



**National
Transportation
Safety Board**

Estimates of Deaths and Injuries in Crashes Involving Single-Unit Trucks

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Single-Unit Truck Characteristics

- Single-Unit Trucks
 - Cargo area typically does not detach from cab with engine
 - All axles are on the same frame
- DOT defines large trucks as those with gross vehicle weight ratings (GVWR) over 10,000 pounds
- This study examined single-unit trucks



Why NTSB Undertook This Study

- Crashes involving large trucks pose a high risk of fatalities to other road users
- Single-unit trucks are excluded from certain safety regulations applicable to tractor-trailers
 - Conspicuity treatments
 - Rear underride guards
- Prior research by UMTRI suggested that single-unit trucks were undercounted in fatal accident databases
- Scope of non-fatal injuries is not well-documented
 - Medical/societal costs of pain, suffering, disability

Single-Unit Trucks are Diverse



Single-Unit Trucks: Background Information

- 8.22 million single-unit trucks
- 110.7 billion miles traveled per year
- Less interstate travel than tractor-trailers
- More urban/suburban travel and intersection collisions than tractor-trailers

Research Aims

- Estimate crash outcomes
 - fatal injuries
 - non-fatal injuries
 - inpatient hospitalizations
 - emergency department visits
- Compare crash characteristics for single-unit trucks versus tractor-trailers
- Identify safety problems and vehicle safety countermeasures for single-unit trucks

Methods Overview

- Used multiple databases to provide a more complete picture
 - TIFA/FARS, GES, and LTCCS
 - Included CODES, state data systems that link hospital records with police reports.
- Staff developed program to decode vehicle identification numbers
- Study used multiple imputation to address missing data in states

Data Sources

- Crash Outcome Data Evaluation System (CODES) for five states
- Trucks in Fatal Accidents (TIFA)
- Fatality Analysis Reporting System (FARS)
- Large Truck Crash Causation Study (LTCCS)
- National Automotive Sampling System/General Estimates System (GES)
- Case studies

The Major Issues Identified

- Vulnerable road users
- Underride (side, rear, front)
- Nighttime crashes on unlit roads
- Data quality and availability
 - Undercounting of single-unit trucks
- Invalid driver's licenses

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Organizations Providing Data and Assistance

- National Highway Traffic Safety Administration (NHTSA)
- The University of Utah CODES Technical Center
- The National Study Center for Trauma & EMS at the University of Maryland, Baltimore
- Delaware Department of Health & Social Services
- Minnesota Department of Health
- Nebraska Department of Health & Human Services

Presentations

- Data Sources and Methods
- Analyses of Safety Issues

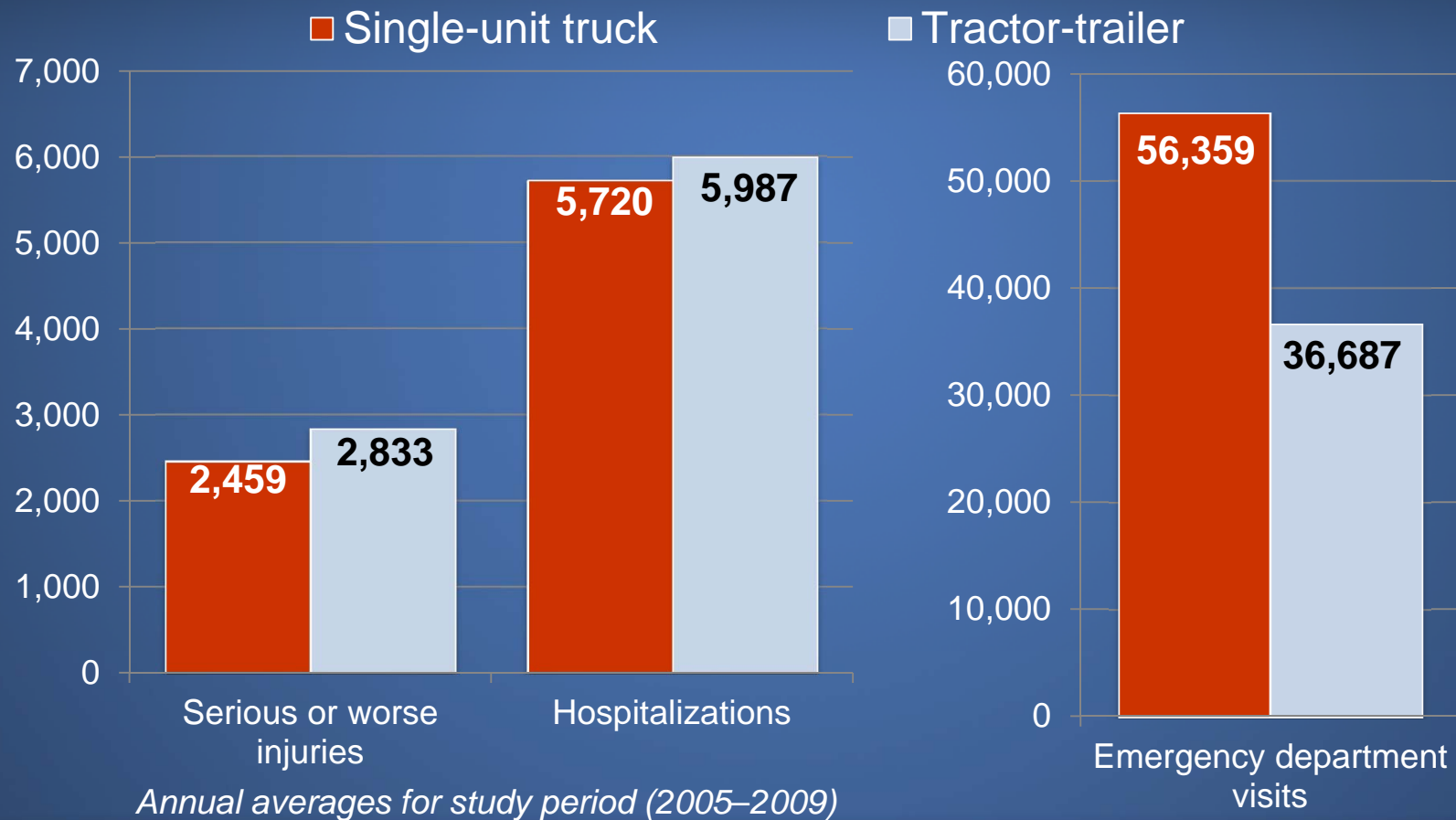
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Data Source: CODES

