



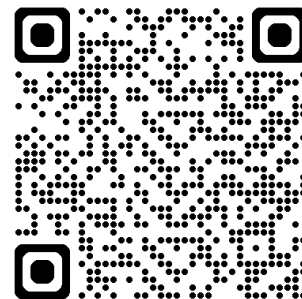
The Hidden Cost of Fatigue: Building Schedules That Protect Drivers and Profits

Wisconsin Motor Carriers Association Convention

Delavan, Wisconsin

September 10, 2026

Get this slide deck at NAFMP.org/events

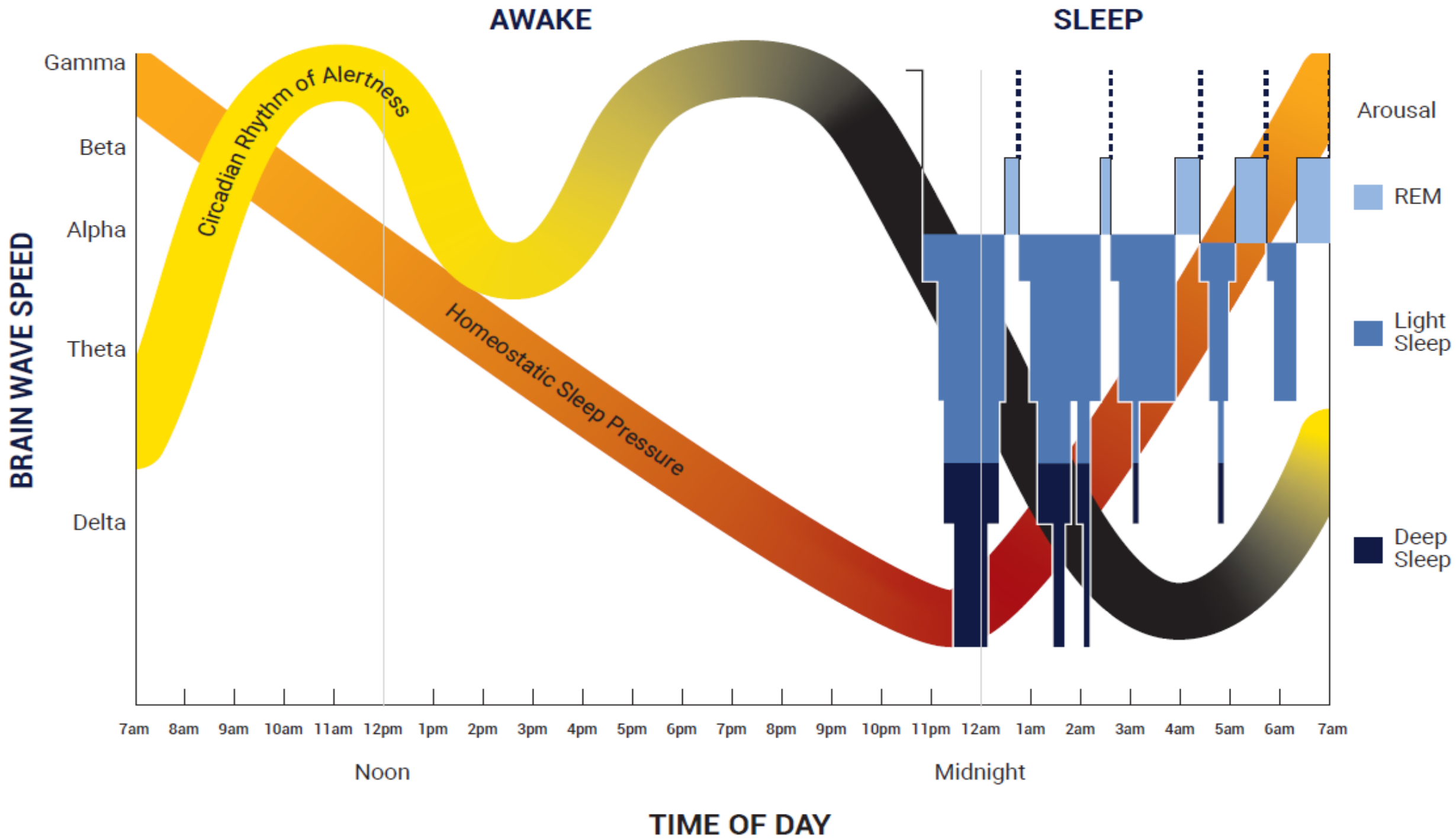


1. Sleep Biochemistry
2. Killer Schedules
3. Characteristics of Fatigue and Its Silent Costs
4. Fatigue Management Program (FMP)
 1. Safety Culture
 2. Fatigue Risk Management System (FRMS)
 1. Sound Scheduling
 2. Detection Technology
 3. Sleep Disorders
5. Next Steps

Sleep Biochemistry

What will kill you faster?

- No Sleep
- No breathing
- Starvation
- Dehydration



Killer Schedules

Crash 1 - Facts



- At 1:48 a.m. July 12 2023, a motorcoach carrying 21 people veered off Interstate 70 near Highland, Illinois, colliding with three parked combination vehicles
- Three passengers died
- The driver and 11 other passengers sustained injuries of varying severity

Source: NTSB

