The Science of Fatigue Management and Technology

Tennessee Trucking Association
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Overview

1. Sleep Biochemistry
2. Characteristics of Fatigue
3. Fatigue Management Program
4. Safety Culture
5. Sound Scheduling
6. Detection Technology
7. Sleep Disorders
8. Next Steps

Sleep Biochemistry



Poll

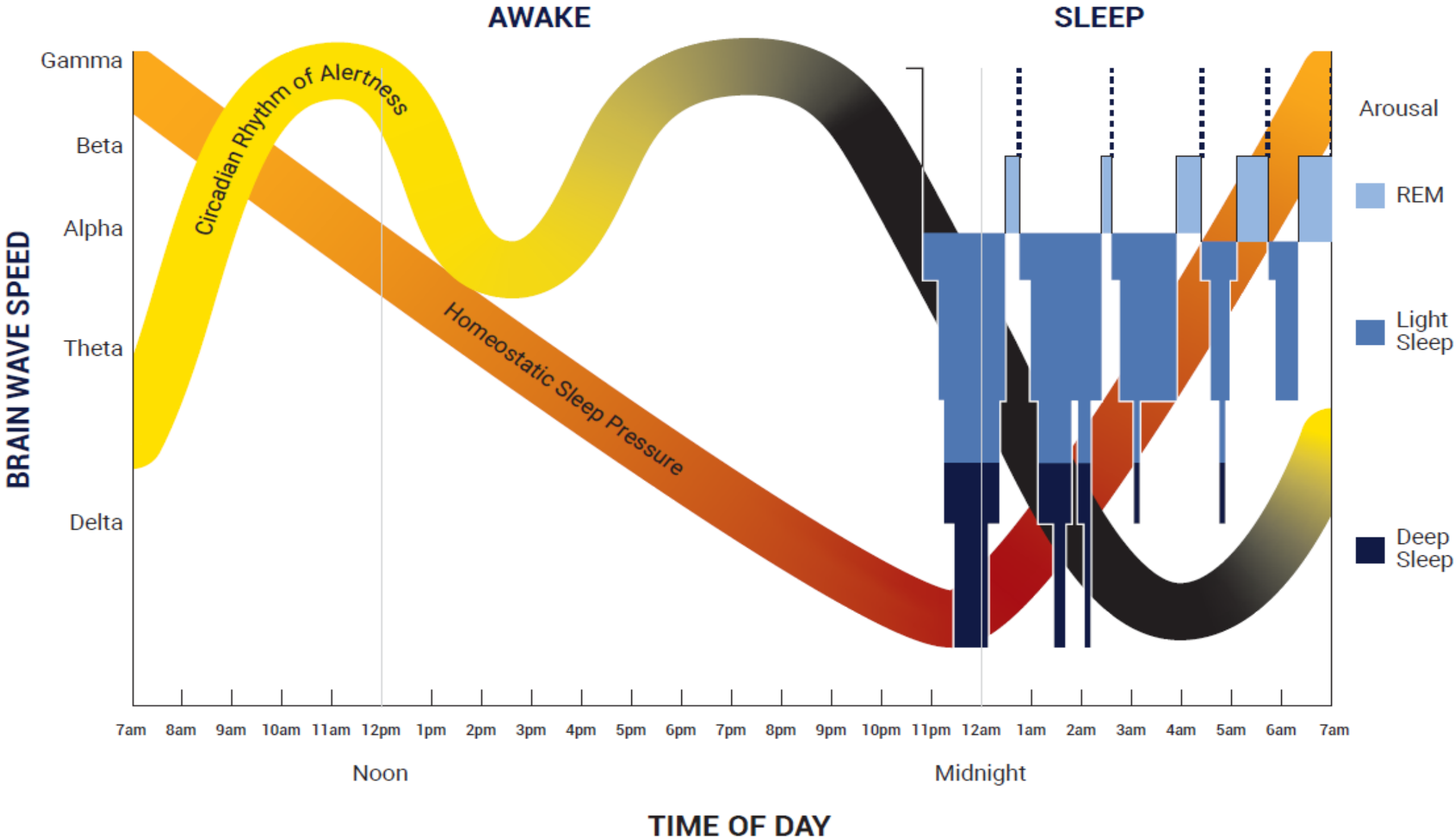
What will kill you faster?

