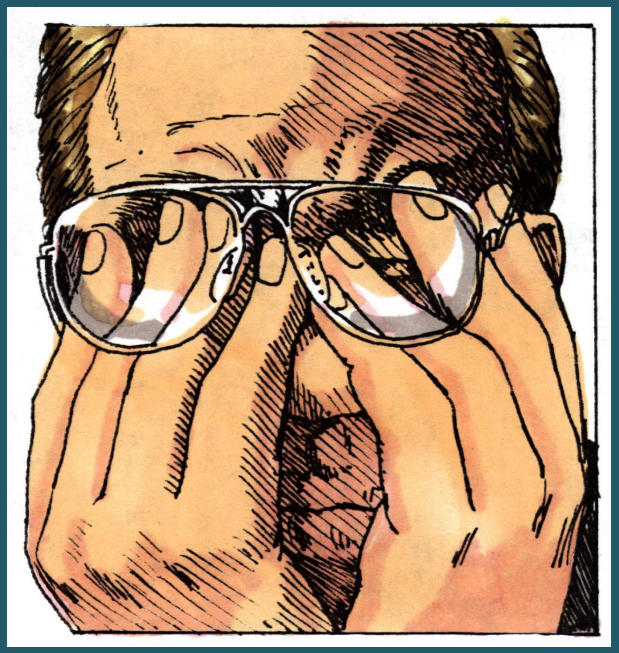
Shattering Myths: The New Face of Fatigue Management



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Facts about the US Mining Sector

- Workforce tends to be significantly older compared to other industries
- Workers in extractive industries tend to work longer hours (avg of 10 hours more per week)
- Many mines are in remote locations and require long commutes and extended work hours

Contributing Factors to Fatigue

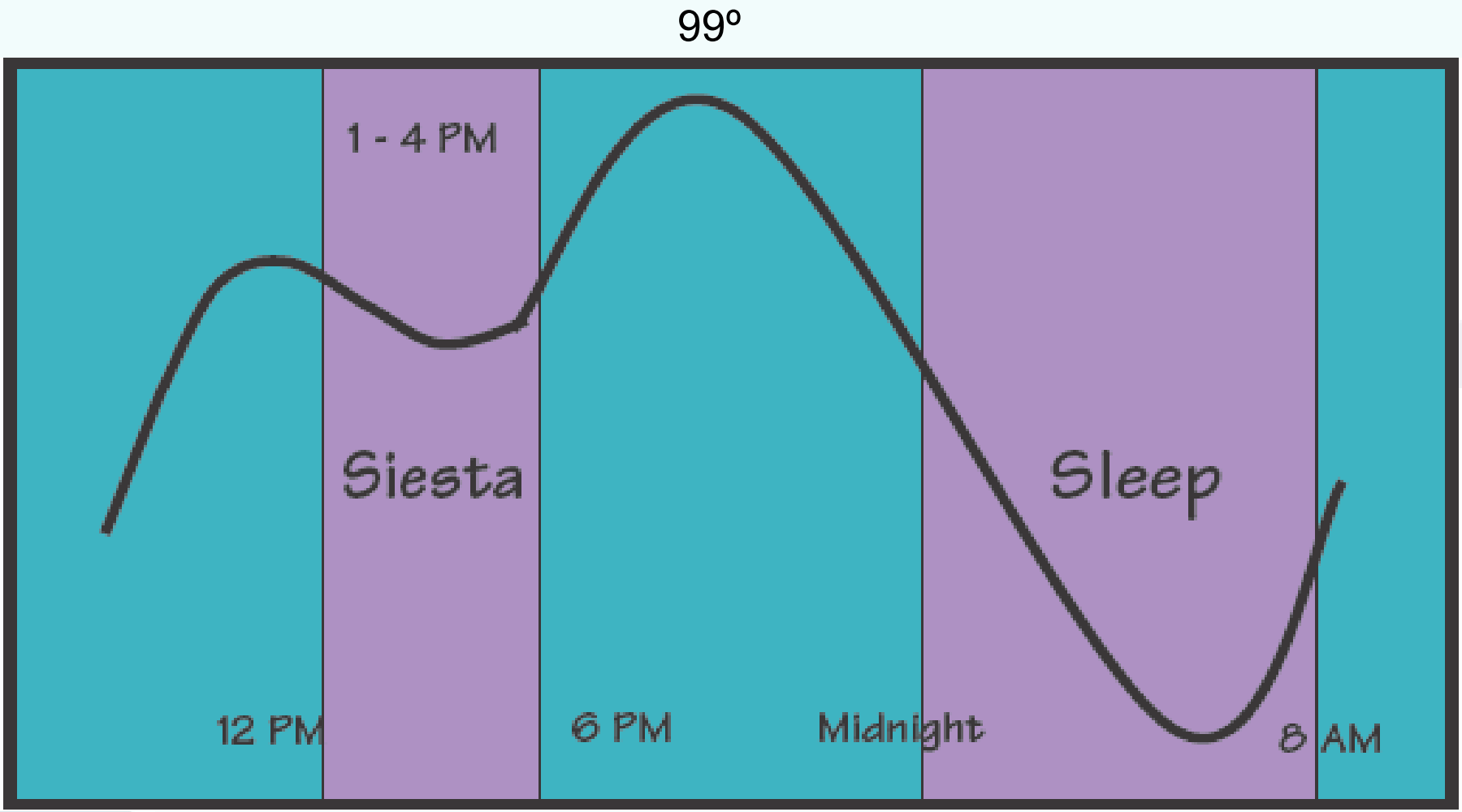
- Circadian Rhythms
- Shift Design
- Quality and Quantity of Sleep