<https://www.nts.gov/investigations/Pages/HWY23MH015.aspx>



Schedule

Source: NTSB

Date	Central Daylight Time																							
	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
Wednesday, June 14, 2023																								
Thursday, June 15, 2023																								
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Monday, July 10, 2023																								
Tuesday, July 11, 2023																								
Wednesday, July 12, 2023																								

Legend

On-duty

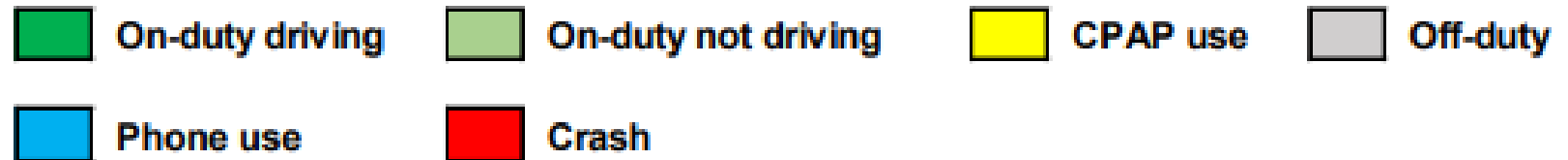
Day off

Schedule



Source: NTSB Date	Central Daylight Time																							
	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
Sunday, July 9, 2023	CPAP use	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty	Off-duty
Monday, July 10, 2023	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use
Tuesday, July 11, 2023	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use
Wednesday, July 12, 2023	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use	CPAP use