- Crash Outcome Data Evaluation System
 - Detailed medical outcomes
 - injury severity
 - hospitalizations
 - emergency department visits
 - Linked to police accident reports

Estimated Annual Injury Outcomes by Involved Large Truck Type, CODES



CODES Data Underestimates Injury Outcomes

- CODES data and derived national estimates underestimate the actual burden
 - e.g., about 10% of large trucks were of undefined types
- Best available data for non-fatal injuries and hospitalizations

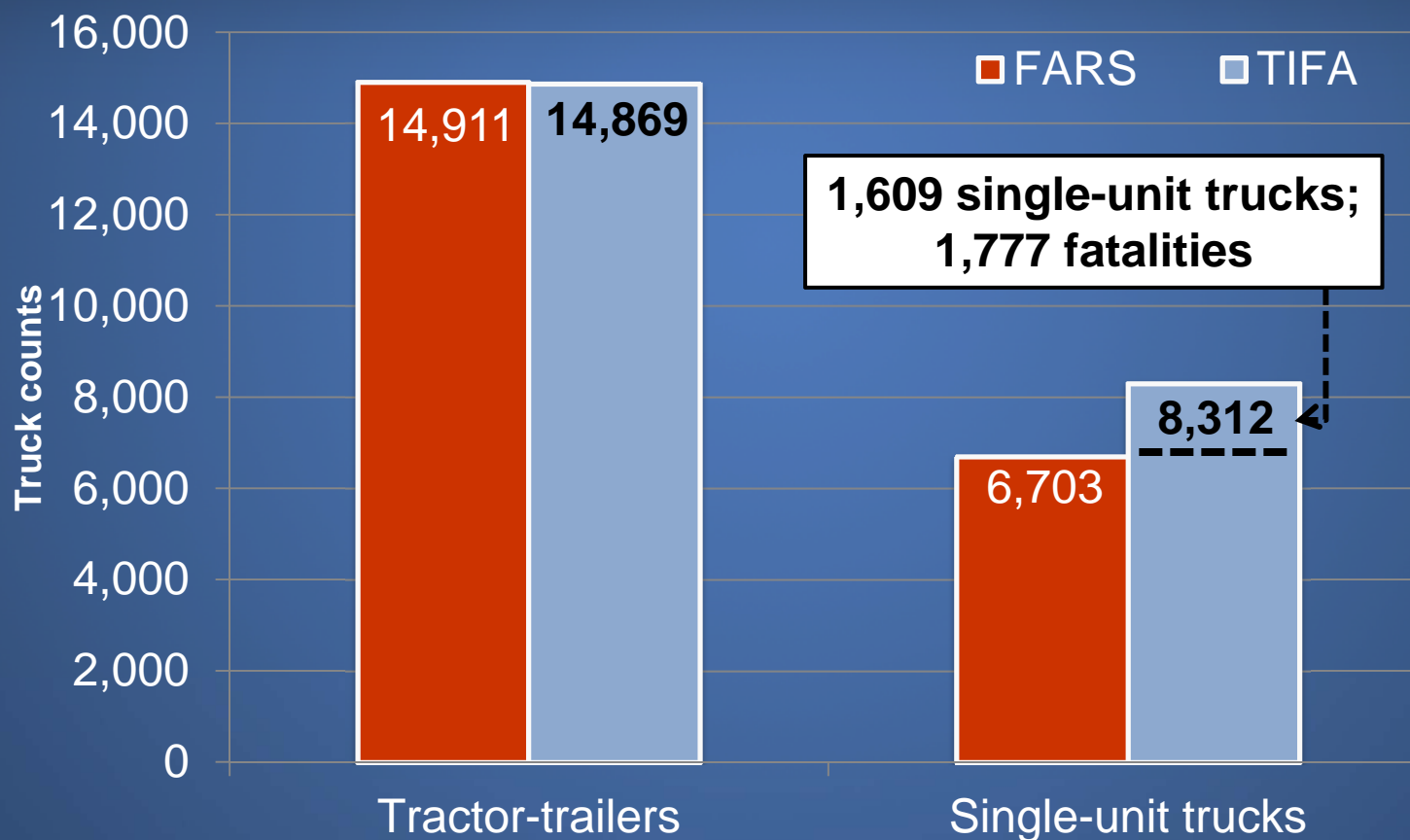
Data Sources: FARS and TIFA

- Fatality Analysis Reporting System
 - a census of fatal motor vehicle accidents in the United States on public roads
- Trucks in Fatal Accidents
 - a supplement to FARS
 - improves the accuracy of FARS data on fatal large truck accidents
 - provides more information on large trucks, motor carriers, and accidents

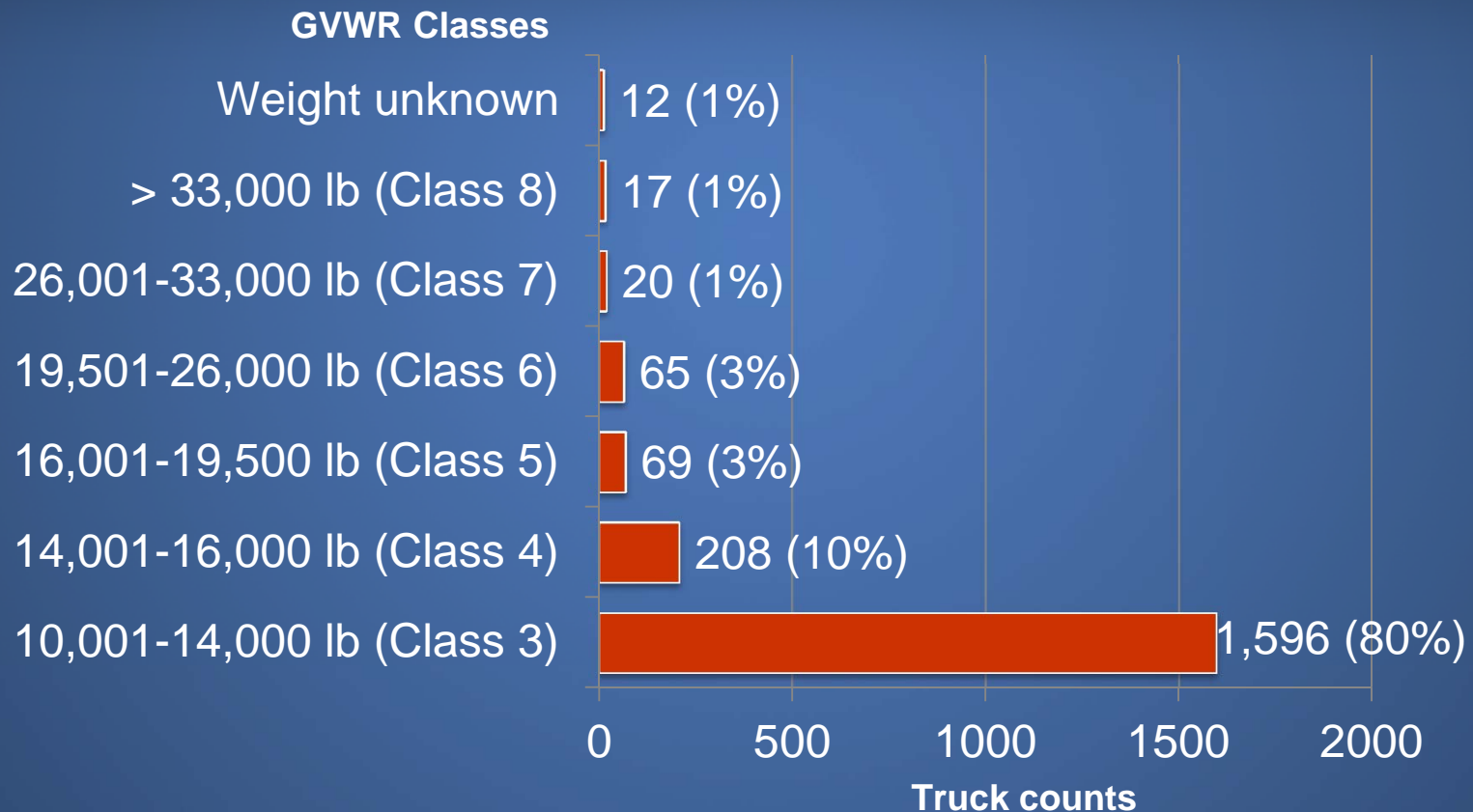
Vehicle Identification Number (VIN)

