TRANSPORTATION LEARNING NETWORK

A partnership with MDT•NDDOT•SDDOT•WYDOT and the Mountain-Plains Consortium Universities

Welcome!

Identification of Fatigue Countermeasures

Presented by:

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Identification of Fatigue Countermeasures

Patrick Sherry, Ph.D.
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Mountain Plains Transportation Consortium
April 23, 2020

Organization of Presentation

- Role of fatigue in transportation accidents.
- Drowsy driving.
- Hours of service.
- Fatigue physiology – biological clock.
- Truck safety – fatigue & performance.
- Fatigue measurement & calibration.
- Study simulations.
- Summary & Recommendations.

Drowsy Driving Accidents

- An allegedly sleepy driver behind the wheel of a FedEx truck caused a terrifying eight car pileup in Nashville, Tennessee, police say.
  - May 6, 2016, 9:49 AM

- Drowsy Driving accident, L

- Potato truck, Charlotte NC

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Drowsy Driving

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HOS 2020 for Trucks

COVID-19 UPDATE

The Federal Motor Carrier Safety Administration has relaxed certain hours-of-service regulations for motor carriers involved in coronavirus-related relief efforts.

Specifically, FMCSA is granting exemption from Parts 390-399 of the Federal Motor Carrier Safety Regulations, which cover hours of service, parts and accessories needed for safe operation, and longer combination vehicles.

The declaration applies to truck operators involved in direct assistance efforts, such as hauling medical supplies and testing equipment, masks, gloves, hand sanitizer, food and personnel.

In order to maintain safety, a driver who has completed a delivery must receive a minimum of 10 hours off duty if transporting property or eight hours off duty if transporting passengers.

- From Transport Topics, March 14, 2020 9:30 AM, EDT

HOS Rule

§395.3 Maximum driving time for property-carrying vehicles.

(1) *Start of work shift.* A driver may not drive without first taking 10 consecutive hours off duty;

(2) *14-hour period.* A driver may drive only during a period of 14 consecutive hours after coming on duty following 10 consecutive hours off duty.

- The driver may not drive after the end of the 14-consecutive-hour period without first taking 10 consecutive hours off duty.

(3) *Driving time and rest breaks.*

- (i) *Driving time.* A driver may drive a total of 11 hours during the 14-hour period specified in paragraph (a)(2) of this section.
- (ii) *Rest breaks.* Except for drivers who qualify for either of the short-haul exceptions in §395.1(e)(1) or (2), driving is not permitted if more than 8 hours have passed since the end of the driver's last off-duty or sleeper-berth period of at least 30 minutes.

(b) No motor carrier shall permit or require a driver to drive, for any period after—

- (1) Having been on duty 60 hours in any period of 7 consecutive days if the employing motor carrier does not operate commercial motor vehicles every day of the week; or
- (2) Having been on duty 70 hours in any period of 8 consecutive days if the employing motor carrier operates commercial motor vehicles every day of the week.

• (c) (1) Any period of 7 consecutive days may end with the beginning of an off-duty period of 34 or more consecutive hours.

- (2) Any period of 8 consecutive days may end with the beginning of an off-duty period of 34 or more consecutive hours.

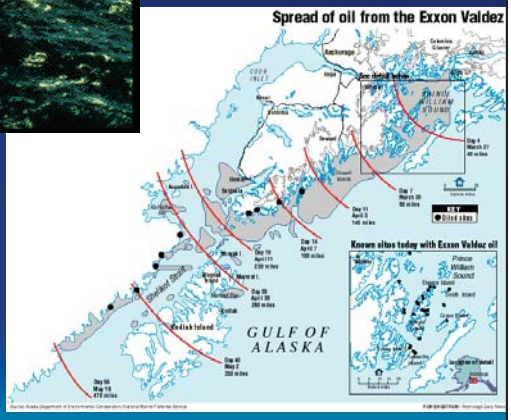
FMCSA 2019

- According to FMCSA fatal accidents were the result of:
  - "Speeding of Any Kind" was the most frequent driver-related factor for drivers of both vehicle types;
  - "Distraction/Inattention" was the second most common for large truck drivers, and
  - "Impairment (Fatigue, Alcohol, Illness, etc.)" was the second most common for passenger vehicle drivers.

1988 - Clapham Junction Train Crash 35 Killed, 100+ Injured

Signal failure caused by a faulty connection wiring installed by worker after 13th consecutive 7-day work week.

Exxon Valdez



Little Rock

- In June 1999 fatal runway accident of AA#1420 in which a MD-82 overran the end of the runway, went down an embankment, and impacted approach light structures in Little Rock, Ark.
- Thunderstorms and heavy rain were reported in the area at the time of the accident. There were 11 fatalities, including the aircraft captain, and numerous injuries among the 145 passengers and crew aboard the flight.

Memorable Fatigue Moments from the Recent Past

- Accident at Three Mile Island nuclear power plant-
  - **Destruction of Unit 2 reactor and release of radioactive gases and water into the environment**
- Nuclear meltdown at Chernobyl -
  - **300 deaths, $13 billion in economic disruption, increased cancer rates and birth defects**
- Release of poisons from Union Carbide in Bhopal-
  - **2,800 deaths, 20,000 cases of respiratory and eye damage, and $3 billion in immediate costs**
- Grounding of the Exxon Valdez -
  - **1400 miles of shoreline contaminated, over $8 billion in direct costs**

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Physiology

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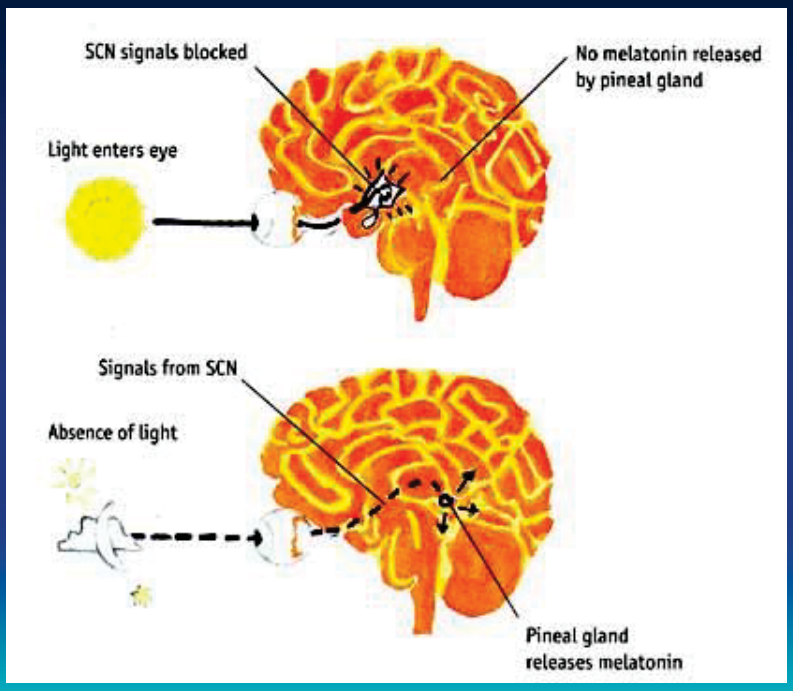
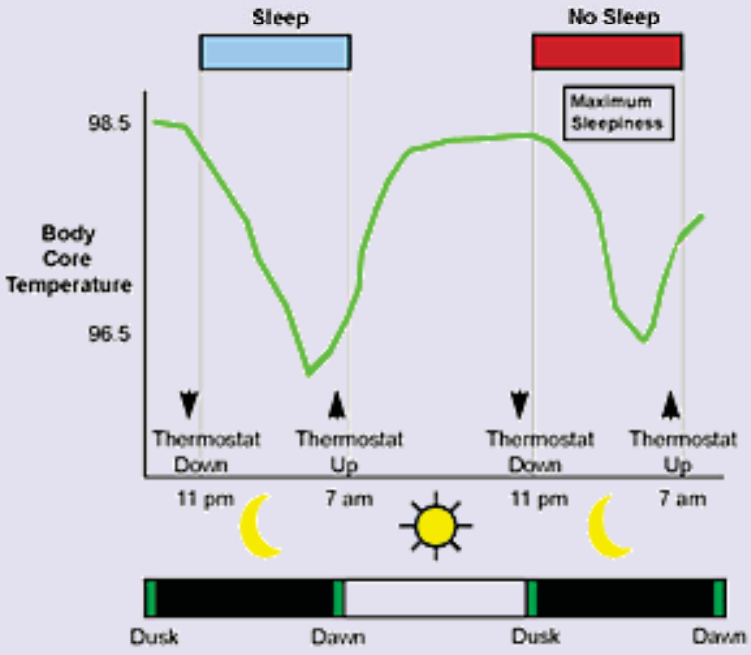
Sleep Physiology

- The ability of hibernating animals to sleep throughout the winter hinges on how the pineal gland responds to light.
- The pineal gland, a pea sized gland that secretes a hormone called melatonin during darkness.
- The action of melatonin, which is sometimes called the sleep hormone, helps to control body rhythms and sleep wake cycles. Helps us get to sleep or stay asleep.
- Darkness stimulates the release of melatonin and light suppresses its activity.



The Biological Clock



Many body functions are regulated by circadian rhythms.

