Maintaining Commercial Driver Alertness, Managing Fatigue, Fostering Driver Health and Wellness:

Assessment of the National Academies' Committee on National Statistics (CNSTAT)

10th Int'l Conference: Managing Fatigue

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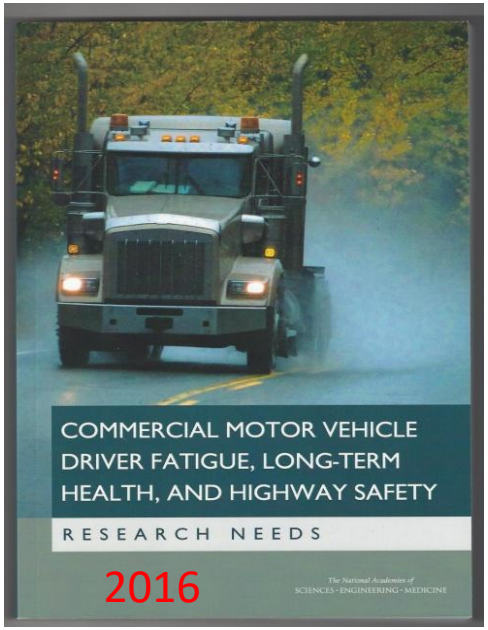

CNSTAT Panel Members

Matthew Rizzo (co-chair): Dept. Neurological Science, Univ. Nebraska Med Ctr

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Daniel Blower, Univ. of Michigan Transportation Research Institute (UMTRI)

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NAS Staff: Michael Cohen, Esha Sinha, Agnes Gaskin, & Rick Pain (consultant)

Chapter 1, Introduction: Importance of the Issues

FMCSA's **3 charges to the Panel**:

- Assess the state of knowledge about the relationship of such factors as **hours of driving**, **hours on duty**, **and periods of rest** to the fatigue experienced by truck and bus drivers while driving

- Assess the relationship of these factors to **drivers' health** over the longer term.

- Identify improvements in data & research methods that can lead to better understanding in both areas.

The CNSTAT Report (June 2016)

Part I – Background

Chapter 2: The Truck and Bus Industries

- characterization of each transportation sector

Chap 3: Consequences of Fatigue from **Insufficient Sleep**

- the main culprit contributing to driver fatigue

Chap 4: Review of **Hours of Service** Regulations

- historical perspective, U.S., Canada, Mexico

Part II – Data & Methodology

Chap 5: Data Sources & limitations of crash databases

Chap 6: Res. Methods/Principles – Assessing Causality

Topics addressed at length include:

Part III – **Current Research Findings**

Chap 7: Fatigue, Hours of Service, Highway Safety

Chap 8: **Fatigue and Health and Wellness**

Chap 9: Technological Countermeasures for and Corporate Management of Fatigue

Part IV – **Research Directions**

Chap 10: Res. Directions for Fatigue & Highway Safety

Chap 11: Res. on Impact of Fatigue on Health & Wellness

- **The Report contains 18 conclusions and 13 recommendations**

Chapter 7: Fatigue, Hours of Service, & Highway Safety

Assessing Role of Fatigue in Increasing the Risk of Truck/Bus Crashes

Research on Fatigue, Hours of Service, and Risk of CMV Crashes - Numerous studies are reviewed in the report.

Research Needs:

Greater experimental control / confounding factors

More research is needed on bus/motorcoach HOS, driver fatigue, and crash risk

Disentangle different causes & effects of operator fatigue

Discern how drivers decide to continue driving when tired

More research needed on the benefits of CPAP as treatment for **sleep apnea (OSA)**

Chapter 8 (a): Fatigue and **Health and Wellness**

Linkages between Fatigue and Health

Conclusion 1: Insufficient sleep can increase the risk of developing various health problems … each can impact alertness while driving and potentially increase crash risk.

