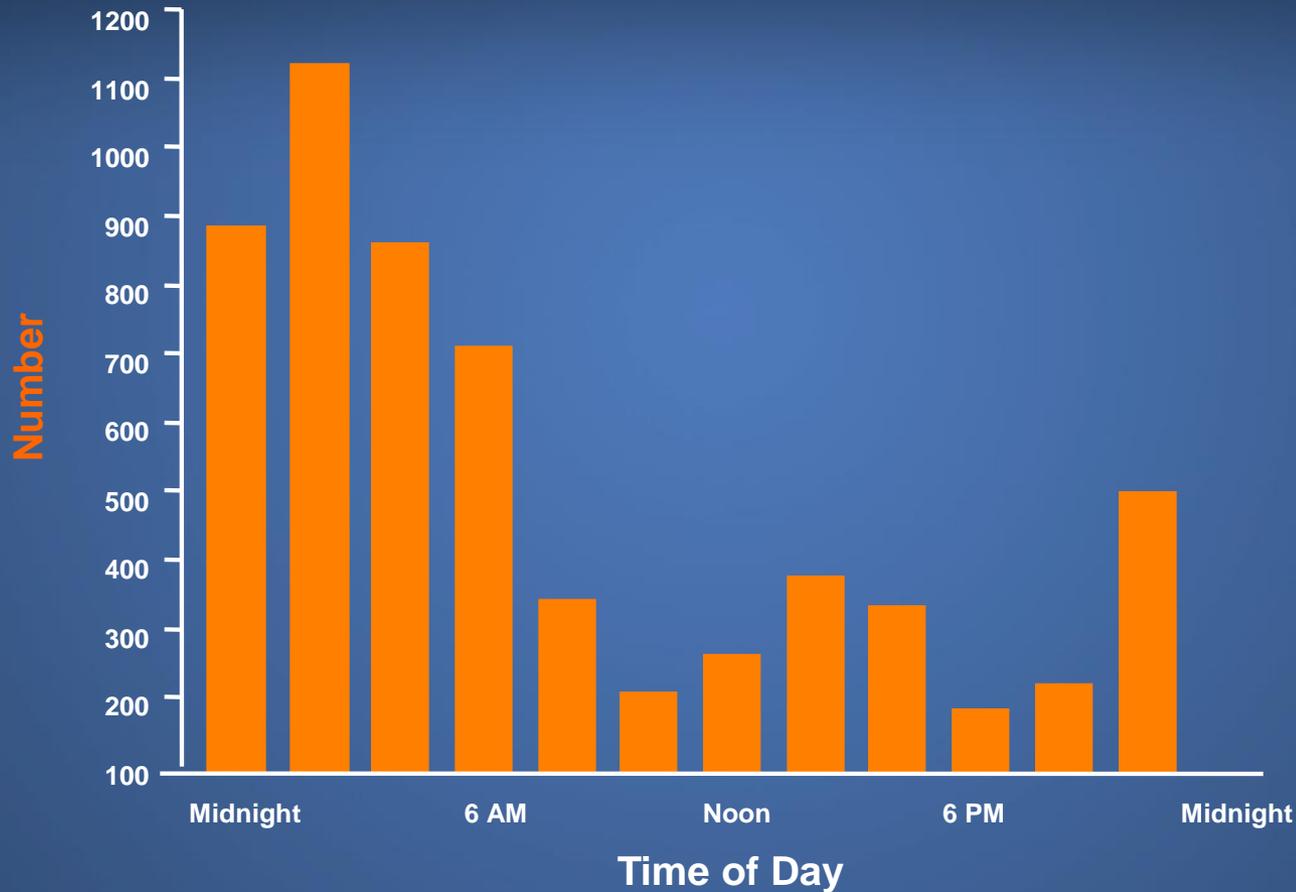
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Fatigue Factors

- sleep
- circadian clock
 - 'sleepy' windows
 - 'alert' windows
 - irregular schedule
 - time zones
- hours awake
- sleep disorders



Fatigue-Related Car Crashes



Fatigue Factors

- sleep
- circadian clock
- hours awake
- sleep disorders
 - ~ 90 sleep disorders
 - sleep apnea



Manage Fatigue = Enhance Safety

- Promote culture change
- Educate everyone
- Strong policies
- Acknowledge risks
- Take action!





National Transportation Safety Board