- Standardized 17-digit number
- VIN-derived information
 - Manufacturer, model year
 - Truck type
 - Gross Vehicle Weight Rating (GVWR)
- Collected in police accident reports
- Captured in databases

Truck Identification Differences, TIFA and FARS, 2005–2009



Single-Unit Trucks Misclassified as Passenger Vehicles in FARS, by GVWR



Data Source: LTCCS

- Large Truck Crash Causation Study
 - Detailed accident investigations, including photographs
 - Focus on specific safety issues and provided cases for expert review

Commercial Driver's Licenses (CDL) for Single-Unit Truck Drivers

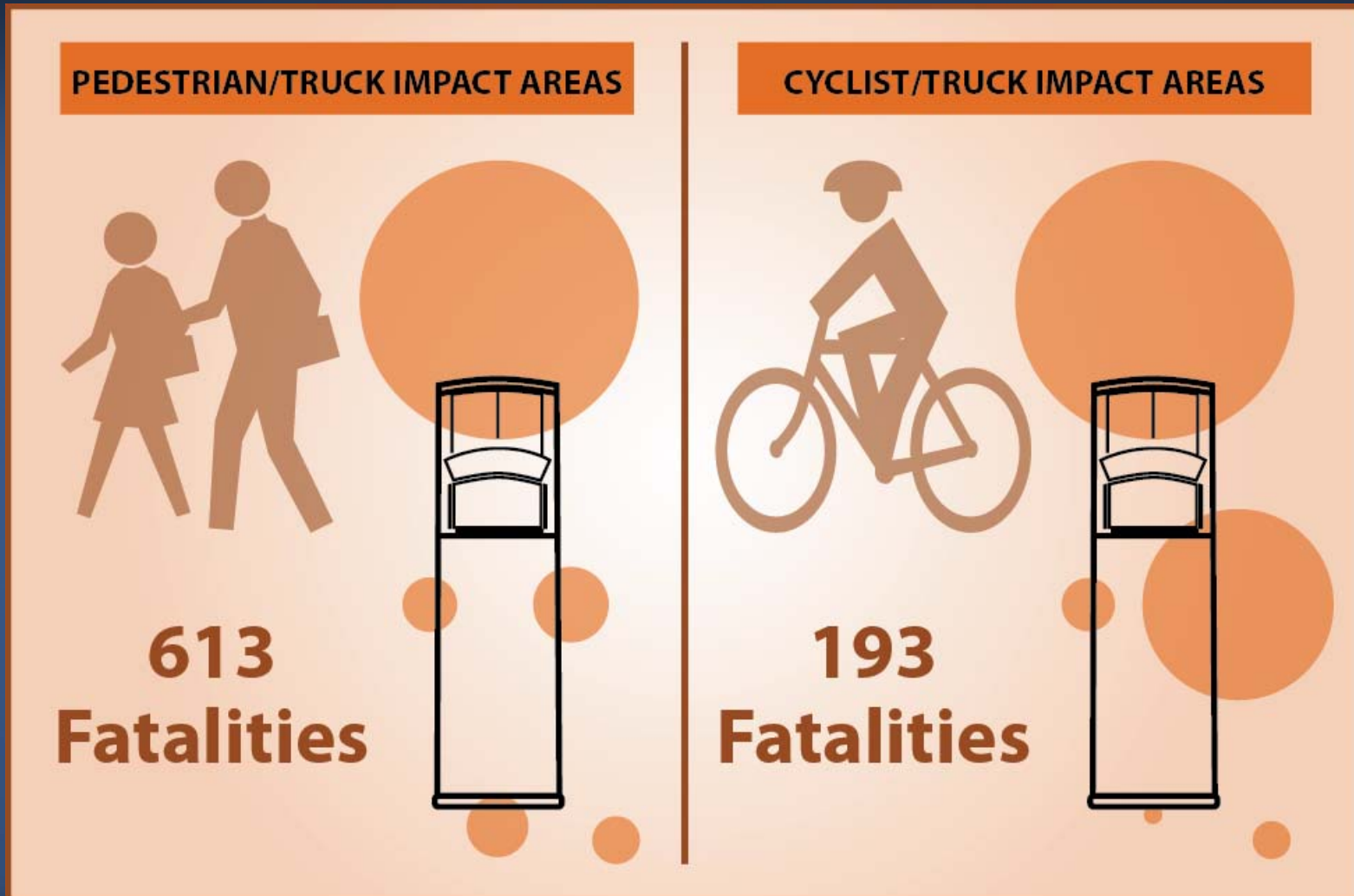
- 5% of drivers in two-vehicle accidents were cited for not having a valid CDL (LTCCS, 2001–2003)
- 6% of drivers involved in fatal accidents had invalid licenses (TIFA, 2005–2009)

