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

1. Circadian Rhythms
2. Shift Design
3. 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

99°
Adjusting the Body Clock

9 Body requires 1 day to adapt for every hour of shift change (12 hour shift change = 12 days adjustment)

9 The question then becomes...
   - do we want to adjust (entrainment)?
Shift Work Design

9 There is NO perfect shift schedule

9 Shorter shift rotations
   - Preferred from a physiological standpoint
   - 2-4 nights max will minimize shifting of rhythms

9 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

1. Replace fluorescent with full spectrum bulbs in designated areas
2. Turn on exposure to these lights between 5-6AM and 7-8PM
3. Minimize light exposure after 8PM
Timing of Incidents

 риск for incidents increased by

Folkard, Lombardi and Tucker

Morning 18%
Afternoon 30%
Night
Successive Nights

Risk for incidents increased by:

- 6%
- 17%
- 36%

Folkard, Lombardi and Tucker
Shift Length

10 hr and 12 hr compared to 8 hr 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

1. In the last 100 years, we have reduced our quantity of sleep from over 9 hrs to less than 7 hrs.

2. Most quality sleep comes early on in the sleep process.

3. 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

Typical Sleep Pattern

- Awake
- Light Sleep
  - Stage 1
  - Stage 2
- Delta Sleep
  - Stage 3
  - Stage 4
- REM

Hours after going to bed
Accumulating Sleep Debt

9 Automatic Behaviour Syndrome
   - several minutes where a person performs routine duties but is not capable of cognition e.g. not remembering drive home

9 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
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...

- Preemptive 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

And workers need to,
- Personally adopt a shift work lifestyle incorporating proven preventative strategies
Thank you!

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