Sleep appears to coincide with the circadian rhythm

The human body wants to sleep between the hours of midnight and 5 am

Effects of the Biological Clock

- **Body rhythms are synchronized to each other**
  - **interfere with one and it interferes with the others**
- **Night shifts interferes with synchronization**
  - **May take a week to reset**
- **Effects include**
  - **Physical and emotional problems**
  - **Sleep disruptions**
  - **Need time to reset!!**

Sleep Loss and Sleepiness: Sleep is a Vital Physiological Function

- Sleep loss is additive and results in cumulative

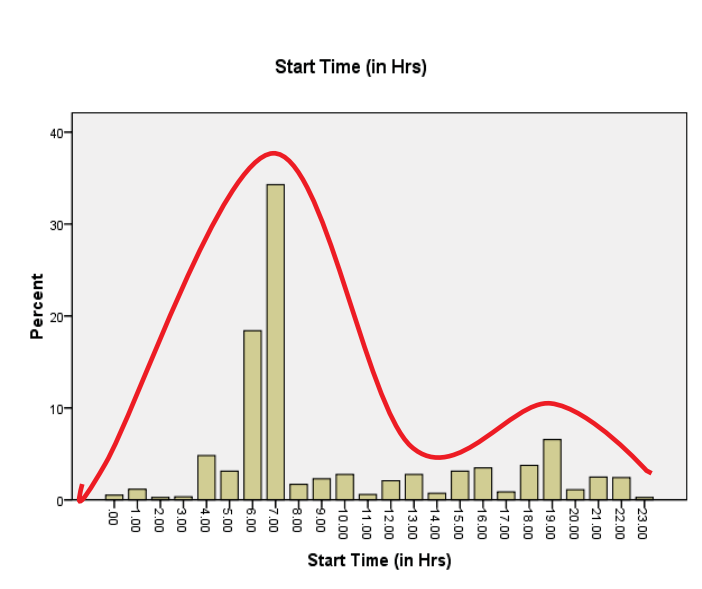
Sleep Debt.

- Sleep debt leads to increased sleepiness over time.

Hours of Operation

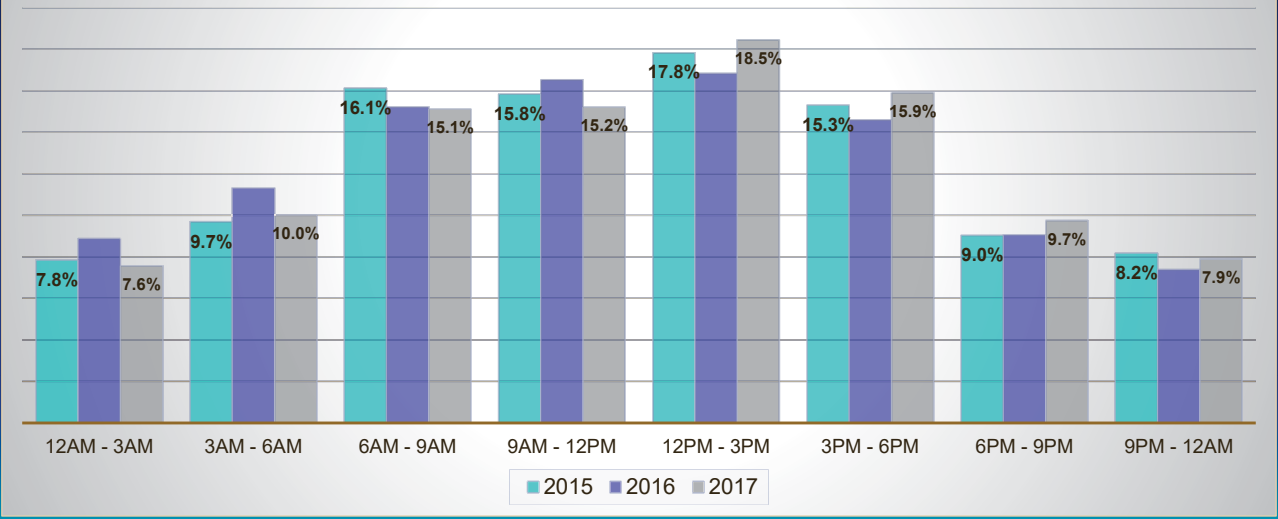
Rail

- The majority of work shifts are da shifts. Only 16.6% of work shifts state after 6 pm.
- 76% of work shifts start between 4 am and 4 pm.



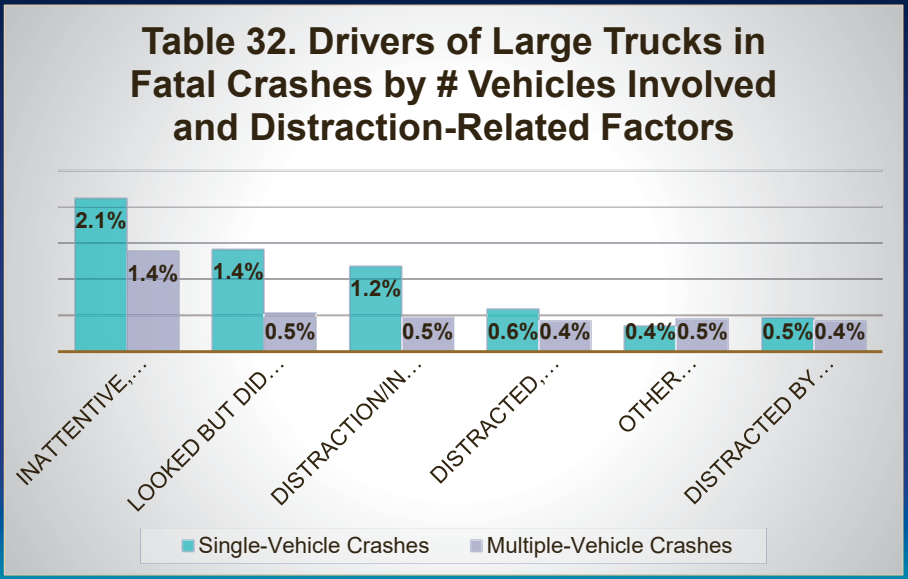
Large Trucks

Table 7. Fatal Crashes Involving Large Trucks by Time of Day, 2015-2017



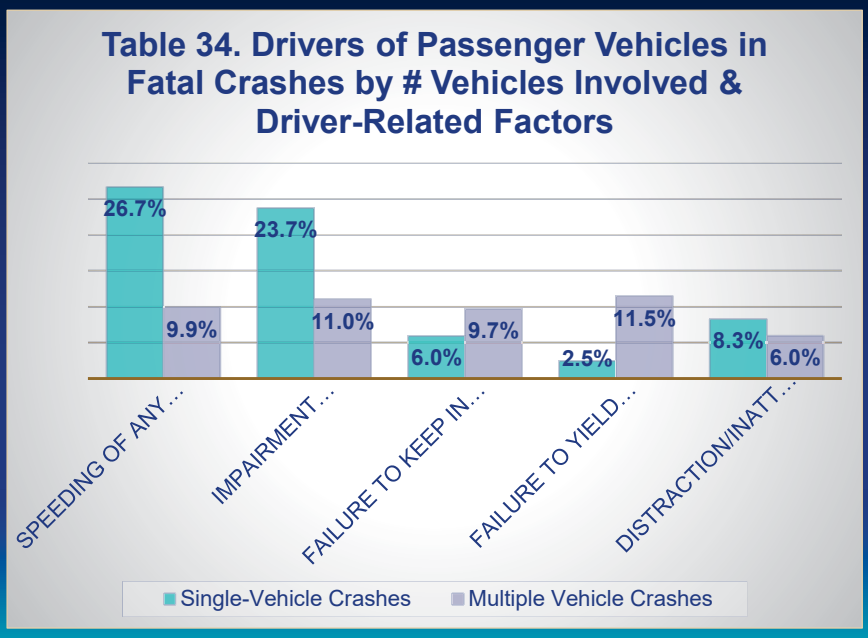
Large Trucks

- Fatigue in the form of inattention and drowsy driving play a significant role in fatalities.



Passenger

- Similarly with passenger vehicles.



Fatigue and Performance

Fatigue Degrades Performance and Mental Abilities

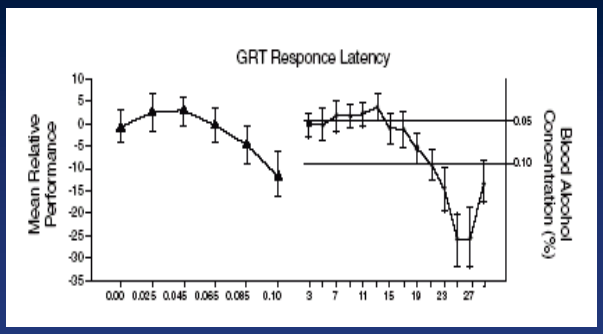
- Accuracy and timing degrade
- Lower standards of performance become acceptable
- Attentional resources are difficult to divide
- The ability to integrate information is lost
- Everything becomes more difficult to perform
- Social interactions decline
- The ability to logically reason is impaired
- Attention wanes
- Attitude and mood deteriorates
- Involuntary lapses into sleep begin to occur