Legend



Crash 2 - Facts



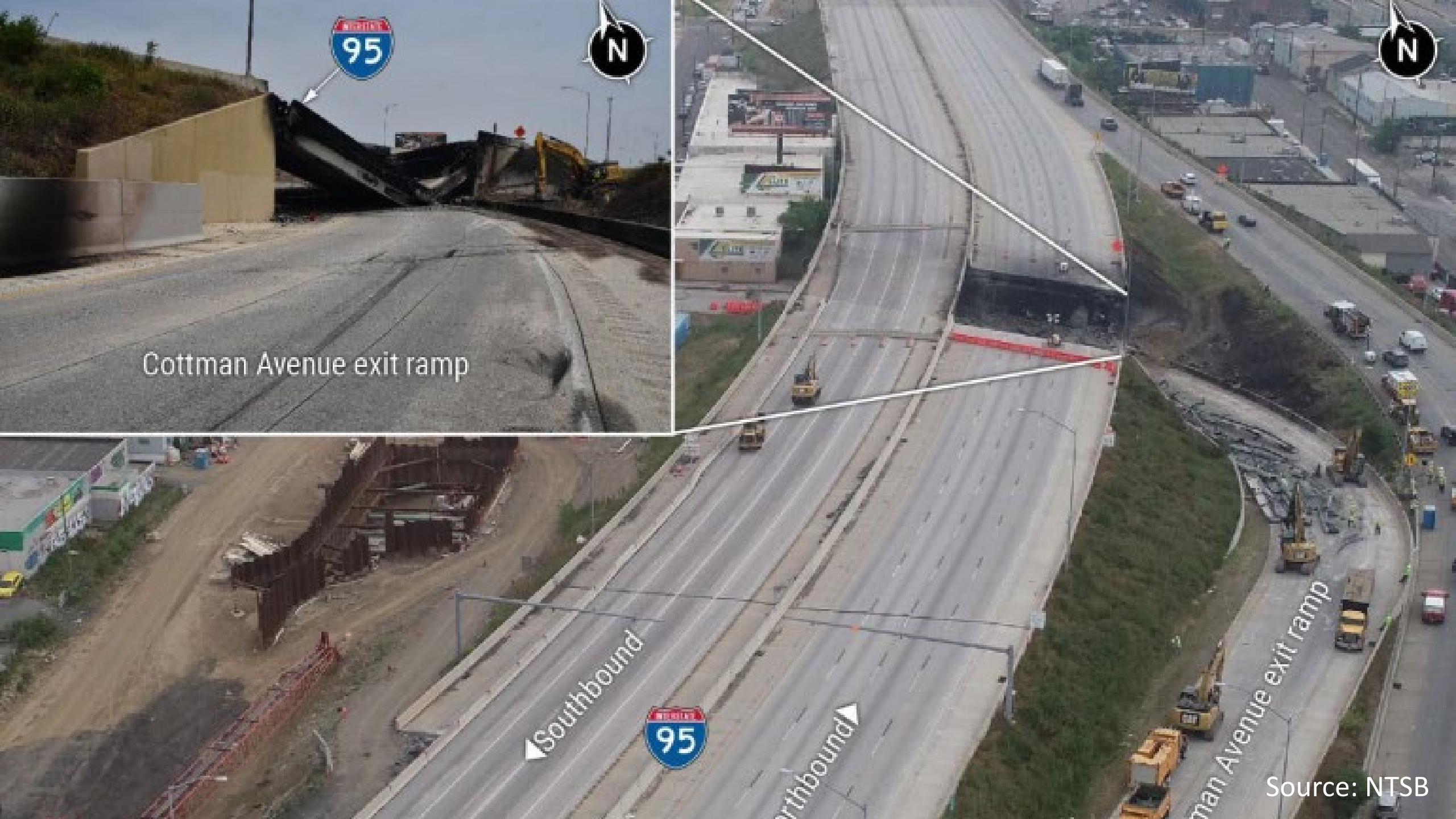
- At 6:17 a.m. June 11 2023, a truck-tractor with a tank trailer carrying 8,500 gallons of gasoline crashed while exiting northbound I-95 in Philadelphia, Pennsylvania
- The driver lost control on a curved exit ramp, causing the truck to overturn and strike a concrete barrier
- The resulting fire destroyed the truck, caused the collapse of northbound I-95 lanes and fatally injured the truck driver

Source: NTSB

<https://www.nts.gov/investigations/Pages/HWY23FH014.aspx>



Cottman Avenue exit ramp



Source: NTSB

Schedule



Source: NTSB Date	Eastern Daylight Time																							
	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
Thursday, June 8, 2023	Phone use			Phone use	Phone use		Phone use	Phone use	Phone use	Phone use	Phone use	Phone use				Phone use			Phone use					
Friday, June 9, 2023									Phone use			Phone use	Phone use	Phone use	Phone use		Phone use							
Saturday, June 10, 2023									Phone use		Phone use		Phone use	Phone use	Phone use	Phone use						Phone use		
Sunday, June 11, 2023	On-duty						Crash																	

Legend



Crash 3 - Facts



- At 6 a.m. Jan. 28 2023, a bus and a box truck collided head-on on New York State Route 37 in Louisville, New York
- The truck crossed the centerline striking the bus, which was transporting workers to a construction site
- This crash resulted in six fatalities, two serious injuries and five minor injuries among the bus passengers, along with minor injuries to the bus driver and serious injuries to the truck driver