Circadian Rhythms

...our built-in body clocks

- Tell us when to be active, when to rest and when to eat
- Controls body temperature, kidney function, hormone secretion, blood pressure , digestion, etc.

Body Temperature Curve



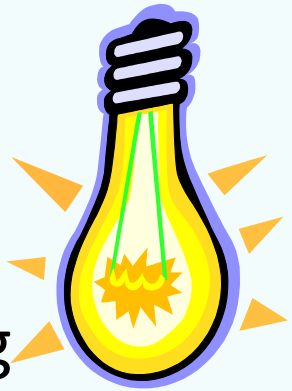
Adjusting the Body Clock

- Body requires 1 day to adapt for every hour of shift change (12 hour shift change = 12 days adjustment)
- The question then becomes…
  - do we want to adjust (entrainment)?

Shift Work Design

- There is NO perfect shift schedule
- Shorter shift rotations
  - Preferred from a physiological standpoint
  - 2-4 nights max will minimize shifting of rhythms
- Long shift rotations
  - Only works if the worker adopts a night time lifestyle
  - Shut down operations can be dangerous

The Effect of Light



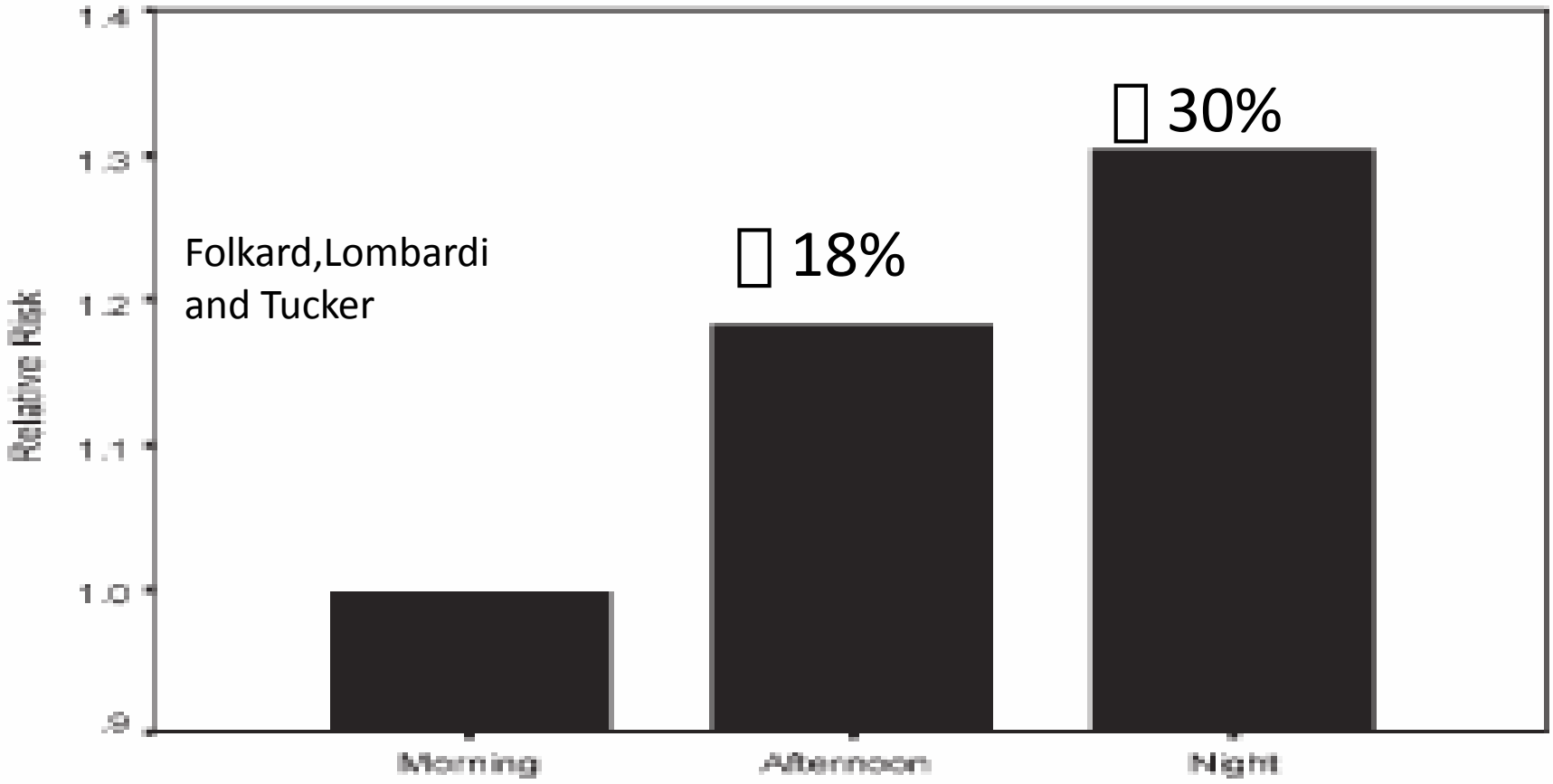
- Light is the primary synchronizing agent for circadian rhythms
- Light at inappropriate times can depress the production of melatonin
- Natural sleep hormone synthesized and secreted at night
- Powerful anti-oxidant
- Age reduces melatonin production