Annual Single-Unit Truck Crash Burden

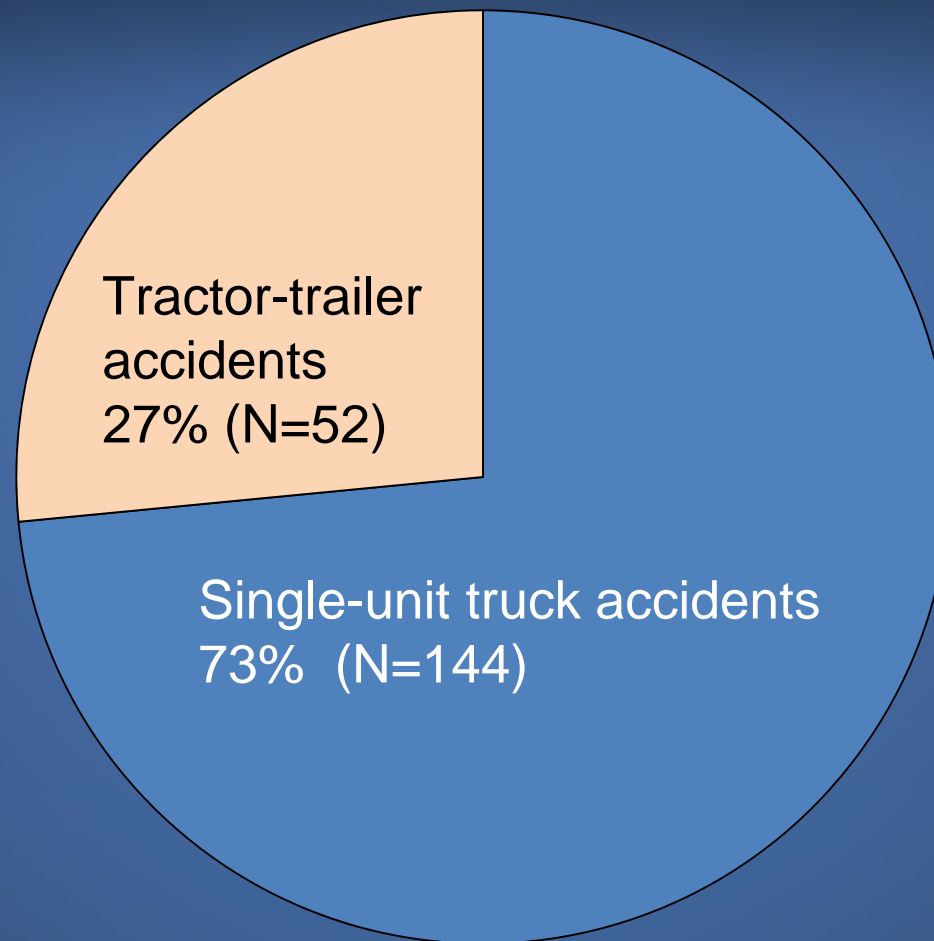
| Outcome | Involving Single-Unit Trucks |
|-----------------------------|------------------------------|
| Fatalities | 1,817 |
| Serious or worse injuries | 2,459 |
| Hospitalizations | 5,720 |
| Emergency department visits | 56,359 |

Annual averages for study period (2005–2009)

Fatalities, Single-Unit Trucks, TIFA, 2005–2009 (One-Vehicle Accidents)



Annual Averages of Pedestrians and Cyclists in Large Truck Accidents, CODES



Single-Unit Truck Side Impacts

- Passenger vehicle collisions with the sides of single-unit trucks are common
 - Average of 810 two-vehicle collisions each year in 5 participating CODES states
- Rates of serious injury and hospitalization: twice as high for single-unit truck side impacts compared with all accident types