Source: NTSB

<https://www.nts.gov/investigations/Pages/HWY23FH005.aspx>



Source: NTSB

Schedule



Source: NTSB

Date

Eastern Time

AM PM

12:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00

Wednesday, January 25

Thursday, January 26

Friday, January 27

Saturday, January 28

— Crash

Legend

Off-duty

On-duty

Phone use

Delivery stops

Crash 4 - Facts



- At 1:36 a.m. Dec. 16 2022, a truck-tractor with a semitrailer crashed into the rear of a slower-moving bus on Interstate 64 near Williamsburg, Virginia
- The truck, traveling between 65 and 70 mph with cruise control, did not brake before impact, while the bus was moving at 20 to 25 mph
- The collision resulted in the deaths of three bus occupants, serious injuries to nine bus occupants and the truck driver, and minor injuries to 11 bus occupants

Source: NTSB

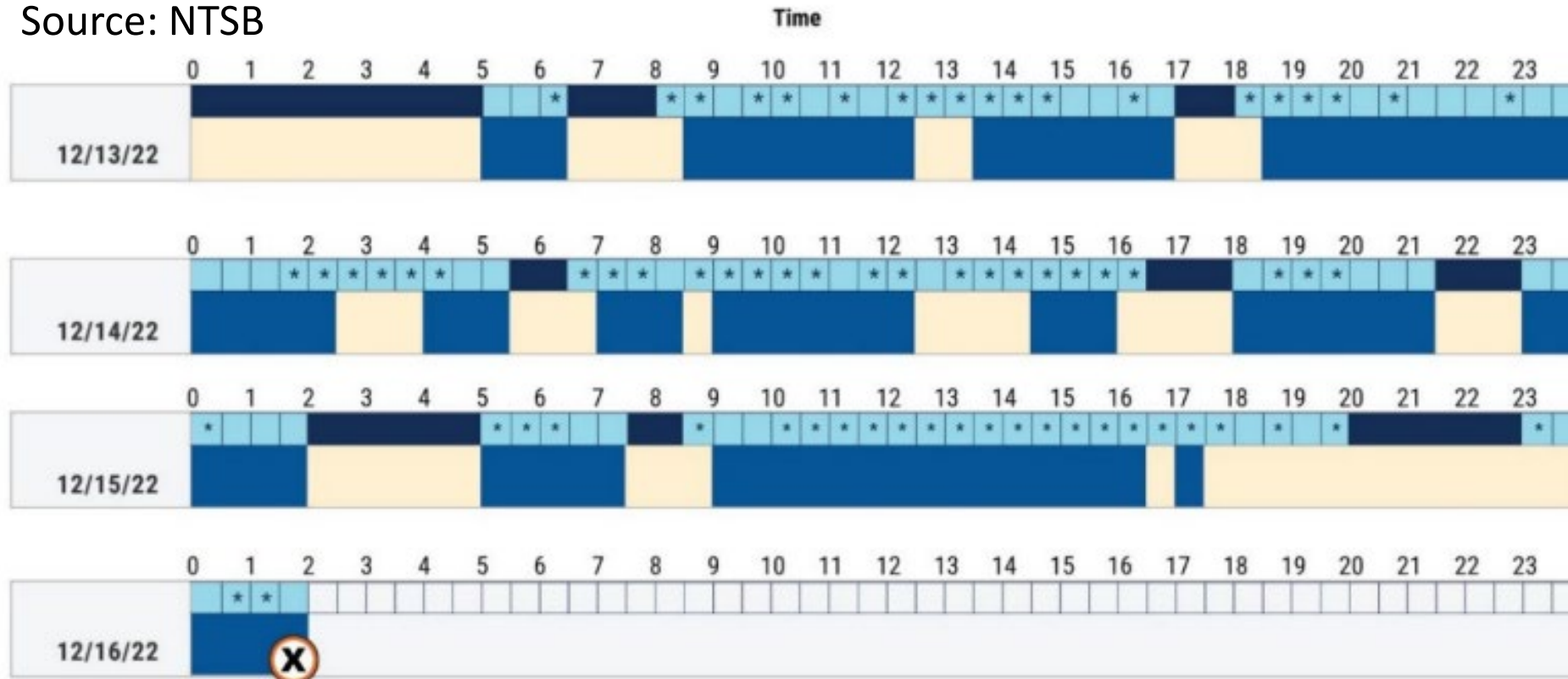
<https://www.nts.gov/investigations/Pages/HWY23MH004.aspx>



