

FTA

FEDERAL TRANSIT ADMINISTRATION

Transit Advisory Committee for Safety (TRACS)

Safety Data Analysis March 26-27, 2019

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Center for Urban Transit Research



U.S. Department of Transportation
Federal Transit Administration

Agenda

- Project Information
- SMS - Risk-Based Decision Making
- Data Centric Analyses – Heavy Rail, Light Rail, Bus, and Demand Response
 - National Transit Database (NTD)
 - National Household Travel Survey (NHTS) w/NTD – analysis of person exposure
- Focus Area Identification and Discussion
- Stakeholder Engagement
- Focus Area Research and Suggested Priorities for Further Research

Project Information

- The data and analyses presented were performed for the Federal Transit Administration, Office of Research, Demonstration and Innovation in collaboration with Office of Transit Safety Oversight
- Projects:
 - Transit Safety Standards Research Plan
 - FTA Standards Development Program
- Main goals:
 - Identify areas of risk for the industry
 - Identify areas for which standards, recommended practices, and/or guidance documents are needed
 - Perform addition focus area research to support standard or practice development or modification
 - Ensure ongoing and structured stakeholder dialogue

SMS Risk-Based Decision Making

- SMS is part of FTA's regulatory framework
- Data centric examination of safety risks allows effective public policy decisions
 - Clearly understanding the risks to the industry
 - Providing support mechanisms, including guidance documents or recommended practices, that may help with safety risk management and assurance processes
 - Ensuring that FTA supported training addresses the process to determine risk and highlights recognized industry-wide risks (safety promotion)
 - Providing funding for demonstration projects/programs to address areas of risk

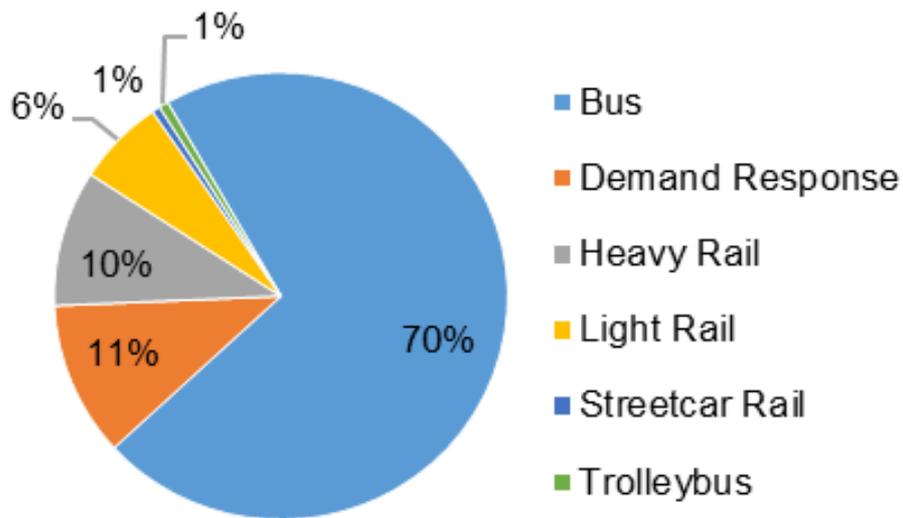
NTD DATA PRESENTATION – GENERAL FINDINGS 2008-2016

Areas of Greatest Risk – Overview

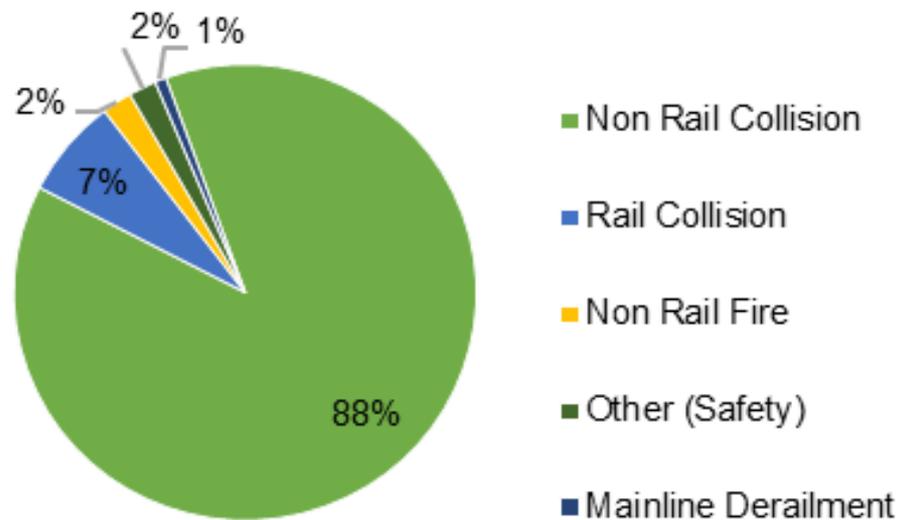
- Heavy Rail
 - Trespasser fatalities
 - Injuries to people waiting/leaving
 - Suicides
 - Injuries and fatalities of right-of-way workers
- Light Rail
 - Collisions with persons
 - Collision-related injuries at intersections/crossings
- Bus
 - Fatalities due to person collisions
 - Fatalities to occupants of other vehicles
 - Injuries associated with rear-ended collisions
- Demand Response
 - Injuries and fatalities associated with motor vehicle collisions
 - Injuries and fatalities associated with rear-ended collisions
- All Modes
 - Assault-related injuries
 - Vehicle operator injuries and involvement in injury and fatal events

Safety Data Overview

2008 - 2016



Reported Safety and Security Events
by Mode

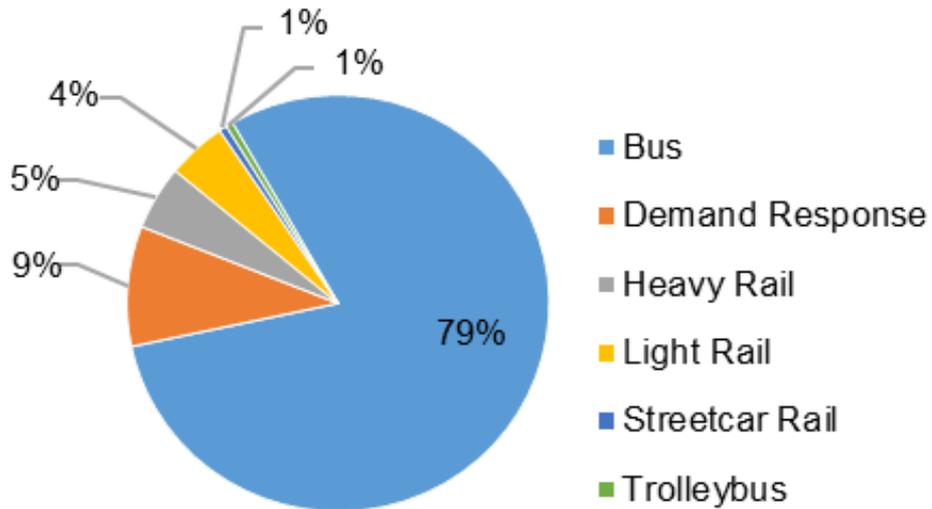


Safety Events by Type*

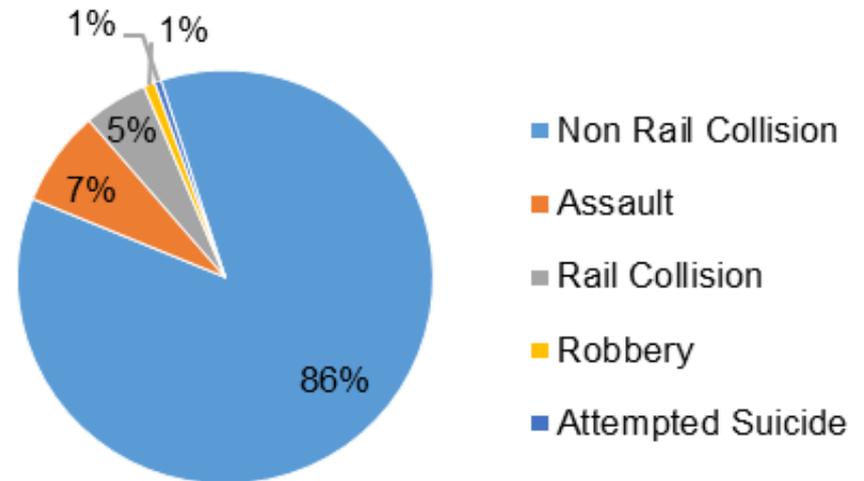
*Rail/non-rail collisions represent 92.7% of safety events (46,581 total safety events)

Injuries by Mode and Type of Event

2008 - 2016



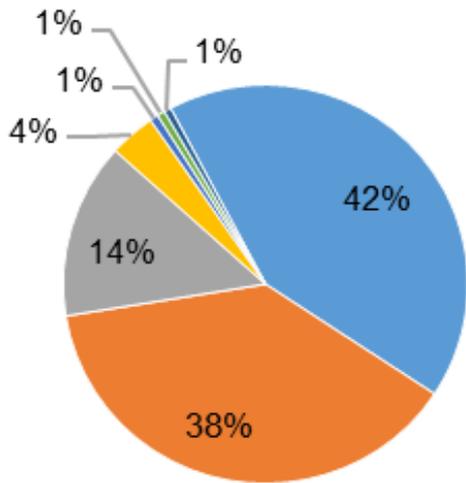
Total Reported Injuries by Mode



Injuries by Type of Event

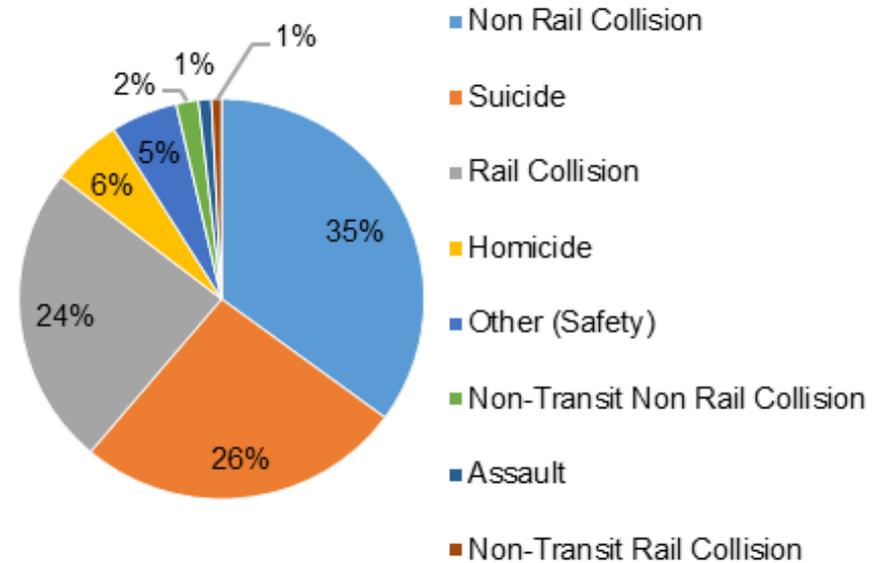
Fatalities by Mode and Type of Event

2008 - 2016



- Heavy Rail
- Bus
- Light Rail
- Demand Response
- Monorail/Guideway
- Commuter Bus
- Vanpool

