



The problem of fatigue: what are the most effective countermeasures?

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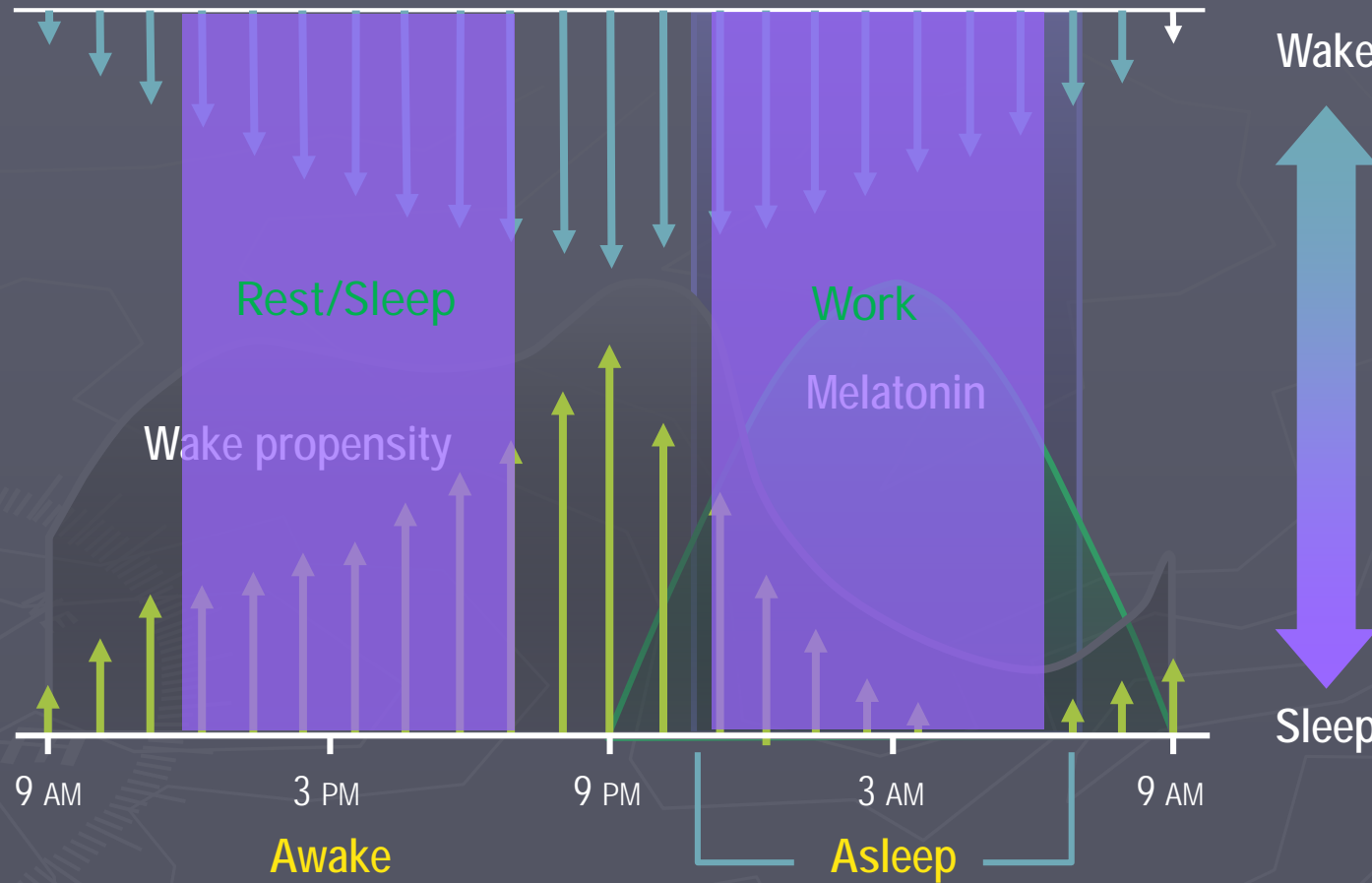
Center for Circadian and Sleep Medicine
Center for Sleep and Circadian Biology
Transportation Center

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Shiftwork and Fatigue Management