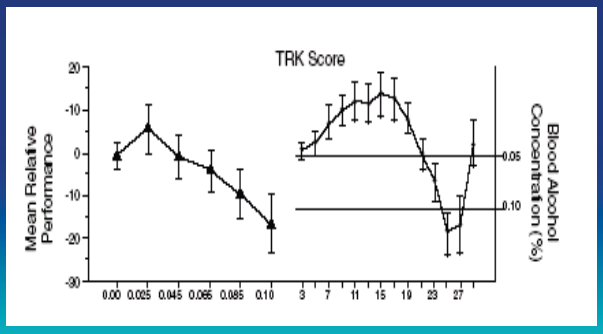
Fatigue & BAC

Trying to come up with a metric…

Performance

- It was observed that during **each hour of wakefulness,** between the seventeenth and twenty-seventh hour, the mean relative decline in performance was
- 2.69% for LOGICAL REASONING (GRT) mean response latency,
- 3.36% for VISUAL TRACKING (TRK)





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Williamson et al (2000)

- *A study of N=39 employees from the transport industry and the army.*
- *Performance was studied over a period of 28 hours of sleep deprivation and alcohol intake up to approximately 0.1% Blood Alcohol Concentration (BAC).*
- *After 17 to 19 hours without sleep, corresponding to approximately 10.30pm and just after midnight, performance on some tests was equivalent or worse than that at 0.05%BAC.*
- *Response speeds were up to 50 percent slower*
- *After longer periods without sleep, performance reached levels equivalent to the maximum alcohol dose given to subjects (0.1%BAC).*

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Implication

- In other words these data show that when people have been awake for over 17-23 hours that they have cognitive performance similar to persons who are over the legal limit of blood alcohol content

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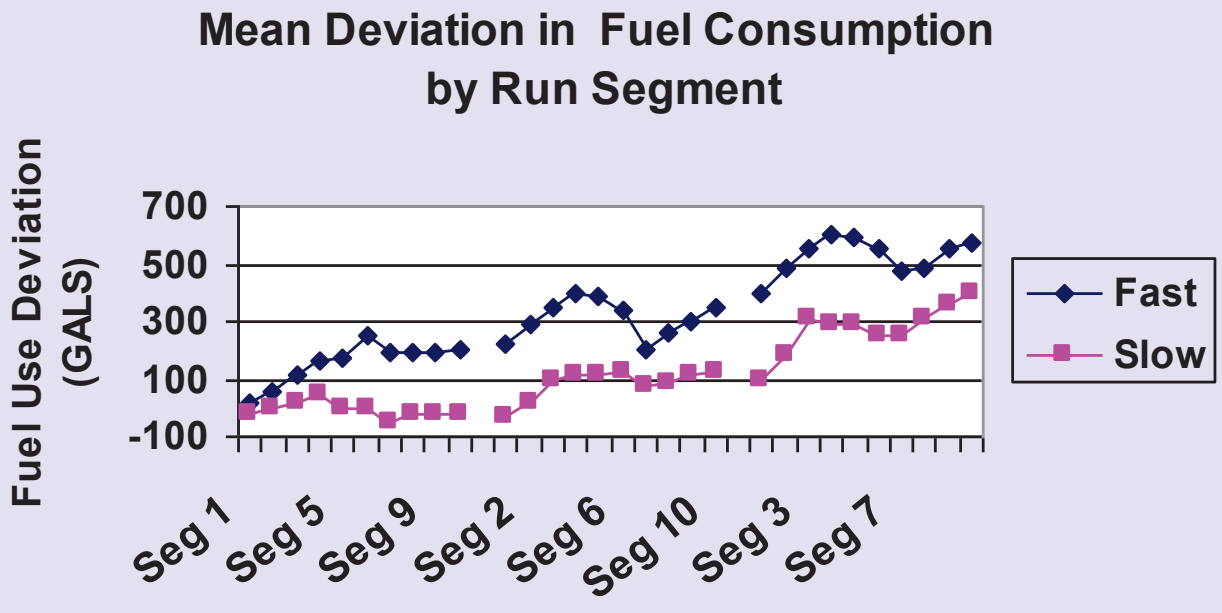
Locomotive Engineers



While not statistically significant over time these results raise questions about the role of fatigue in performance. Fuel consumption increases in locomotive engineers following these schedules over time.

Effects of Extended Work Hours
(overtime)

Barger et. al (2005) Study

- *Barger et. al. c*onducted a nationwide, Web-based survey in which 2737 residents in their first postgraduate year (interns) completed 17,003 monthly reports that provided detailed information about work hours, work shifts of an extended duration, documented motor vehicle crashes, near-miss incidents, and incidents involving involuntary sleeping.

Barger, L. K., Cade, B. E., Ayas, N. T., Cronin, J. W., Rosner, B., Speizer, F. E., & Czeisler, C. A.; Harvard Work Hours, Health, and Safety Group (2005). Extended Work Shifts and the Risk of Motor Vehicle Crashes among Interns. *New England Journal of Medicine*, *352*, 125-134.

Risk of Motor Vehicle Crashes and Near-Miss Incidents after Extended Shifts

Table 1. Risk of Motor Vehicle Crashes and Near-Miss Incidents after Extended Shifts.*

Variable	Extended Work Shifts (≥24 hr)	Nonextended Work Shifts (<24 hr)
Crashes		
No. reported	58	73
No. of commutes	54,121	180,289
Rate (per 1000 commutes)	1.07	0.40
Odds ratio (95% CI)	2.3 (1.6–3.3)	1.0
Near-miss incidents		
No. reported	1,971	1,156
No. of commutes	54,121	180,289
Rate (per 1000 commutes)	36.42	6.41
Odds ratio (95% CI)	5.9 (5.4–6.3)	1.0

* A within-person case-crossover analysis was used to assess the risks of motor vehicle crashes and near-miss incidents among interns during commutes after extended shifts as compared with nonextended shifts. A two-by-two table was constructed for each intern who reported either a crash or a near-miss incident, consisting of the number of crashes or near-miss incidents after an extended shift, the number of crashes or near-miss incidents after a nonextended shift, the number of extended shifts that did not precede a crash or a near-miss incident, and the number of nonextended shifts that did not precede a crash or a near-miss incident. CI denotes confidence interval.

Barger et al. 352 (2): 125, Table 1 January 13, 2005

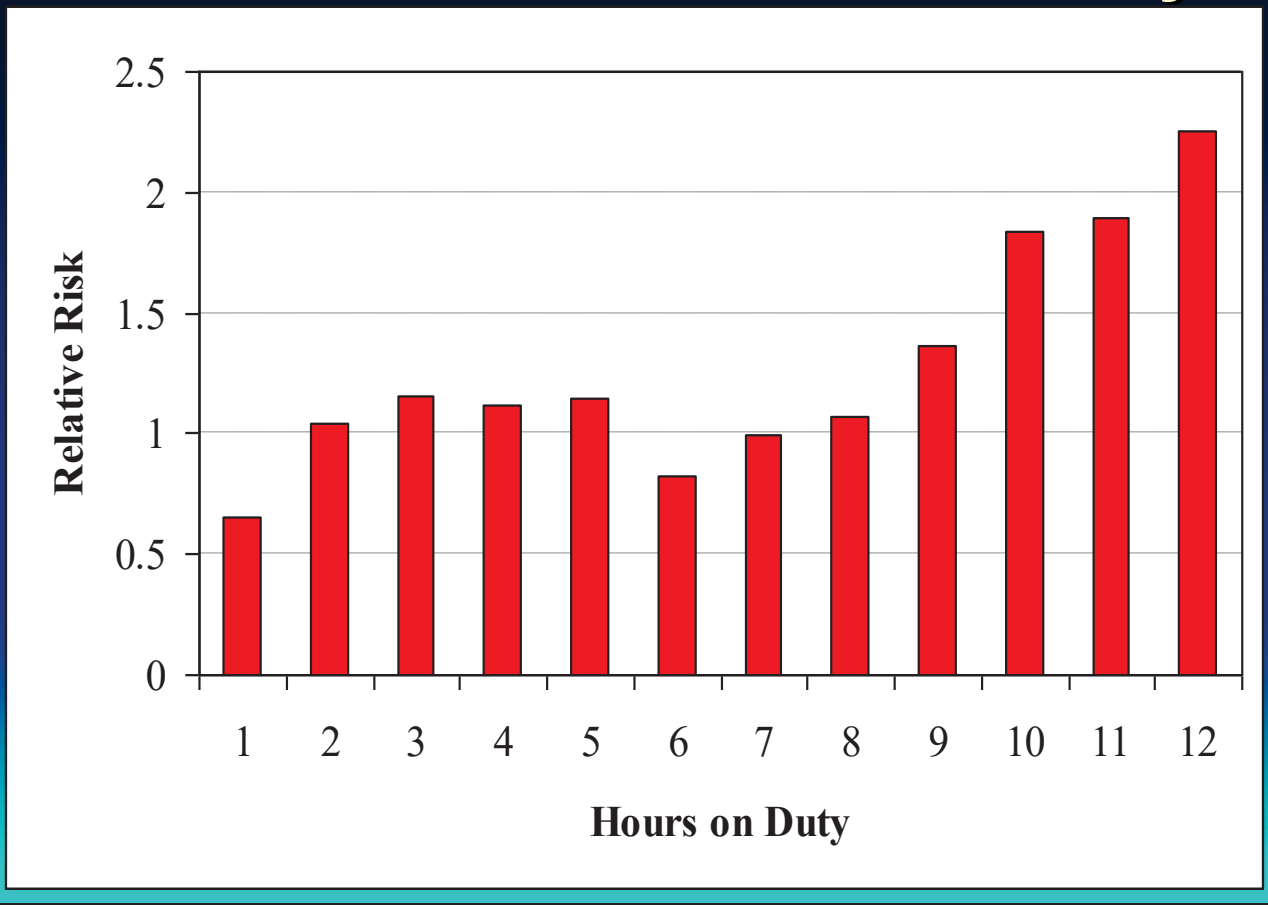
The NEW ENGLAND JOURNAL of MEDICINE

Barger - Results

- Odds for reporting a motor vehicle crash and a near-miss incident after an extended work shift, compared to a non-extended duration, were 2.3 and 5.9, respectively.
- Every extended work shift that was scheduled in a month increased the monthly risk of a motor vehicle crash by 9.1 percent
- Increased the monthly risk of a crash by 16.2 percent
- When interns worked **five or more extended shifts,** per month, the risk that they would fall asleep while driving or while stopped in traffic was significantly increased (odds ratios, 2.39 and 3.69 respectively).