Total Reported Fatalities by Mode

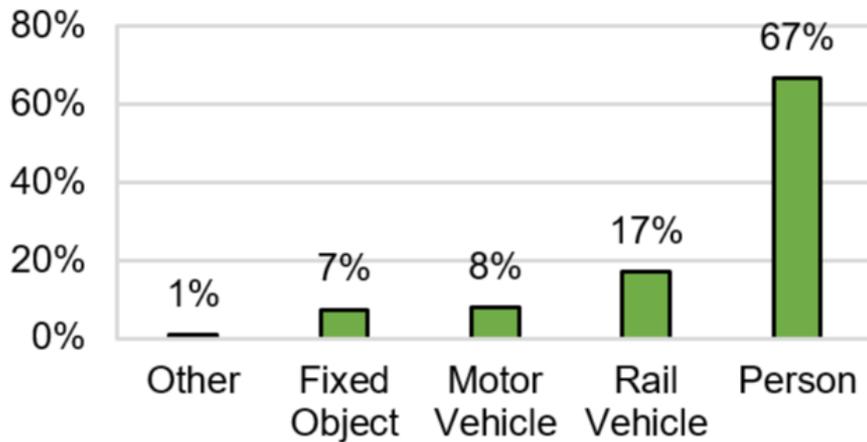


Fatalities by Type of Event

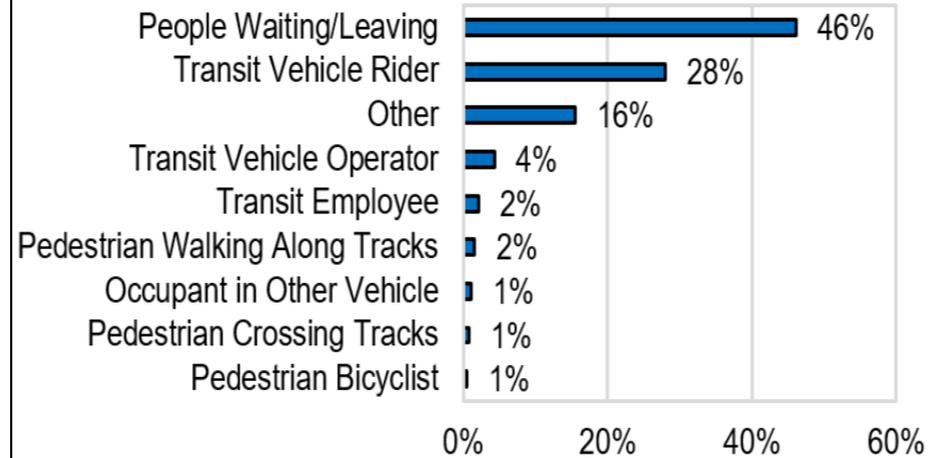
Heavy Rail Injuries

2008-2016

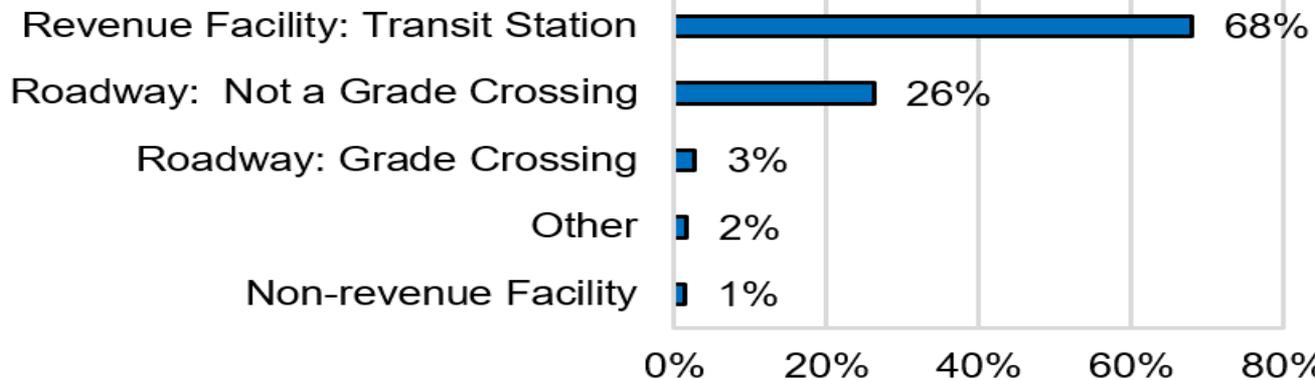
Collision Type



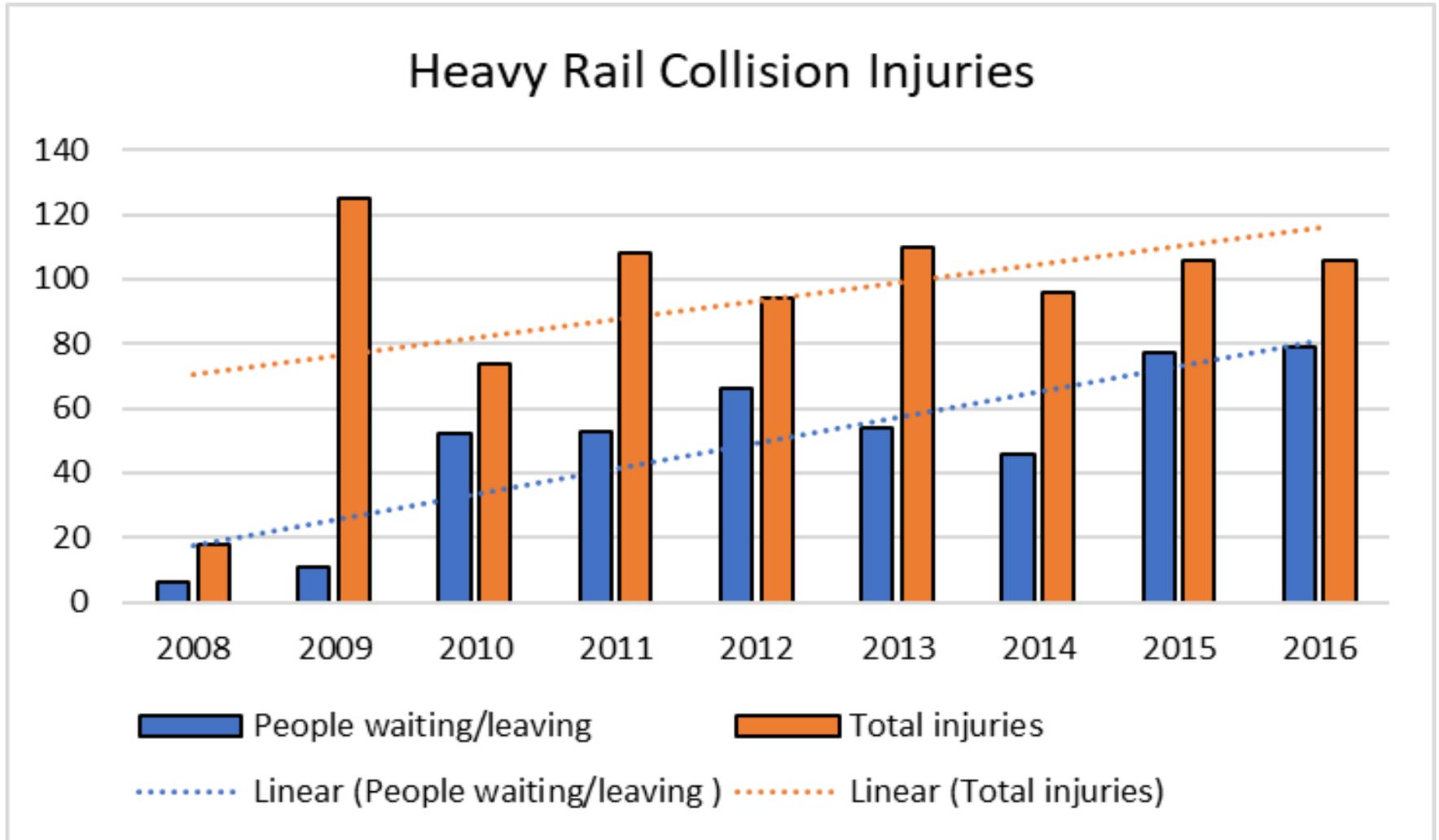
Person Type



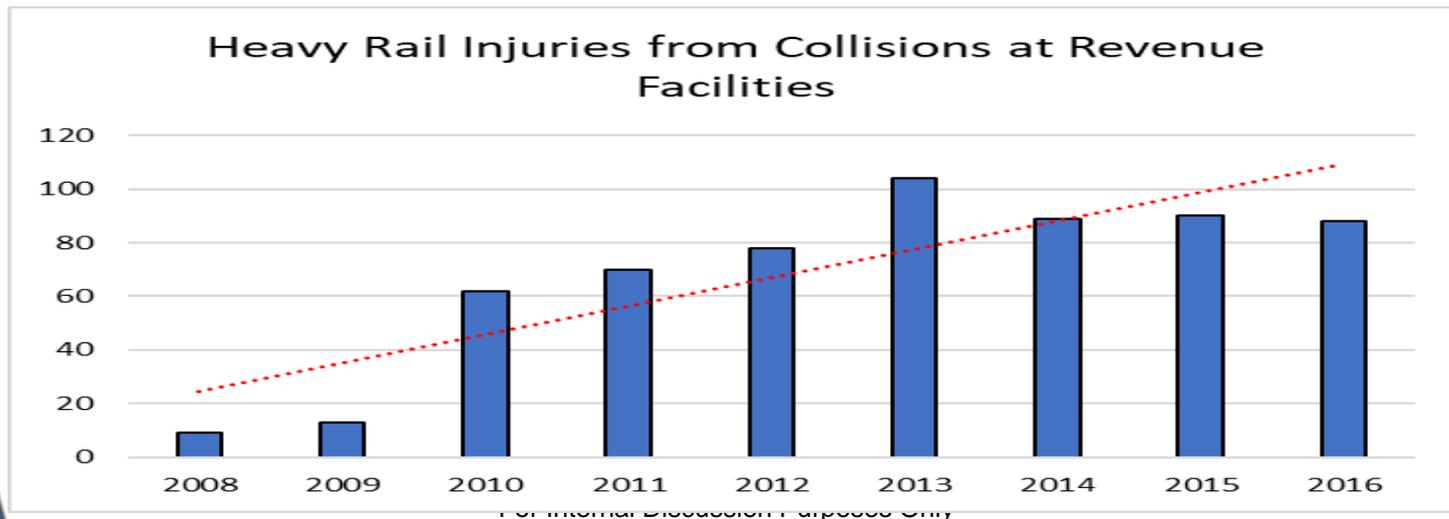
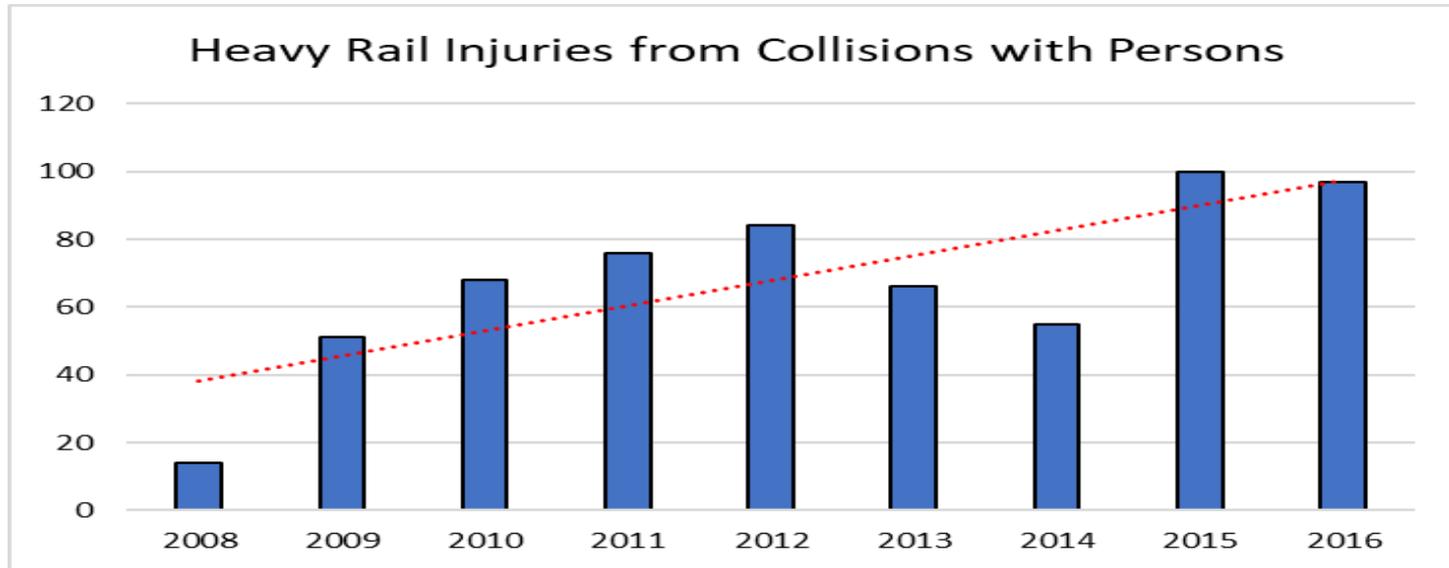
Location Type



Heavy Rail Injuries - Trends



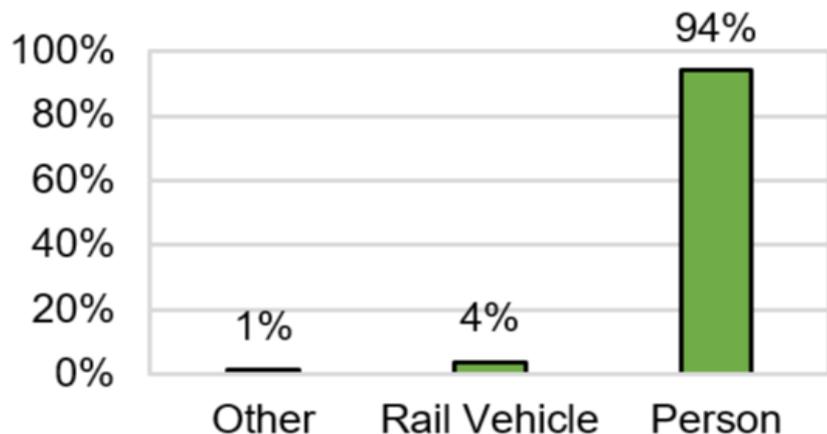
Heavy Rail Injuries - Trends



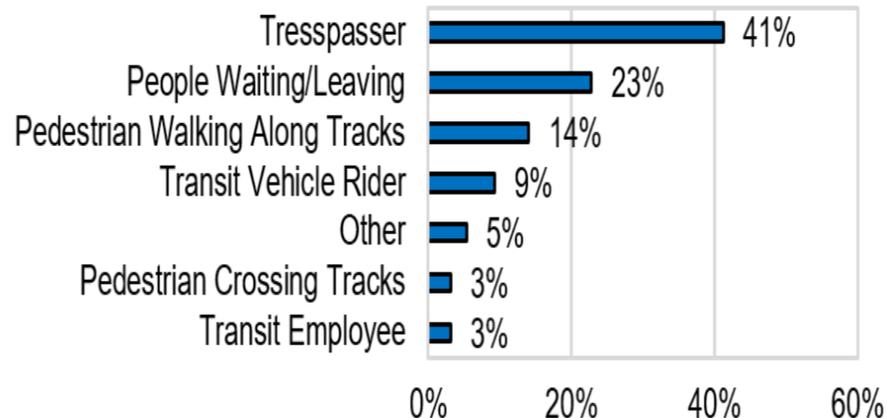
Heavy Rail Fatalities

2008-2016

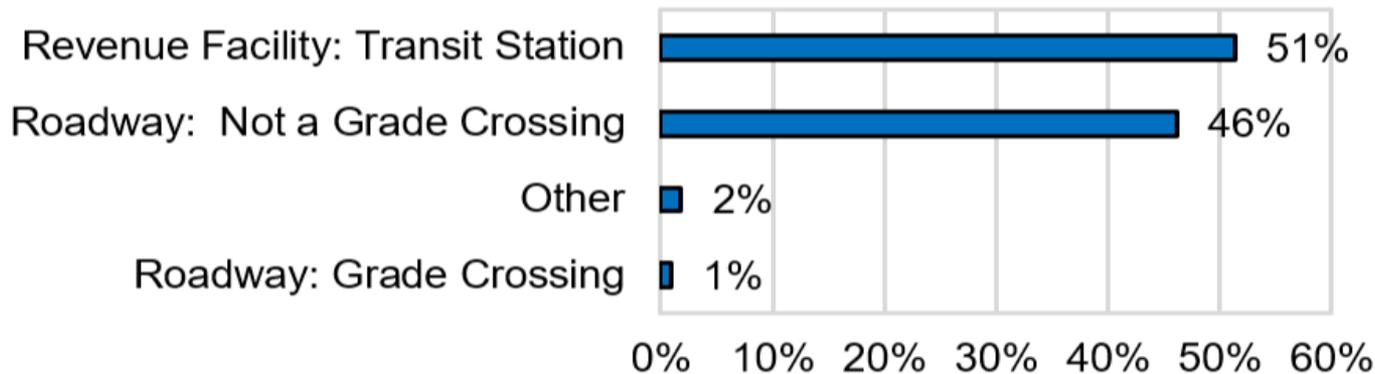
Collision Type



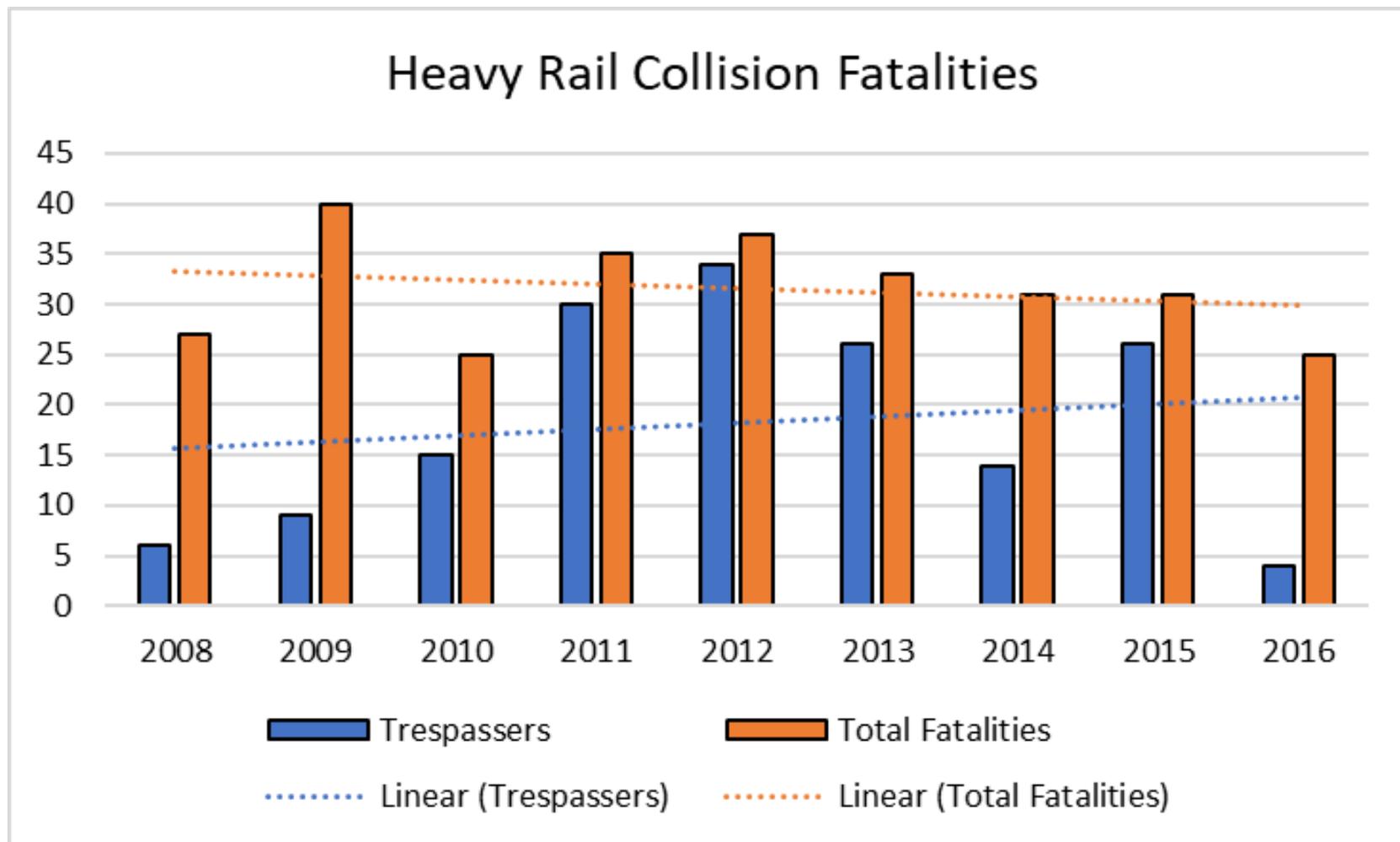
Person Type



Location Type

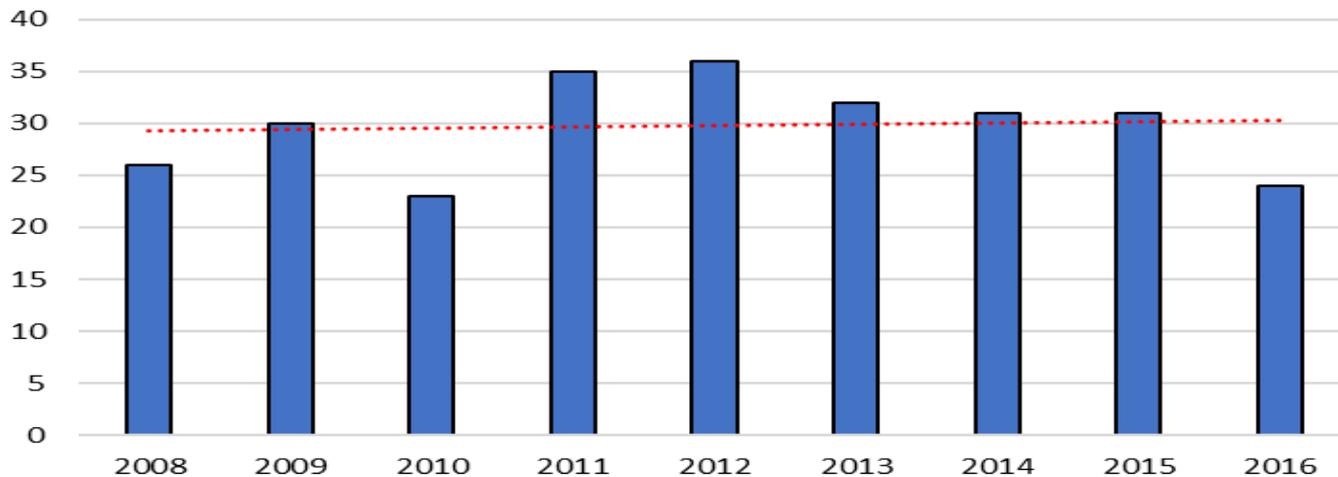


Heavy Rail Fatalities - Trends

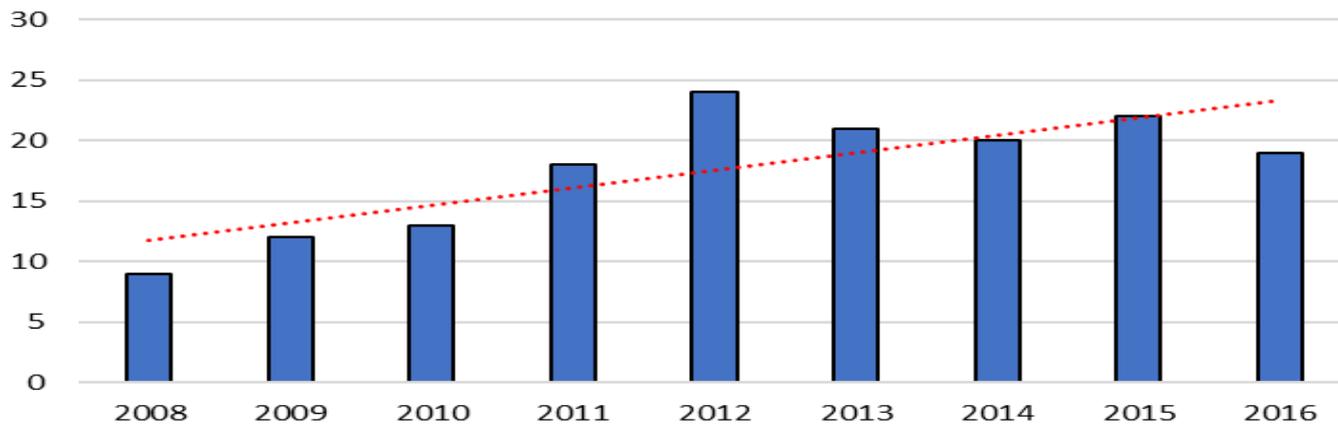


Heavy Rail Fatalities - Trends

Heavy Rail Fatalities from Collisions with Persons



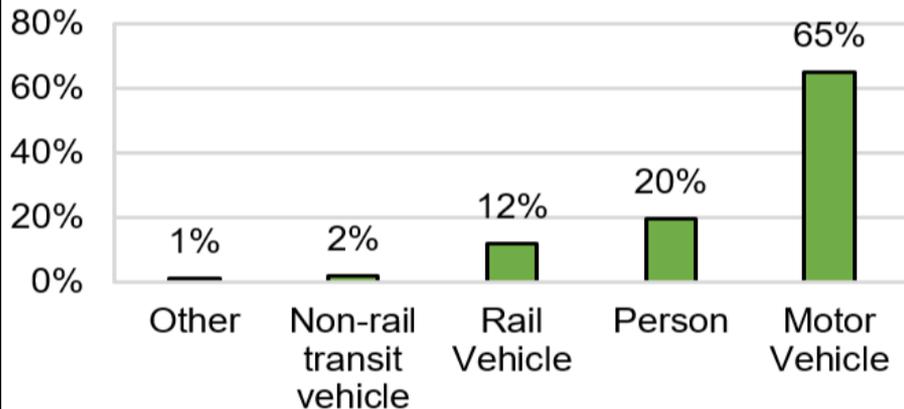
Heavy Rail Fatalities from Collisions at Revenue Facilities