A. No Sleep

B. No breathing

C. Starvation

D. Dehydration


AWAKE
SLEEP
Gamma
Beta
Alpha
Theta
Delta
BRAIN WAVE SPEED
Circadian Rhythm of Alertness
Homeostatic Sleep Pressure
Arousal
REM
Light Sleep
Deep Sleep
7am 8am 9am 10am 11am 12pm 1pm 2pm 3pm 4pm 5pm 6pm 7pm 8pm 9pm 10pm 11pm 12am 1am 2am 3am 4am 5am 6am 7am
Noon
Midnight
TIME OF DAY

Characteristics of Fatigue



Poll

Alertness and fatigue are like an on/off switch, you are either awake or asleep

A **True**

B **False**

Alertness Spectrum

Delta brain waves	Deep sleep	**1 to 4 Hertz**
Theta brain waves	Sleeping or daydreaming when awake	**4 to 8 Hertz**
Alpha brain waves	Awake and calm	**8 to 12 Hertz**
Beta brain waves	Awake, alert, busy, and focused	**12 to 38 Hertz**
Low beta waves	Thinking	12 to 15 Hertz
Beta waves	Performing or focusing	15 to 22 Hertz
High beta waves	Excited or anxious	22 to 38 Hertz
Gamma brain waves	Highly alert and consciousness	**30 to 80 Hertz**

Poll

The only cause of fatigue is insufficient sleep

A **True**

B **False**

Alertness Has Supply & Demand

Supply Factors

Internal individual susceptibility: circadian rhythm, amount of sleep, time of day, time awake, stimulants, other drugs, health, genes, mood



Demand Factors

Task related: Time on task, task complexity, task monotony

Environmental: Road conditions, weather, stress (heat, noise, vibration), vehicle design, social interaction, other stimulation