Folkard Studies

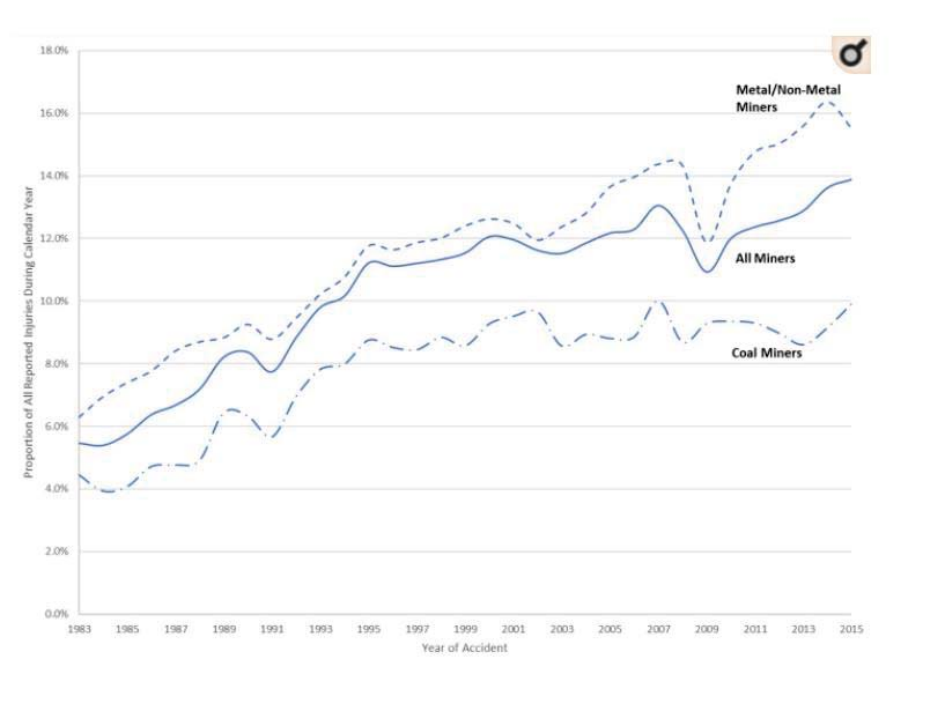
Relative risk over hours on duty



Mining Industry

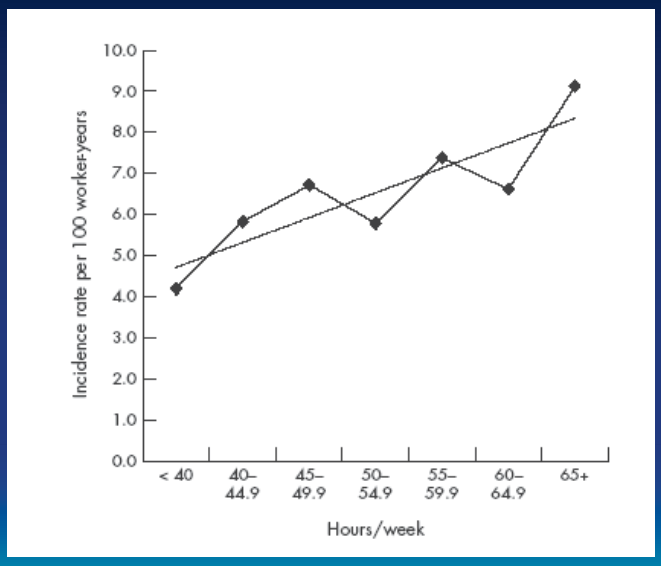
- **A 2019 study of the mining industry revealed that a** total of 52 206 injuries (9.6%) occurred during long working hours. The proportion of long working hour injuries increased from 5.5% of all injuries in 1983 to its peak in 2015 at 13.9% ($p<0.001$).
- In two separate adjusted models, long working hour injuries were associated with a higher odds of death (adjusted OR [aOR]=1.32; 95% CI 1.18 to 1.48) and injury incidents involving two or more workers (aOR=1.73; 95% CI 1.58 to 1.89).

Mining Injuries & Overtime



Incidence Rate of Accidents Increased
by hours worked per week

Dembe Study (2005)

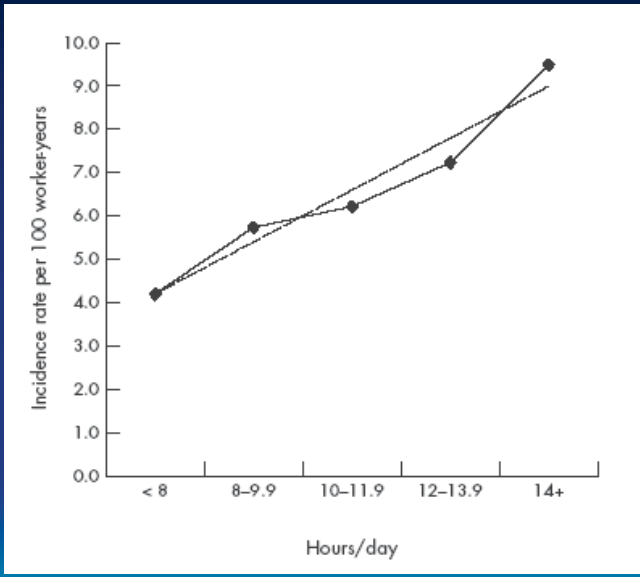


Dembe, et. Al. (2005)

A total of 110 236 job records were analyzed, encompassing 89,729 person-years of accumulated working time.

Working over 55+ hours per week increases risk of accidents to 7 per 100 work years.

Incidence rate Increased by Hours Worked per day



Dembe, et. Al. (2005)

Dembe Study (2005)

Results

Dembe Study (2005)

The number of hours worked per week (over 40) and the number of hours worked per day (over 8) were positively associated with an increasing risk of injury (per 100 worker-years).

Conclusions

- Working in jobs with schedules that routinely involve overtime work or extended hours increases the risk of suffering an occupational injury or illness.
- Overtime schedules had the greatest relative risk of occupational injury or illness, followed by schedules with extended (>12) hours per day and extended (>60) hours per week.
- The risk of injury was found to increase with the increasing length of the work schedule, even after controlling for the entire amount of working time spent "at risk" for injury.
- Additional analyses indicated that the increased injury risks are not merely the result of the demanding work schedules being concentrated in riskier occupations or industries.

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Effects of Restricted Sleep Schedules

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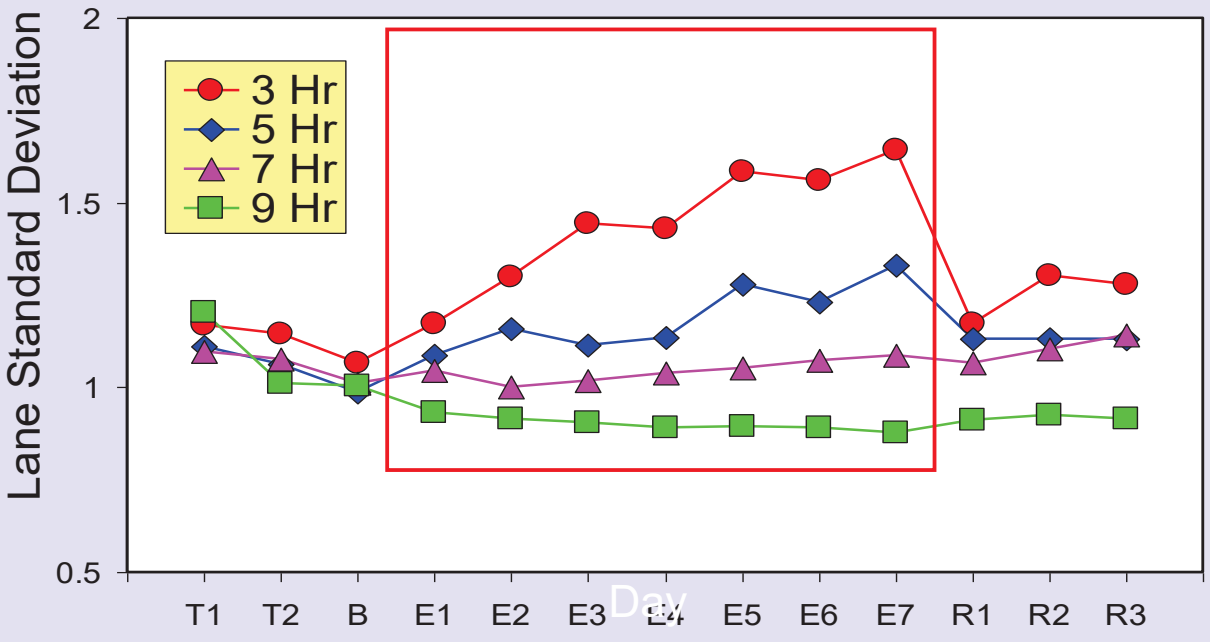
Driving Simulator:
Standard Deviation of Lane Position