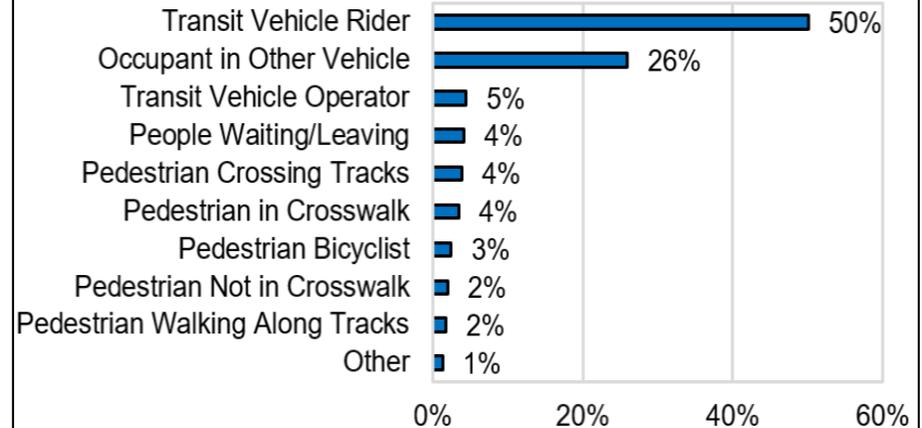
Light Rail Injuries

2008-2016

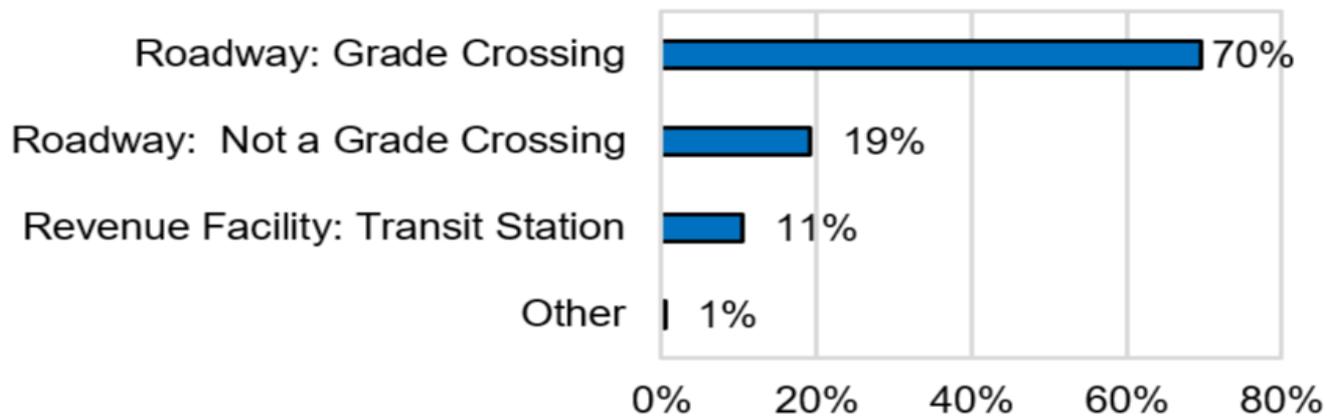
Collision Type



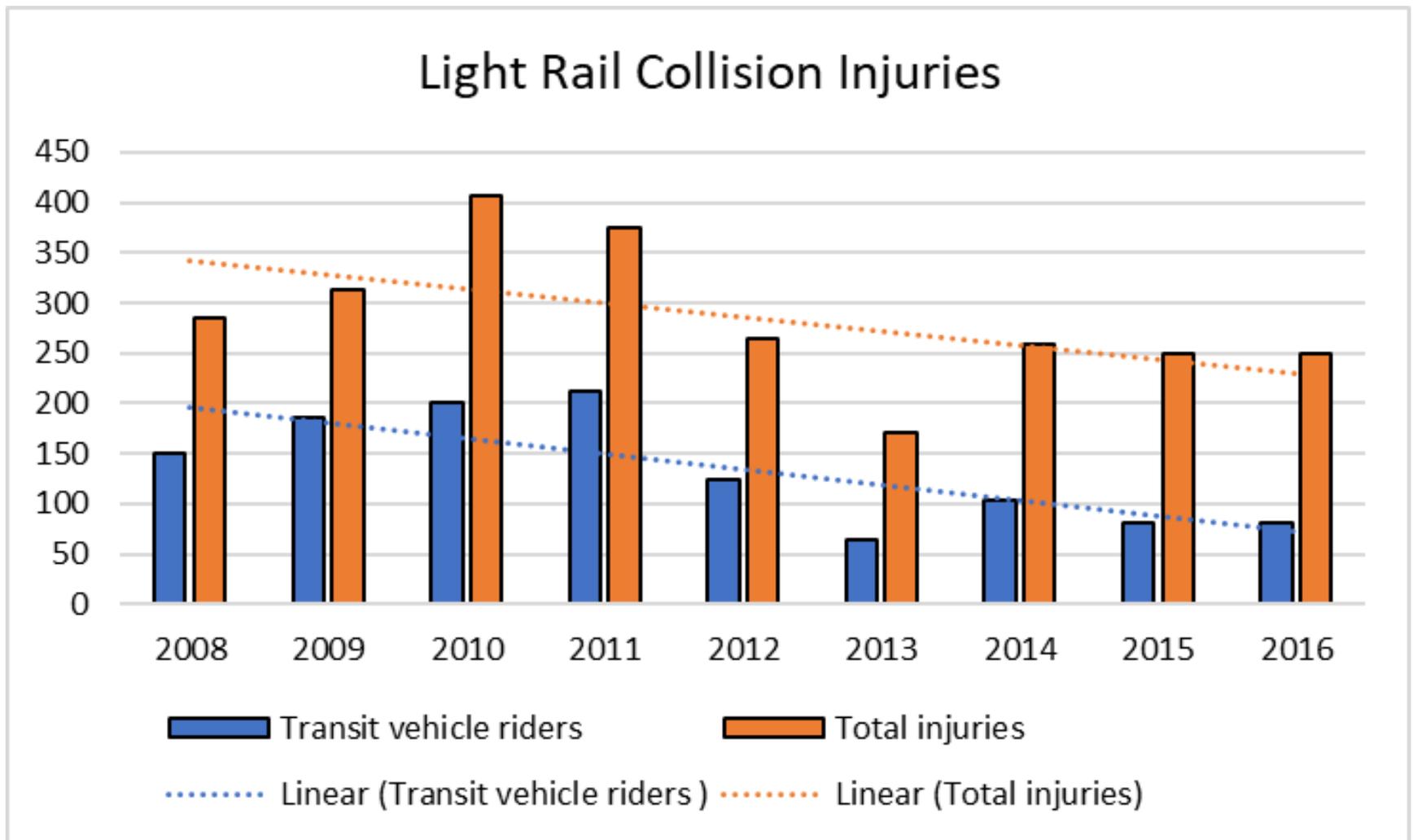
Person Type



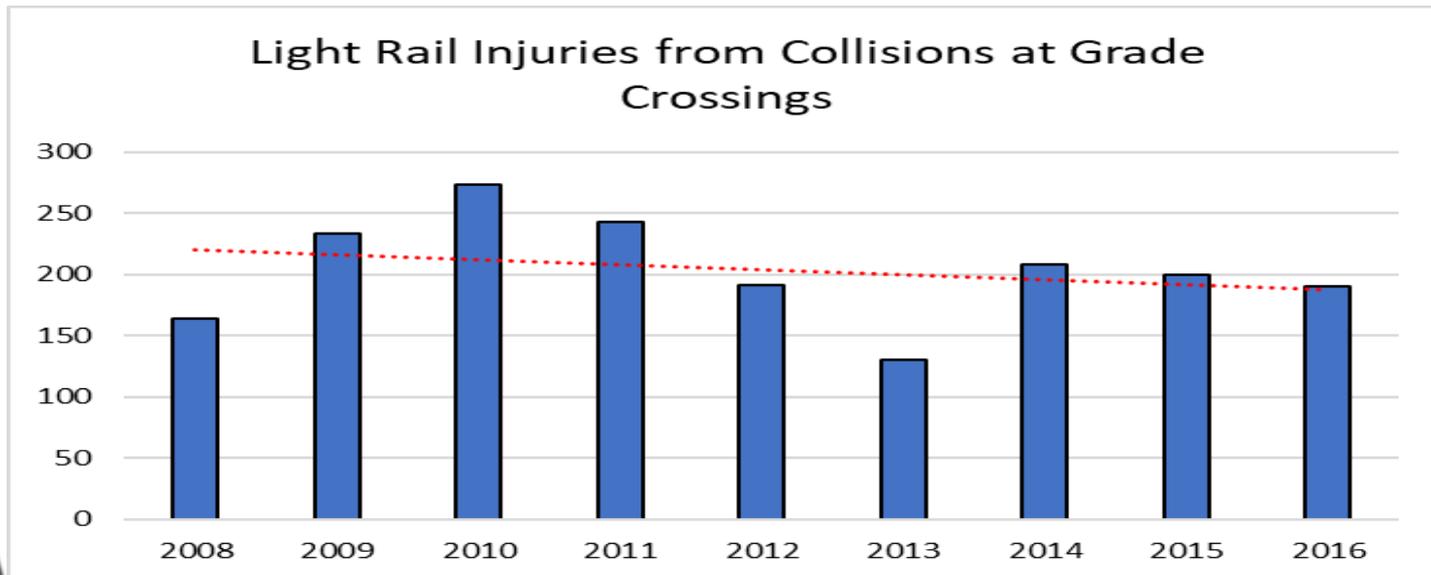
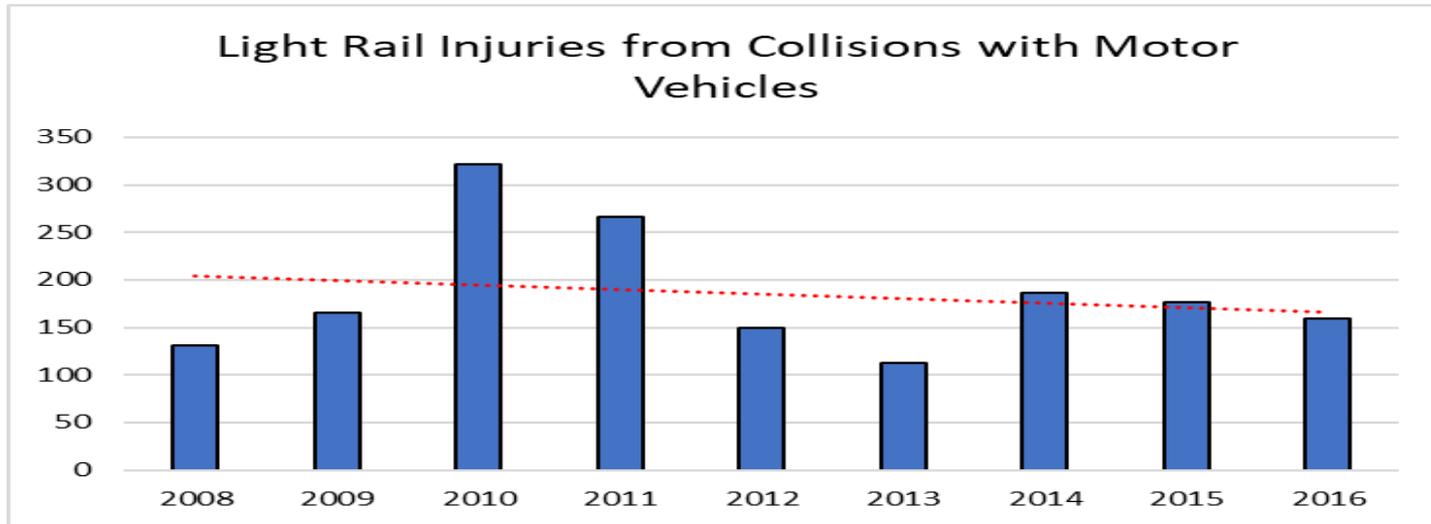
Location Type



