U.S. Department of Transportation
Federal Motor Carrier Safety Administration

FMCSA Effectiveness Models

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Overview

- Purpose of Effectiveness Models.
- Carrier Intervention Effectiveness Model.
- Roadside Intervention Effectiveness Model.

PURPOSE OF EFFECTIVENESS MODELS

Purpose of Effectiveness Models

- Government Performance and Results Act of 1993 (GPRA).
  - Fiscal Year (FY) based.
- Analytical Models:
  - Carrier Intervention Effectiveness Model (CIEM).
  - Roadside Intervention Effectiveness Model (RIEM).
- Measures of Effectiveness based on improvement in crash rates (crashes per power unit [PU]):
  - Crashes Avoided.
  - Injuries Prevented.
  - Lives Saved.

CARRIER INTERVENTION EFFECTIVENESS MODEL

CIEM Methodology – Carrier Interventions

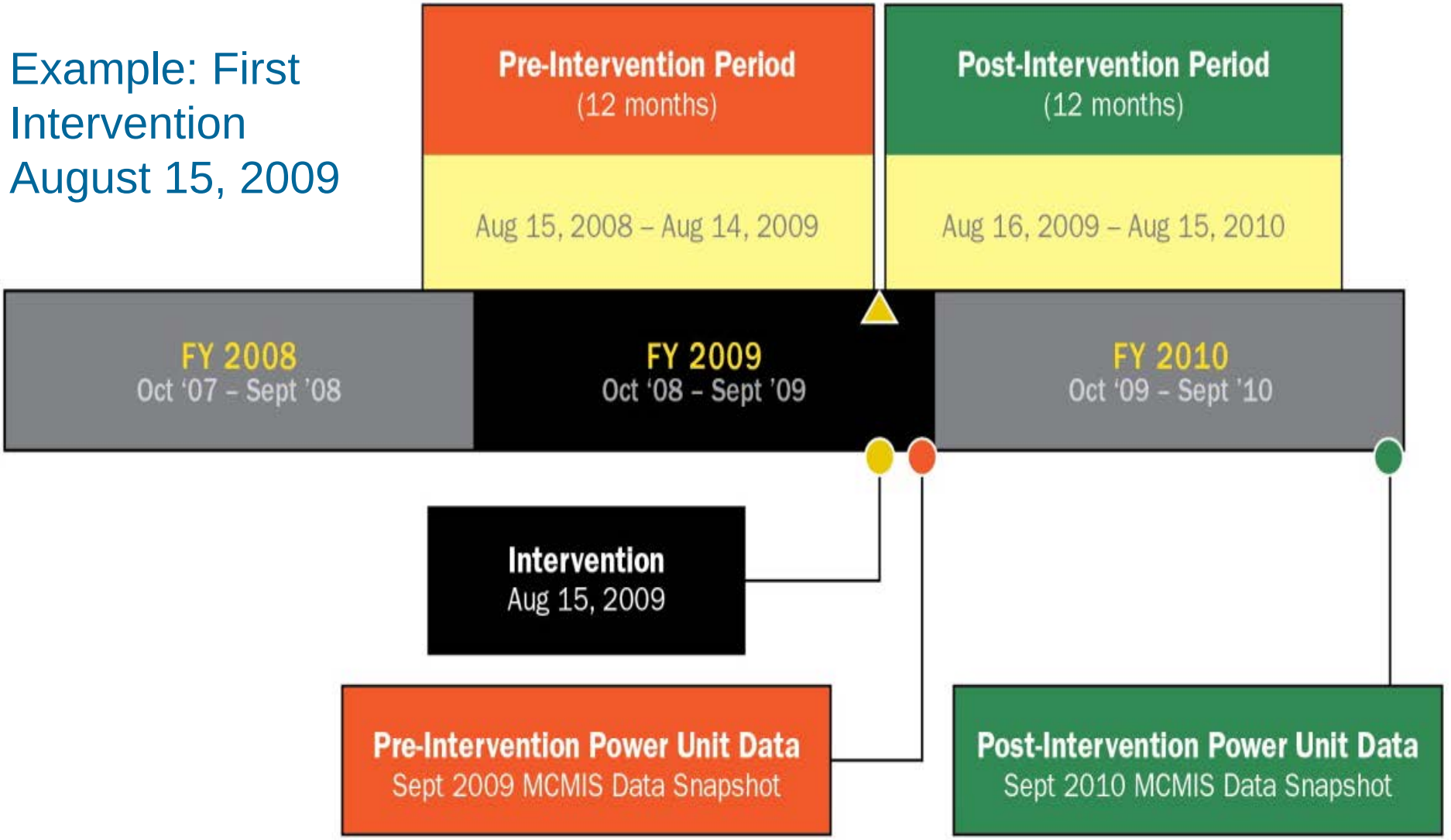
- Motor carriers with one of the following interventions:
  - Compliance review (CR).
  - Non-ratable review.
  - Performance and Registration Information Systems Management (PRISM) warning letter.
  - Compliance, Safety, Accountability (CSA) warning letter.
  - Offsite investigation.
  - Onsite focused investigation.
  - Onsite comprehensive investigation.