Belenky et al, J. Sleep Res. 2003

SLEEP HABITS of Adults

- On average, adults sleep 6 hours and 58 minutes per night during the workweek
- sleeping about 40 minutes longer on the weekend.
- 30% of adults sleep less 6.5 hrs during week.
- Swedish study found shift workers obtained 2 hours less sleep per day than non shift workers
- Australian study found that on a 12 hr rotation people obtained an average of 5.2 hours of sleep (Reid, Fletcher)

NATIONAL SLEEP FOUNDATION

2012 *Sleep in America*® Poll: Planes, Trains, Automobiles and Sleep

Controls

Sleep
- Hours slept on workdays: 6h 53m
- Nap on workdays: 27%

Work
- Hours per shift: 8.5 hours
- Commute time: 23.8 minutes

Job performance and sleepiness
- Made a serious error at work: 5%
- Had car accident to/from work: 1%

Johnson, K. D., Sherry, P., & Kales, S. N. (2014). Association of sleep habits with accidents and near misses in United States transportation operators. *Journal of Occupational & Environmental Medicine*, *56*(5), 510–515.

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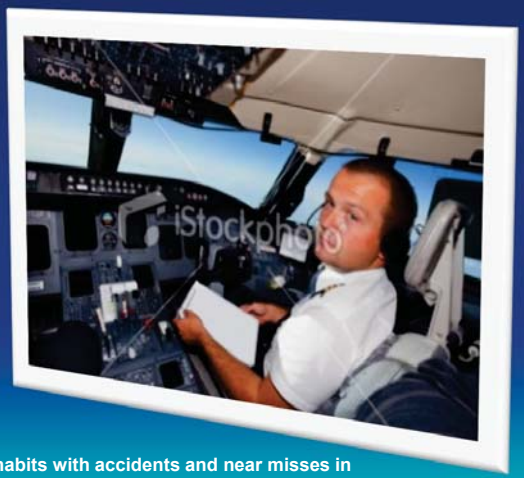
2012 *Sleep in America*® Poll: Planes, Trains, Automobiles and Sleep

Pilots

Sleep
- Hours slept on workdays: 6h 59m
- Nap on workdays: 58%

Work
- Hours per shift: 10.4 hours
- Commute time: 45.5 minutes

Job performance and sleepiness
- Made a serious error at work: 20%
- Had car accident to/from work: 6%



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Sleep in America® Poll - www.sleepfoundation.org

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Truck Drivers

Sleep
- Hours slept on workdays: 6h 50m
- Nap on workdays: 42%

Work
- Hours per shift: 10.1 hours
- Commute time: 24.3 minutes

Job performance and sleepiness
- Had a 'near miss' at work: 14%
- Sleepiness never impact job: 69%

Johnson, K. D., Sherry, P., & Kales, S. N. (2014). Association of sleep habits with accidents and near misses in United States transportation operators. *Journal of Occupational & Environmental Medicine*, *56*(5), 510–515.

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Sleep in America® Poll - www.sleepfoundation.org

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2012 Sleep in America® Poll: Planes, Trains, Automobiles and Sleep

Rail Workers

Sleep
- Hours slept on workdays: 6h 43m
- Nap on workdays: 56%

Work
- Hours per shift: 9.8 hours
- Commute time: 31.0 minutes

Job performance and sleepiness
- Had a 'near miss' at work: 18%
- Had car accident to/from work: 6%

Johnson, K. D., Sherry, P., & Kales, S. N. (2014). Association of sleep habits with accidents and near misses in United States transportation operators. *Journal of Occupational & Environmental Medicine*, *56*(5), 510–515.

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Sleep in America® Poll - www.sleepfoundation.org

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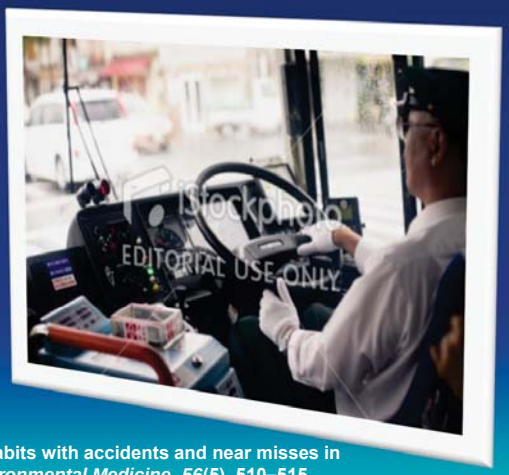
2012 *Sleep in America*® Poll: Planes, Trains, Automobiles and Sleep

Bus/Taxi/Limo

Sleep
- Hours slept on workdays: 7h 0m
- Nap on workdays: 53%

Work
- Hours per shift: 7.2 hours
- Commute time: 17.8 minutes

Job performance and sleepiness
- Had a 'near miss' at work: 12%
- Sleepiness never impacts job: 71%



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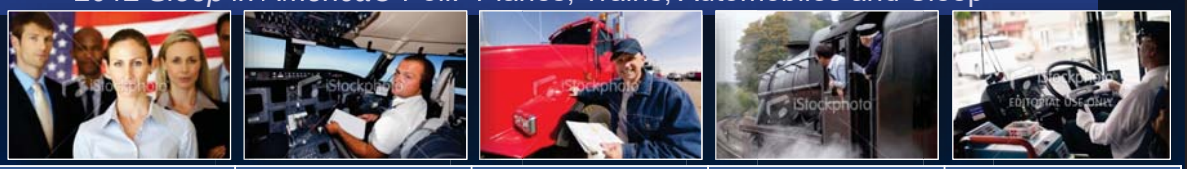
2012 *Sleep in America*® Poll: Planes, Trains, Automobiles and Sleep



	Control$_{(B)}$	Pilots$_{(C)}$	Truck Drivers$_{(D)}$	Rail Workers$_{(E)}$	Bus/Taxi/Limo$_{(F)}$
Workday wake time	6:28 AM$_{F}$	6:37 AM$_{F}$	6:20 AM	7:04 AM$_{BF}$	5:53 AM
Workday bed time	10:58 PM$_{DF}$	10:45 PM	10:23 PM	11:13 PM$_{DF}$	10:24 PM
Hours slept workdays	6h 53m	6h 59m$_{E}$	6h 50m	6h 43m	7h 0m$_{E}$
Report less sleep than needed workdays	27%$_{DF}$	41%$_{BDF}$	19%	34%$_{DF}$	18%
Naps workdays	27%	58%BD	42%B	56%BD	53%BD
Sleep affects job performance at least once a week	17%$_{F}$	23%$_{DF}$	15%	26%$_{BDF}$	10%
"Near miss" at work due to sleepiness (ever)	8%	11%	14%$_{B}$	18%$_{B}$	12%
Serious error at work due to sleepiness (ever)	5%	20%$_{BDEF}$	6%	9%	7%

Johnson, K. D., Sherry, P., & Kales, S. N. (2014). Association of sleep habits with accidents and near misses in United States transportation operators. *Journal of Occupational & Environmental Medicine*, *56*(5), 510–515.

Letters indicate significant differences at the 95% confidence level.
[1]ESS: Function of the Epworth Sleepiness Scale
[2]SDS: Function of the verified Sheehan Disability Scale (scales attributes of work, social life and family)
[3]NSF disability index: Scale developed by the NSF based on the Sheehan Disability Scale (scales attributes of work, social life, family, mood and sexual or intimate relations)

For more information about the 2012 *Sleep in America*® Poll visit sleepfoundation.org

Study Simulations

Modeling Sleep & Performance

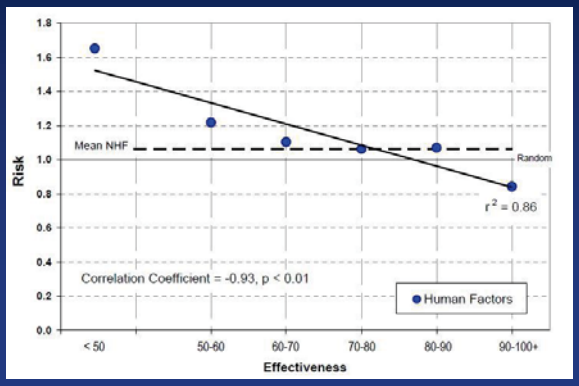
- Considerable research has been conducted to determine the pattern of cognitive performance of human beings exposed to various sleep and wake cycles.
- After gathering that data there have been various efforts to develop statistical and mathematical models that simulate and “fit” the data.
- It is possible, with over a 95% high degree of certainty that, on the average, if a person has a certain amount of sleep that he/she will demonstrate a certain level of cognitive performance.

Calibration and Interpretation

- An effectiveness score of 90-100 is the typical level for a person getting 8 hrs sleep per day and awake from about 0700 to 2300 hr (day shift).
- An effectiveness score of 70 is the minimum level for a rested person after being awake for 21 hr at 0400 hr.
- An effectiveness score of 70 is about equal to the effects of 0.08 BAC and lapse likelihood five times greater than a well-rested person during the daytime.