Light Rail Injuries - Trends



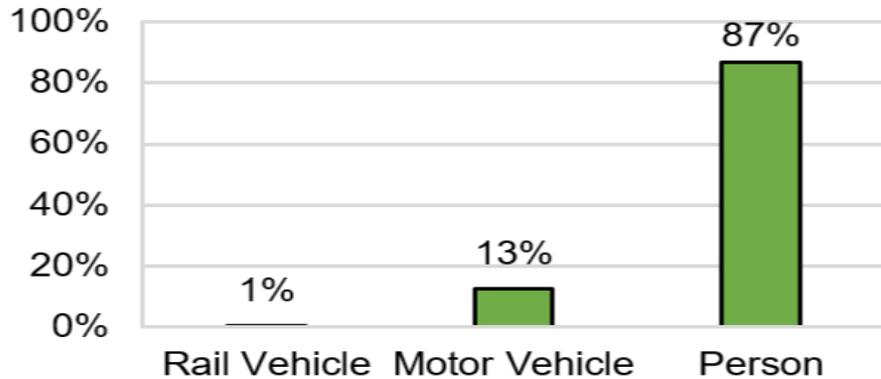
Light Rail Injuries - Trends



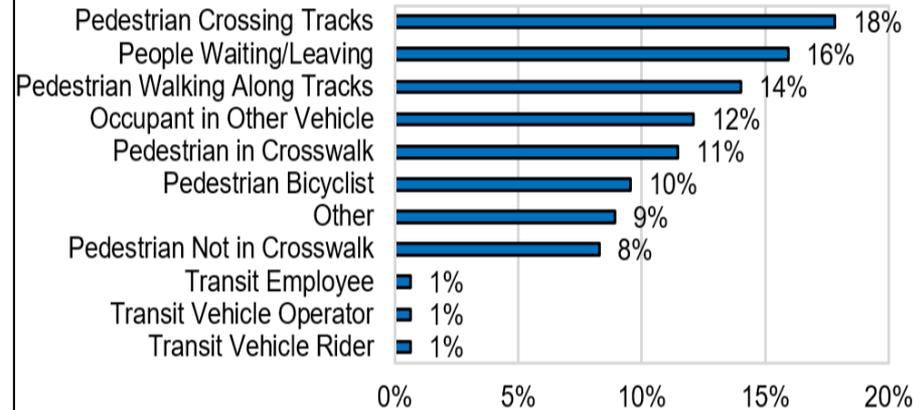
Light Rail Fatalities

2008-2016

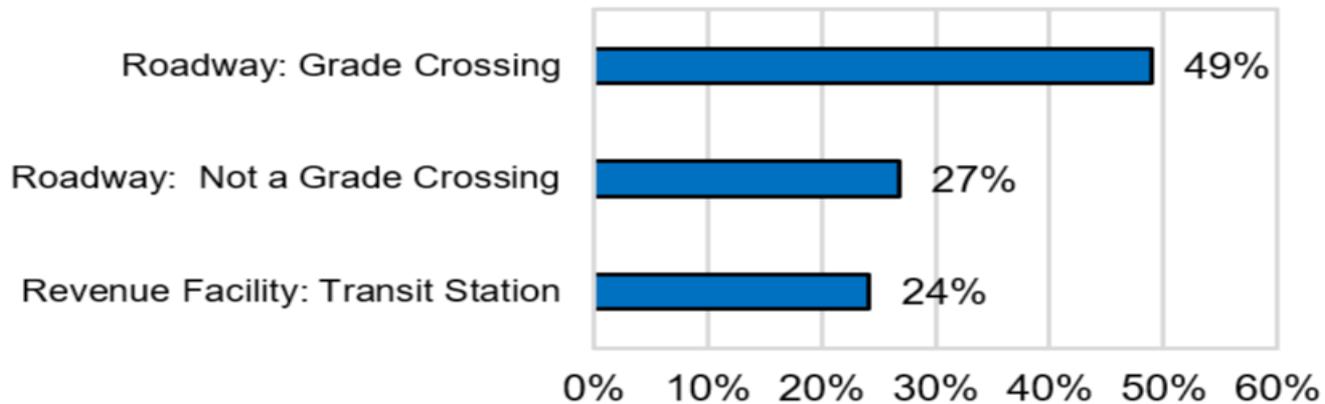
Collision Type



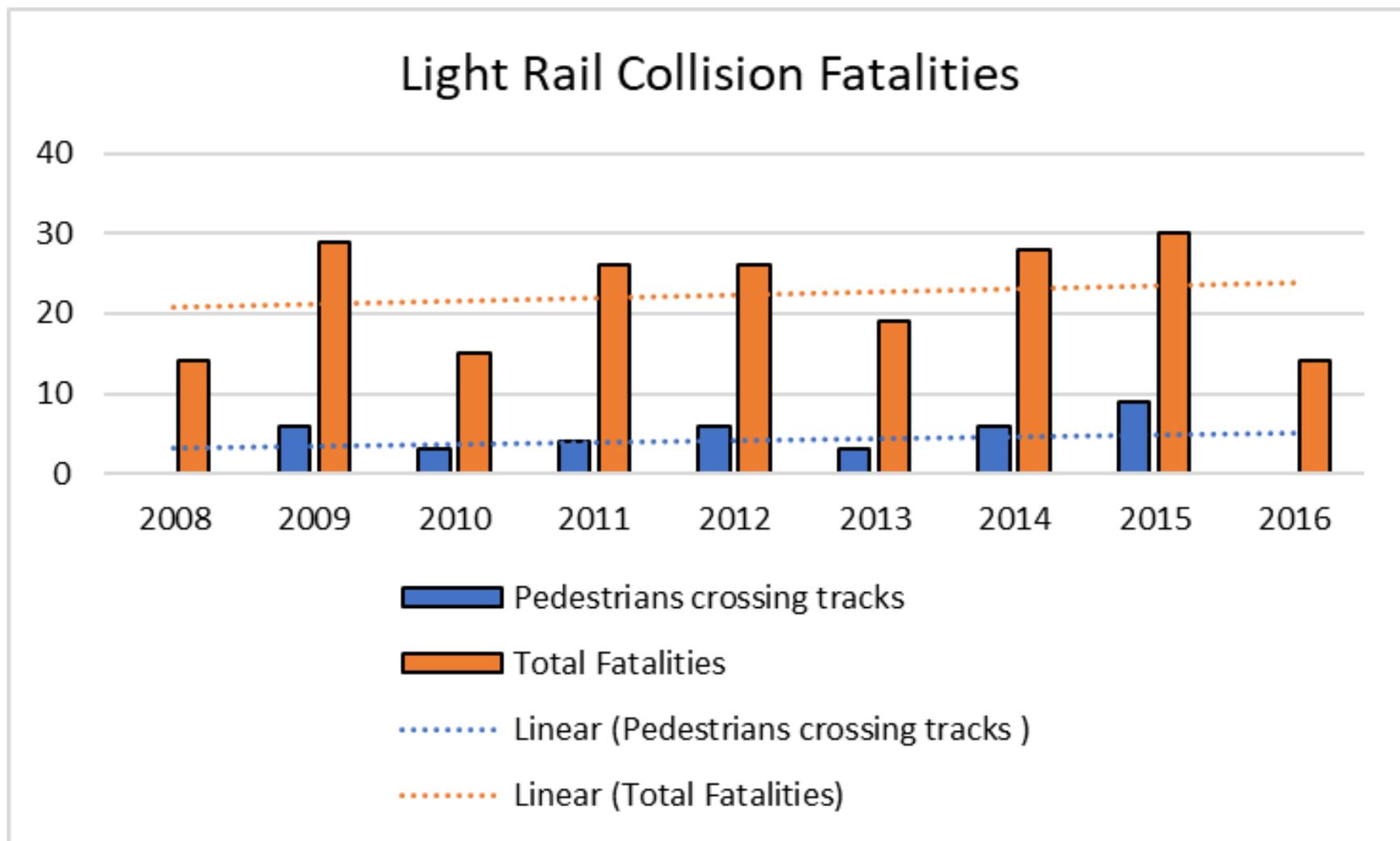
Person Type



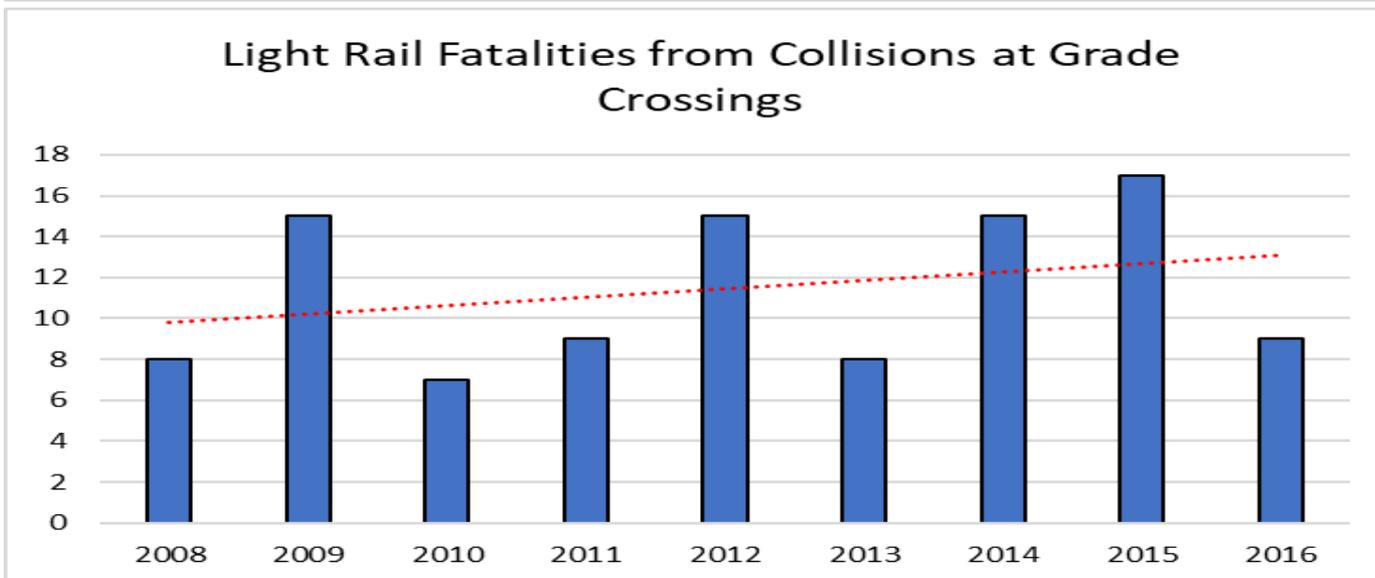
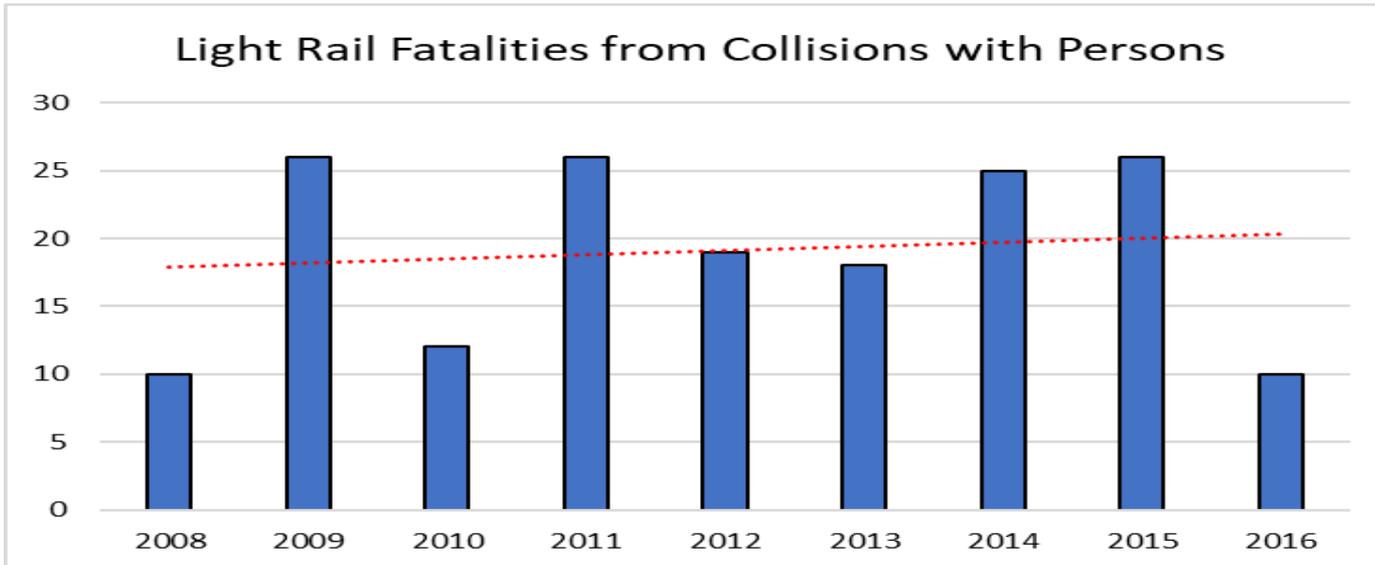
Location Type



Light Rail Fatalities - Trends



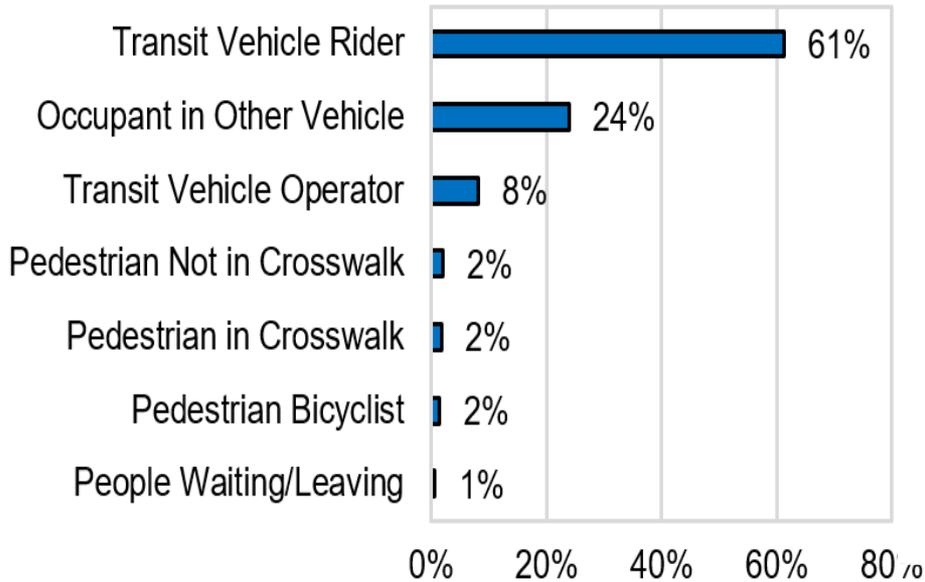
Light Rail Fatalities - Trends



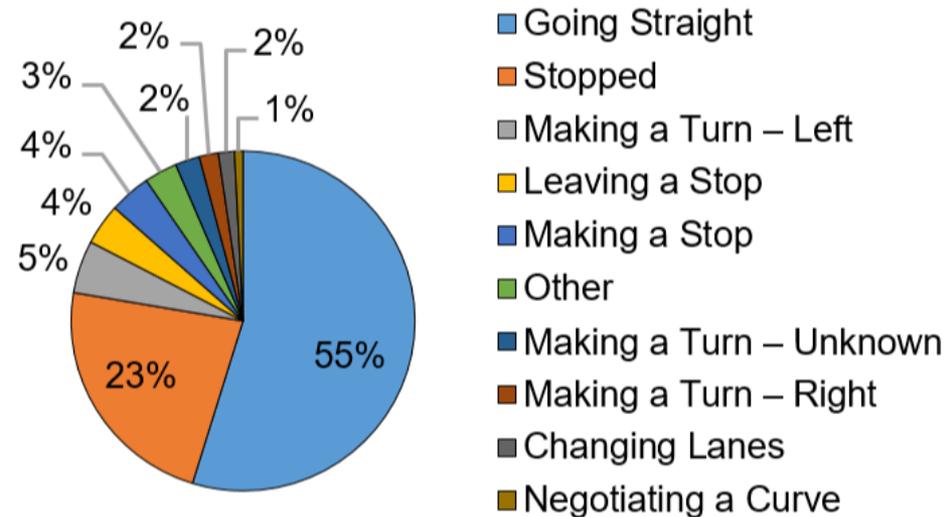
Transit Bus Injuries

2008-2016

Person Type



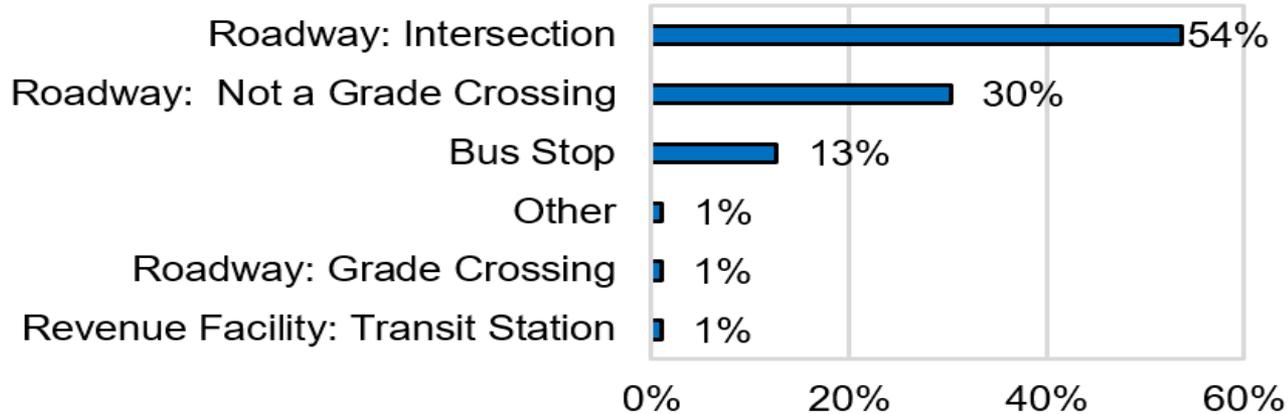
Vehicle Action



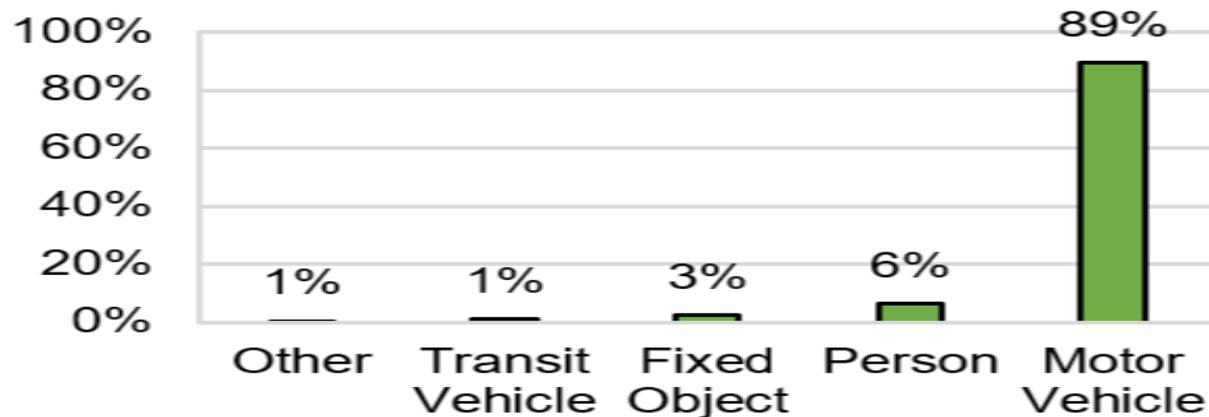
Transit Bus Injuries

2008-2016

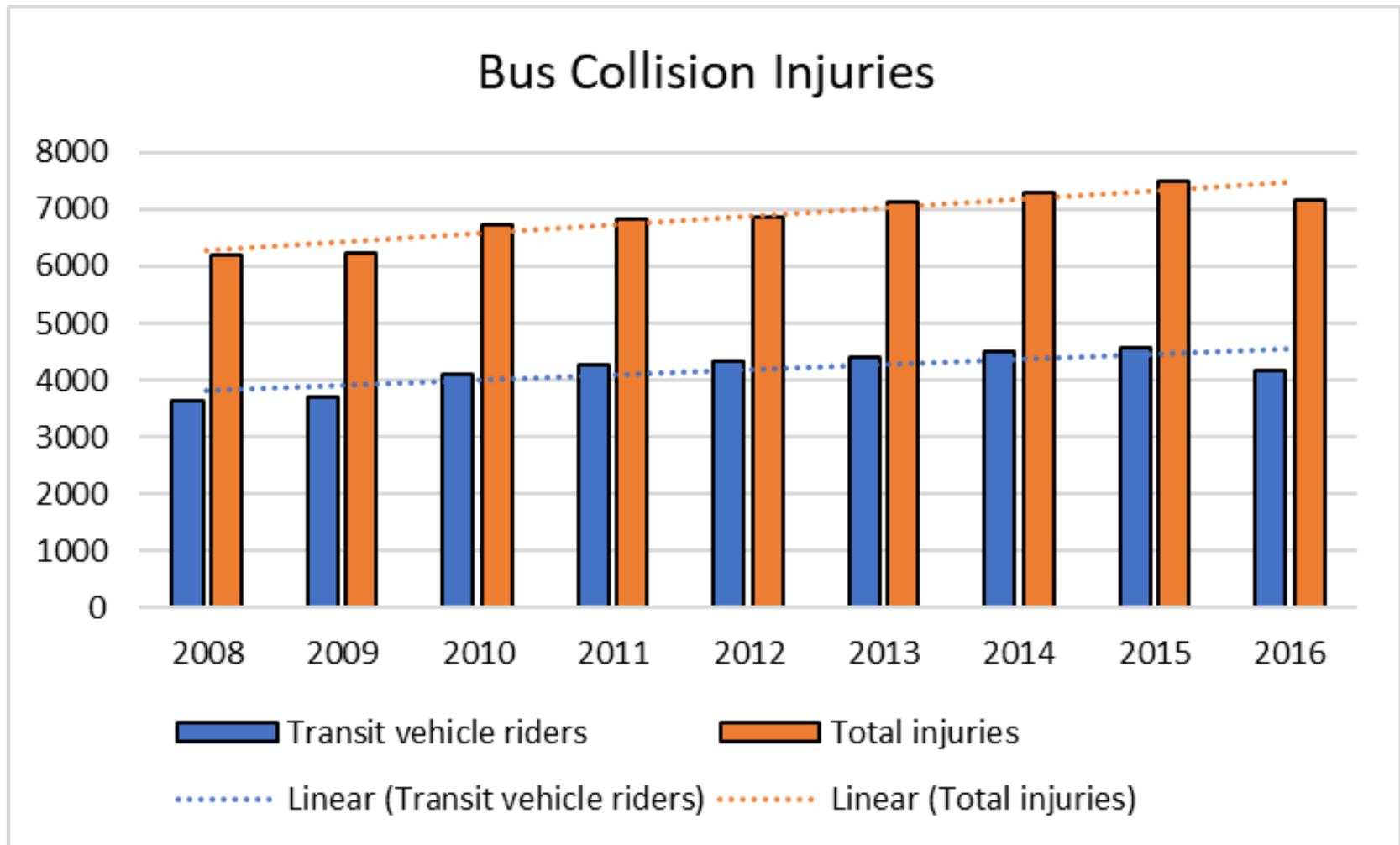
Location Type



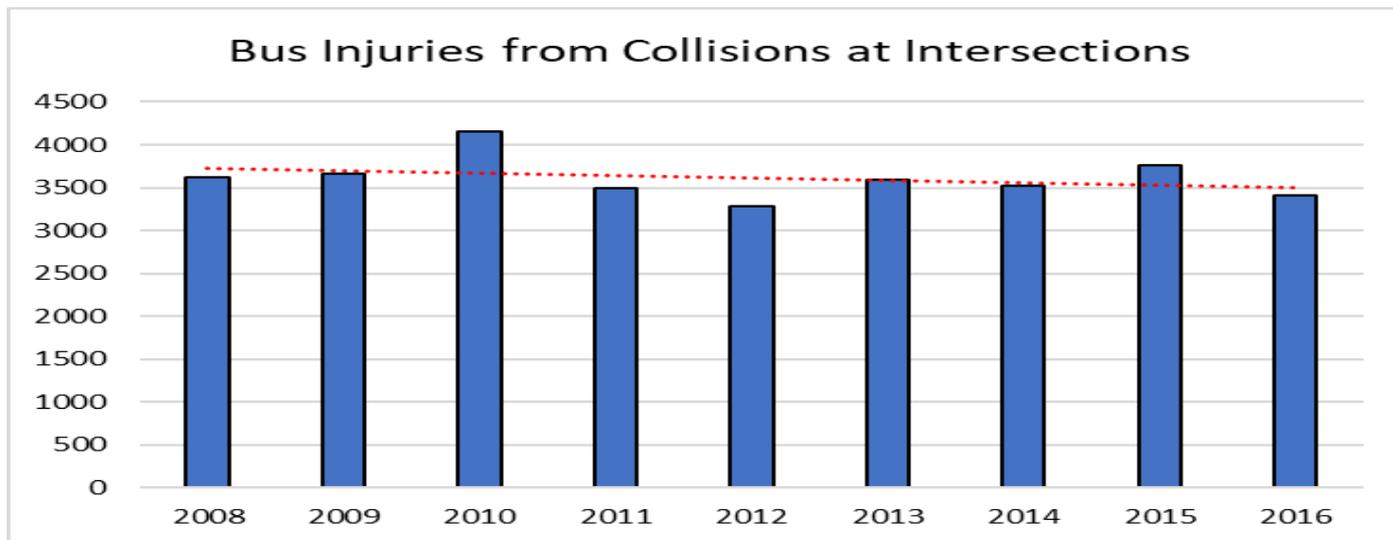
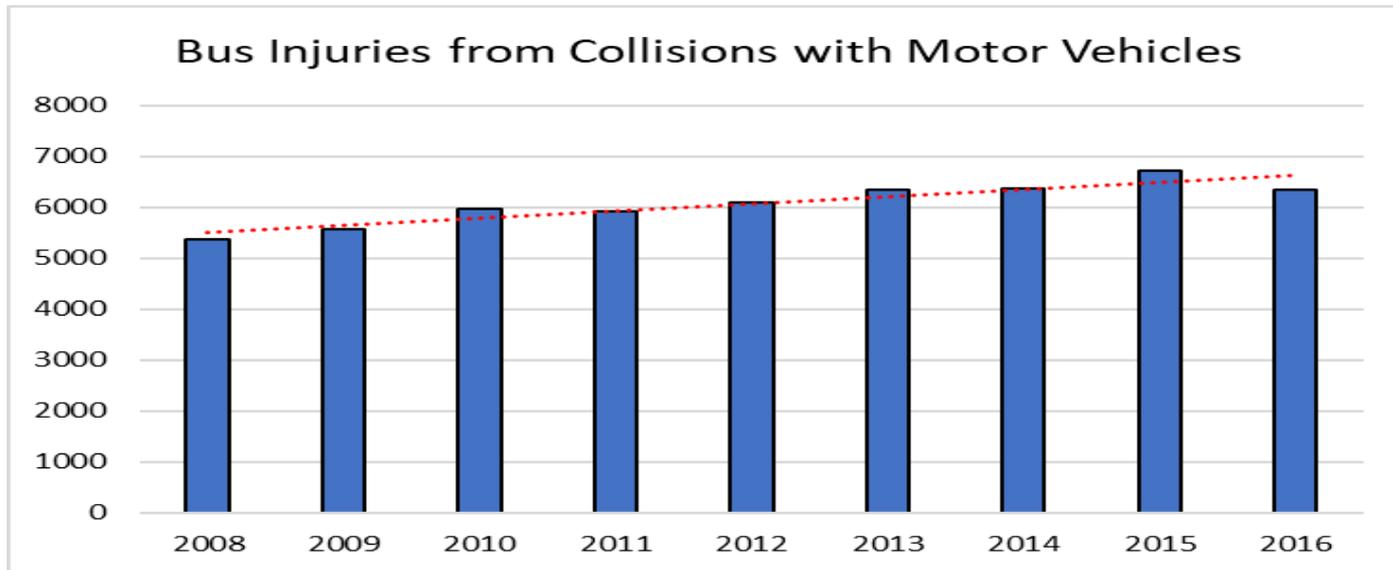
Collision Type