Homeostatic
sleep drive

Circadian
alerting signal



- Shiftwork is associated with reductions in sleep duration and working at a time when the circadian alerting signal is low
- Duty hours rules are used as a means of allowing adequate time for rest and limiting time on task

24 Hour Split Sleep-Wake / Work-Rest Schedules

- Many marine schedules have 2 work and 2 rest intervals / 24 hours
- 12 hour shifts are also common

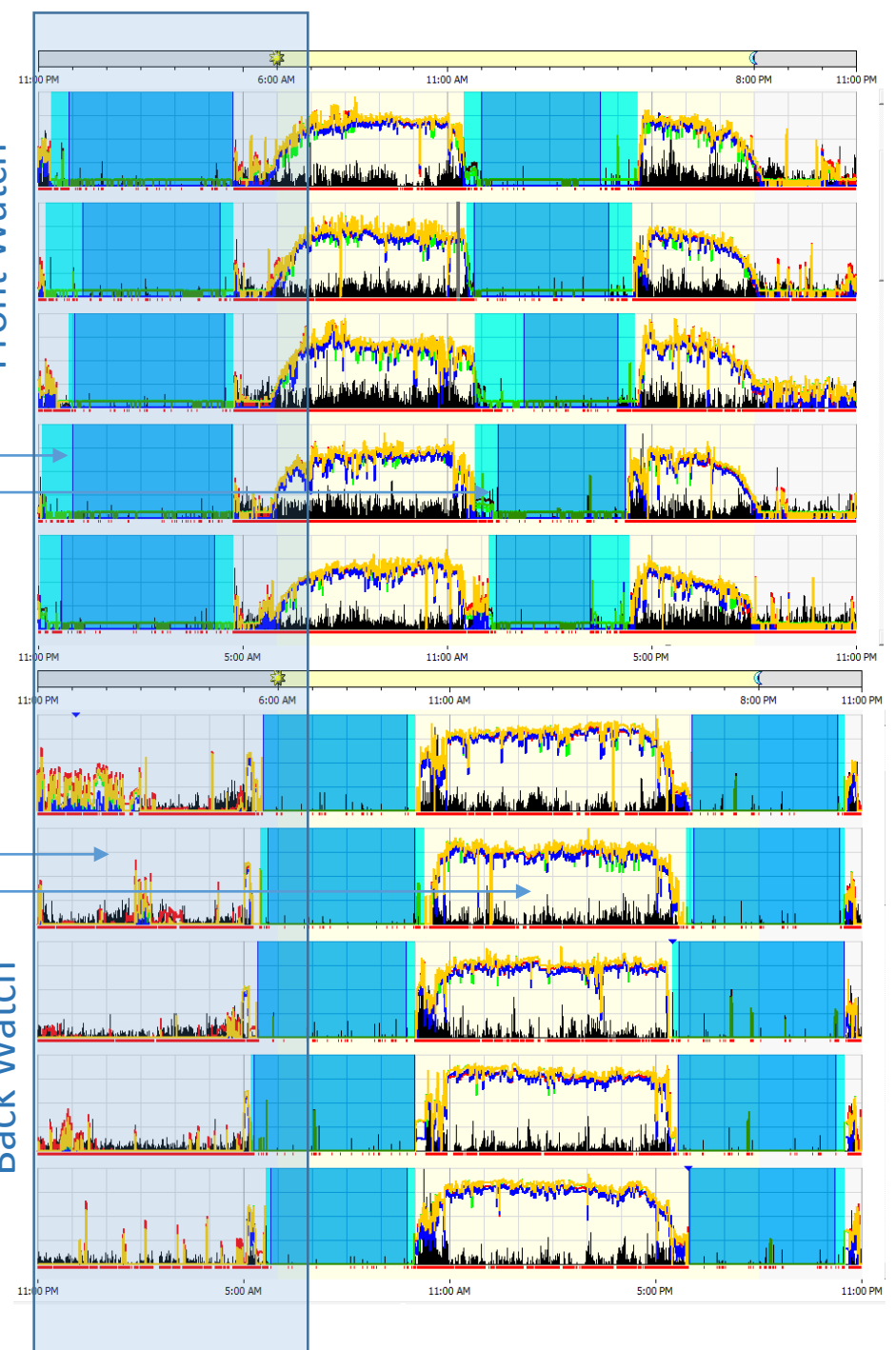
Black = activity
Yellow, blue, Green = Light
Aqua = rest interval