Validation and Calibration of a Fatigue Assessment Tool for Railroad Work Schedules, Summary Report , FRA, 2006. DOT/FRA/ORD-06/21

Fatigue Measure

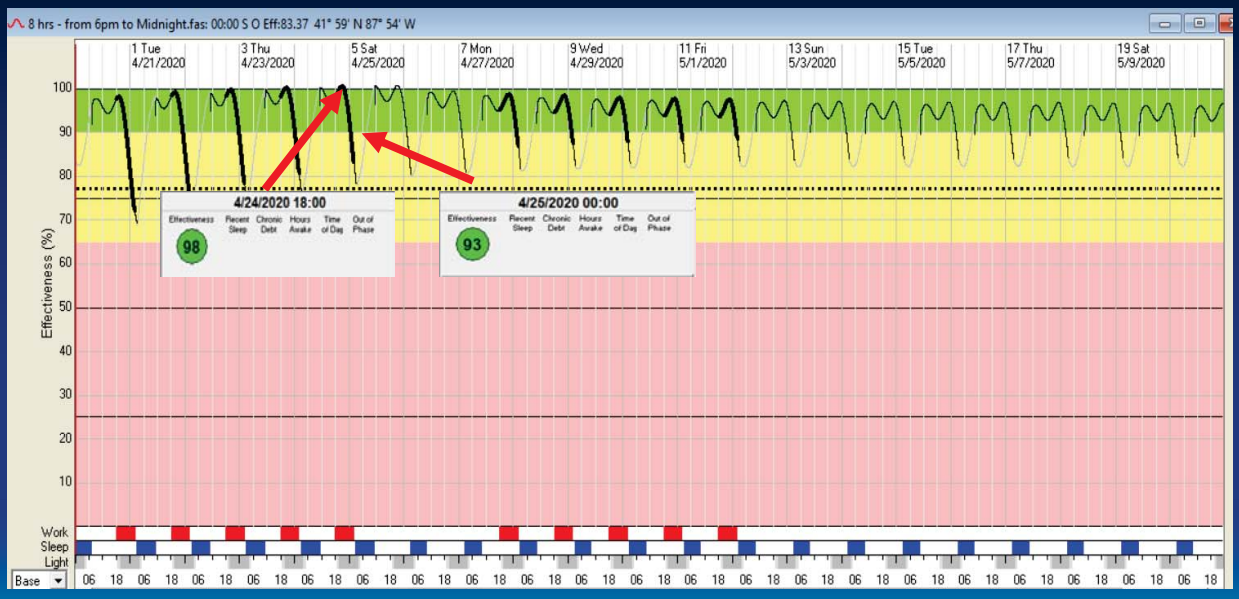


- Human factors accident risk is a linear function. A significant negative correlation exists between accident risk and effectiveness, the inverse of fatigue ($r = -0.93$, $p < 0.01$).
- Results show that for effectiveness scores between 90 and 100 a reduction of risk occurs.
- Effectiveness scores below 90 - risk progressively increases.
- At effectiveness scores below 50, a 65 percent increase in accident risk occurs.

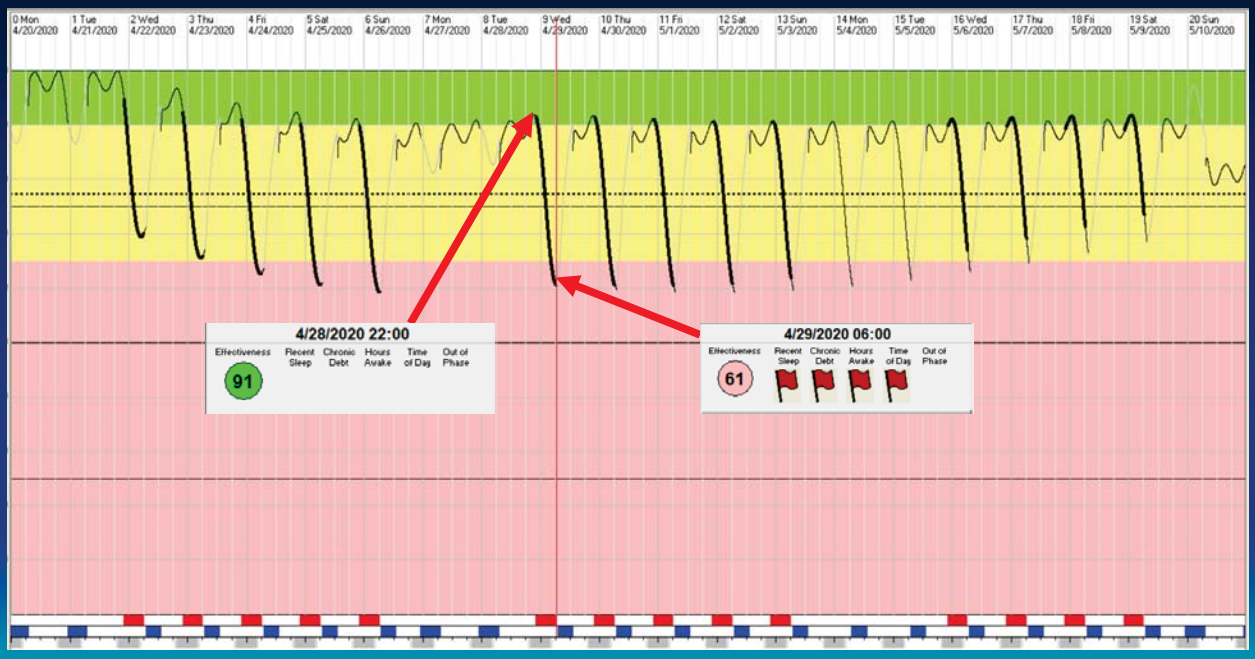
Source: Validation and Calibration of a Fatigue Assessment Tool for Railroad Work Schedules, Summary Report , FRA, 2006. DOT/FRA/ORD-06/21

Typical 8 hour day – 8 am to 5 pm

Evening Shift - 8 hrs – 6pm – 12 midnight



Midnight Shift - 8 hrs – 10pm – 6am



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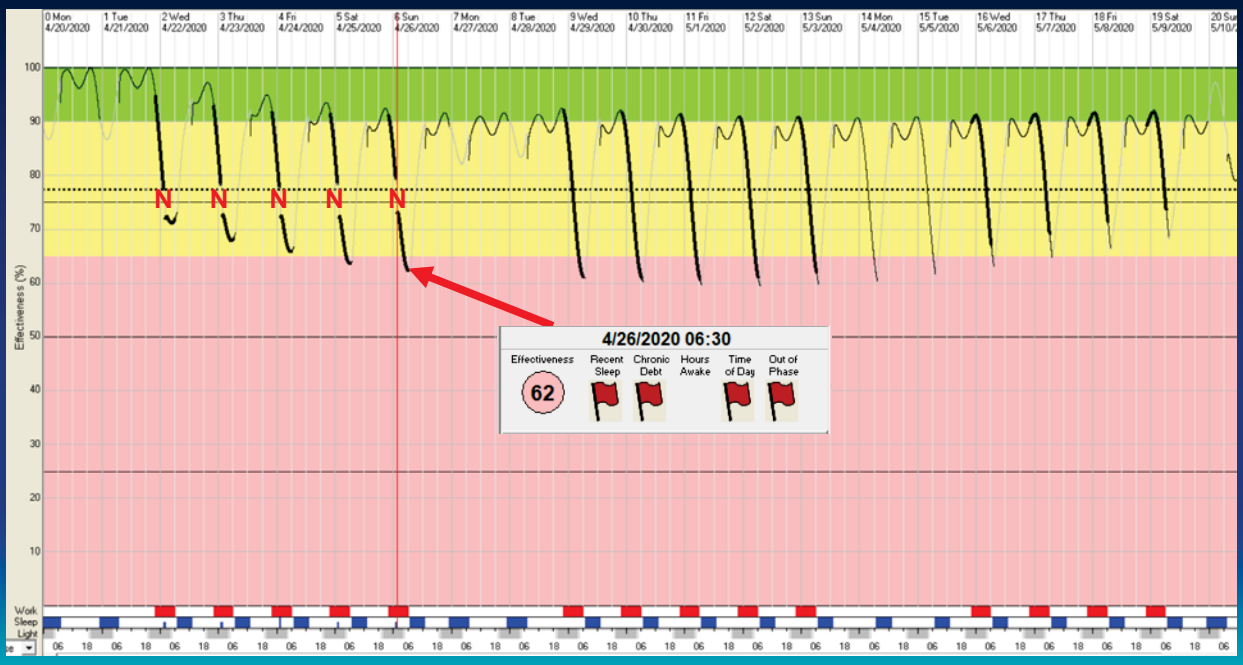
Midnight Shift - 8 hr – 10pm – 6am – 30m naps