Transit Bus Injuries - Trends



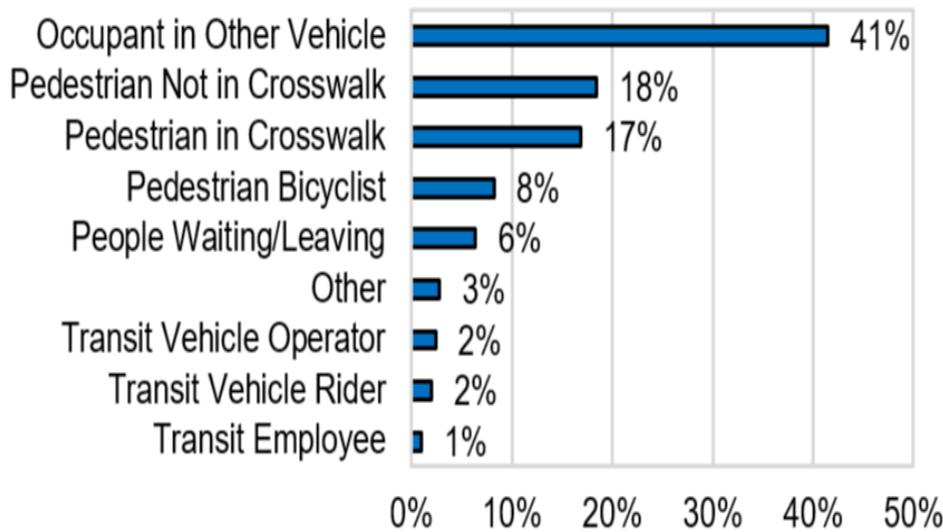
Transit Bus Injuries - Trends



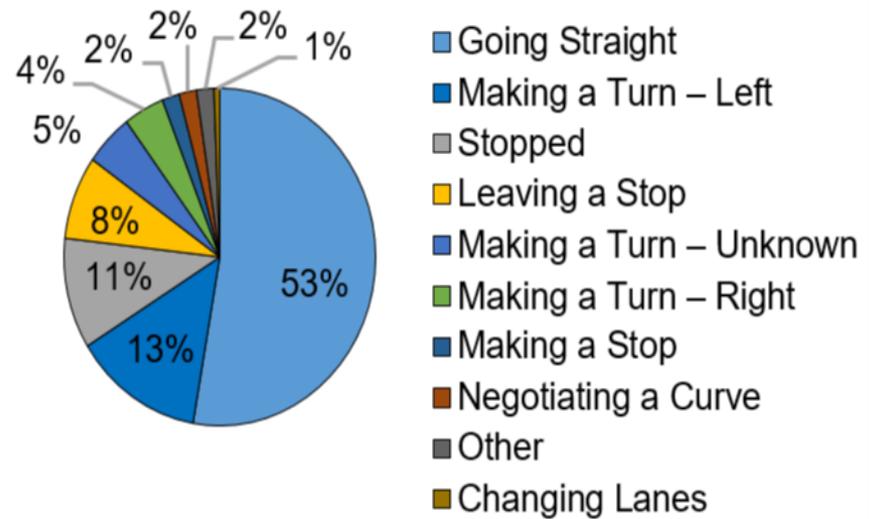
Transit Bus Fatalities

2008-2016

Person Type

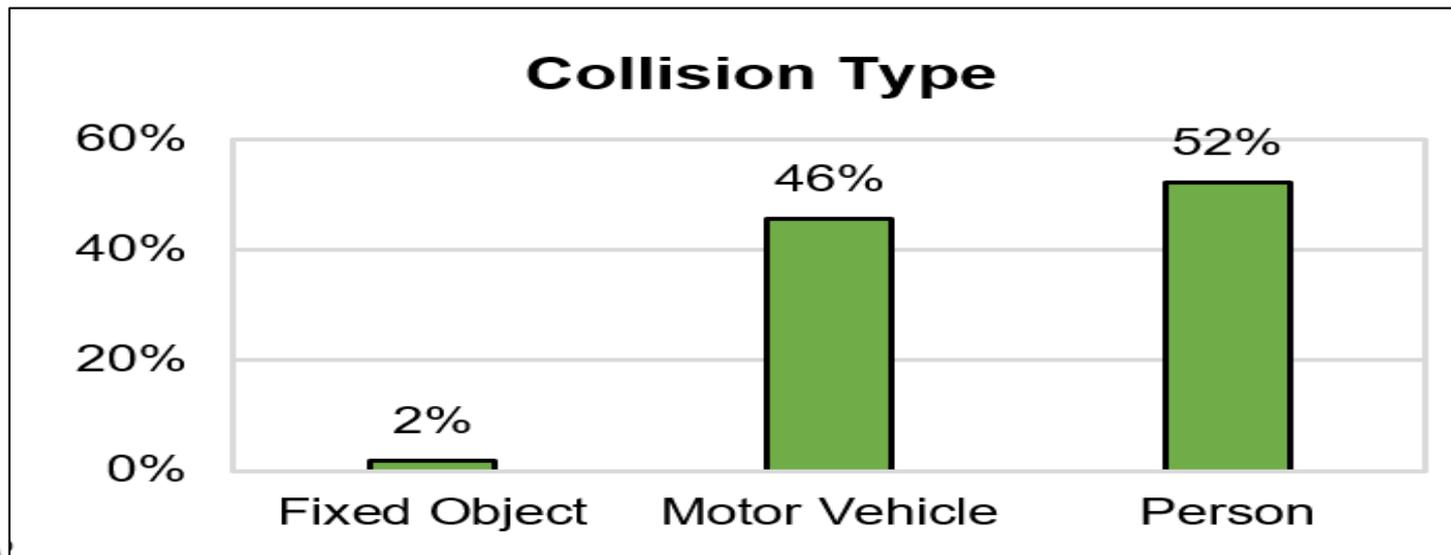
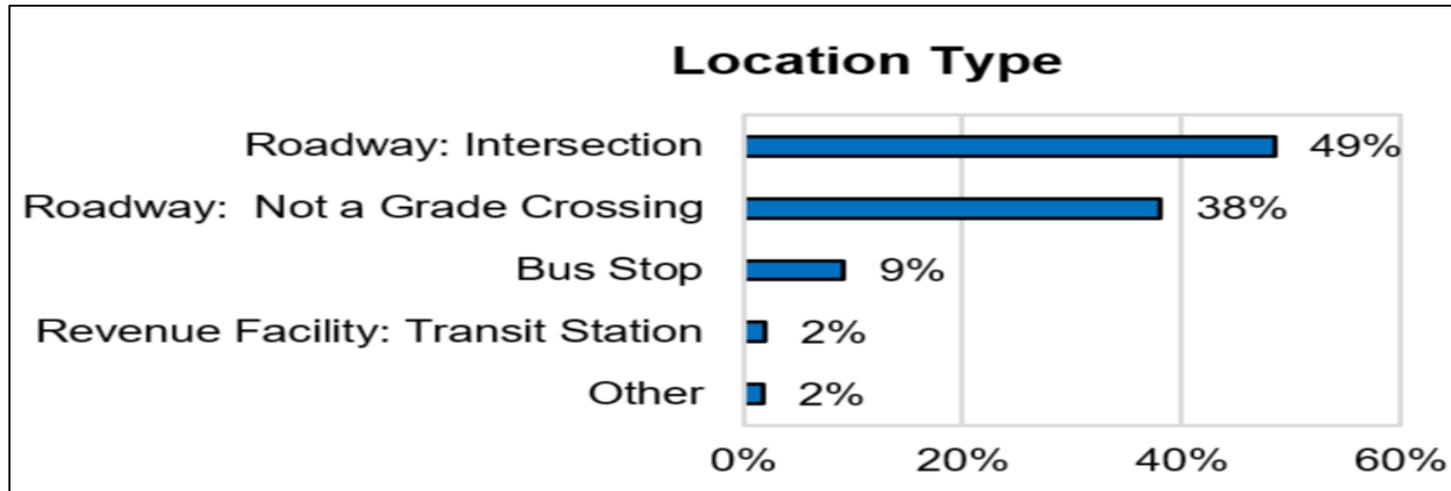


Vehicle Action

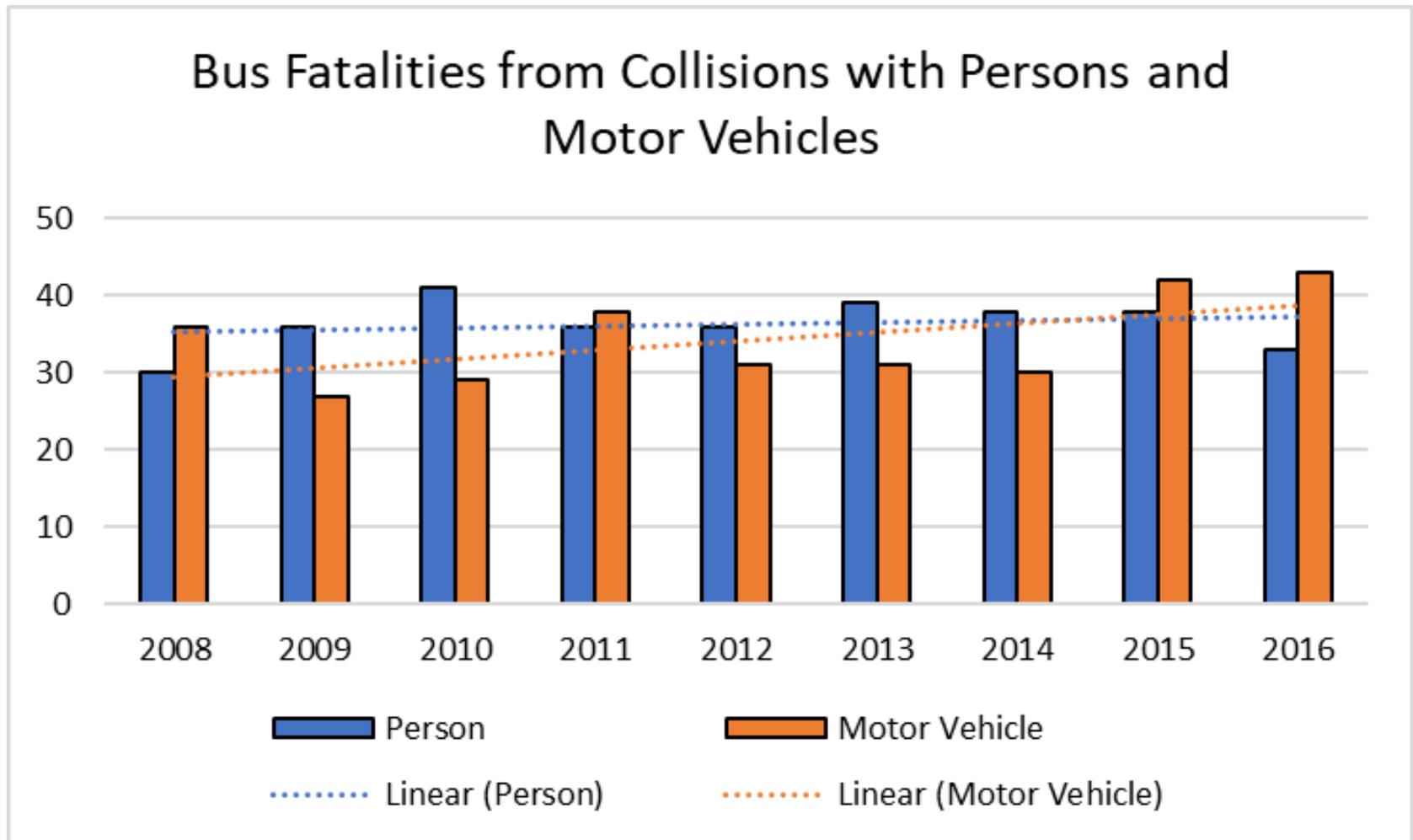


Transit Bus Fatalities

2008-2016



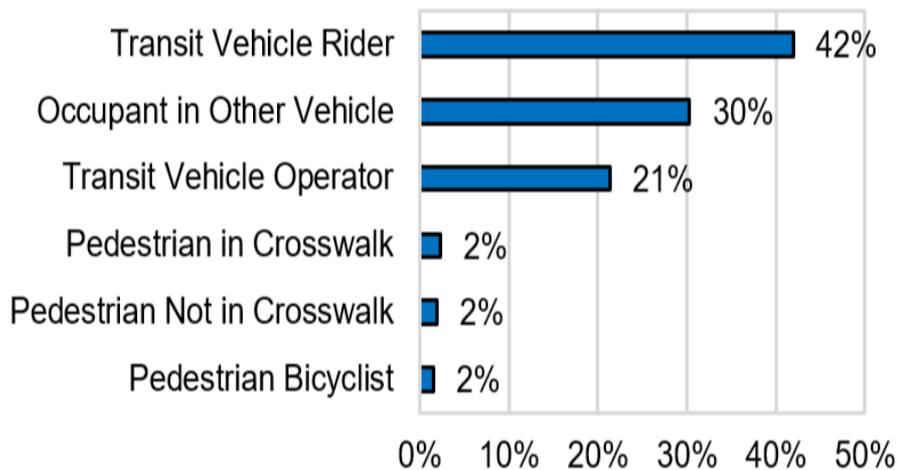
Transit Bus Fatalities - Trends



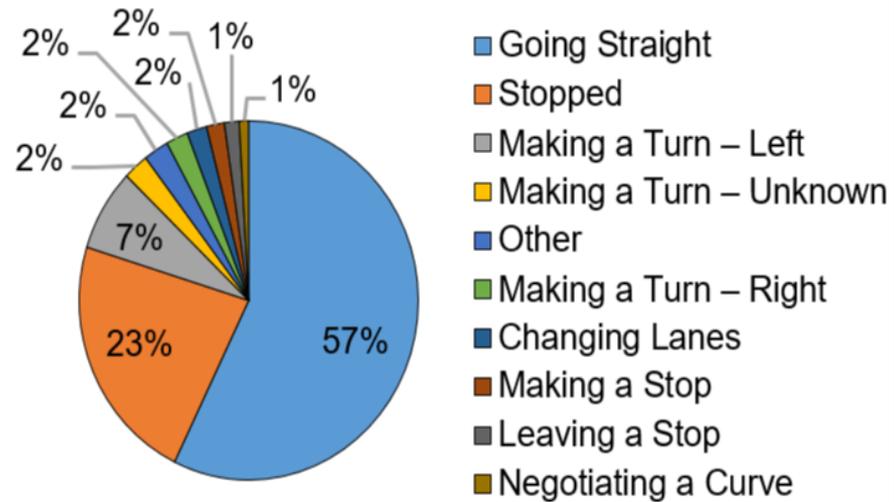
Demand Response Injuries

2008-2016

Person Type

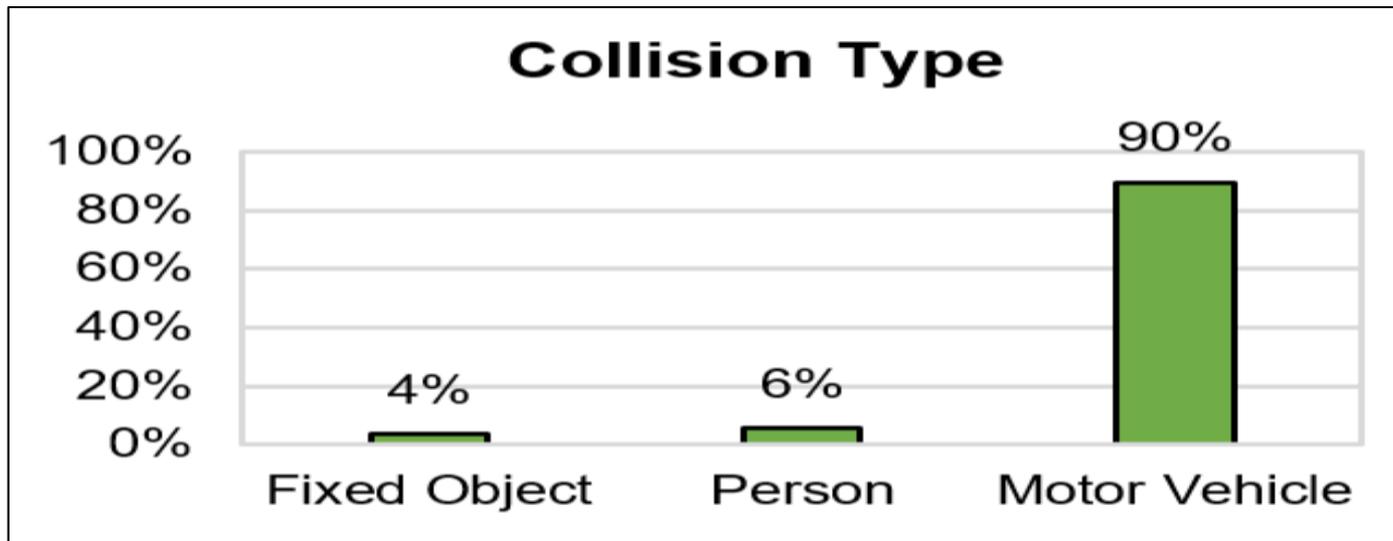
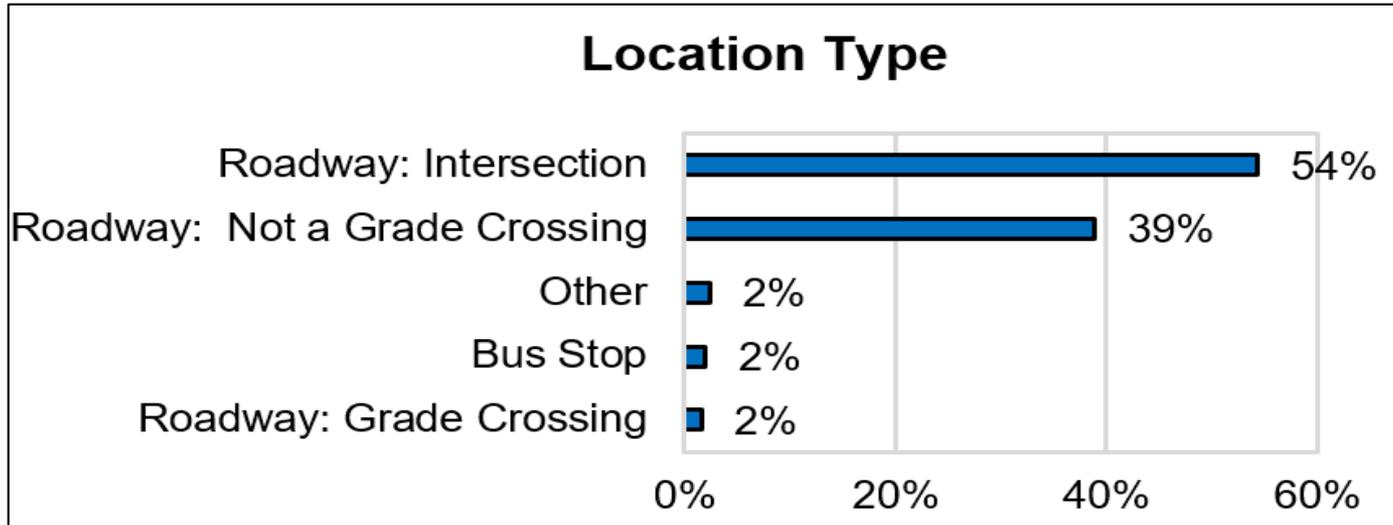