Poll



In truck/bus crash statistics, driver fatigue is…

A. The number 1 cause

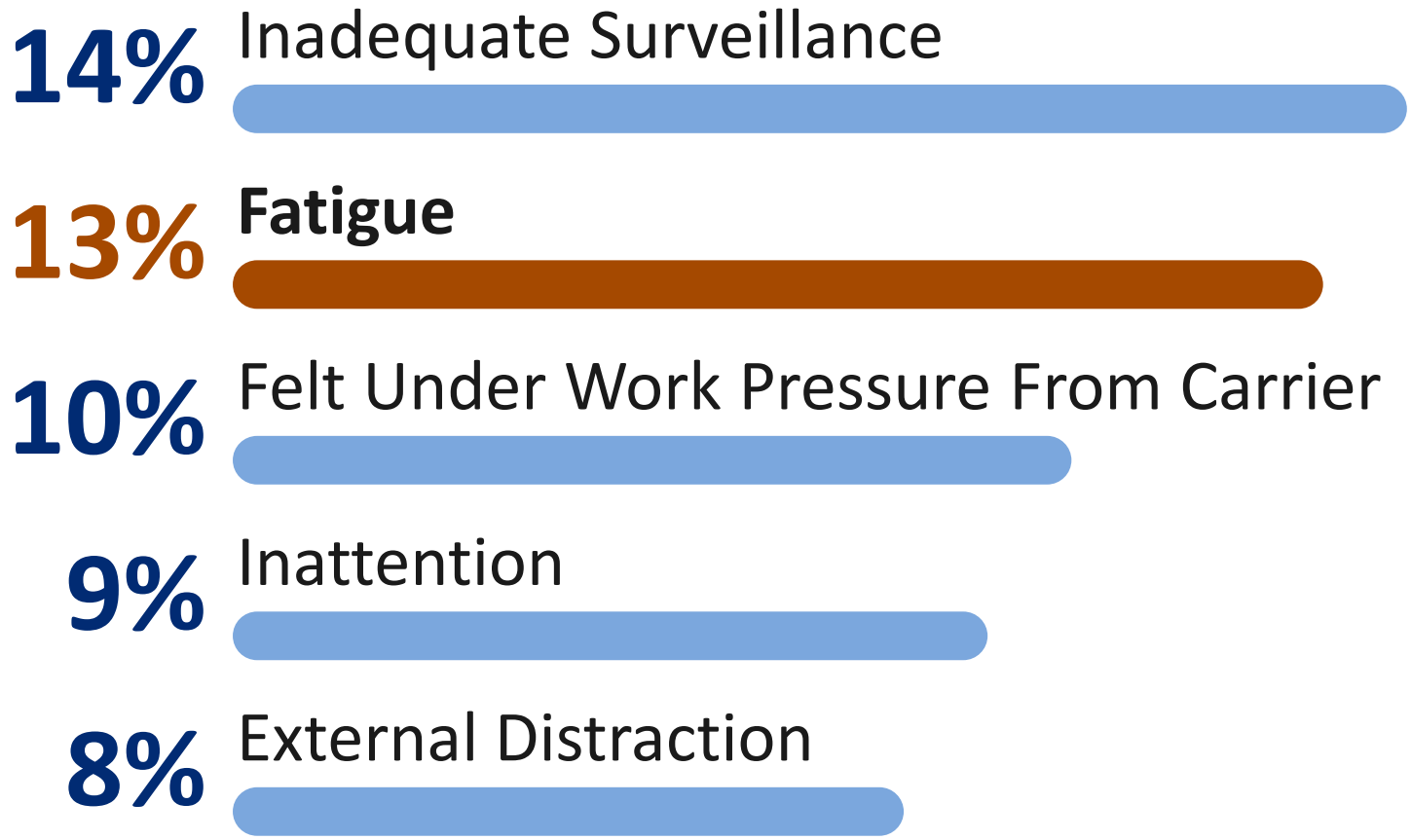
B. Not a significant cause

C. Underrepresented

Crash Causation: 87% Driver Related

Non-Performance	Driver fell asleep, was disabled by heart attack or seizure or physically impaired for another reason
Recognition	The driver was inattentive, distracted by something inside or outside the vehicle or failed to observe the situation adequately for some other reason
Decision	Driver was driving too fast for conditions, misjudged the speed of other vehicles or followed other vehicles too closely
Performance	Driver panicked, overcompensated or exercised poor directional control

Crash Causation Associated Factors



54%

Total: Crashes where diminished vigilance was involved

Source: FMCSA Large Truck Crash Causation Study

NTSB Report

30–40%

Research has suggested that CMV driver fatigue is a contributing factor in 30 to 40 percent of all CMV crashes

> "The Safety Board believes that the incidence of driver fatigue is underrepresented in FARS in general and in FARS specifically with regard to CMV drivers

NTSB Report: Factors That Affect Fatigue In Heavy Truck Accidents

Volume 1: Analysis Volume 2: Case Summaries

CMV Driving Worsens Fatigue

- Tight schedule to get enough sleep
- Unfamiliar & uncomfortable sleep locations
- Extended work hours + commuting
- Sleep disruptions
- Changing work schedules
- Difficulty finding nutritious food on the road
- Work/sleep periods conflict with circadian rhythm
- Limited opportunities for exercise
- Limited time for rest & naps
- Personal, work and environmental stressors



Why manage fatigue?

Fiduciary Duty for Lifetime Earnings and Profits

Lower Fatigue Related Crashes

Lower Legal Liability Exposure

Cost Reduction

- Driver retention
- Medical costs
- Maintenance

Labor Force

- Safer
- More productive
- Healthier & happier

Articles: Nailing the Top Ten Industry Issues through Fatigue Management

Part One Part Two

Silent Killer of Drivers and Profits



Fatigue is a physiological state that forces the brain to prioritize survival over demanding cognitive functions

Fatigue Management Program



Fatigue Management Program (FMP)