Medical certification of health of CMV drivers

Obstructive Sleep Apnea (OSA)

Increased risk of crashes for CMV drivers with OSA

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

Chap. 8(b): **Treatment for Obstructive Sleep Apnea (OSA)**

Conclusion 3: Need better understanding of effects of treating OSA in CMV drivers with positive airway pressure (PAP) therapy (e.g., CPAP) with respect to amount and quality of sleep obtained, and driver cognition and driving performance following PAP treatment sessions.

Medical examination policy regarding OSA (extensive coverage)

Conclusion 4: Medical examiners who certify CMV drivers are not consistent 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.

Chap. 8(c): Lifestyle Factors and CMV Drivers' Health

Conclusion 5: Substantial data gaps limit understanding the 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 work/live with occupational pressures that adversely affect health.

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

Chap. 8(d): Current **Fatigue Mgmt & Health/Wellness Programs** for CMV Drivers

- They are mostly large truck carrier and bus industry initiatives
- FMCSA's Fatigue Outreach & Health/Wellness Initiatives (reviewed)

Conclusion 8: Insufficient information as to:

(1) how the variety of current fatigue management and health & wellness programs are designed

(2) whether drivers/employers actually adhere to these programs

(3) whether these programs are effective in achieving their goals.

Chap. 9: Countermeasures & Management of Fatigue

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

(this is almost stating the obvious !)

Conclusion 10: There is no biological substitute for sufficient sleep

Technological Approaches for Detecting/Managing Operator Fatigue

-- Online Operator Fatigue Detection Technologies (while driving)

-- **Fitness-for-Duty** Devices (before driving & while on duty)

-- Biomathematical Models used for scheduling (best for big ops)

Conclusion 11: Operator fatigue has negative safety implications for numerous classes of workers, including commercial drivers.

Such concerns motivated a variety of applied research projects on detecting, preventing, and/or managing operator fatigue.

Chap. 10 Collection of Survey Data on CMV Drivers

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

In **mid-2016** FMCSA & NIOSH discussed plans to address this recommendation

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

It would be highly desirable to link survey data to relevant electronic health records, with a focus on conditions that threaten drivers' health and safety.

Chap. 11 Regarding - Obstructive Sleep Apnea

Screening CMV Drivers for OSA

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

This contentious issue is headed toward **Public Rule Making**

As soon as possible, DOT should **supply medical examiners** with clear criteria or guidance on when it is appropriate to refer presenting drivers for sleep malady testing.

Chap. 11: more on Obstructive Sleep Apnea

Recommendation 12: FMSCA should support peer-review process in all stages of research on OSA and CMV drivers.

Research **focus** to understand the incidence of OSA in CMV drivers; **its impact on driver fatigue, safety, & health**; benefits of treatments. **Topics** include:

- **determine percent of drivers whose quantity/quality of sleep & driving performance are affected at various levels of apnea-hypopnea (mild, moderate, severe OSA);**

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

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

- **determine impact of PAP treatment on long-term health & crash rates for CMV drivers with varying degrees of apnea severity; and**

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

Chap. 11 - more on fatigue & H&W

-- Utility of commercial driver medical examination data

-- Needed research on psychoactive drug use and driving performance

-- Research directions for evaluation of health and wellness programs

Chap. 11 - more recommendations on fatigue & H&W

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

- **Evaluate effectiveness of North American Fatigue Management Program (NAFMP) on educating truck & bus drivers in how to modify their behavior to counter fatigue**