Source: NTSB

Schedule

Source: NTSB



Key

* = cell activity in period

■ = driver activity

■ = sleeper berth

■ = sleep opportunity

■ = awake

Source: NTSB

ⓧ = CRASH

Crash 5 - Facts



- At 10:07 p.m. June 9 2021, a truck-tractor with a tank trailer crashed into a queue of stopped passenger vehicles on SR-202 in Phoenix, Arizona
- Traveling at 62-64 mph without slowing or steering, the truck initiated a chain-reaction collision involving seven other vehicles
- The crash resulted in four fatalities and 11 injuries among passenger vehicle occupants, with the truck-tractor and one car consumed by fire

Source: NTSB

<https://www.nts.gov/investigations/Pages/HWY21MH008.aspx>



Source: NTSB



Source: NTSB



Source: NTSB



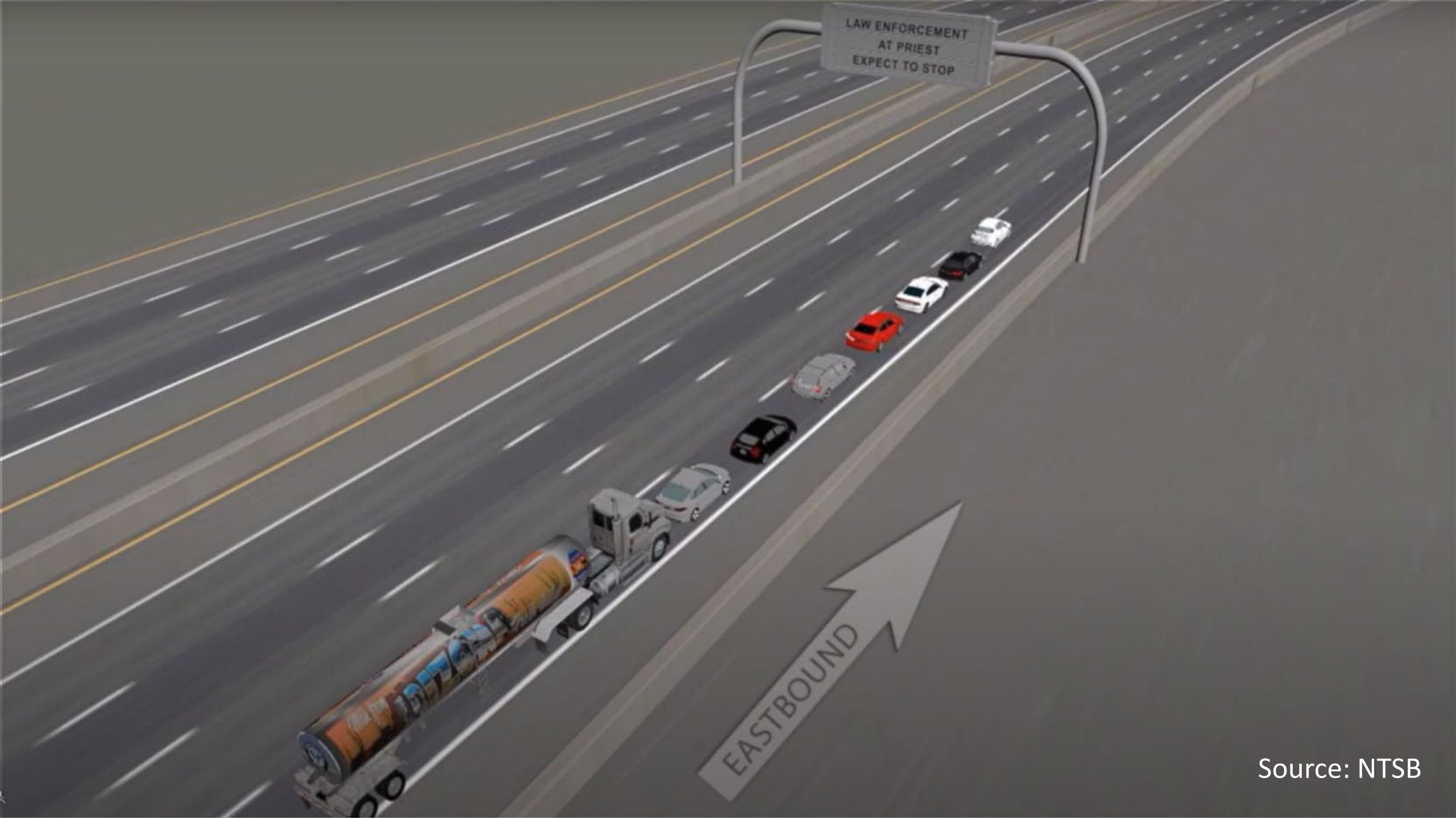
Source: NTSB



TIME -0.25

62 MPH 100 km/h

Source: NTSB



Source: NTSB



Fatally injured: 4 persons
Hospitalized: 11 persons

Source: NTSB



Source: NTSB

Schedule



Source: NTSB

Mountain Standard Time

Date

12:00 a.m.

1:00

2:00

3:00

4:00

5:00

6:00

7:00

8:00

9:00

10:00

11:00

12:00 p.m.

1:00

2:00

3:00

4:00

5:00

6:00

7:00

8:00

9:00

10:00

11:00

Sunday, June 6

Monday, June 7

Tuesday, June 8

Wednesday, June 9

Legend:



On-duty



Off-duty
(Sleep Opportunity)



Off-duty
(Not Sleeping)



Commute



Phone use
outside on-duty times



Crash

Crash 6 - Facts



- At 6:45 a.m. June 12 2020, a truck-tractor with a semitrailer struck the end of a slowed and stopped traffic queue on Interstate 39 near Arlington, Wisconsin, which had formed due to prior collisions
- This initiated an eight-vehicle crash that resulted in four fatalities and three serious injuries

Source: NTSB

<https://www.nts.gov/investigations/Pages/HWY20FH006.aspx>

Peterbilt
truck-tractor

Mack truck

Freightliner
truck-tractor

VW sedan

Kia SUV

Source: NTSB



Characteristics of Fatigue

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

- True
- 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

The only cause of fatigue is insufficient sleep

- True
- 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

In truck/bus crash statistics, driver fatigue is...

- The number 1 cause
- Not a significant cause
- 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



- 14% Inadequate Surveillance
- 13% Fatigue
- 10% Felt Under Work Pressure From Carrier
- 9% Inattention
- 8% External Distraction
- **54% Total: Crashes where diminished vigilance was involved**

[FMCSA Large Truck Crash Causation Study](#)

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

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
- Extended work hours + commuting
- Changing work schedules
- Work/sleep periods conflict with circadian rhythm
- Limited time for rest & naps
- Unfamiliar & uncomfortable sleep locations
- Sleep disruptions
- Difficulty finding nutritious food on the road
- Limited opportunities for exercise
- 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](#)