Safety Culture

1) Education
2) Training
3) Continuous communications – Including partnerships

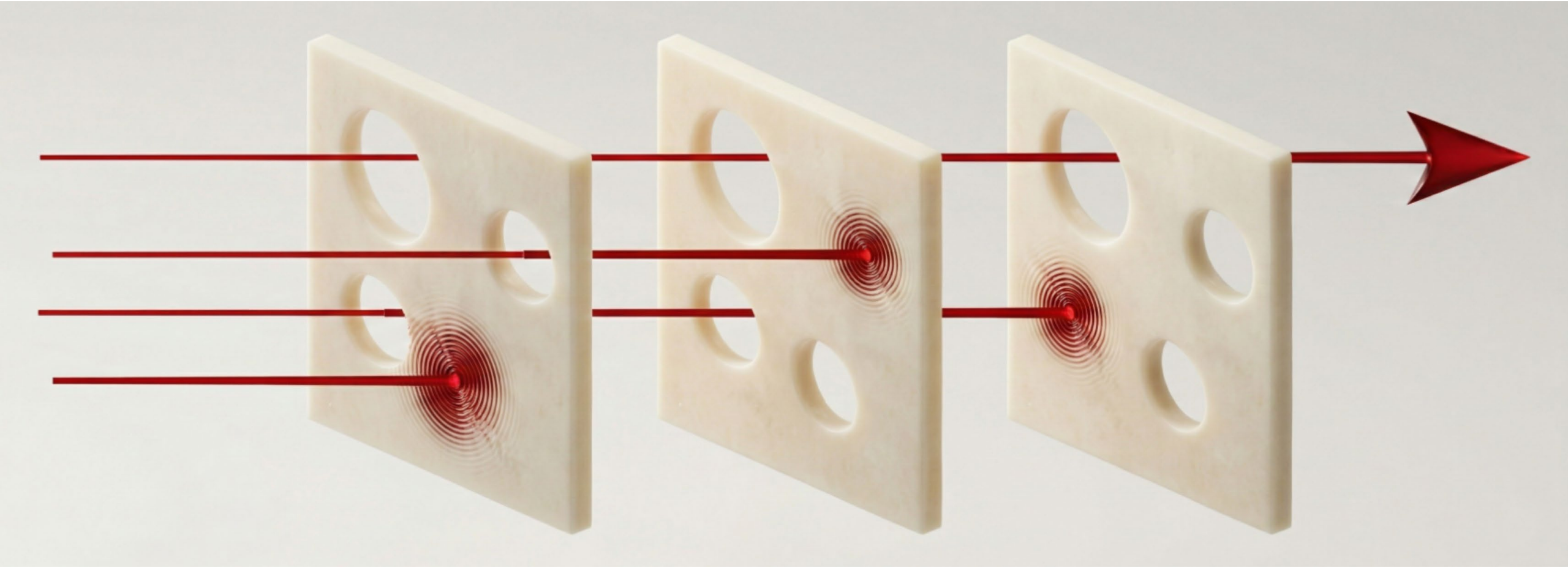
Fatigue Risk Management System

1) Operations
2) Identify risks with processes and controls
   - Predictive, proactive, reactive
   - Sound scheduling, sleep disorders management program, fatigue detection technologies
3) Risk assessment
4) Measures and countermeasures
5) Evaluation

RESOURCES

FMP Template | Module 2: Safety Culture and Management Practices Implementation Manual

The Swiss Cheese Model



Swiss Cheese Layer:

Safety Culture



Safety Culture

Knowledge

Skills

Attitudes

Behavior Change

Elimination of Stigmas

Education & Training Courses

eLearning Platform & PowerPoint Downloads

Motor carrier executives and managers

Module 1 (Intro), 2 (Safety Culture), 7 (Sleep Disorders), 10 (Technologies)

Motor carrier trainers

Module 5 (Train-the-Trainer)

Motor carrier dispatchers and driver managers

Module 9 (Scheduling)

Freight Shippers, Receivers, Brokers

Module 6 (Role of shippers & receivers on driver safety)

Drivers

Module 3 (Driver Ed), 8 (Sleep Disorders) & 9 (Scheduling)

Driver Families

Module 4 (Family Ed)

Wellness Affects All Body Systems

Messaging
Nervous · Endocrine · Immune · Reproductive

Plumbing
Respiratory · Cardiovascular · Digestive · Urinary

Support
Skeletal · Muscular · Integumentary

Sleep Hygiene
Webinar

Positive Relationships
Webinar

Mindfulness
Webinar

Nutrition
Webinar

Exercise
Webinar

Objective Signs of Fatigue

1. Eyelid drop or loss of focus
2. Yawning
3. Wandering, scattered or disjointed thoughts, dreamlike visions
4. Head movements, gentle swaying, jerking
5. Reduced field-of-view (AKA: tunnel vision, highway hypnosis, white line fever)
6. Fidgeting, shifting positions, adjusting windows & HVAC
7. Progressive weaving, crossing rumble strip, drift and jerk steering
8. Delayed or incorrect responses



9 Microsleeps

Fatigue Management Strategies

- General
- At home
- On the road
- Night driving
- Changing time zones
- Team driving

MODULE 3 Driver Education

More on Safety Culture

WEBINAR

Safety Culture: Transforming Fatigue Management from a Liability into a Competitive Advantage

ARTICLE

Don’t Stay in the Expensive Blind Spot of Stigmas

ELEARNING MODULE

Module 2: Safety Culture and Management Practices

Swiss Cheese Layer:

Sound Scheduling and Routing Practices



Scheduling Practices

- ✓ Sound scheduling and routing
- ✓ Time of day, recent sleep, continuous hours awake, cumulative sleep debt
- ✓ Shared responsibility mitigating driver fatigue in work schedules
- ✓ Regular schedules
- ✓ Forward vs backward scheduling