Vehicle Action

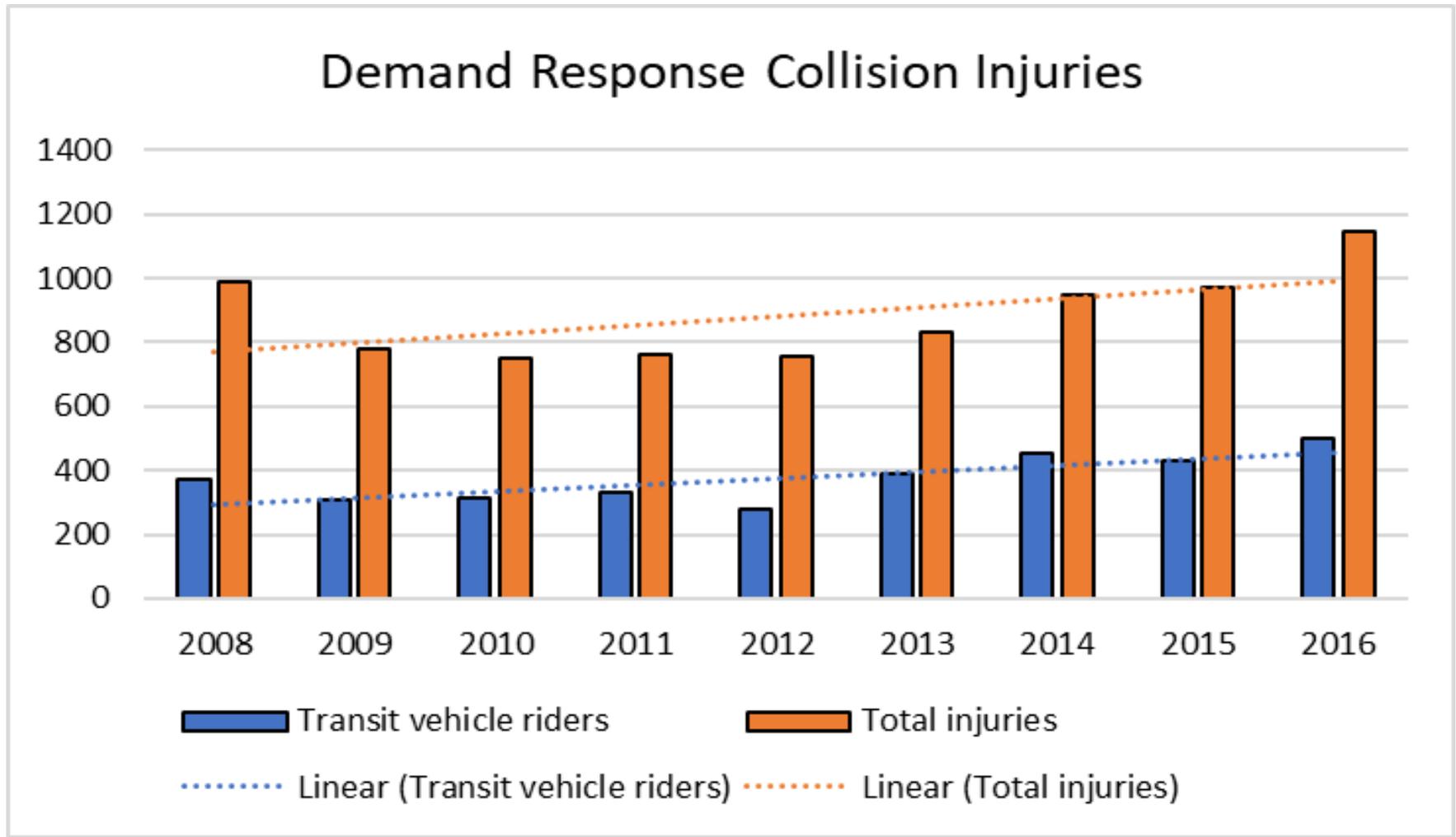


Demand Response Injuries

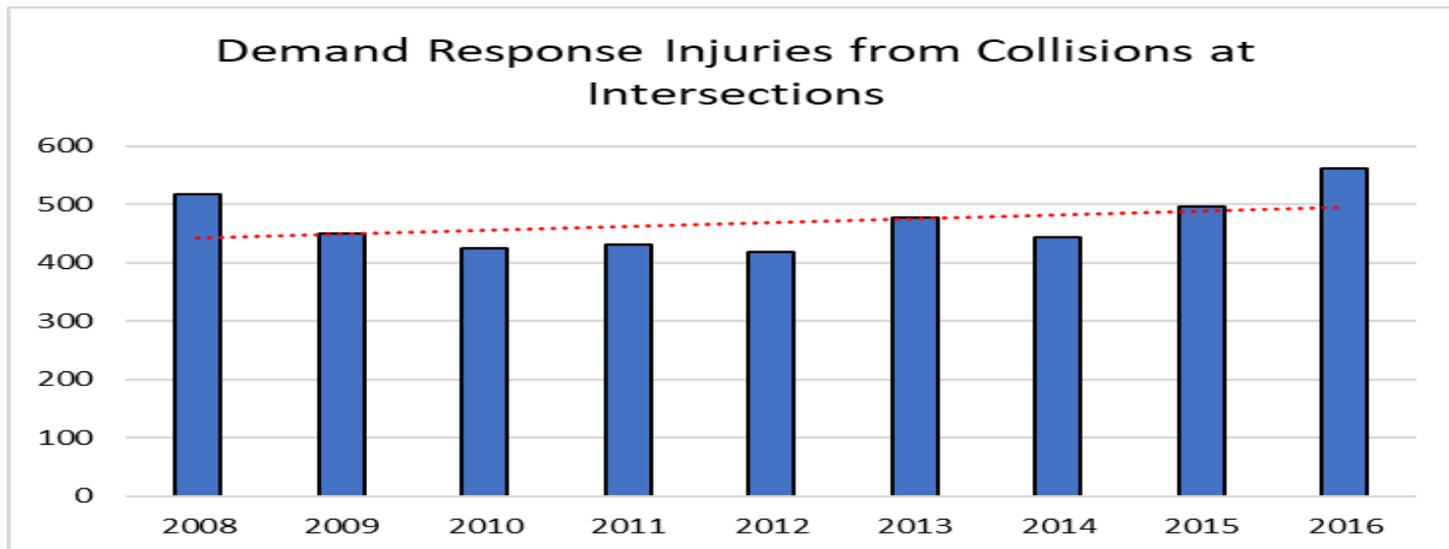
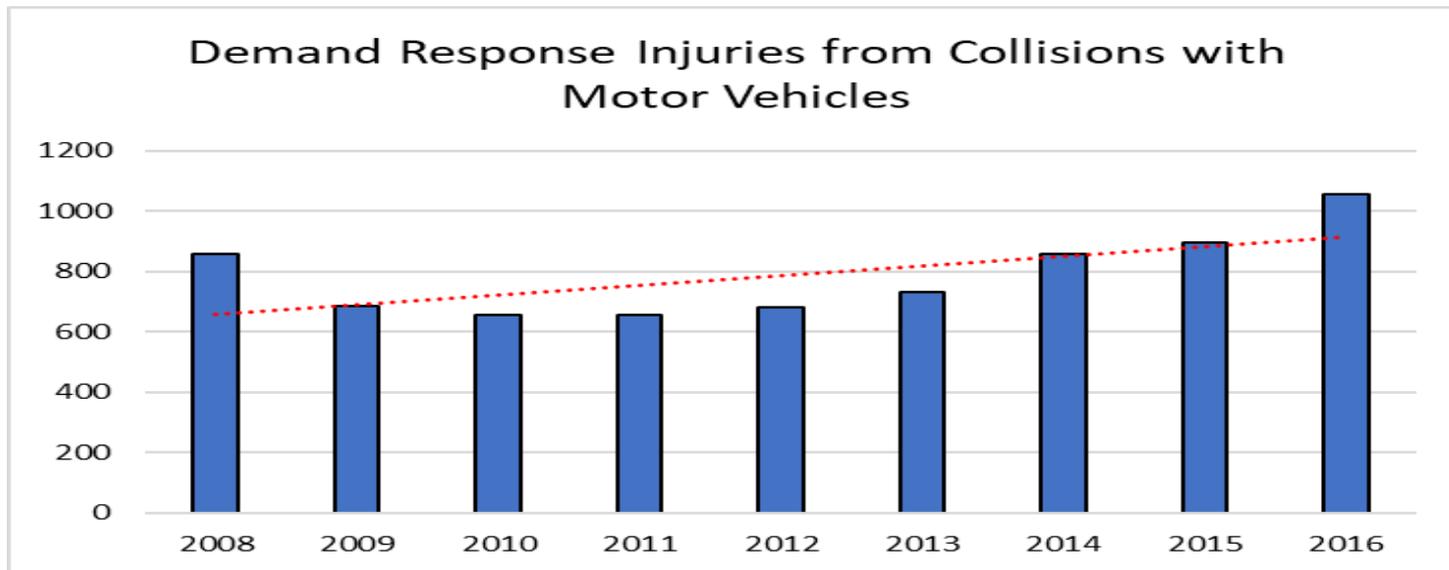
2008-2016



Demand Response Injuries - Trends



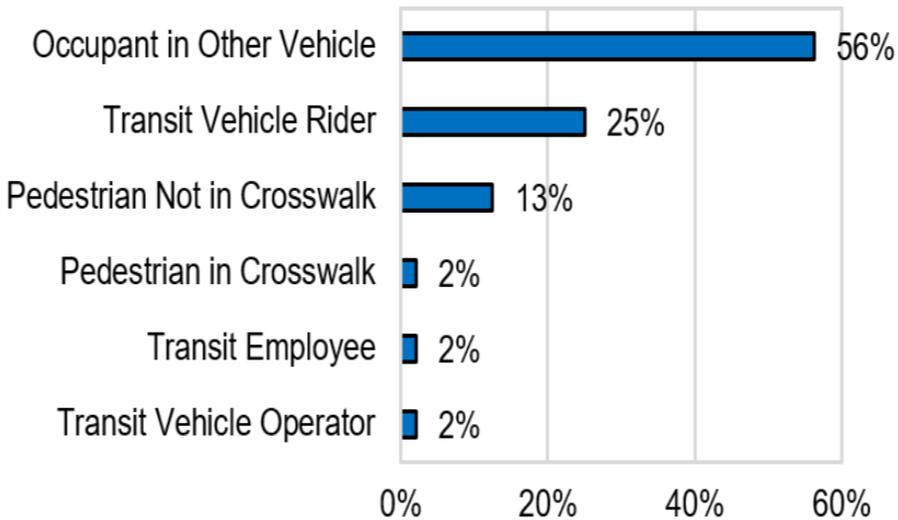
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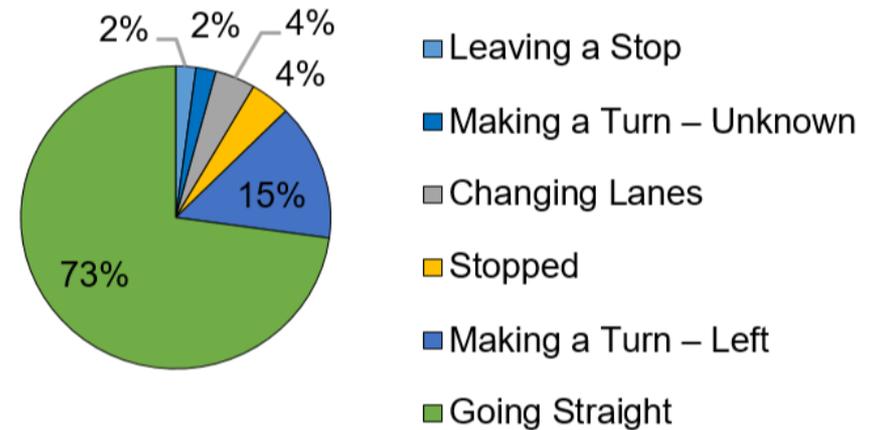
Demand Response Fatalities

2008-2016

Person Type

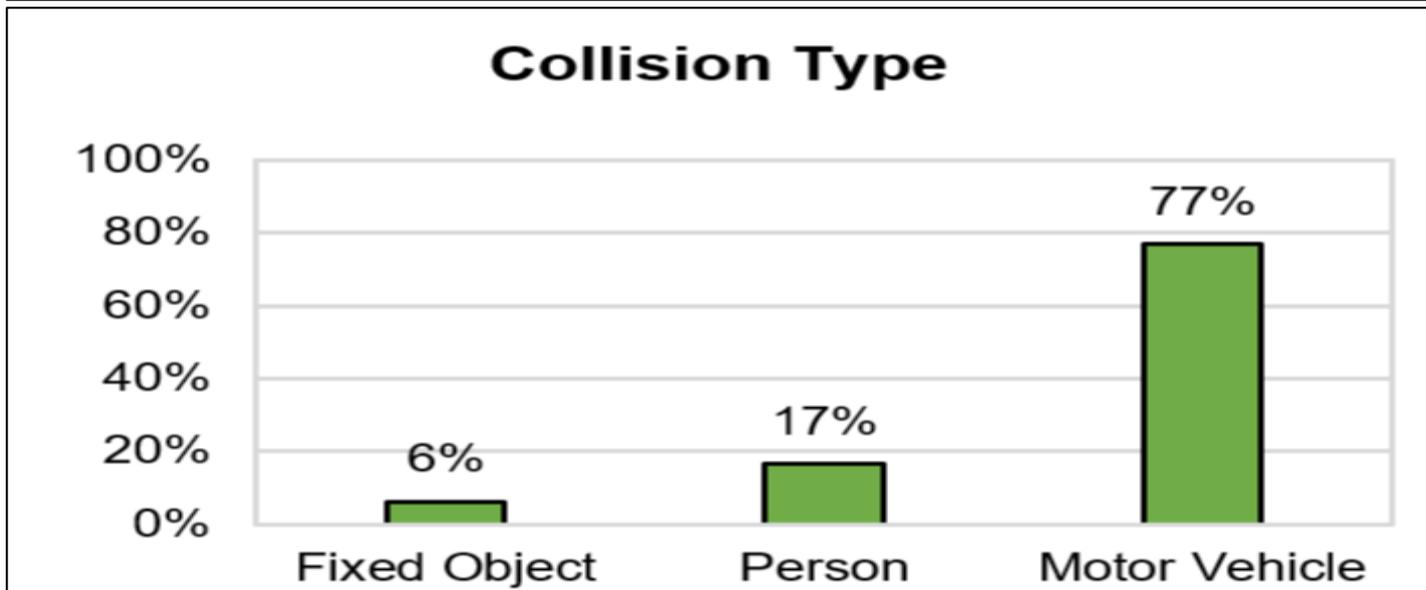
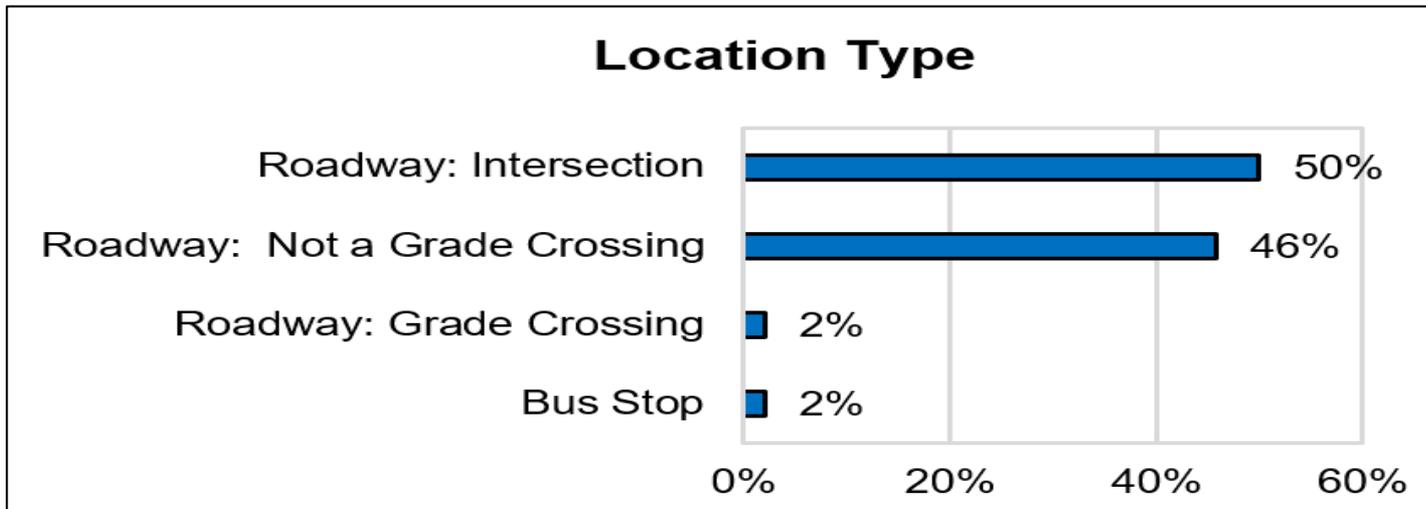


