Compliance, Safety, Accountability (CSA):

Roadside Violation Severity Weights of the Safety Measurement System

Motor Carrier Safety Advisory Committee (MCSAC)
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U.S. Department of Transportation
Federal Motor Carrier Safety Administration

CSA2010
Comprehensive Safety Analysis

To Cover:

- Driver Performance Based Foundation for CSA Safety Measurement System Roadside Violation Severity Weights
- Details on the Purpose of Weights and How They Were Derived
- Potential MCSAC Involvement in Refinements

Driver Based Foundation for Current Violation Severity Weights

Where does it all start?

Are BASIC Violations Associated with Crash Involvement?

Driver-Based Analysis Approach:

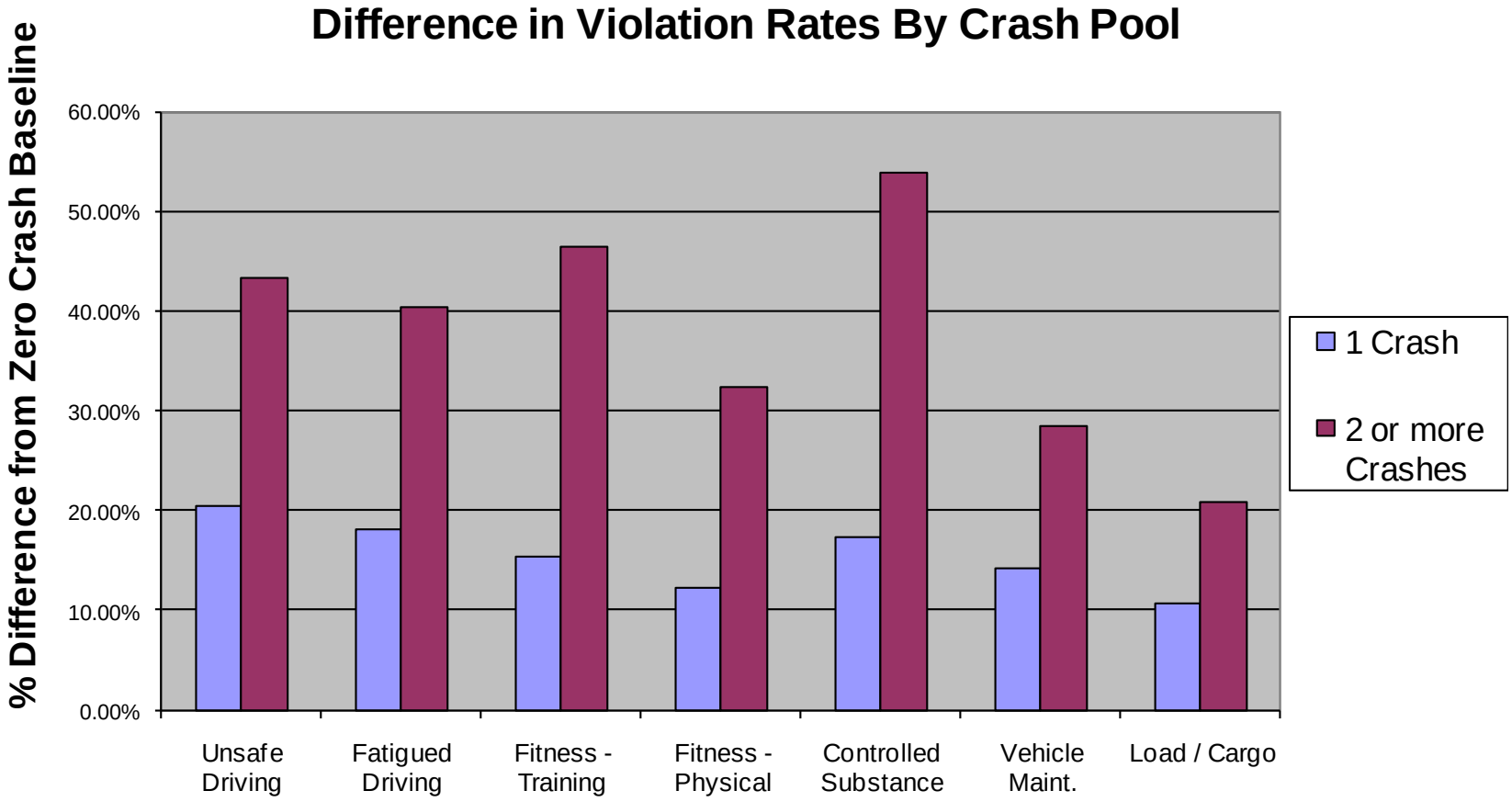
Compared CMV drivers' BASIC violation rates from inspections for different levels of crash involvement. Data pulled from Driver Information Resource (DIR).