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

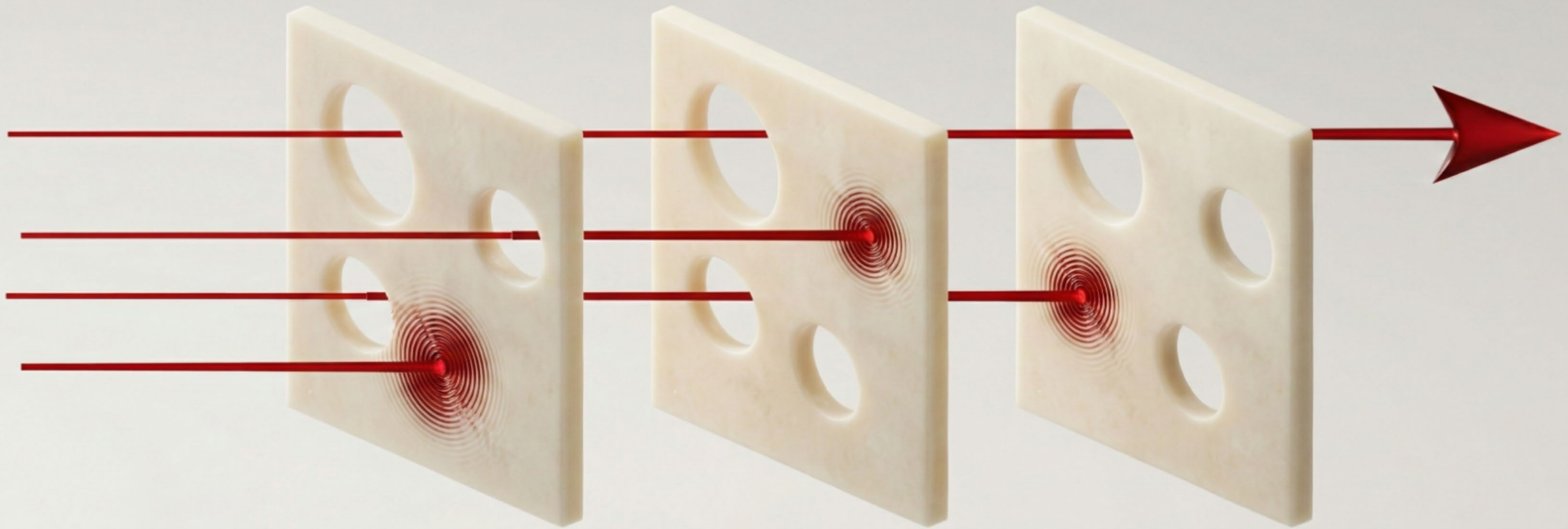
- 1) Operations
- 2) Identify risks with processes and controls
 - Predictive, proactive, reactive
 - Sound scheduling, sleep disorders management program, fatigue detection technologies
- 3) Risk assessment
- 4) Measures and countermeasures
- 5) Evaluation

[FMP Template](#)

[Module 2: Safety Culture and Management Practices](#)

[Implementation Manual](#)

The Swiss Cheese Model

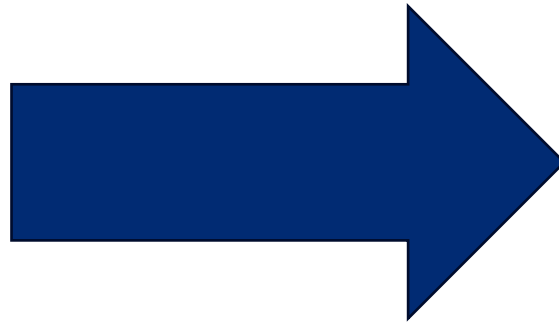


Swiss Cheese Layer: Safety Culture

Safety Culture



- Knowledge
- Skills
- Attitudes



- ✓ Behavior Change
- ✓ Elimination of Stigmas

Education & Training Courses



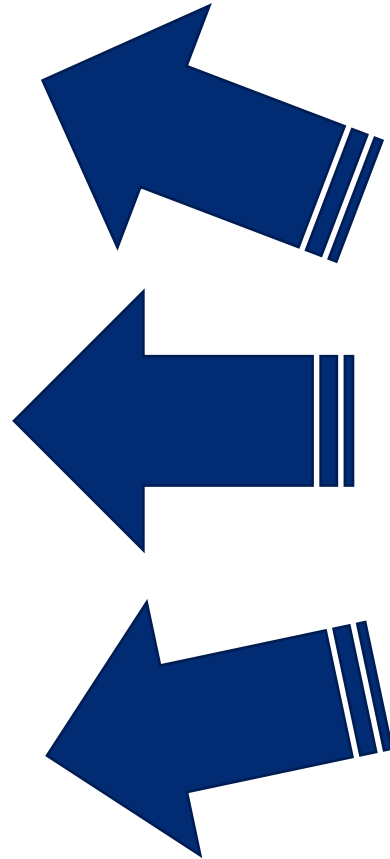
eLearning Platform & PowerPoint Downloads

- 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



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

Webinar: The Scheduling Puzzle: Sleep Science and Driver Fatigue

Module 9: Driver Scheduling and Tools

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](#)
- [Solution Series Webinars](#)
- [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