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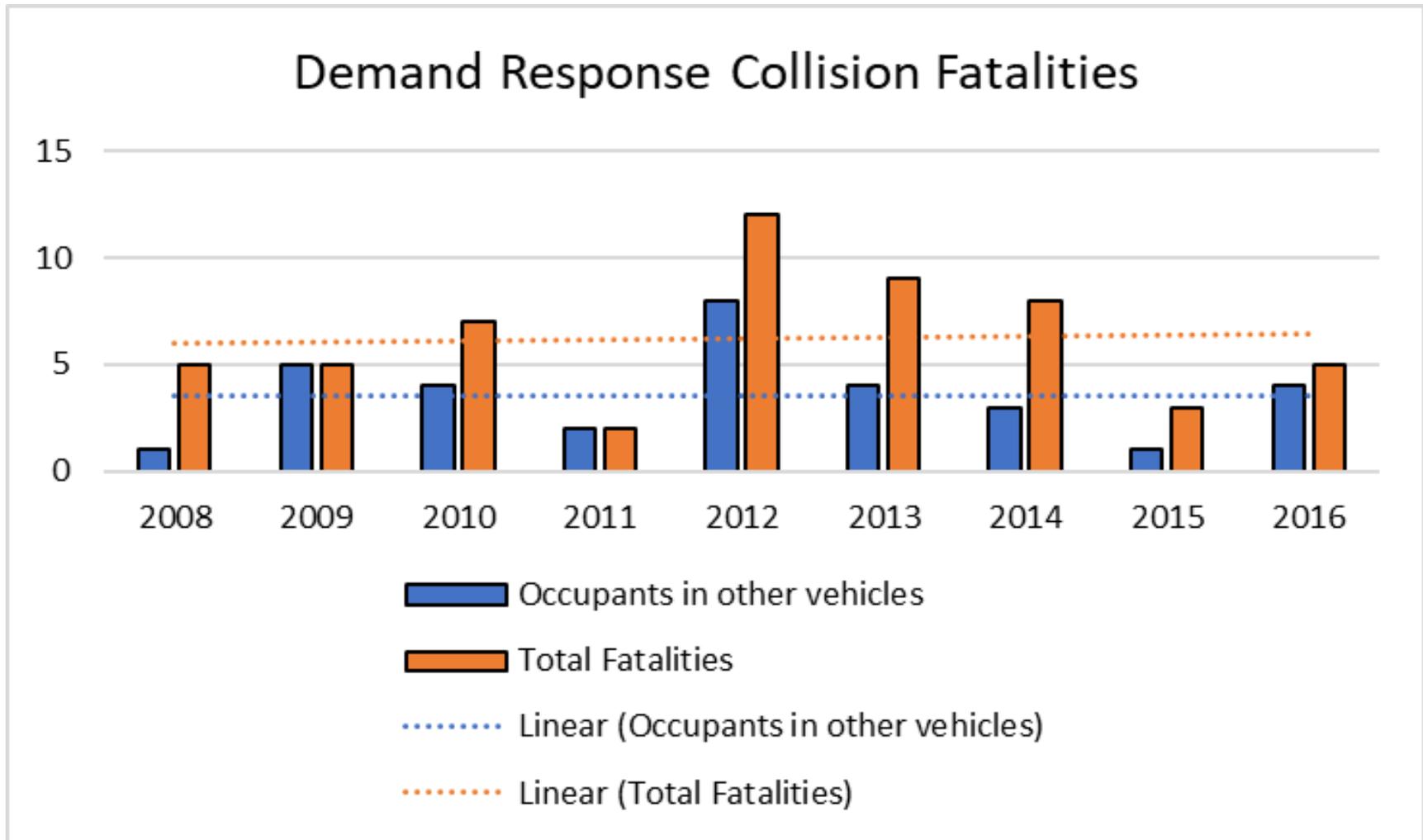


Demand Response Fatalities

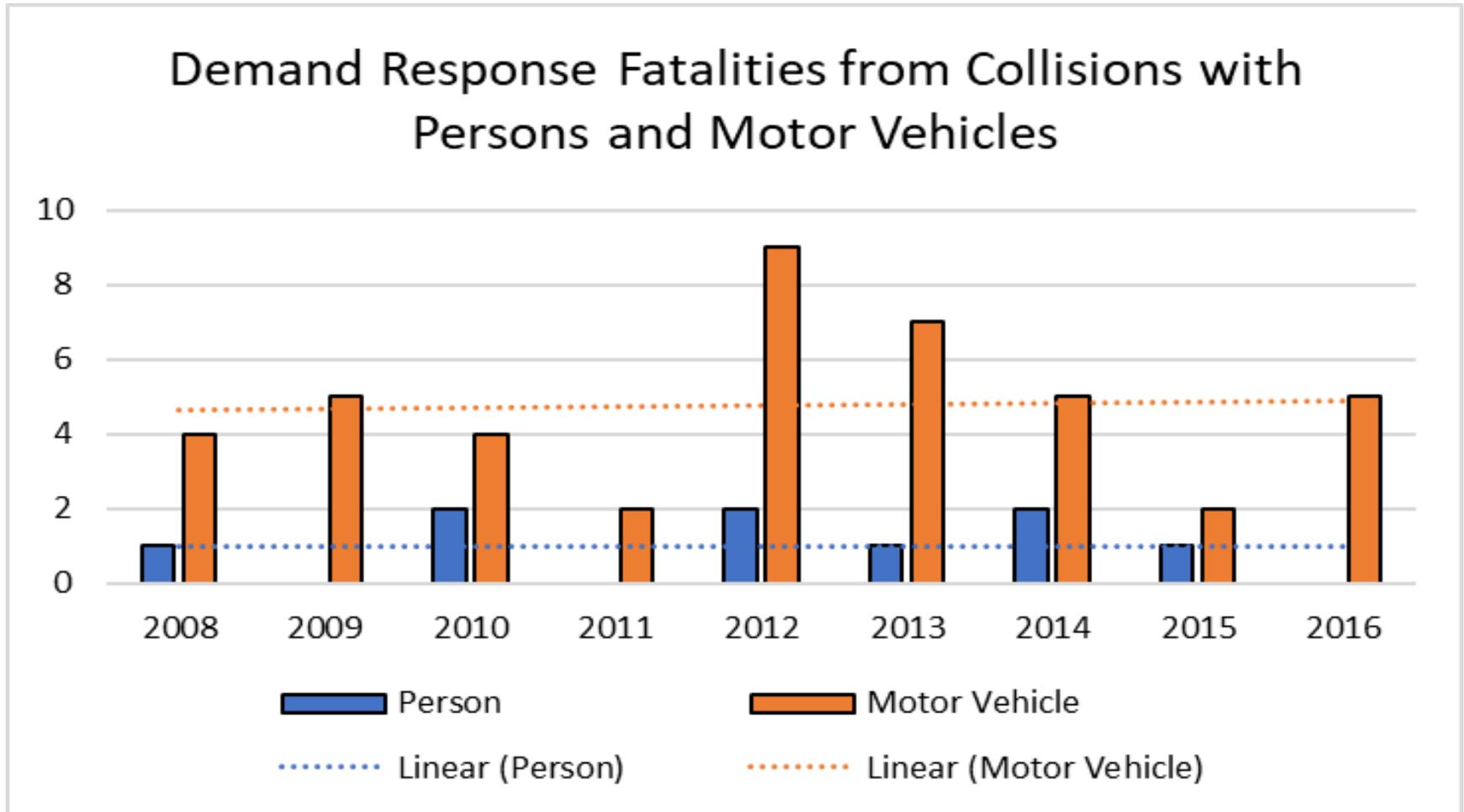
2008-2016



Demand Response Fatalities - Trends



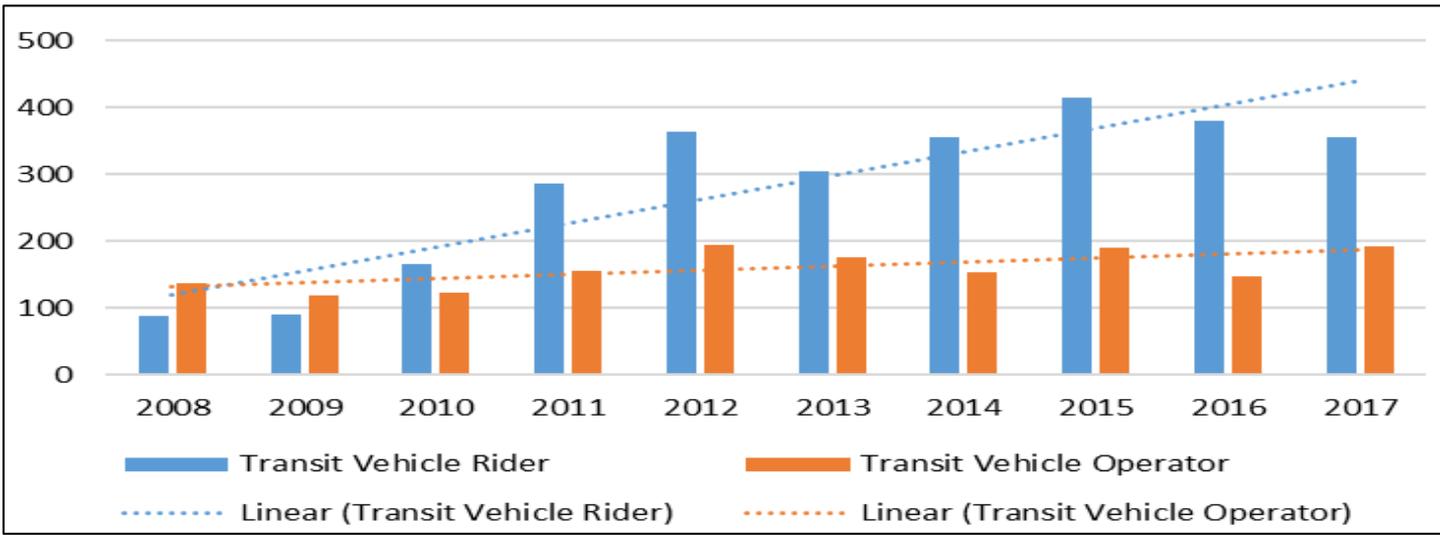
Demand Response Fatalities - Trends



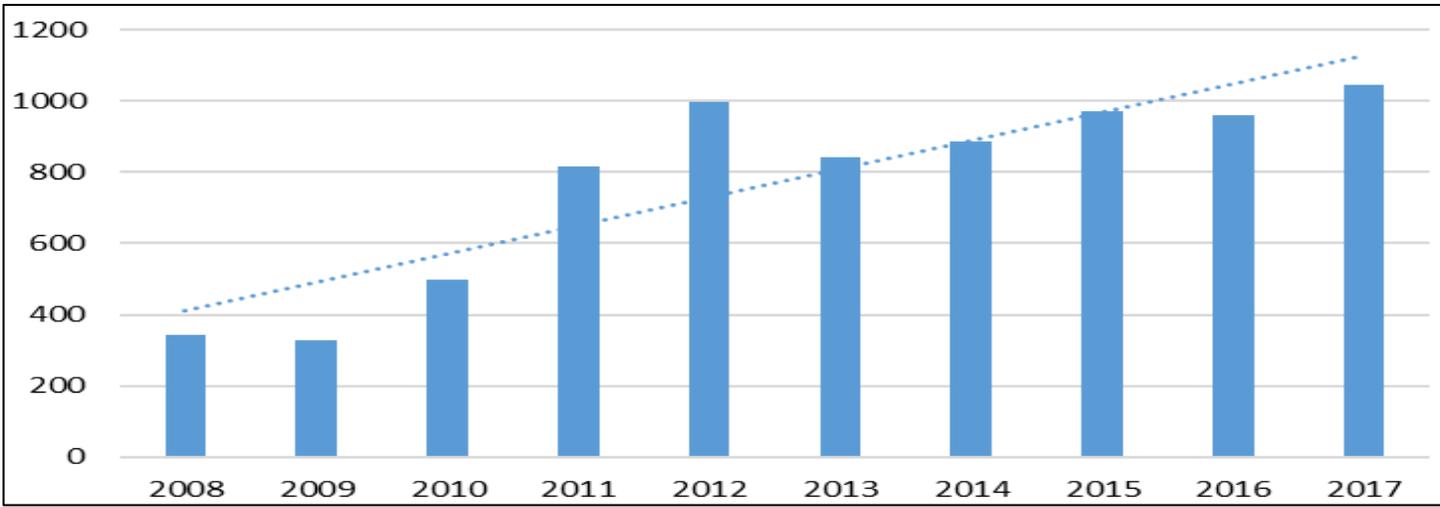
Assault Injuries

Assault-Related Injuries: Vehicle Riders and Operators

All Modes
2008 - 2016

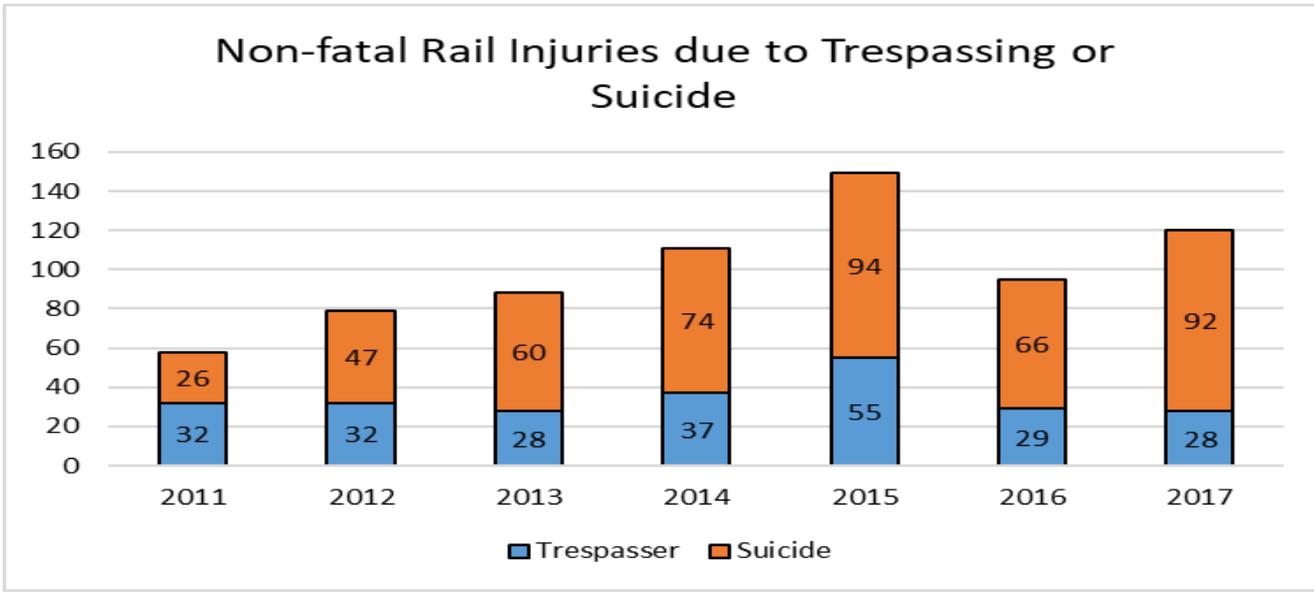
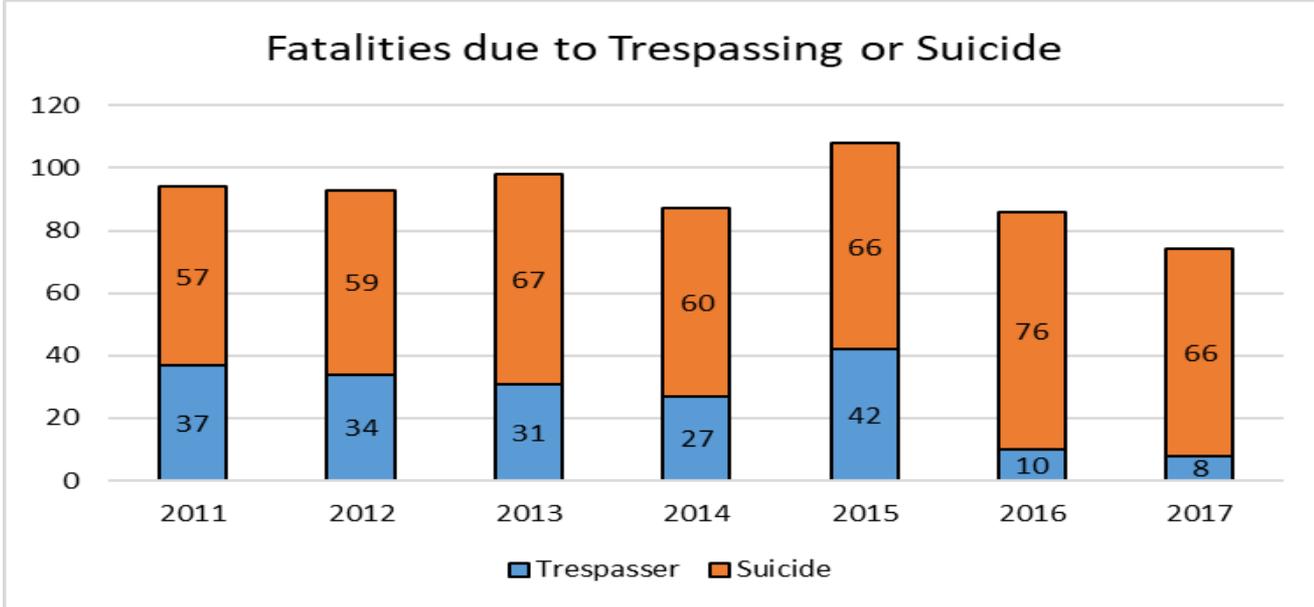


Total Assault-Related Injuries



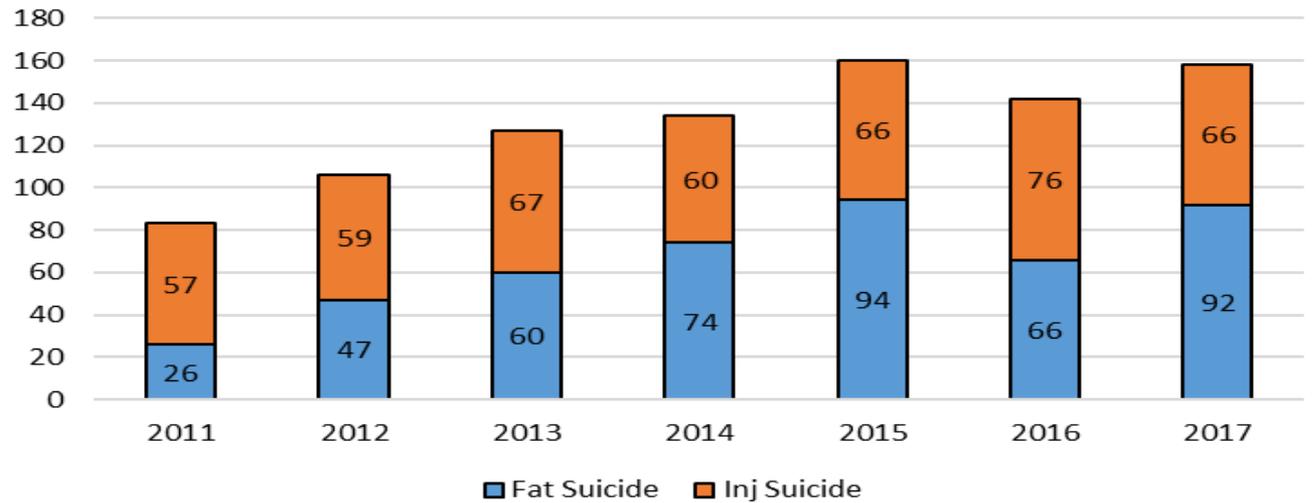
Trespassing and Suicides

All Rail Transit Modes

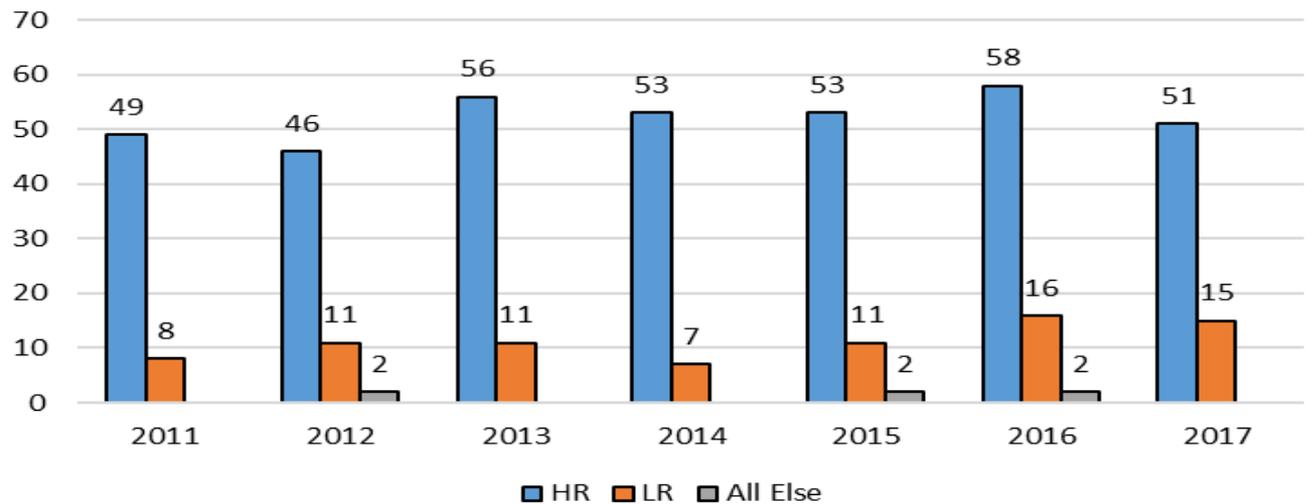


Suicides in Rail Transit

Suicide Injuries and Fatalities



Rail Suicide Fatalities by Rail Mode



NTD Data – Summary

- Safety Events - Collisions
 - 78.5% of all safety events
 - 77.0% of collision events were reported in transit bus
 - 82.3% of collision-related injuries were reported in transit bus
 - 51.4% of collision-related fatalities were reported in transit bus