Side Underride

LTCCS Side Underride



- Underride occurred in about 50% of passenger vehicle collisions with the sides of single-unit trucks (in accidents resulting in death or injury)

Side Underride Guards



Kumar et al, 2009



Krone Safe Liner

Rear Underride Accident



Rear Underride

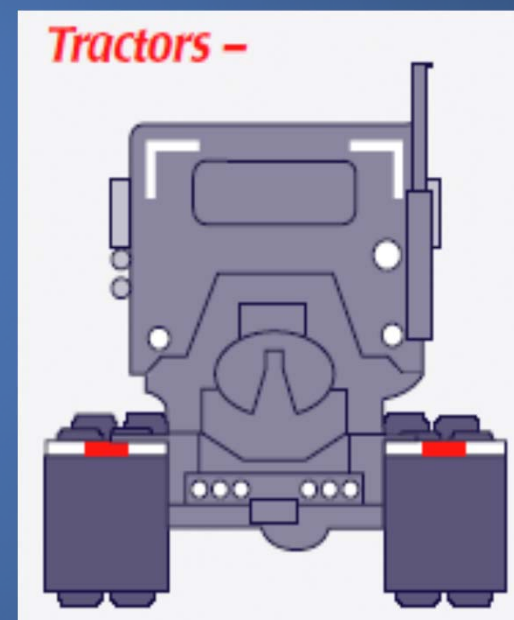
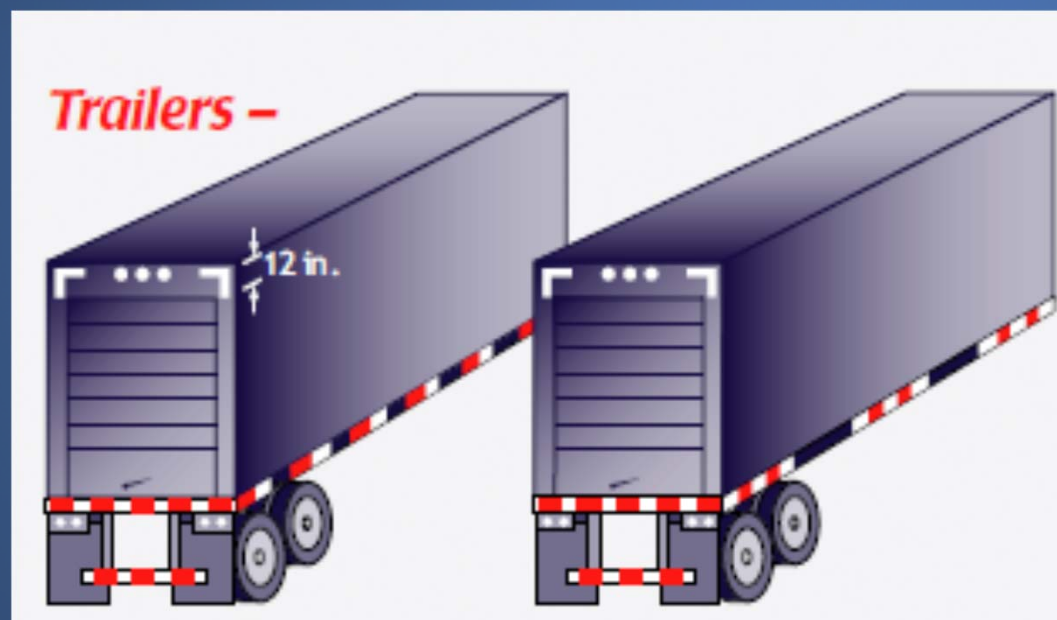
- Passenger vehicle collisions with the rears of single-unit trucks are common and can result in serious injury
 - In CODES states: about 30 hospitalizations and 340 emergency department visits each year from truck rear impacts
- Underrides occur in 70% or more of collisions between passenger vehicles with the rears of single-unit trucks (in accidents resulting in death or injury)