Swiss Cheese Layer: Sleep Disorder Management

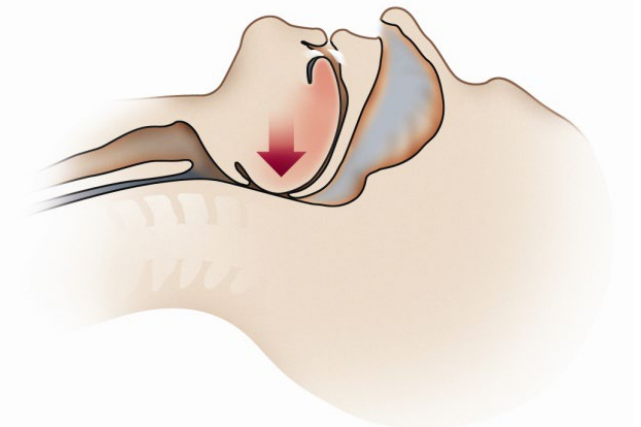
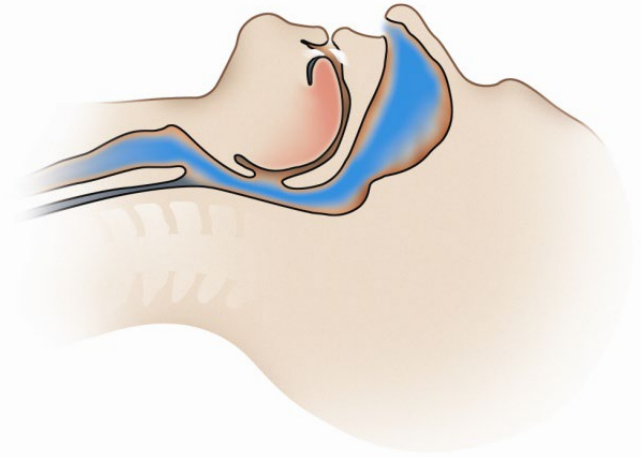
Fatigue Susceptibility



- 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
- Some people with severe OSA can have 100 per hour



Sleep Disorders Management Program



1. Education
2. Screening
3. Testing
4. Treatment
5. Monitoring

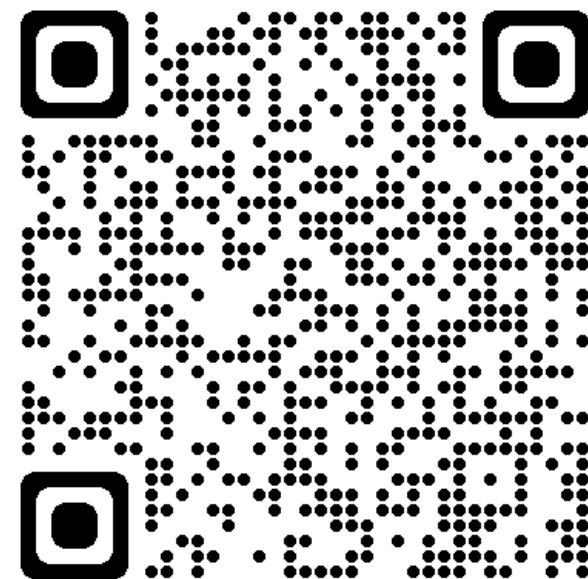
More on Sleep Disorders Management

- [Webinar: Guide to Establishing a Sleep Disorders Management Program](#)
- [Module 7: Motor Carrier Sleep Disorders Management](#)
- [Module 8: Driver Sleep Disorders Management](#)

Next Steps



nafmp.org



NAFMP Website Free Resources



- Tools
 - FMP Template
 - Implementation Manual
 - ROI Calculator
- Courses
 - eLearning Platform
 - PowerPoints with and without audio
 - For carrier's executives, safety managers, dispatchers, instructors, drivers, driver's families, shippers & receivers
- Webinars, Info Sessions & Articles
 - Gallery
 - List
 - Categories
 - Sign up for article notifications
- Podcast
 - The NAFMP Pod
 - Available from eight platforms
- Events
 - Download individual event
 - Subscribe to Calendar of future events

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



Rodolfo Giacomani

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Commercial Vehicle Safety Alliance

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Scan vCard and add me to your contacts





CVSA[®]

Get this slide deck at NAFMP.org/events