Organizational Light Recommendations

- Replace fluorescent with full spectrum bulbs in designated areas
- Turn on exposure to these lights between 5-6AM and 7-8PM
- Minimize light exposure after 8PM

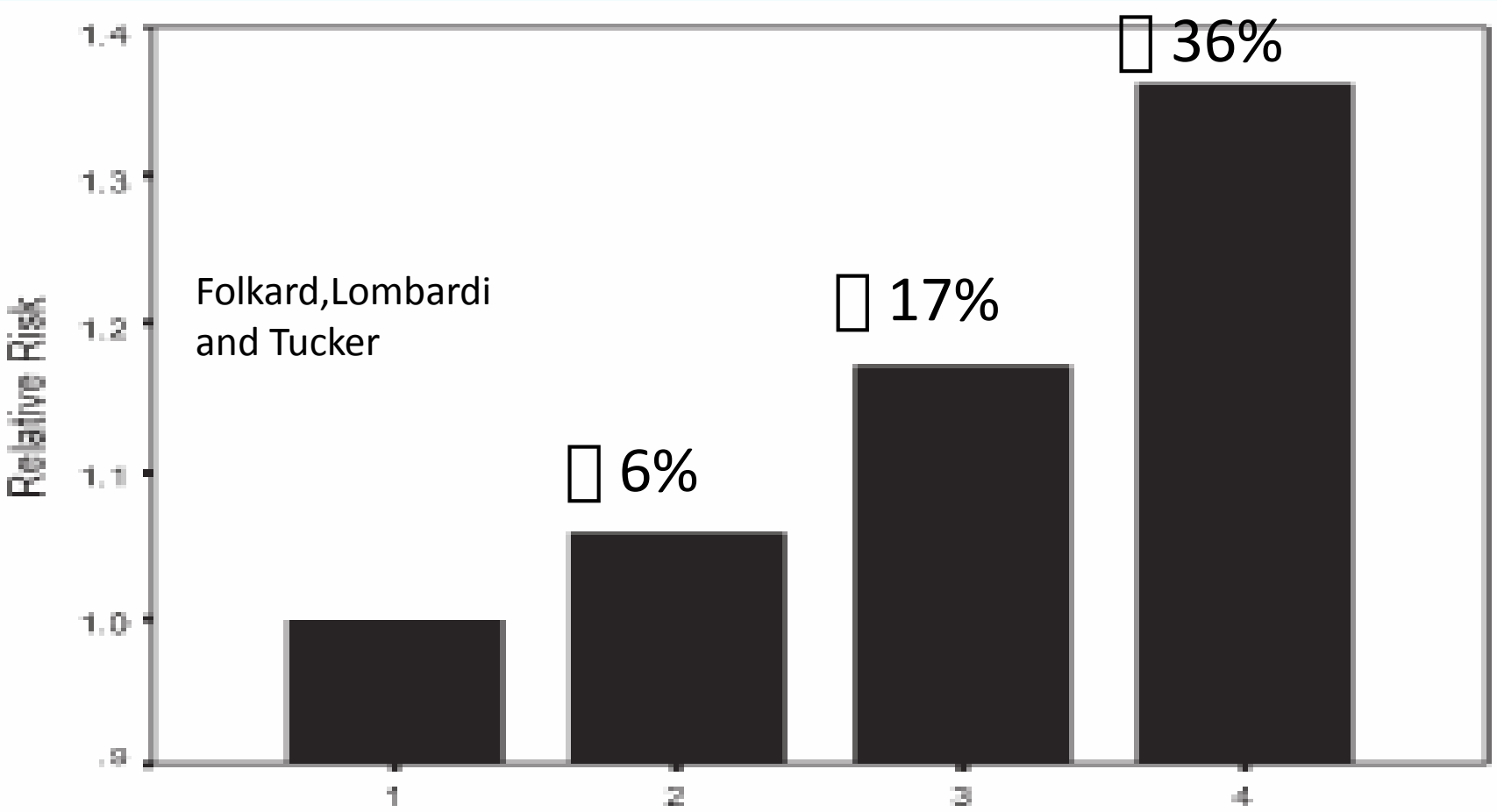
Timing of Incidents

❾ Risk for incidents increased by



Successive Nights

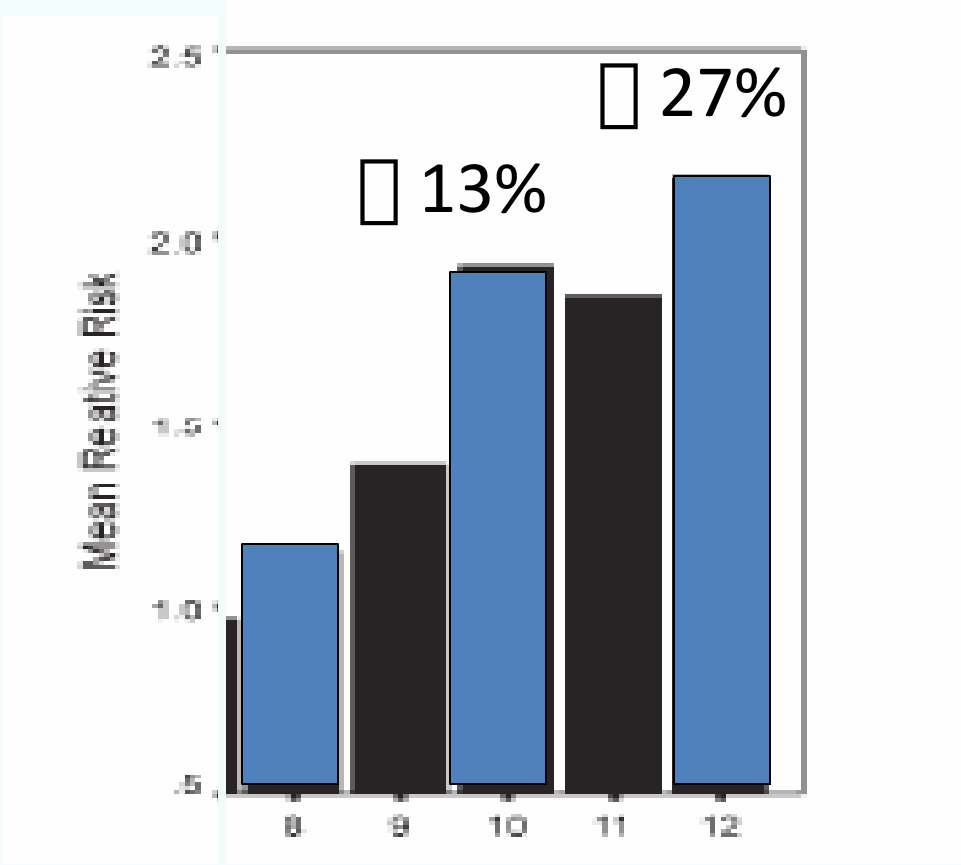
- Risk for incidents increased by,



Shift Length

- 10 hr and 12 hr compared to 8hr shifts

Folkard,Lombardi and Tucker



Adequate Time off

- Recommend 11-16 hours off between shifts; 10 hrs or less result in short sleep episodes
- When the time off occurs is just as important as how long the break is
- At least 24 hrs off after block of night shifts
- Max 48 hrs work/week
- Overtime or on-call assignments are not recommended beyond 12 hr shifts