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

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

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

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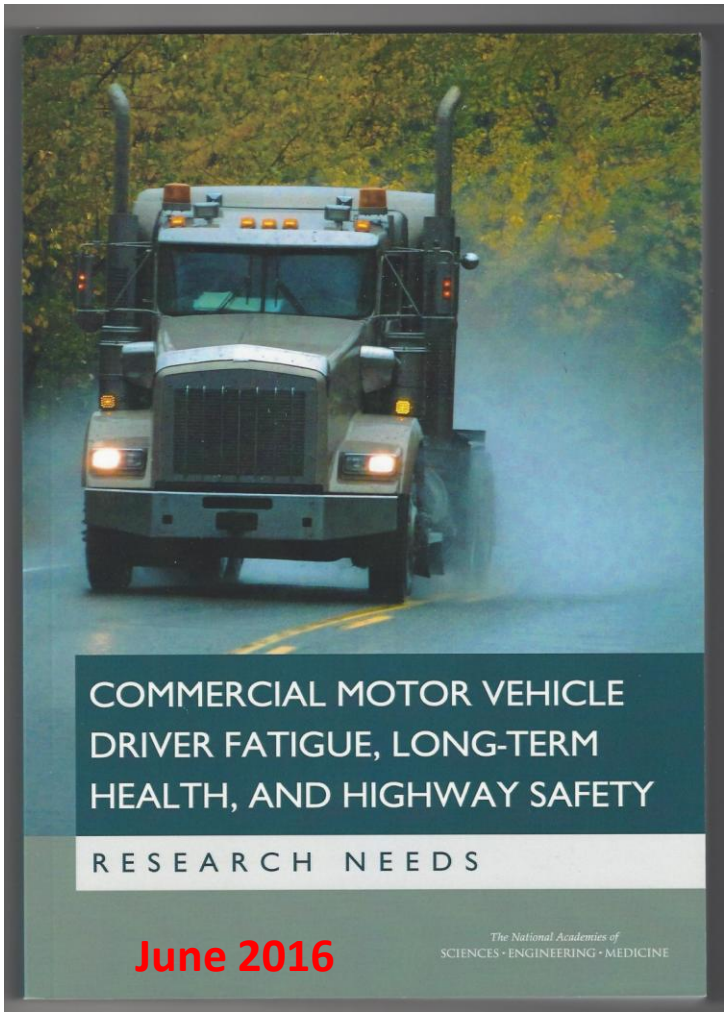

Report Published in **June 2016**
by the: National Academies Press,
www.nap.edu

Report available in pdf on various web sites
https://www.nap.edu/download/21921

Extra: Additional Backup Slides

Part II: Chapters 5 & 6: Data & Methodology

Chap. 5(a): Data Sources – a statistical committee's take on data

Publicly available crash databases

- Fatality Analysis Reporting System (FARS)
- Trucks & Buses involved in Fatal Accidents (TIFA & BIFA)
- National Automotive Sampling System (NASS)
- Motor Carrier Management Information System (MCMIS)

Limitations of CMV Crash Data Bases –discussed at length

FMCSA's Large Truck Crash Causation Study (LTCCS) Database

Data on Vehicle Miles Traveled (needed as baseline for most statistics)

Research or Study-Based Data Sets, e.g.:

- Naturalistic Driving Study (NDS) data sets
- Driving Simulator studies

Chapter 5 (b): Data Sources cont'd

Proprietary Data, e.g. data being collected by:

American Transportation Research Institute (ATRI)

Data collected by large truck carriers (mainly for internal use only)

Other Data Sources: Paper logs, inspection reports, surveys

Needed Information

Exposure: hour of day, miles driven etc.

Trip length and driving hours

Diversity of routes and loads

Regular vs. irregular schedules

Driver loading and unloading activities

Operations at night

Sleep quality indicators

Method of driver compensation

Potential New Data Sources (advantages / disadvantages)

Electronic on-board recorders/logging devices

Telematics, on-board safety systems

Chapter 6: Research Methodology and Principles: Assessing Causality

The report details numerous related statistical topics:

Definition of causal effect

Drawing inferences and standardizing crash counts

Randomized Controlled Trials vs. Observational Studies

- Regression adjustment isn't state-of-the-art
- Design methods: cohort study, case-control, case-crossover
- Analysis methods: propensity score methods, marginal structural models, multiple control groups, instrumental variables, regression discontinuity, interrupted time series

A.B. Hill's (1965)criteria on dose-response relationship

Chapter 9 (b) Fatigue Management Programs

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

Conclusion 13: Biomathematical models can be useful for developing general work-rest schedules. However, existing models do not account for individual variation. In applying them, care must be taken to address likely impacts of irregular work schedules.

