Commercial Motor Vehicle Driver Fatigue, Long-term Health, and Highway Safety: An Overview

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The NAS Panel

- FMCSA funded National Academy of Sciences to form Panel on Research Methodology and Statistical Approaches to Understanding Driver Fatigue Factors in Motor Carrier Safety and Driver Health

- The charge to the panel:

  "… to assess the state of knowledge about the <u>relationship of such factors</u> as hours of driving, hours on duty, and periods of rest to the <u>fatigue</u> experienced by truck and bus drivers while driving and the implications for the <u>safe operation of their vehicles</u>. The panel will also assess the relationship of these factors to <u>drivers' health</u> over the longer term. It will identify improvements in data and research methods that can lead to better understanding in both areas."
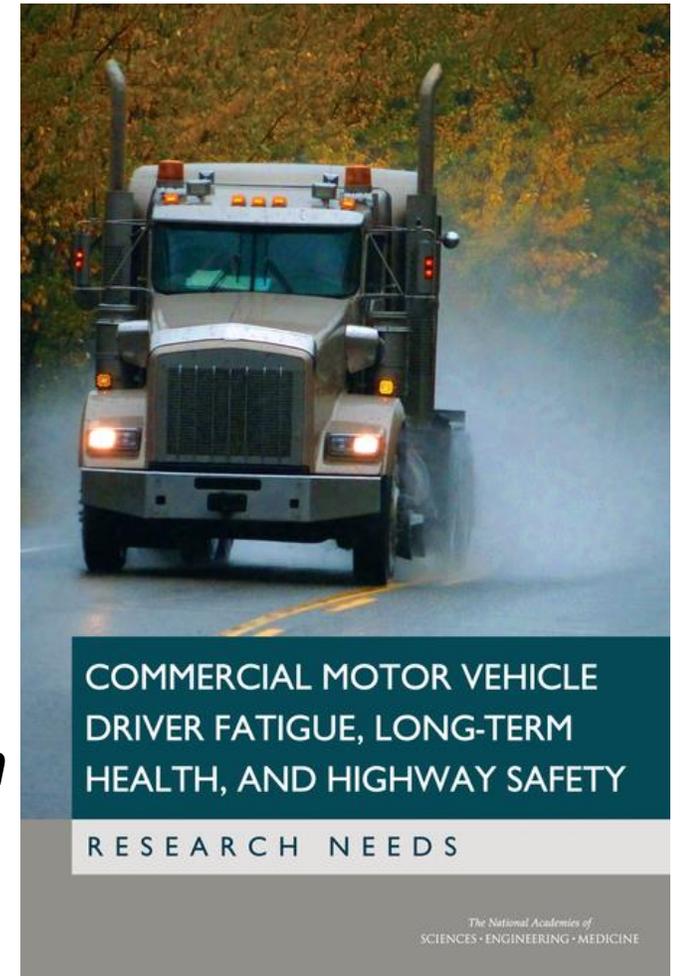
Panel Members

Matthew Rizzo (co-chair): Neurological Sciences, University of Nebraska Medical Center

Hal S. Stern (co-chair): Statistics, University of California, Irvine

Daniel Blower, University of Michigan Transportation Research Institute

Charles A. Czeisler, Brigham and Woman's Hospital, Harvard Medical School

David F. Dinges, Psychiatry, University of Pennsylvania School of Medicine

Joel B. Greenhouse, Statistics, Carnegie Mellon Univ.

Feng Guo, Statistics, Virginia Tech University

Richard J. Hanowski, Virginia Tech Transportation Institute, Virginia Tech University

Natalie P. Hartenbaum, Occumedix, Inc.

Gerald P. Krueger, Krueger Ergonomics Consultants

Melissa M. Mallis, M3Alertness Management, LLC

John R. Pearson, Council of Deputy Ministers (Canada) Responsible for Transp. & Highway Safety

Dylan S. Small, Statistics, University of Pennsylvania

Elizabeth A. Stuart, Mental Health and Biostatistics, Johns Hopkins University

David H. Wegman, Work Environment, University of Massachusetts, Lowell

Table of Contents of the Report

Background

- Chapter 1 – Introduction (overview, including charge)
- Chapter 2 – The Truck and Bus Industries
- Chapter 3 – Consequences of Fatigue from Insufficient Sleep
- Chapter 4 – Hours of Service Regulations

Current Research Data and Methods

- Chapter 5 – Data Sources
- Chapter 6 – Research Methodology and Principles: Assessing Causality

Current Research Findings (includes 18 conclusions)

- Chapter 7 – Fatigue, Hours of Service, and Highway Safety
- Chapter 8 – Fatigue and Health and Wellness
- Chapter 9 – Technological Countermeasures for and Corporate Management of Fatigue

Research Directions (includes 13 recommendations)

- Chapter 10 – Research Directions for Fatigue and Highway Safety
- Chapter 11 – Research Directions for Studying the Impact of Fatigue on CMV Drivers' Health and Wellness