Front Watch

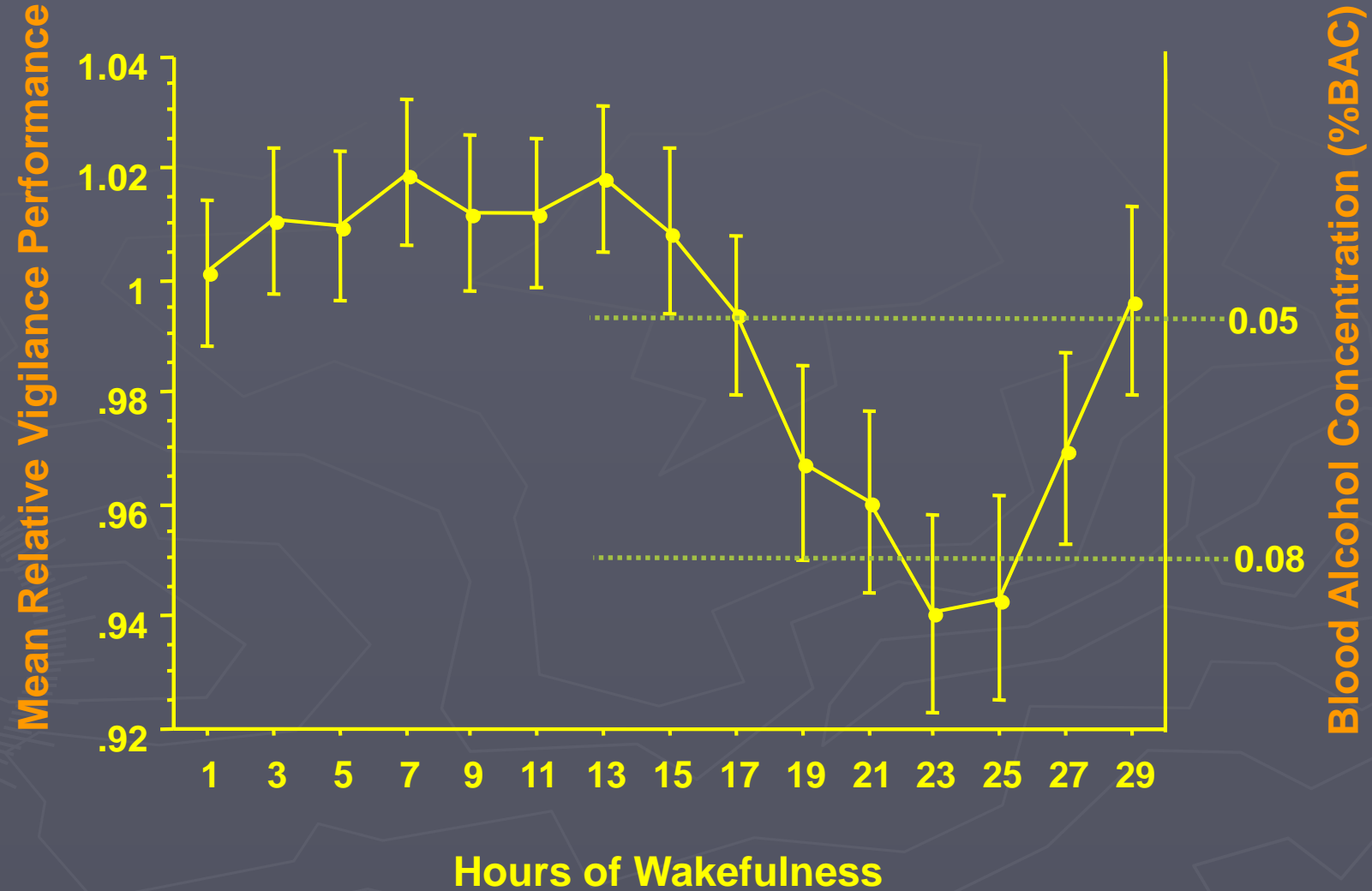
Rest interval

Work Intervals

Back Watch



Expressing The Performance Impairment Due to Fatigue as a Blood Alcohol Equivalent