- Systems Designed to Mitigate the Effects of Fatigue (discussed in detail):

  Roadway rumble strips
  Rest areas (public and private)
  Vehicle-to Infrastructure (V2I) Systems
  Vehicle-based systems (e.g., Lane Departure Warning Systems)
  Partially autonomous vehicles
  NHTSA research & outreach initiatives on drowsy driving

Chapter 9 (c)

Conclusion 14: Roadway rumble strips help prevent fatigue-related crashes .

However, drivers may treat rumble strips as if they provide repeated emergency alerts (alarms). Drivers may use rumble strips to postpone taking other countermeasures, e.g., stopping to rest.

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

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

Chapter 9 (d)

Conclusion 17: Fatigue risk management plans and fatigue risk management systems (FRMS) used in aviation, rail and pipeline industries should be studied further.

They may provide models to apply to CMV driving.

Importance of Safety Culture

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

Part IV: Chapters 10 & 11

Chap.10-Research Directions for Fatigue & Highway Safety

Any approach to assessing the role played by operator fatigue and changing crash risk needs to incorporate classical fatigue factors as well as any confounding factors.

A large matrix in the report, **Table 10-1: Attempts to identify causal factors and their potential for serving in statistical models predicting crash rate and degree of fatigue.**

– FMCSA could attempt to fill out Table 10-1 as it offers helpful foundations for planning their research program(s).

Chapter 10(b) Research Directions

Commercial Driver License Info Sys Database
-- Commercial Driver Surveys
-- Need Continuing Survey of Truck & Bus Drivers

Data from vehicles should be available to researchers
e.g., from on-board logging devices

Recommendation 2: FMCSA should evaluate whether CMV drivers' use of electronic on-board recorders 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 substantial research benefits.

The proposed rule should allow for "research use" of such e-recorded data; but captured in a manner that protects individualized confidential data from disclosure.

Chapter 10 (c): Research Directions

- Data are already being collected by electronic data recorders, telematics, and collision avoidance and fatigue detection systems.

- Could/should focus research on data **of all serious crashes,** collected automatically in the timeframe just prior to onset

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

Chapter 10 (d) Other Data Sources

-- Vehicle Inspection Reports (e.g., MCMIS, CVSA)

-- Data from Large Carriers

-- American Transportation Research Ins. (ATRI) Data

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

Must ensure **data confidentiality** is maintained

– perhaps through restricted access arrangements or use of statistical techniques for disclosure protection.

Chapter 10 (e) Some Key Research Questions

-- Driving exposure data

-- Driver decision-making

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

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

Comparisons enabled by the availability of these baseline data would benefit several proposed lines of new research.

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

Chapter 10 (f) Methodological Issues

- Study designs and associated data sets (improvements)
- Improve Naturalistic Driving Studies (NDS)
  - e.g., clarify definition & utility of Safety Critical Events
- Improving crash reports and observational data studies
- Use of encouragement designs, propensity scoring, etc.

Assessing new technologies to reduce fatigued driving

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

Chapter 10 (h) Statistical Issues

Complex Correlation Structures (discussed)

Power of Studies (discussed)

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

Peer review should include expertise from all relevant fields, including epidemiology and statistics—especially causal inference—to address appropriate design and analysis methods.

Chapter 11 (a): Research Directions: Impact of Fatigue on CMV **Health and Wellness**

A **framework** for assessing factors related to driver health/wellness

Table 11-1. – is similar to Table 10.1 – to help FMCSA

identify research directions

Need for an ongoing survey of CMV drivers

Goal: to understand driver health dynamics

– i.e. study what happens to driver health over time.

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