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Complexity of the Issues

- Factors associated with crash risk

Predictor domain	Sample predictors / variables	Possible data sources	Outcome variables
Driver	Demographics, health, sleep history, medications, experience, safety record, exposure	Bureau of Labor Stats. Driver surveys	- Crash rate - Serious crash rate - Fatal crash rate - SCE rate - Fatigue
Truck/Bus	Type, age, maintenance history, crash history, technology	Carrier	
Environment	Weather, precipitation, traffic density, safety features	Accident reports	
Carrier	Fleet size, turnover rate, safety culture, safety record, compensation	US DOT Carriers	

- Similar table for driver health
  - Only top two domains
  - Different outcomes

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Key Conclusions

- Lack of sleep / lengthy or irregular work schedules
  $\rightarrow$ driver fatigue (acute, chronic)
- Fatigue (in many domains) has negative safety implications
- Lack of sleep $\rightarrow$ health problems $\rightarrow$ alertness/crash risk
- Need more data re: driver sleep, habits, pressures, health
- Obstructive sleep apnea
  - Risk factor for crashes
  - Better understanding of treatment needed
  - Inconsistency among examiners in identifying
- Technological innovations for detecting driver fatigue are still in early phases
- Fatigue management / health & wellness programs need more study
- CMV industry may benefit from fatigue management practices in other industries

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Recommendations (non-data, non-methodology)

- FMCSA should support research needed to understand driver decisions regarding sleep/work (especially when fatigued)

- Need evaluation guidelines to evaluate new technologies focused in driver fatigue (FMCSA, NHTSA, CDC, NIH)

- The Dept. of Health and Human Services and/or U.S. DOT should fund, design, and conduct an ongoing survey permitting <u>longitudinal comparisons of CMV drivers</u> to track changes in their health status, and factors associated with changes, over time.

- FMCSA should encourage medical examiners to use best practices for identifying drivers who need sleep malady testing

- FMCSA should support extensive research program on all aspects of obstructive sleep apnea (OSA) and CMV drivers
  - Determine prevalence
  - Determine effective guidance for screening
  - Determine impact of treatment/recommended nature of treatment

- FMCSA should carry out research on fatigue management and training (effectiveness of NAFMP, education programs, incentive-based programs)

Some final thoughts

- Panel applauded FMCSA for:
    - Openness in working with the panel
    - Their work in a challenging environment (difficult multivariate research problems, congressional mandates, limited funding)
- Some followup activity has happened
    - Increased use of peer review in FMCSA research process
    - Creation of TRB Motor Carrier Safety Research Analysis Committee
- Questions/comments – sternh@uci.edu

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Conclusions

Conclusion 1: <u>Insufficient sleep</u> can <u>increase risk</u> of developing various <u>health problems</u> ... each can impact alertness while driving and potentially increase crash risk.

Conclusion 2: Evidence from non-CMV drivers suggests <u>OSA increases crash risk</u>. There is no evidence nor compelling reason for thinking the same would not also be true for CMV drivers.

Conclusion 3: Better understanding needed on <u>effects of treating OSA</u> <u>in CMV drivers</u> with positive airway pressure therapy (e.g. CPAP) with respect to amount and quality of sleep they obtain, and their cognition and driver performance following PAP treatment sessions.

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Conclusions (cont'd)

Conclusion 4: <u>Medical examiners</u> who certify CMV drivers are <u>not consistent</u> in understanding and applying current best practice to identify drivers at risk of moderate to severe OSA.

Examiners are inconsistent deciding when a driver should be referred for additional sleep testing.

Conclusion 5: Substantial <u>data gaps</u> limit understanding factors that impact health and wellness of CMV drivers.

Need better understanding of drivers' current status and long-term prospects with respect to health and wellness.

Conclusion 6: Many CMV drivers <u>work/live with occupational pressures</u> that adversely affect health.

Conclusions (cont'd)

Conclusion 7: <u>Insufficient data</u> on prevalence of sleep insufficiency, diet and exercise habits, and economic pressures for the population of CMV drivers.

Conclusion 8: Insufficient information as to:

(1) **how the variety of current fatigue management and health and wellness programs <u>are designed</u>,**

(2) **whether drivers/employers <u>actually adhere to these programs</u>,**

(3) **whether these programs are <u>effective</u> in achieving their goals.**

Conclusions (cont'd)

Conclusion 9: Acute and chronic sleep insufficiency produces fatigue in drivers, as do <u>lengthy and irregular work schedules</u>.

Conclusion 10: There is <u>no biological substitute for sufficient sleep</u>.

Conclusion 11: Operator fatigue has negative safety implications for <u>numerous classes of workers</u>, including CMV drivers.

Conclusion 12: Despite 3 decades of research "technological innovations" for <u>detecting driver fatigue in near real-time</u> and operational strategies for their use are still in the early phases of understanding and application.