- ✓ Consider travel time to employment location
- ✓ Consider rests and naps during work shift
- ✓ Maximum of 16 hrs. per day or less
- ✓ Maximize benefits of scheduling tools
- ✓ Develop customized strategies for managing fatigue

Scheduling

WEBINAR

The Scheduling Puzzle: Sleep Science and Driver Fatigue

ELEARNING MODULE

Module 9: Driver Scheduling and Tools

Swiss Cheese Layer:

Sleep Disorder Management



Fatigue Susceptibility

Sleep Deprivation

- Sleep-related behaviors
- Sleep hygiene

Individual Differences

- Genetic variations
- Health & fitness

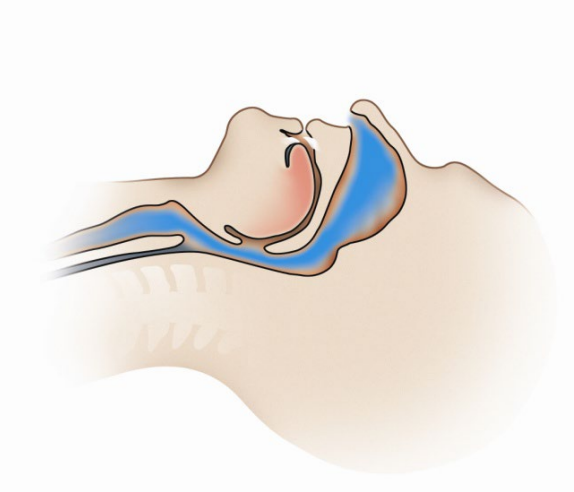
Medical Conditions

- Medications
- **Sleep disorders:** Insomnia, narcolepsy, restless leg syndrome, sleepwalking, abnormal circadian rhythms, obstructive sleep apnea (OSA)

Obstructive Sleep Apnea

Apnea = stoppage of breathing lasting 10+ seconds

OSA = breathing stops repeatedly during sleep due to closures of the upper airway



Apnea rate per hour:

<5 = normal

≥5 = OSA

OSA severity (mild, moderate, severe) based on rate

100

Some people with severe OSA can have 100 per hour



Sleep Disorders Management Program



Education **Screening** **Testing** **Treatment** **Monitoring**

More on Sleep Disorders Management

WEBINAR

Guide to Establishing a Sleep Disorders Management Program

ELEARNING MODULE

Module 7: Motor Carrier Sleep Disorders Management

ELEARNING MODULE

Module 8: Driver Sleep Disorders Management

Swiss Cheese Layer:

Fatigue Detection Technologies



Fatigue Management Technologies Types

1. Scheduling & Trip Planning
2. Fitness for Duty Testing
3. Performance Monitoring
4. Driver Monitoring

More on Fatigue Detection Technology

WEBINAR

The Alertness Toolkit – A Motor Carrier's Guide to Fatigue Management Technologies

WEBINARS

Solution Series Webinars

ELEARNING MODULE

Module 10: Fatigue Monitoring and Management Technologies

Technology Catalog Sources

2024

Good-Practice Guidance – To support industry uptake of rapidly emerging Fatigue and Distraction Detection Technologies (FDDT)

By Australia's National Heavy Vehicle Regulator (NHVR)

2020

Review of Commercially Available Devices to Detect Fatigue and Distraction in Drivers

By Institute for Road Safety Research in the Hague, Netherlands

2019

Commercial Motor Vehicle Operator Fatigue Detection Technology Catalog and Review

By National Surface Transportation Safety Center for Excellence

Fatigue Technology Best Practices

1. Must be integrated into overall FMP
2. Take full advantage of the technology capabilities
3. Develop well-defined protocols
4. Explain the role of technology to drivers
5. Create meaningful driver expectations
6. Present consistent and detailed feedback to drivers
7. Maintain a positive atmosphere
8. Reinforce that safety is everyone's responsibility

Next Steps



NAFMP

North American Fatigue Management Program

nafmp.org

NAFMP Website Free Resources

Tools

- FMP Template
- Implementation Manual
- ROI Calculator

Podcast

- The NAFMP Pod
- Available from eight platforms

Courses

- eLearning Platform
- PowerPoints with and without audio
- For carrier's executives, safety managers, dispatchers, instructors, drivers, driver's families, shippers & receivers

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Connect with me to coordinate a free fatigue management session or course for your organization



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Scan vCard and add me to your contacts



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