CIEM Methodology – Carrier Selection & Grouping

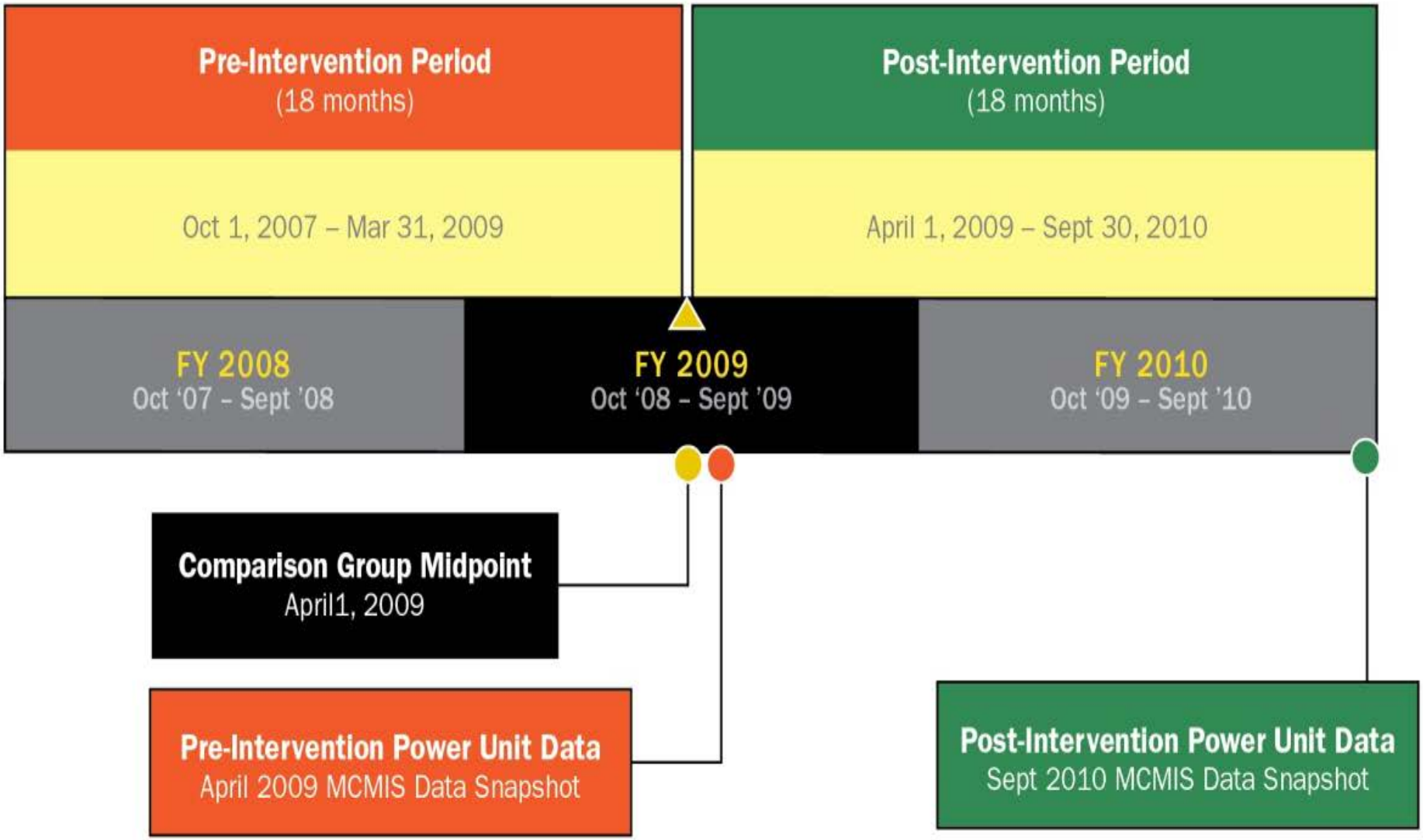
- Selection criteria for Treatment Group:
  - Interstate carrier or intrastate hazardous material (HM) carrier at time of the intervention.
  - Meets outlier tests to identify suspect crash and PU data.
- Selection criteria for Comparison Group:
  - Interstate carrier or intrastate HM carrier with no interventions.
  - Meets outlier tests.
- Carriers grouped by size:
  - 1–5 PUs.
  - 6–20 PUs.
  - 21–100 PUs.
  - More than 100 PUs.