Conclusions (cont'd)

Conclusion 13: Biomathematical models can be useful for developing <u>general work-rest schedules</u>.

However, existing models <u>do not account for individual variation</u>. In applying them, care must be taken to address likely impacts of <u>irregular work schedules</u>.

Conclusion 14: Roadway <u>rumble strips</u> help prevent fatigue-related crashes .

Conclusion 15: Repeated surveys indicate there are still <u>insufficient numbers</u> of publically available <u>rest areas</u> where CMV drivers can rest.

Conclusions (cont'd)

Conclusion 16: Additional research is needed on <u>effectiveness</u> of all <u>devices</u> that address reduced driver vigilance and fatigue.

Conclusion 17: Fatigue risk management plans and <u>fatigue risk management systems</u> (FRMS) used in aviation, rail and pipeline industries <u>should be studied further</u>. They may provide models to apply to CMV driving.

Conclusion 18: Further research is needed on impact of corporate safety culture on <u>driver decision-making</u> for countering fatigued driving, and on crash frequency.

Recommendations

Recommendation 1: NIOSH should be enlisted to design and conduct a regularly scheduled survey (every 5 to 10 years) to understand demographics and employment circumstances of all CMV drivers in various industry segments.

Recommendation 2: FMCSA should evaluate whether <u>CMV drivers' use of electronic on-board recorders</u> correlates with reduced frequency of violations of hours-of-service rules, and reduced frequency of crashes.

Recommendation 3: FMCSA proposes to mandate use of electronic on-board recorders. Access to such recorded data could offer <u>substantial research benefits</u>.

Recommendations (cont'd)

Recommendation 4: When trucks and buses involved in serious crashes, contain electronic records, data regarding functioning of the driver should be made available to safety researchers in a qualified confidential way.

Recommendation 5: FMCSA should <u>incentivize those who capture driver performance data</u> … to increase availability of those data relevant to research issues of operator fatigue, hours of service and highway safety.

Recommendation 6: FMCSA should improve <u>collection of baseline data on "driving exposure"</u> by including in its data collection efforts greater detail on the driving environment.

Then <u>provide access to these data</u> at low levels of geographic aggregation—even for individual highway segments.

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Recommendations (cont'd)

Recommendation 7: FMCSA should support research to <u>understand driver behavior</u> related to fatigue and sleep deficiency, including <u>what motivates "driver-decisions"</u> about continuing to drive when they feel fatigued.

Recommendation 8: Using a human-systems integration (HSI) framework, FMCSA and NHTSA, in consultation with CDC and NIH, should <u>develop evaluation guidelines</u> and protocols for <u>third-party testing</u>, including field testing, to <u>evaluate new technologies</u> purporting to reduce impact of fatigue on driver safety.

Recommendation 9: FMCSA should make <u>greater use of independent peer review</u> in crafting requests for proposals, making decisions regarding research awards, and monitoring the progress of projects (including in study design and analysis stages).

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Recommendations (cont'd)

Recommendation 10: The Dept. of Health and Human Services and/or U.S. DOT should fund, design, and conduct an ongoing survey permitting <u>longitudinal comparisons of CMV drivers</u> to track changes in their health status, and factors associated with changes, over time.

Recommendation 11: FMCSA should continue to encourage all individuals in the National Registry of Certified Medical Examiners to <u>use current best practices</u> to identify drivers who should be <u>referred for additional sleep malady testing</u>, and in making determinations about commercial driver's license renewal extensions.

Recommendations (cont'd)

Recommendation 12: FMSCA should support <u>peer-review processes</u> in all stages of research on obstructive sleep apnea (OSA) and CMV drivers.

- **determine percentage of CMV drivers whose quantity/quality of sleep and driving performance are affected at various levels of apnea-hypopnea (i.e. index of OSA severity);**

- **determine effective guidance for sleep-screening referrals to discriminate CMV drivers with and without OSA;**

- **delineate causal chain from diagnosis of OSA (i.e. as a function of severity) to increased likelihood of crash frequency among CMV drivers;**

- **determine impact of treatment with positive airway pressure (PAP) on long-term health and crash rates among CMV drivers with varying degrees of apnea severity; and**

- **identify recommended duration of PAP treatment (e.g., suggested hours of treatment per day/week) before a driver can return to driving.**

Recommendations (cont'd)

Recommendation 13: FMCSA should carry out a research program on "driver fatigue management and training," including:

- evaluating effectiveness of the North American Fatigue Management Program (NAFMP) for educating truck and bus drivers in how to modify their behavior to counter fatigue

- determining how effective NAFMP training modules are in meeting the needs of drivers' employers, fleet managers, safety/risk managers, dispatchers, driver trainers and those conducting carrier-sponsored employee health and wellness programs

- evaluating any new education programs regarding sleep apnea that FMCSA currently has, or plans to develop; and

- examining possibilities for developing and evaluating incentive-based programs for improving health and fitness, including regular coaching, assessment, and support.