Rear Underride Protection



Insurance Institute for Highway Safety, 2013

Conspicuity Standards for Trailers and Tractors

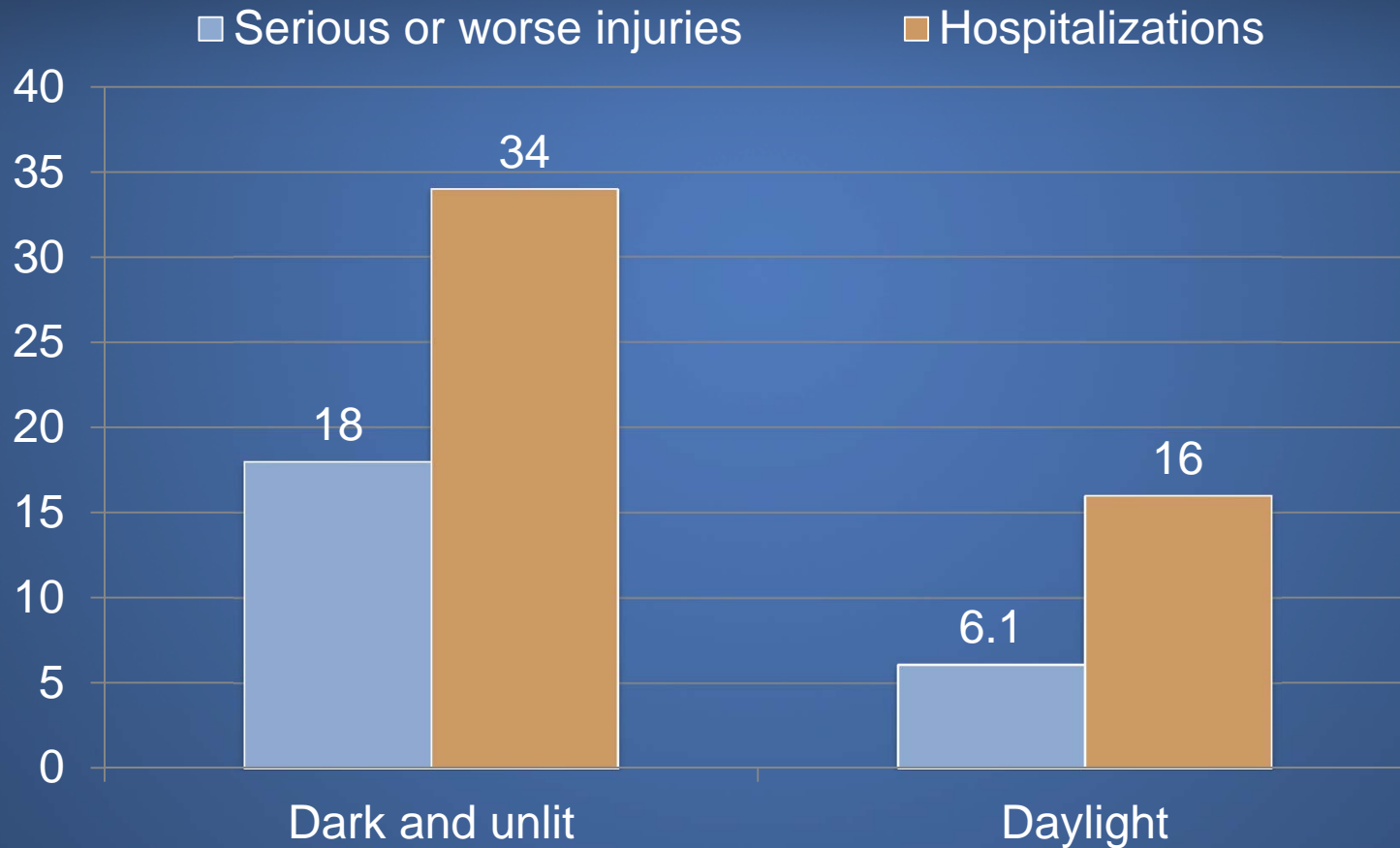


FMCSA, 3M

Conspicuity: Dark and Unlit Roads

- National estimate: 5,921 single-unit trucks involved in accidents on dark and unlit roads during 2005–2009
 - 6% of single-unit truck involvements
- State data
 - 21% for dump trucks (rear-end impacts)
- High-risk accidents

Serious injury and hospitalization rates per 1,000 passenger vehicle occupants, collisions with sides/rears of single-unit trucks by light conditions, CODES, 2005–2009



Conspicuity

- Dark and unlit roads: 41% reduction in accidents involving sides and rears of trailers with retroreflective tape



Previous Recommendation Topics

- **Front underride protection systems on large trucks**
 - Majority of fatal large truck accidents involve fronts of trucks
 - 70% of passenger vehicle collisions with fronts of single-unit trucks recorded as front underride
- **Electronic stability control**
 - 1,000 rollovers (single-unit trucks, 2005–2009)
 - 8,900 single-unit run-off road accidents

Previous Recommendation Topics

- **Adaptive cruise control and collision warning systems**
 - Truck frontal impacts: high risk of death and injury
 - NTSB case reviews and prior research indicated that these systems could be beneficial for large trucks, including single-unit trucks
- **Lane departure warning systems**
 - Sideswipe accidents: high risk of death and injury
 - Prior research indicated value of lane departure warning systems