CIEM Methodology – Treatment Group Timeline

Example: First Intervention August 15, 2009



CIEM Methodology – Comparison Group Timeline

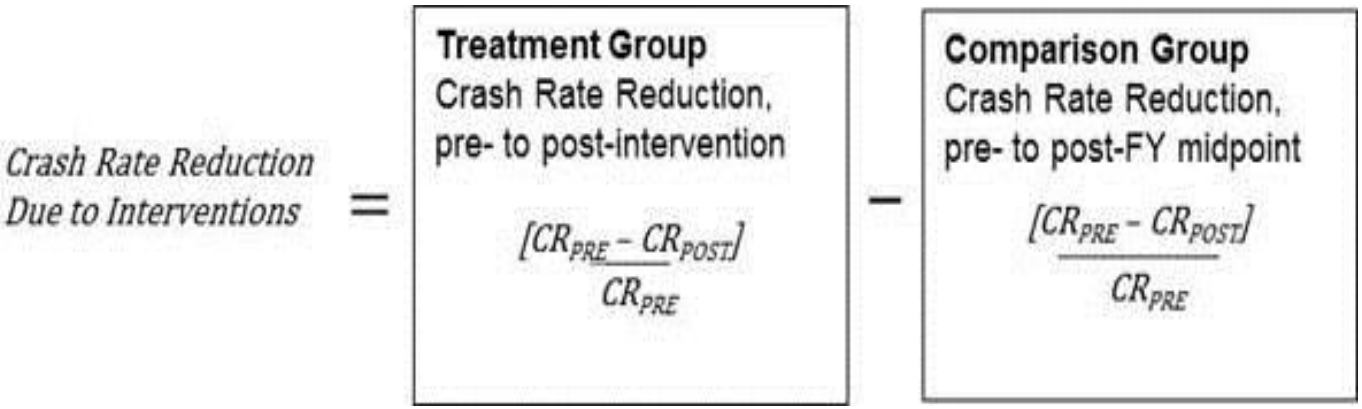


CIEM Methodology – Crash Rate Calculations

- Crash rates calculated for each size group.
- Treatment Group crash rates:
  - Pre-intervention crashes/Pre-intervention PUs.
  - Post-intervention crashes/Post-intervention PUs.
- Comparison Group crash rates:
  - Pre-midpoint crashes/midpoint PUs.
  - Post-midpoint crashes/endpoint PUs.

CIEM Methodology – Crash Rate Reduction

- Crash rate reduction due to interventions:



- Result is called Average Treatment Effect:
  - Expressed as a percentage.
  - Test for statistical significance each size group.
  - Exclude non-statistically significant differences from calculation of safety benefits.

CIEM Methodology – Crashes Avoided

- Treatment Group Crashes Avoided for each size group:
  - Apply the Average Treatment Effect to post-intervention PUs to estimate crashes avoided.
- Extrapolate for filtered Treatment Group carriers:
  - Assumption: on average, carriers eliminated from Treatment Group based on filters exhibit a response to interventions similar to Treatment Group carriers.
  - Apply Average Treatment Effect process to excluded carriers.
- Sum estimated reductions for Treatment Group and excluded carriers to estimate total crashes avoided.

CIEM Methodology – Safety Benefits

- Estimate Lives Saved and Injuries Prevented based on:
  - Probability of a crash involving an injury or fatality (2-year average).
  - Average number of fatalities and injuries per relevant crash (2-year average).