Sleep Factors

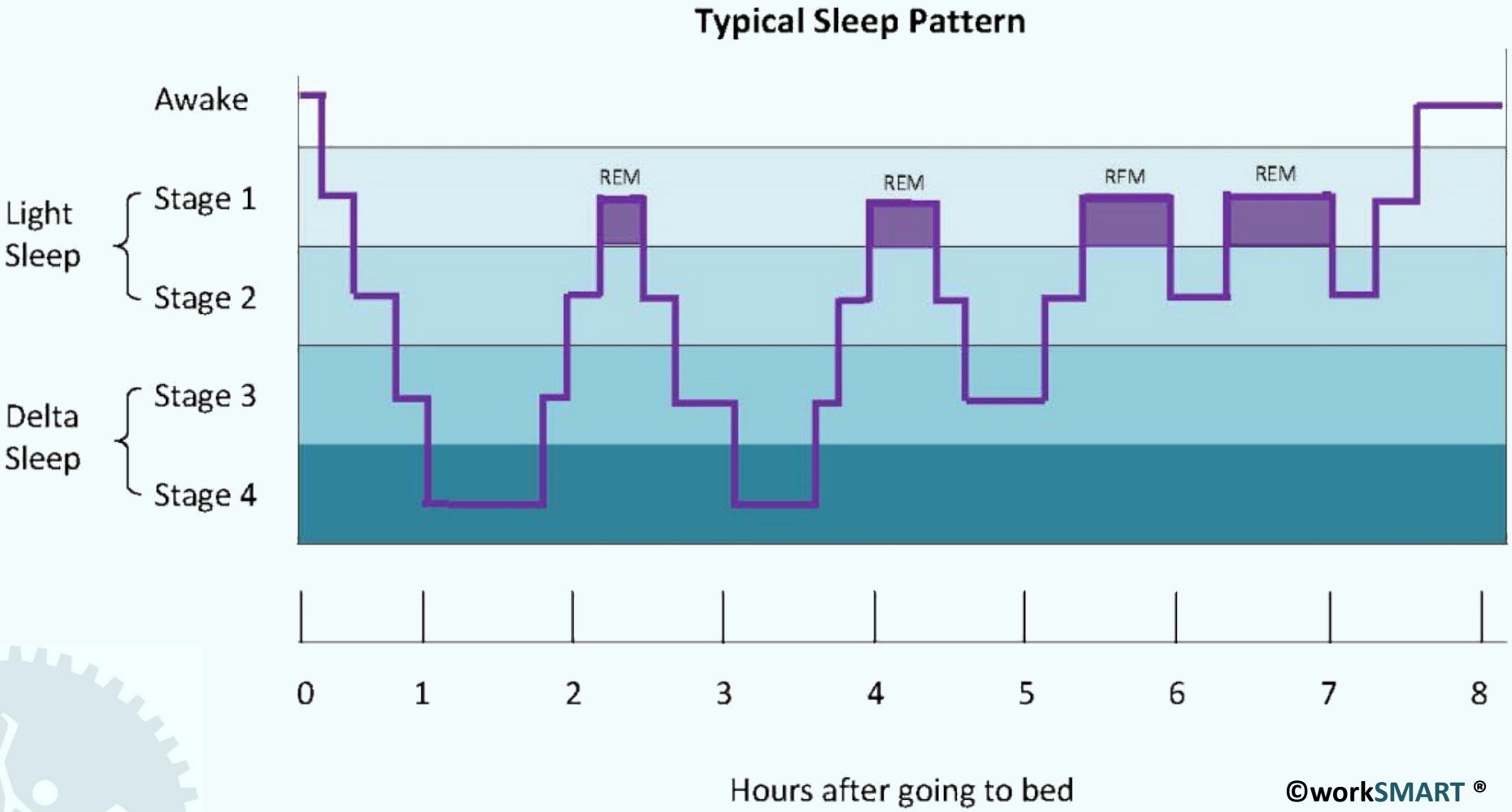
- In the last 100 years, we have reduced our quantity of sleep from over 9 hrs to less than 7 hrs
- Most quality sleep comes early on in the sleep process
- Only sleep cures fatigue

How much is enough?