What We Learned

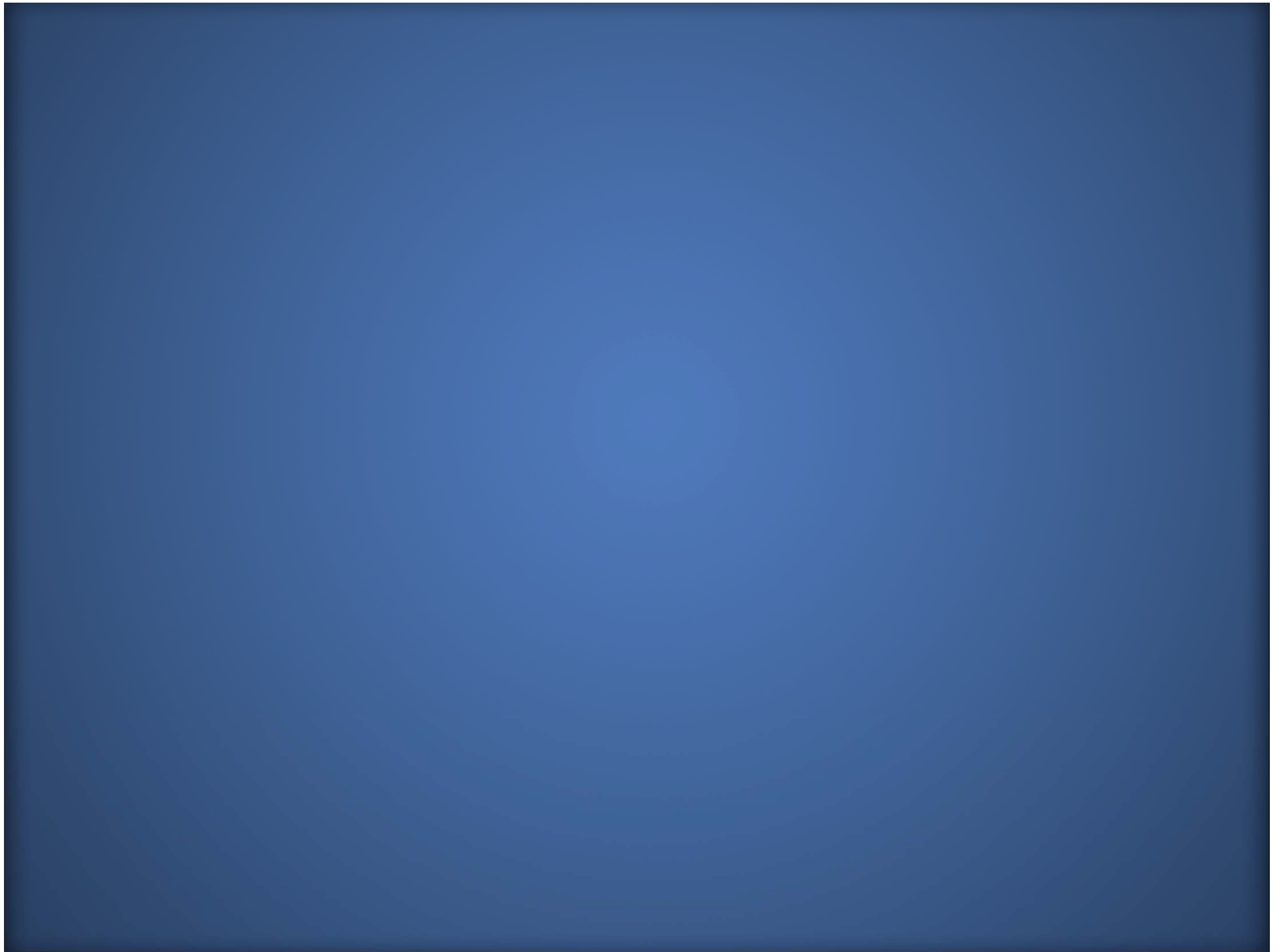
- **Single-unit trucks are involved in a disproportionate share of passenger vehicle occupant deaths in multivehicle crashes**
 - 9% of deaths vs. 4% of miles and 3% of registered vehicles
- **Considerable societal impacts**
 - Fatalities, injuries, hospitalizations, emergency department visits
- **Rear underride guards and conspicuity-enhancing treatments should be required for single-unit trucks**
 - Basis: rear underride collisions; nighttime crashes on unlit roads

What We Learned

- **Additional vehicle-based countermeasures are needed**
- **Adverse effects of single-unit truck accidents have been underestimated, but this problem can be addressed by using VINs**
- **Multiple data sources needed**
 - TIFA
 - CODES



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How FARS and States Classify Single-Unit Trucks

- Single-unit trucks in FARS are identified using
 - police reported vehicle body type
 - numbers of attached trailing units
- States use police-reported vehicle body type information

Analytical Methods

- Multiple data sources
- Descriptive statistics
- National estimates
- Comparison between single-unit truck and tractor-trailer accidents
- Case reviews