CIEM Results – Treatment Group Selection

Intervention Type	Number of Interventions			Treatment Group Carriers		
	FY 09	FY 10	FY 11	FY 09	FY 10	FY 11
CSA Warning Letter	2,184	5,790	39,004	1,546	4,011	30,448
PRISM Warning Letter	7,500	7,415	1,764	5,003	5,073	1,206
Offsite Investigation	345	456	375	282	311	277
Onsite Focused Investigation	520	1,207	6,279	387	904	4,137
Onsite Comprehensive Investigation	386	829	1,399	243	507	758
Compliance Review	16,517	14,577	8,274	9,133	8,192	4,253
Non-Rated Review	879	1,098	1,135	235	662	587
Total	28,331	31,372	58,230	16,829	19,660	41,666

CIEM Results – Size Grouping

Carrier Size Group	Number of Carriers (Treatment Group)			Number of Carriers (Comparison Group)		
	FY 09	FY 10	FY 11	FY 09	FY 10	FY 11
1 (1–5 PUs)	8,085	9,851	23,661	379,869	376,993	379,343
2 (6–20 PUs)	5,660	6,493	11,683	47,167	41,865	40,176
3 (21–100 PUs)	2,578	2,758	4,998	11,232	8,918	8,324
4 (≥100 PUs)	506	558	1,324	2,115	1,376	1,187
Total	16,829	19,660	41,666	440,383	429,152	429,030

CIEM Results – Average Treatment Effect

Adjusted Crash Rate Reduction By Carrier Size Group	FY 2009	FY 2010	FY 2011
1 (1–5 PUs)	34.5%	29.3%	28.8%
2 (6–20 PUs)	20.3%	13.9%	30.0%
3 (21–100 PUs)	7.2%	-2.1%*	15.9%
4 (≥100 PUs)	-0.2%*	-4.9%*	3.2%*

* Non-statistically significant

CIEM Results – Safety Benefits

Fiscal Year	Treatment Group Carriers			
	Number of Carriers	Crashes Avoided	Injuries Prevented	Lives Saved
2009	16,829	1,569	987	52
2010	19,660	1,094	683	36
2011	41,666	4,761	2,924	156
	Extrapolated to all Carriers Receiving Interventions			
2009	26,396	2,398	1,508	80
2010	29,589	1,685	1,051	55
2011	56,482	6,145	3,774	201

ROADSIDE INTERVENTION EFFECTIVENESS MODEL

RIEM Methodology – Roadside Interventions

- Roadside Interventions:
  - Roadside Inspection.
  - Traffic Enforcement.
- Violations:
  - Crash risk probabilities calculated for each violation based on post-crash inspections compared to non-crash inspections.
  - Violations classified in “violation groups” of related violations with same crash risk probability.

RIEM Methodology – Crash Risk Reduction

- Crash risk reduction calculation based on:
  - Crash risk probability from a violation during a “daytrip.”
  - Duration of the reduction, in days.
  - Correction rate of violations in that “violation group.”
- Crashes avoided per violation group is the product of:
  - Crash risk reduction for each violation group.
  - Number of inspections with violations in each “violation group” in the FY.
- Total crashes avoided:
  - Sum of crashes avoided per violation group.

RIEM Methodology – Safety Benefits

- Estimate Lives Saved and Injuries Prevented based on:
  - Probability of a crash involving an injury or fatality (2-year average).
  - Average number of fatalities and injuries per relevant crash (2-year average).

RIEM Results – Roadside Interventions

Interventions	FY 2008	FY 2009	FY 2010
Roadside Inspections	2,723,576	2,788,728	2,849,350
Traffic Enforcements	756,169	730,916	710,983
Total	3,479,745	3,519,644	3,560,333

RIEM Results – Safety Benefits

Intervention Benefits	FY 2008	FY 2009	FY 2010
Crashes avoided due to roadside inspections	8,464	8,149	8,154
Crashes avoided due to traffic enforcements	9,053	8,789	8,330
Total Crashes Avoided	17,517	16,938	16,484
Injuries prevented due to roadside inspections	5,381	5,206	5,129
Injuries prevented due to traffic enforcements	5,755	5,615	5,240
Total Injuries Prevented	11,136	10,821	10,369
Lives saved due to roadside inspections	304	276	258
Lives saved due to traffic enforcements	325	297	263
Total Lives Saved	629	573	521

Effectiveness Model Reports

- CIEM:
  - Carrier Intervention Effectiveness Model FY 2009 through 2011: http://ntl.bts.gov/lib/54000/54400/54484/RRA-14-011-CIEM_Summary_Report-FINAL-508C.pdf
  - CIEM Technical Report – to be published March 2015.
- CREM:
  - Compliance Review Effectiveness Model FY 2008: http://ntl.bts.gov/lib/51000/51200/51282/CREM_FY_2008.pdf.
- RIEM:
  - Roadside Intervention Effectiveness Model FY 2010: http://ntl.bts.gov/lib/54000/54100/54126/13-062_-_RIEM_FY2010_-_FINAL_-_508C.pdf.

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