- Population: Drivers with substantial inspection history (7+ inspections excluding post-crash)
- Crash involvement – Place each driver into 1 of 3 pools

Crash Pool	Total Drivers
0 Crashes	197,762
1 Crash	40,893
2+ Crashes	7,119

- BASIC violation rate
  - Mapped each driver's violations to BASICs and derived a rate
  - Calculated average violation rate by BASIC for drivers in each crash pool

Driver-Based Analysis Results



Driver-Based Analysis Conclusions

- Demonstrated association between poor driver safety performance in each BASIC and increase in crash involvement even using simple (non-weighted) violation rates.
- Strongest associations occur in BASICs directly related to driver behavior behind the wheel, rather than vehicle or cargo-related BASICs.
  - Confirms Large Truck Crash Causation Study results.

Derivation of Violation Severity Weights

Violation Severity Weight Purpose

- One of the goals of the CSMS is to identify habitual safety problems.
- Severity weights help tune CSMS by differentiating varying degrees of crash risk associated with specific violations.
- The violations and their associated severity weights are calculated across multiple inspections to identify systemic safety issues.

Violation Severity Weights

General Approach:

- Cover all safety-based roadside inspection violations in a systematic manner.
- Develop weights based on empirical analysis to the extent possible.
- Supplement results with expert judgment.
- Because each BASIC in calculated independently in the CSMS, develop the violation severity weights relative to the crash risk associated with only the violations within the same BASIC.

Results:

- Assigned severity weight from 1 to 10 scale (where 1 represents lowest crash risk, 10 represents the highest within the BASIC) to every safety-based violation .
- Can NOT compare weights across different BASICs (e.g., 5 in one BASIC is not equivalent to a 5 in another BASIC).

Derivation of Preliminary Severity Weights – 6 Step Process

1. BASIC Mapping
   - All safety-related roadside violations mapped to appropriate BASIC.
2. Violation Grouping
   - Grouped ‘like’ violations together in each BASIC.
     - Allows rarely cited violations to be used in statistical analysis.
     - Helps ensure similar violations receive same severity weight.

Derivation of Preliminary Severity Weights – 6 Step Process (Continued)

3. Driver Regression Model

- Using the same driver violation / crash data used in the **aforementioned** Driver-Based Analysis:
  - Statistical regression was conducted for violation groups in each BASIC.
  - Regression examined relationship between violation rates in each violation group (e.g., tires, brakes) and crash involvement of the approximately 250K drivers.
  - Of the 34 violations groups that related to crash occurrence, 27 (79%) showed statistically significant relationships between high violation rates and increased crash occurrence.

Derivation of Preliminary Severity Weights – 6 Step Process (Continued)

3. Driver Regression Model

- Example: Unsafe Driving BASIC

Violation Group	Regression Coefficients	Statistically Significant
Reckless Driving	1.94	Yes
Dangerous Driving	1.17	Yes
Speeding related	1.11	Yes
Other Driver Violations	1.11	Yes
HM related	1.00	No

- Statistical coefficients were used to generate initial violation severity weights from 1 to 10.