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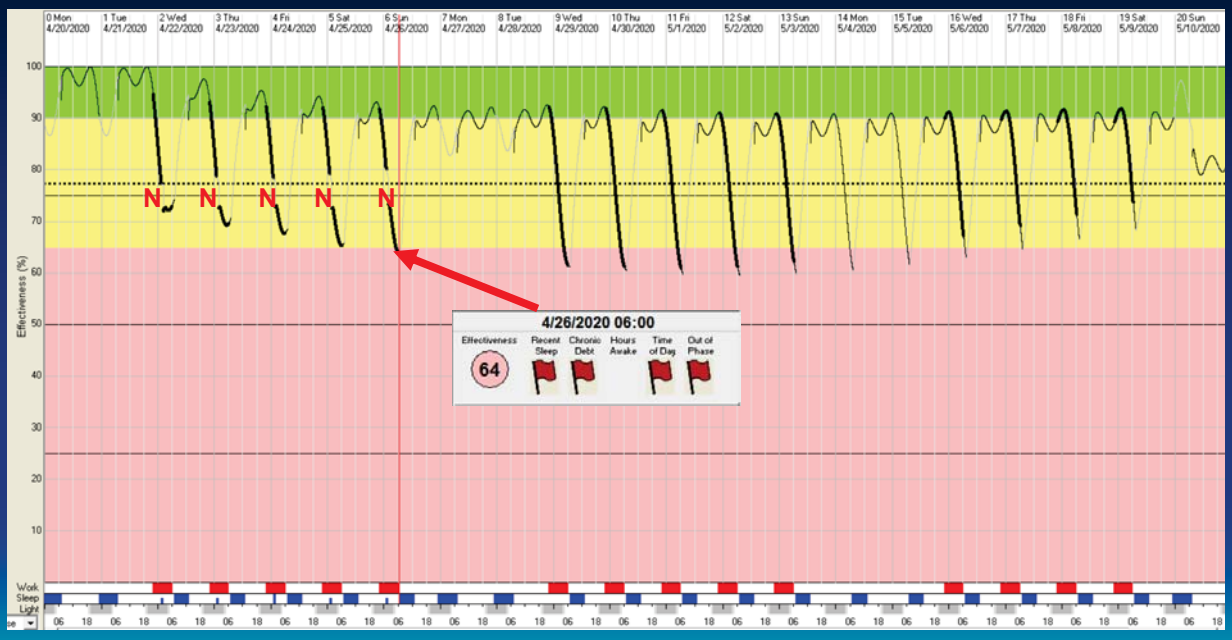
Midnight Shift - 8 hr – 10pm – 6am – 45m naps



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Alertness Strategies

Napping

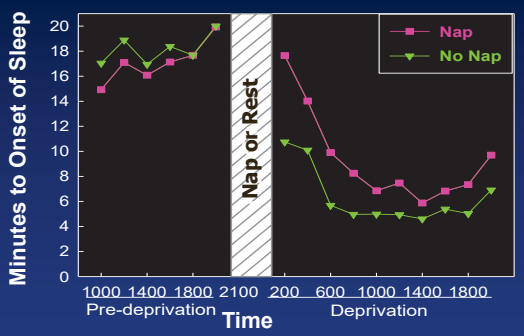
Preventive Strategies: Strategic Napping

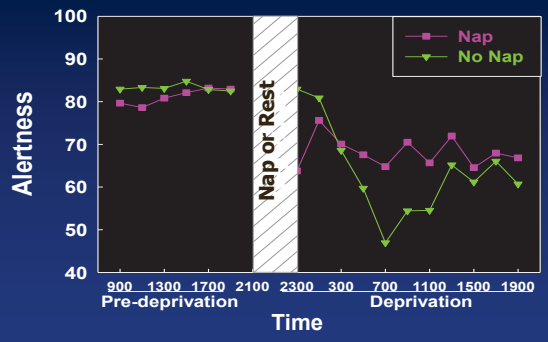
- **Before or during work period:**
  - A nap can acutely improve alertness.
  - If immediately before or during a work period, limit nap to 45 minutes.
  - Nap can be longer at other times.
  - A nap will decrease the length of continuous wakefulness before a work period; some sleep is better than none.
  - A good time to nap is between the hours of 1-3 pm. Remember your circadian rhythms.

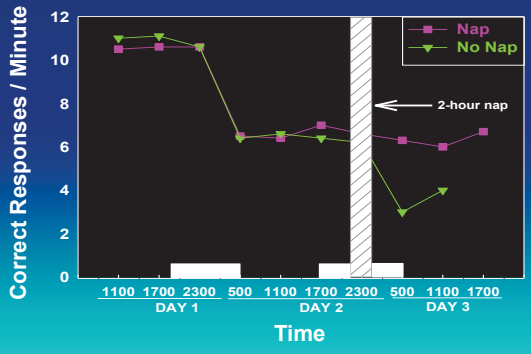
Take Advantage of Strategic Naps

- Naps can maintain or restore performance when sleep is shortened, disrupted, or missed altogether
- Naps ranging from 40 minutes to 2 hours are best, but even short naps (15-20 minutes) are better than nothing
- To implement naps:
  - **Create a quiet, dark, cool environment (mask out noise & light)**
  - **Plan naps at conducive sleep times (0100-0500 or 1400-1600)**
  - **Place naps early in the Sustained Ops period (or before sleep loss)**
  - **Set aside as much time as possible for the nap**
  - **Allow time for sleep inertia to dissipate**
- Naps can bridge the gap between regular sleep periods

Naps Can Temporarily Make Up for Lost Sleep







Source: Caldwell and Caldwell, 1998; Angus, et al., 1992

Two Approaches

- What you do at home…
- What you can do at work…

What Can Be Done?

- **Several strategies are potentially useful to overcome fatigue in the workplace**
  - **Avoidance of night work/Proper shift scheduling**
  - **Sufficient daily sleep**
  - **Strategic naps**
  - **Rest breaks**
  - **Exercise**
  - **Environmental stimulation**
  - **Physical fitness**

Operational Strategies: Napping

- **Take advantage of opportunities to nap.**
  - Research has shown that napping under controlled circumstances can be a very effective countermeasure to fatigue.
  - While a nap will not repay a "sleep debt," it will improve alertness.
  - Employees are not only allowed to nap; they are encouraged to do so (where and when authorized).

Operational Strategies

- **Use caffeine strategically.**
  - Use caffeine to acutely increase alertness.
  - Don't use it when already alert (e.g., start of work or after sleep).
  - Avoid caffeine near bedtime.

- **Be sensible about nutrition.**
- **Drink plenty of water.**

Caffeine Content

- Drip 115-175
- Espresso 100mg of caffeine 1 serving (1.5-2oz)
- Brewed 80-135
- Instant 65-100
- Decaf, brewed 3-4
- Decaf, instant 2-3
- Tea, iced (12 oz..) 70
- Tea, brewed, imported 60
- Tea, brewed, U.S. 40
- Tea, instant 30
- Mate 25-150mg

https://awakechocolate.com/

Best Practices

- **Minimize sequences of very late night or very early morning shifts no more than 2 to four nights in succession**
- **Avoid permanent shifts**
- **Avoid short intervals of off-time between shifts – at least 24hrs**
- **Avoid working both weekend days – plan some free weekends**
- **Avoid working every day of the week**
- **Consider working shorter shift periods for very late night or very early morning work**
- **If on a rotating shift schedule make sure it rotates forward**
- **Keep schedule as regular as possible**
- **Prepare for short shift changes**
- **Avoid relying on overtime**
- **Examine start and end times**
- **Consider shorter night shifts**

Fatigue Countermeasures

Fatigue Countermeasures Program (FCP) should consider, but is not limited to, the following:

a. Education and Training
b. Employee and Train Scheduling Practices (e.g., line-ups, calling times, work/rest cycles, relief-staffing, employee availability, shift predictability)
c. Emergency response requirements short-term (e.g., derailments) and extended (e.g., natural disasters)
d. Alertness strategies (e.g., napping, employee empowerment)
e. Evaluation of policies and procedures (e.g., effects on fatigue issues)
f. Rest environments (e.g., lodging)
g. Work environments
h. Implementation strategies and review of FCP program effectiveness.

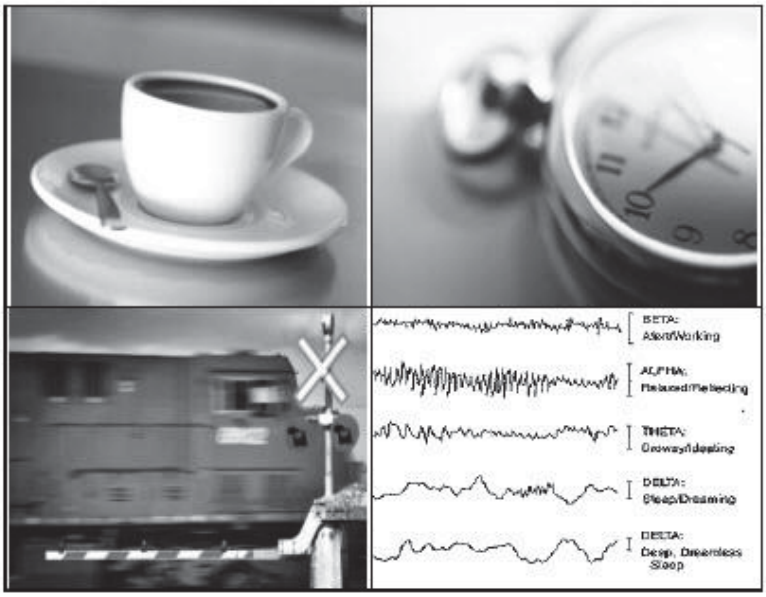
Recommendations

- FMPs - and a review process
- Time on duty should not exceed 12 hours
- No more than 4 consecutive 12h shifts in a 144 h period
- Need to get 8h sleep in a 24h period
- Min 2d off to recover from extended work schedules
- At LEAST 10h off between shifts
- Need more time to recover from consecutive night shifts

Summary and Conclusions

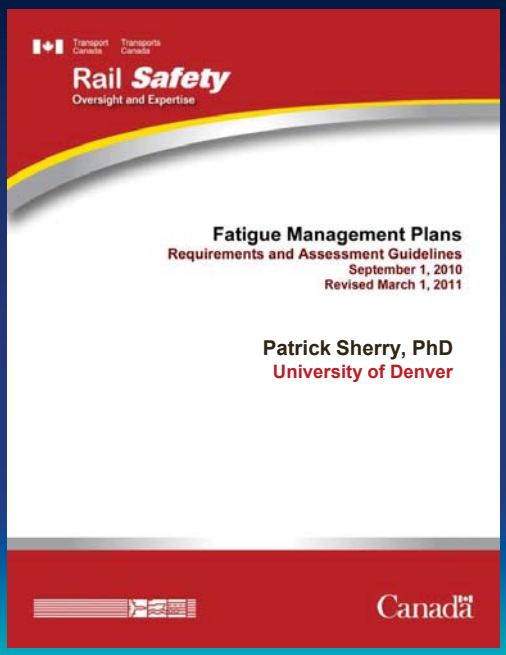
- Fatigue is a major contributor to accidents, lost productivity, and poor quality of life
- Remember, sleep is a physical necessity--not a luxury, and there is NO substitute for SLEEP!