- Most require 7.5-8 hours as a minimum
- Missing out on 1 hr can increase physiological sleepiness the next day
- Age drops our ability to sleep to an average of 5-6 hours, requiring napping as a supplement
- You cannot train yourself

Adult Sleep Pattern

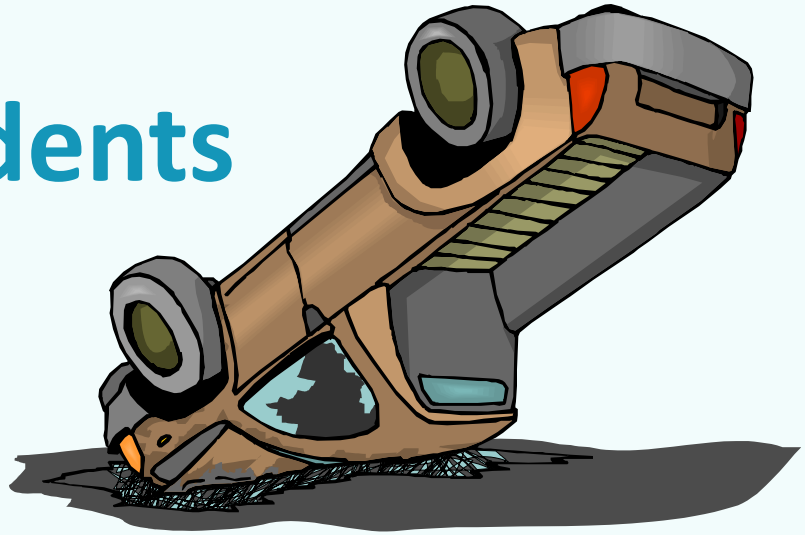
Adapted from NASA Ames Fatigue Countermeasure Program



Accumulating Sleep Debt

- Automatic Behaviour Syndrome
  - several minutes where a person performs routine duties but is not capable of cognition e.g. not remembering drive home
- Microsleeps
  - If debt continues to accumulate, brain disengages (no sensory input)

Motor Vehicle Accidents



- Fatigue related crashes tend to …
  - be more severe
  - generally reflect little or no avoidance action
  - involve high impact speed
  - be single vehicle accidents

Short Term Wakefulness

Lamond and Dawson - Australian Researchers

- 17 hours of wakefulness = .05% BAC
- 22 hours of wakefulness = .08% BAC
- 24 hours of wakefulness = .10% BAC

P Byrne - Biotechnologist

- 24 hours of wakefulness will take 5 days of 9 hours of sleep to recover from the sleep loss

Fatigue Related Technology

Measuring Sleep

- Sleep is measured using polysomnography
  - Measures brain waves, heart rate, and muscle actions in a clinical setting
- Actigraphy is portable polysomnography that a worker wears like a wristwatch

Actigraphy Pros and Cons

- Measures the same quantitative sleep/wake variables and compares to work schedules over a period of time
- Can identify sleep disorders
- Does not measure current state of fatigue, alertness or effect on performance
- Does not assist in immediate intervention of a fatigued worker

Measuring Fatigue / Performance

- Only scientifically validated method for measuring levels of fatigue and its effect on performance is PVT (psychometric vigilance testing)
- Eye gaze intelligence technology utilizes PERCLOS measures to correlate against PVT

Pros and Cons of Eye Gaze Technology

- Provides workers with objective measurement of current state of alertness
- Real-time identification of medium & high-risk situations to individuals and/or control centres
- Device specific features
  - Non-invasive is preferred (some require eyeglasses to be worn which has limitations)
  - Ability to look at vehicle and specific operational alertness data to develop/refine policies and SOPs

A Systematic Approach

- An effective fatigue management system requires the organization to incorporate,
  - Operational Countermeasures
    - Optimize shift schedules through a fatigue risk assessment
    - Incorporate physical design elements to offset fatigue and enhance alertness
    - Consider technological assistance to measure sleep, fatigue and performance
    - Include fatigue as a measure in incident investigations

Continued…

- Preventative Countermeasures
  - Provide education to workers and family members to minimize fatigue and optimize alertness
  - Train supervisors in detection of fatigue symptoms and how to keep crews alert

⑨ And workers need to,

- Personally adopt a shift work lifestyle incorporating proven preventative strategies

Thank you!

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