Adapted from Dawson & Reid, 1997, Nature Vol 388: 235

NCFRP

REPORT 36

Enhancing Sleep Efficiency on Vessels in the Tug/Towboat/ Barge Industry

 TRANSPORTATION RESEARCH BOARD


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NATIONAL
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Investigators: Kathryn Reid Ph.D., Fred Turek Ph.D., Greg Belenky M.D., Phyllis Zee M.D., Ph.D.

The objective of this research was to develop a compendium of best practices for enhancing sleep efficiency on towboats in the U.S. Tug/Towboat/Barge industry.



Countermeasure:
An action taken to counteract a
danger or threat

Fatigue Countermeasures

- ▶ Countermeasures are a coordinated group of formal and sometimes informal policies, procedures and behaviors used by organizations and employees to reduce the risks associated with work schedule related fatigue.
- ▶ They can be implemented before, during or after a shift to mitigate rather than eliminate the risk of fatigue.

Best countermeasure for sleep
loss related fatigue.....?

SLEEP

Recommendations for Best Practices Related to Optimizing Sleep.....



Recommended Best Practices

Safety Management System (SMS)



**Fatigue Risk
Management
System
(FRMS)**



**Other
components
of SMS
Not
Applicable
to this report**

- Education
- Stress Management
- Commuting
- Fitness for Duty
- Wellness Program
- Reg. Medical Examiners
- Sleep Disorder Screen
- Monitoring of Practices
- Nutrition
- Exercise/Physical Activity
- Fatigue Modeling
- Sleep Environment
- Sleep Strategies
- Duty Hours
- Reporting Missed Sleep

Avoiding Fatigue – Countermeasures

Shared Responsibility

- ▶ Managing duty hours
- ▶ Education programs – sustained and with knowledge acquisition standards
- ▶ Health/wellbeing screening [including sleep disorders]
- ▶ Strategic napping
- ▶ Fitness for duty

Managing Fatigue - Countermeasures

- ▶ Strategic napping
- ▶ Strategic use of caffeine to increase alertness
- ▶ Appropriately timed bright light exposure to reduce short-term circadian misalignment
- ▶ Increased supervision or peer monitoring of task performance to prevent errors / team work
- ▶ Provision of transport home after a shift to reduce the likelihood of a journey - related accident

Working with crew to develop FRMS?
Why it is important.....?



Countermeasures

Crew reported useful or that they wanted to learn more about

▶ Personal countermeasures

- ▶ Caffeine consumption: how much and when, avoid caffeine close to bedtime
- ▶ Meals: nutrition, when to eat and drink
- ▶ Exercise: when and how
- ▶ Managing stress: techniques for reducing stress, relaxation

▶ Environment

- ▶ Light management: avoid light during sleep (blackout shades), avoid light at shift change over in morning
- ▶ Noise: policies to reduce noise
- ▶ Sleeping environment: mattress, pillows

▶ Other factors

- ▶ Education - learning how sleep or lack thereof effects work, learning about circadian rhythms
- ▶ Organizational - travel time reduced at crew change, watch change protocols

Beyond the Reports Recommendations.....

- Reaching a consensus on effective and realistic countermeasures
- Monitoring the effectiveness of recommended strategies
 - A challenge for trucking for 20 years has been proving that screening and treatment for Obstructive Sleep Apnea makes a difference to safety
 - Noise reduction strategies – crew still report significant sleep disturbance from noise
- Developing new countermeasures and/or optimizing current countermeasures by combining them
- Testing the validity of new technologies to monitor or predict fatigue in maritime operations
 - Fatigue Modeling
 - Fatigue Tracking
 - Often relies on self-assessment of fatigue – what is fitness for duty?
 - Sleepiness Detection
 - Vigilance testing, EEG, eye movements, head movements
 - Consumer fitness trackers i.e. Fitbit, Jawbone, iwatch etc
 - Sleep, activity level, caloric intake

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Thank you