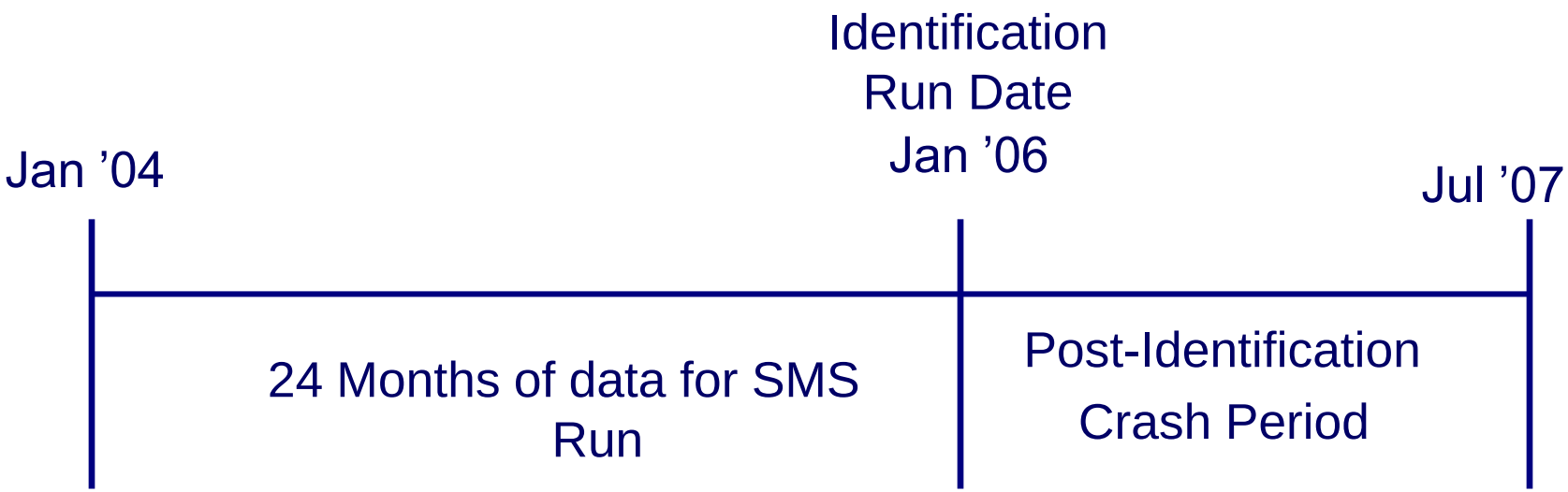
Derivation of Preliminary Severity Weights – 6 Step Process (Continued)

4. Crash Consequence Analysis
   - Incorporated findings from the Violation Severity Assessment Study (VSAS) to address crash consequence (severity of outcome).
5. Subject Matter Expert (SME) Review
   - Enforcement SMEs reviewed purely statistically based results.
   - Modifications were made based on SME input.