Alertness Strategies for the Rail Industry: Managing the Challenges of 24-hour Operations



Edited by:
Patrick Sherry, Ph.D.
University of Denver

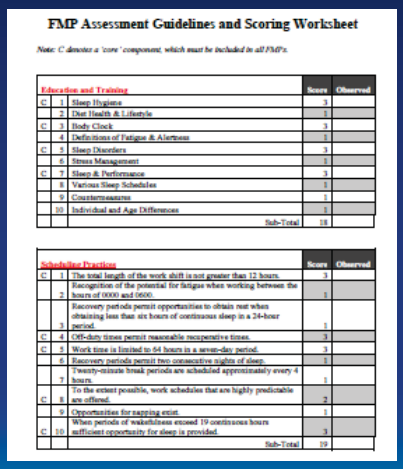
Fatigue Management Plan Guidelines



FMPs must address the key aspects of fatigue management programs in place within the railway as specified in the Canadian “Rail Safety Act: Work/Rest Rules”

https://www.tc.gc.ca/media/documents/railsafety/fatigue-mgmt.pdf

FMP Assessment Guidelines & Scoring Worksheet

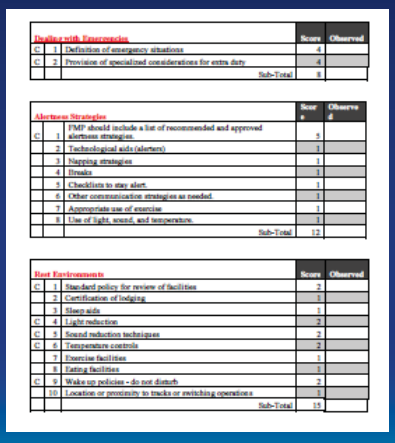


FMP Assessment Guidelines and Scoring Worksheet

Note: C denotes a 'core' component, which must be included in all FMPs.

		Education and Training	Score	Observed
C	1	Sleep Hygiene	3	
	2	Diet Health & Lifestyle	1	
C	3	Body Clock	3	
	4	Definitions of Fatigue & Alertness	1	
C	5	Sleep Disorders	3	
	6	Stress Management	1	
C	7	Sleep & Performance	3	
	8	Various Sleep Schedules	1	
	9	Countermeasures	1	
	10	Individual and Age Differences	1	
		Sub-Total	18	

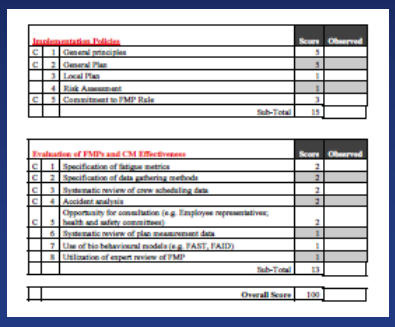
		Scheduling Practices	Score	Observed
C	1	The total length of the work shift is not greater than 12 hours.	3	
	2	Recognition of the potential for fatigue when working between the hours of 0000 and 0600.	1	
	3	Recovery periods permit opportunities to obtain rest when obtaining less than six hours of continuous sleep in a 24-hour period.	1	
C	4	Off-duty times permit reasonable recuperative times.	3	
C	5	Work time is limited to 64 hours in a seven-day period.	3	
	6	Recovery periods permit two consecutive nights of sleep.	1	
	7	Twenty-minute break periods are scheduled approximately every 4 hours.	1	
C	8	To the extent possible, work schedules that are highly predictable are offered.	2	
	9	Opportunities for napping exist.	1	
C	10	When periods of wakefulness exceed 19 continuous hours sufficient opportunity for sleep is provided.	3	
		Sub-Total	19	



		Dealing with Emergencies	Score	Observed
C	1	Definition of emergency situations	4	
C	2	Provision of specialized considerations for extra duty	4	
		Sub-Total	8	

		Alertness Strategies	Score	Observed
C	1	FMP should include a list of recommended and approved alertness strategies.	5	
	2	Technological aids (alerters)	1	
	3	Napping strategies	1	
	4	Breaks	1	
	5	Checklists to stay alert.	1	
	6	Other communication strategies as needed.	1	
	7	Appropriate use of exercise	1	
	8	Use of light, sound, and temperature.	1	
		Sub-Total	12	

		Rest Environments	Score	Observed
C	1	Standard policy for review of facilities	2	
	2	Certification of lodging	1	
	3	Sleep aids	1	
C	4	Light reduction	2	
C	5	Sound reduction techniques	2	
C	6	Temperature controls	2	
	7	Exercise facilities	1	
	8	Eating facilities	1	
C	9	Wake up policies - do not disturb	2	
	10	Location or proximity to tracks or switching operations	1	
		Sub-Total	15	



		Implementation Policies	Score	Observed
C	1	General principles	5	
C	2	General Plan	5	
	3	Local Plan	1	
	4	Risk Assessment	1	
C	5	Commitment to FMP Rule	3	
		Sub-Total	15	

		Evaluation of FMPs and CM Effectiveness	Score	Observed
C	1	Specification of fatigue metrics	2	
C	2	Specification of data gathering methods	2	
C	3	Systematic review of crew scheduling data	2	
C	4	Accident analysis	2	
C	5	Opportunity for consultation (e.g. Employee representatives; health and safety committees)	2	
	6	Systematic review of plan measurement data	1	
	7	Use of bio behavioural models (e.g. FAST, FAID)	1	
	8	Utilization of expert review of FMP	1	
		Sub-Total	13	
		Overall Score	100	

https://www.tc.gc.ca/eng/railsafety/guideline-631.htm

Scheduling Practices

Scheduling Practices:

Scheduling Practices			Score	Observed
C	1	The total length of the work shift is not greater than 12 hours.	3	
	2	Recognition of the potential for fatigue when working between the hours of 0000 and 0600.	1	
	3	Recovery periods permit opportunities to obtain rest when obtaining less than six hours of continuous sleep in a 24-hour period.	1	
C	4	Off-duty times permit reasonable recuperative times.	3	
C	5	Work time is limited to 64 hours in a seven-day period.	3	
	6	Recovery periods permit two consecutive nights of sleep.	1	
	7	Twenty-minute break periods are scheduled approximately every four hours.	1	
C	8	To the extent possible, work schedules that are highly predictable are offered.	2	
	9	Opportunities for napping exist.	1	
C	10	When periods of wakefulness exceed 19 continuous hours sufficient opportunity for sleep is provided.	3	
		Sub-Total	19	

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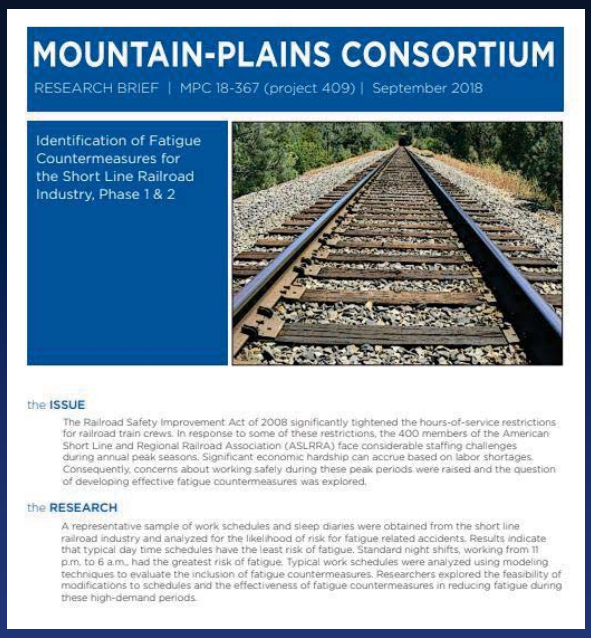

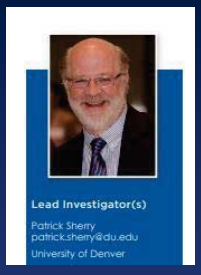

https://www.ugpti.org/resources/reports/downloads/mpc18-367-brief.pdf

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TRANSPORTATION LEARNING NETWORK

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and the Mountain-Plains Consortium Universities

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