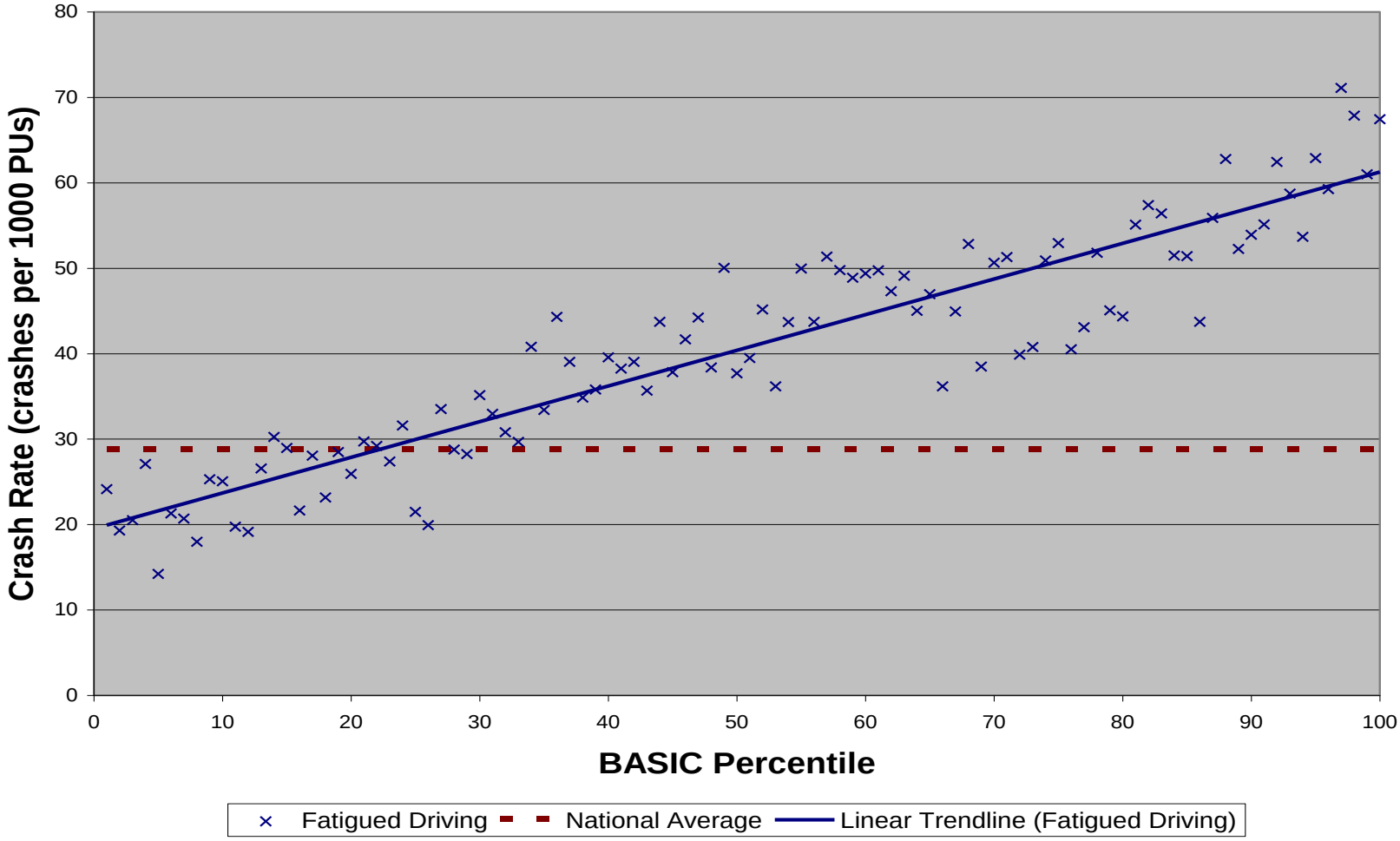
Derivation of Preliminary Severity Weights – 6 Step Process (Continued)

6. CSMS Effectiveness Test
   - A. Performed simulated CSMS runs, calculating carrier measures (with severity weights) and percentile ranks from 0 (lowest) to 100 (highest) for each BASIC, using historical data;
   - B. Observed each carrier's crash involvement over the immediate 18 months after the simulated CSMS timeframe; and
   - C. Calculated the relationship between the percentile ranks in each BASIC and the subsequent post-CSMS carrier crash rates.
     - ➢ Iterative process used to optimize the ability of CSMS to identify high crash risk carriers. Led to changes such as adding severity weight of 2 for OOS conditions.

Effectiveness Test Timeline



Fatigued Driving (HOS) BASIC Effectiveness Results



Severity Weight Observations

- Violations related to crash consequence (e.g., HM-related violation) rather than to crash occurrence have lower weights.
- Easily observable violations (e.g., tires, lights) are weighted more in some instances than violations that would intuitively be more likely to cause a crash.
  - Approach based on statistical and observed “Relationship” of violations to crashes.
  - “Relationship” doesn’t necessarily equate to causation.
- The level of precision of the severity weights is not a major factor in identifying carriers with safety problems in the CSMS.
  - Carriers with safety problems simply have more violations.

Status

- Violation severity weights have garnered significant attention from industry and enforcement
- Violation severity weights will play a role in pending NPRM on new safety fitness regulations
- FMCSA would like to engage MCSAC in refining weights

Proposed Task

MCSAC review and make recommendations regarding appropriate violation group weight by:

A. Determining if individual roadside violations are in the correct violation group

B. Within each BASIC, rank each violation group in priority of crash risk

C. Using the priority ranking in Step B for each BASIC, assign a crash risk of “high”, “medium”, or “low” to each violation group