NTD Data – Summary

- Heavy Rail
 - 41.2% of fatalities are trespassers
 - 23.0% of fatalities are people waiting/leaving
 - Fatalities to people waiting/leaving average annual increase of 25.1% from 2008 - 2016
 - 94.3% of fatalities are due to collisions with persons
 - 66.7% of injuries are due to collisions with persons
 - Injuries to people waiting/leaving increased 13 fold from 2008 – 2016

NTD Data – Summary

- Light Rail
 - 86.6% of light rail fatalities are due to collisions with persons
 - Nearly 70% of light rail collision-related injuries were sustained at light rail grade crossings
 - Injuries sustained from light rail grade crossing collisions increased 15.9% from 2008 through 2016

NTD Data – Summary

- Transit Bus
 - 52.3% of fatalities are collisions with persons
 - 45.7% of fatalities are collisions with motor vehicles
 - 41.0% of bus fatalities are to occupants of other vehicles
 - The majority (61.3%) of bus injuries are to bus occupants – 23.1% due to rear-ended collisions
 - Rear-ended collisions increased 74.6% from 2008-2016

NTD Data – Summary

- Demand Response
 - 77.1% of fatalities and 89.7% of injuries are due to collisions with motor vehicles
 - Rear-ended collisions – 18.8% of all fatalities and 30.1% of all injuries
 - Rear-ended collisions increased 70.3% from 2008-2016

NTD Data – Summary

- Security Events
 - Assault-related bus injuries increased 75.1% from 2008 – 2016
 - Transit vehicle riders represent the largest share of assault-related injuries (45.8%)
 - 83% of suicides reported in transit are in heavy rail
 - Suicides increased 214% from 2008-2017

RISK-BASED ANALYSIS – METHODOLOGY AND FINDINGS

Risk-Based Assessment

- Fatalities, injuries, and exposure across person types
- Data:
 - 2016 NTD
 - 2017 National Household Travel Survey (NHTS)
 - 2016 National Highway Statistics Report (NHSR)
- Goal - quantify and compare exposure by normalizing across person types and measures

Data for Measuring Exposure

- NTD
 - Total passenger miles traveled (PMT), road-based PMT
 - Vehicle/train miles as employee miles
 - Unduplicated passenger trips, linked trips
 - Ratio of vehicle/train miles over length of vehicle trips as employee trips
- 2017 NHTS
 - Person miles/person trips for persons walking, biking in urbanized areas
 - Person miles/person trips for walking in urban areas with light rail
 - Person trips for persons riding in household vehicles in urban areas
 - Person who used transit in urban areas
- 2016 NHSR
 - Person miles for urban non-freeway travel
 - Person trips for urban non-freeway travel by trucks

Data for Person Miles

Category	Person Type	Data Source
Transit user	Transit vehicle rider	NTD
	People waiting or leaving	None. not meaningful
Transit worker	Transit vehicle operator	vehicle or train miles from NTD
	Other transit employee	None. not meaningful
Roadway user	Bicyclist	NHTS for bike
	Pedestrian in crosswalk	NHTS for walking
	Pedestrian not in crosswalk	NHTS for walking
	Pedestrian crossing tracks	NHTS for walking
	Occupant of other vehicle	HS converted from urban non-freeway vehicle miles – NTD road-based passenger miles
Other	Non-transit worker	None. not meaningful
	Pedestrian walking along tracks	None. Data not available
	Other (including trespasser)	None. probably not meaningful
	Suicide	None. probably not meaningful

Data for Person Trips

Category	Person Type	Data Source
Transit user	Transit vehicle rider	UPT from NTD adjusted for transfers
	People waiting or leaving	UPT from NTD
Transit worker	Transit vehicle operator	Ratio of vehicle or train miles over average length of vehicle trips from NTD
	Other transit employee	None. May not be meaningful
Roadway user	Bicyclist	NHTS for biking in urban areas
	Pedestrian in crosswalk	NHTS for walking in urban areas
	Pedestrian not in crosswalk	NHTS for walking in urban areas
	Pedestrian crossing tracks	NHTS for walking in urban areas with LR
	Occupant of other vehicle	NHTS for non-transit vehicles in urban areas + HS truck driver trips in urban areas
Other	Non-transit worker	None. not meaningful
	Pedestrian walking along tracks	None. Data not available
	Other (including trespasser)	None. probably not meaningful
	Suicide	None. probably not meaningful

Data for Persons

Category	Person Type	Data Source
Transit user	Transit vehicle rider	Used transit in urban areas from NHTS
	People waiting or leaving	Used transit in urban areas from NHTS
Transit worker	Transit vehicle operator	Operator employees from NTD
	Other transit employee	Maintenance employees from NTD
Roadway user	Bicyclist	Biked in urban areas from NHTS
	Pedestrian in crosswalk	Walked in urban areas from NHTS
	Pedestrian not in crosswalk	Walked in urban areas from NHTS
	Pedestrian crossing tracks	Walked in urban areas with LR from NHTS
	Occupant of other vehicle	Traveled in non-transit vehicles in urban areas from NHTS
Other	Non-transit worker	None. Data not available
	Pedestrian walking along tracks	Walked in urban areas with LR from NHTS
	Other	Walked in urban areas from NHTS
	Suicide	Total urban population

Annual Average Fatalities and Non-Fatal Injuries

Category	Person Type	Fatalities	Non-Fatal Injuries
Transit user	Transit vehicle rider	13.3	4,599.0
	People waiting or leaving	24.7	219.3
Transit worker	Transit vehicle operator	3.0	882.0
	Other transit employee	4.7	79.7
Roadway user	Bicyclist	8.3	114.7
	Pedestrian in crosswalk	13.7	167.3
	Pedestrian not in crosswalk	18.0	161.0
	Pedestrian crossing tracks	3.0	12.0
	Occupant of other vehicle	37.0	1,969.7
Other	Non-transit worker	0.0	13.3
	Pedestrian walking along tracks	6.0	8.3
	Other (including trespasser)	26.7	59.0
	Suicide	57.3	32.3

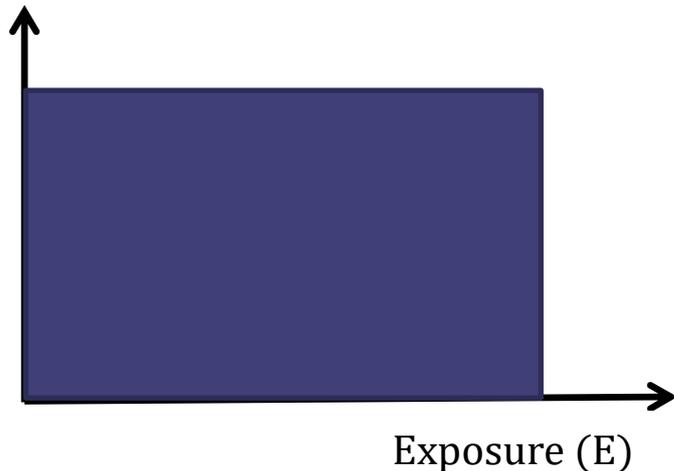
Dimensions of the Safety Problem

Fatalities (F)

= Exposure (E)

$$\times \frac{\text{Fatalities (F)}}{E}$$

Fatality Rate (F/E)

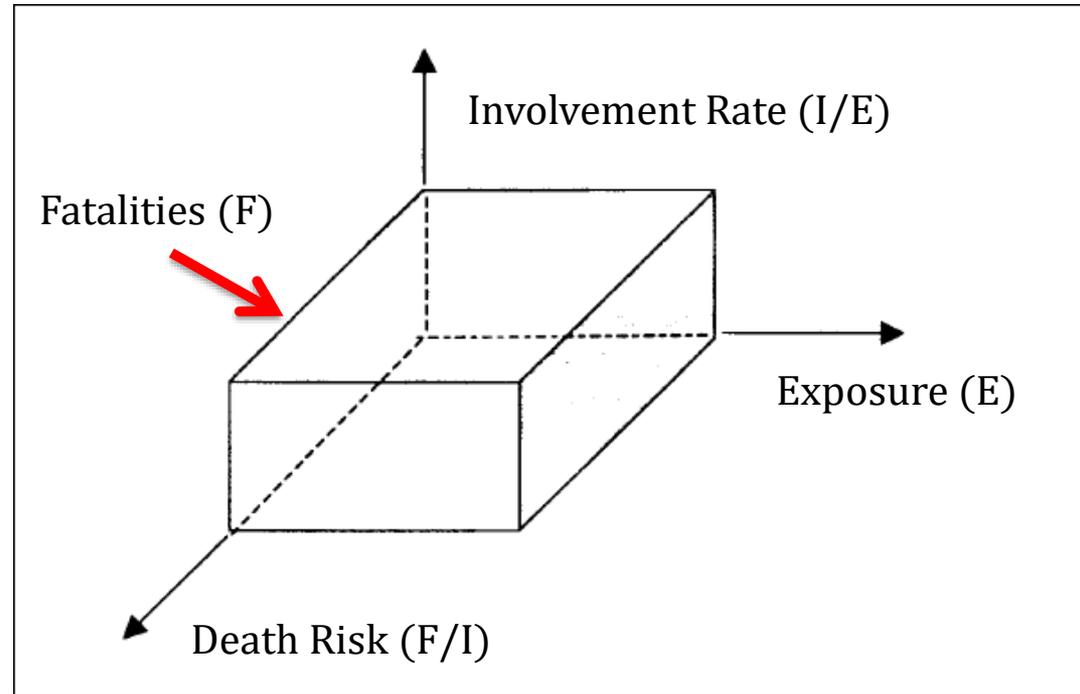


Fatalities (F)

= Exposure (E)

$$\times \frac{\text{Injuries of All Severity (I)}}{E}$$

$$\times \frac{\text{Fatalities (F)}}{\text{Injuries of All Severity (I)}}$$



For Internal Discussion Purposes Only

Involvement Rates by Exposure Type

Category	Person Type	Per Billion Person Miles	Per 100 Million Person Trips	Per 100,000 Persons
Transit user	Transit vehicle rider	110.18	60.82	48.16
	People waiting or leaving		2.57	2.55
Transit worker	Transit vehicle operator	272.26	397.77	629.50
	Other transit employee			123.14
Roadway user	Bicyclist	16.31	3.63	3.14
	Pedestrian in crosswalk	7.45	0.52	0.45
	Pedestrian not in crosswalk	7.37	0.51	0.45
	Pedestrian crossing tracks	1.23	0.08	0.06
	Occupant of other vehicle	0.95	0.80	1.22
Other	Non-transit worker			
	Pedestrian walking along tracks			0.06
	Other (including trespasser)			0.21
	Suicide			0.04

For Internal Discussion Purposes Only

Risk of Death

Category	Person Type	Death Risk (chance of dying once injured)	Vulnerability
Transit user	Transit vehicle rider	0.3%	Low
	People waiting or leaving	7.1%	Medium
Transit worker	Transit vehicle operator	0.3%	Low
	Other transit employee	4.4%	Medium
Roadway user	Bicyclist	6.1%	Medium
	Pedestrian in crosswalk	9.1%	Medium
	Pedestrian not in crosswalk	9.8%	Medium
	Pedestrian crossing tracks	28.8%	High
	Occupant of other vehicle	2.0%	Low
Other	Non-transit worker	1.7%	Low
	Pedestrian walking along tracks	48.5%	High
	Other (including trespasser)	31.3%	High
	Suicide	54.4%	High

Fatality Rates by Exposure Type

Category	Person Type	Per 10 Billion Person Miles	Per Billion Person Trips	Per Million Persons
Transit user	Transit vehicle rider	3.19	1.76	1.39
	People waiting or leaving		2.60	2.58
Transit worker	Transit vehicle operator	9.23	13.48	21.34
	Other transit employee			68.14
Roadway user	Bicyclist	11.05	2.46	2.13
	Pedestrian in crosswalk	5.63	0.39	0.34
	Pedestrian not in crosswalk	7.41	0.51	0.45
	Pedestrian crossing tracks	2.45	0.17	0.13
	Occupant of other vehicle	0.17	0.15	0.22
Other	Non-transit worker			
	Pedestrian walking along tracks			0.25
	Other (including trespasser)			0.66
	Suicide			0.23

Risk-Based Exposure Findings

- Transit vehicle operators have significantly higher rates of involvement in injury/fatality incidents than any other persons
- Transit employees have the highest fatality exposure rate
 - Track and maintenance workers are included
 - Demonstrates the level of fatality exposure of ROW workers

TRANSIT SAFETY FOCUS AREAS

Focus Area Identification

- Data/research
 - Internal/project and external research
 - Other industry input to the process
- Legislative/regulatory priorities
 - MAP-21 and/or FAST Act
 - FTA advisory issued
- Independent/advisory recommendations
 - TRACS or NTSB
 - CUTR Transit Safety Standards Working Group
- Initial areas of focus – areas of risk or mitigation practices to address areas of risk

Safety Focus Areas – Bus and Rail

- **Safety Risk Management / Assessment Processes**
 - Close call reporting
 - Accident/incident investigation
 - Fatigue risk management
 - Safety risk management
 - Internal SMS evaluation/ assessment
 - Event data recorders

Safety Focus Areas – Bus and Rail

- **Procedural**

- Medical fitness for duty
- Employee assault prevention (also infrastructure elements)
- Training
- Transit operations control center
- Transit scheduling/operator break times
- Emergency preparedness
- Operational rules, practices, and procedures
- Fire/life safety
- Vehicle (bus) safety and maintenance

Safety Focus Areas – Bus and Rail

- **Rail and Bus Infrastructure/Technologies**
 - Passenger vehicle workstations
 - Passenger vehicle safety (includes crashworthiness/CEM)
 - Rail/highway grade crossings
 - Rail maintenance-of-way equipment
 - Rail signals and communication systems
 - Rail track and structures
 - Rail tunnels
 - Rail traction power electrification equipment
 - Rail vertical transportation equipment
 - Right-of-way worker protections

STAKEHOLDER ENGAGEMENT

Industry Stakeholder Engagement

- Project/program presentations
 - 2017 TRB Annual Meeting
 - 2017 and 2018 TRB Task Force on Transit Safety and Security
 - 2017 and 2018 APTA Bus and Paratransit Conference – Bus Safety Committee meeting
 - 2017 APTA Rail Conference – Rail Safety Committee meeting
 - 2018 TRB LRT Committee meeting – APTA Rail Conference
 - 2017 APTA Safety Coordinating Committee – Annual Meeting and EXPO
 - 2017 APTA Mid-Year Safety Committee
- CUTR Transit Standards Working Group (7 meetings)

CUTR Working Group Members

- Tracy Hammer, TriMet
- Ni Lee, BART
- Jim Fox, SEPTA
- Ron Nickle, MBTA
- Paul Goyette, Lee Tran
- Richard Czeck, GCRTA
- Vijay Khawani, LAMetro
- Patrick Moore, Greeley-Evans Transit
- Susan Hausmann, TxDOT
- Sean Cagan, Houston Metro
- Tom Lamb, New York MTA
- Narayana Sundaram, APTA
- Brian Alberts, APTA
- Charlie Dickson, CTAA
- Ed Watt, ATU
- Pat Lavin, WMATA
- Colin Mulloy, HART
- Abhay Joshi (AJ), MARTA
- Stephan Parker, TRB
- Robin Phillips, National RTAP

CUTR Transit Standards Working Group

- Roles:
 - Identify areas of greatest risk within their properties and across the industry
 - Provide technical support to research team
 - Provide input to transit focus area research
 - Verify/validate research results
 - Provide input on research recommendations
 - Identify areas of potential risk
- WG meets quarterly
- Focus area research committees meet as required

WG Focus Area Priorities – Rail

FOCUS AREA TOPIC - RAIL	Score	Rank
Right-of-Way Worker Protection	234	1
Close-Call Employee Reporting Systems	182	2
Rail Track and Structure Safety	136	3
Passenger Vehicle Safety	128	4
Rail Signal and Communication System Safety	126	5
Rail/Highway/Pedestrian Grade Crossing	121	6
Training	96	7
Safety Risk Management	93	8
Tunnel Design	87	9
On-board Event Data Recorders	79	10

WG Focus Area Priorities - Transit Bus

FOCUS AREA TOPIC - <i>BUS</i>	Score	Rank
Close-Call Employee Reporting Systems	279	1
Passenger Vehicle Safety	264	2
Front Line Employee Assault Prevention	255	3
Medical Fitness for Duty	227	4
Distraction Prevention Programs	225	5
Training	218	6
On-board Event Data Recorders	211	7
Vehicle (Bus) Safety and Maintenance	200	8
Accident/Incident Investigation	167	9
Operational Rules, Practices and Procedures Compliance Program	144	10

FOCUS AREA RESEARCH

FTA Focus Area Research – Late Stage

- Event Data Recorders – Transit Rail
- Event Data Recorders – Transit Bus
- Crashworthiness/Crash Energy Management – Rail
- Crashworthiness/Crash Energy Management – Bus
- Emergency Lighting/Signage – Rail
- Review of Specifications and Guidelines for Rail Tunnel Design, Construction, Maintenance, and Rehabilitation
- Review of Track Inspection and Maintenance Standards
- Inward and Outward Facing Audio and Video Recordings - Rail
- Light Rail Technology Scan/Case Studies

FTA Focus Area Research – Early Stage

- Transmission Based Train Control
- Tunnel Evacuation
- Tunnel Inspection/Maintenance
- Tunnel Repair/Rehabilitation
- Fitness for Duty/Fatigue Risk Management
- Bus and Rail Accident Investigation Practices

Work Group Priorities for Focus Area Research

- Suggested Priorities
 - Methods to reduce injuries/fatalities at rail/highway or intersection rail crossings
 - Rail signals and communication systems
 - Right of way worker protection
- Suggested Secondary Priorities
 - Emergency management/preparedness
 - Safety risk assessments
 - Training

Thank You!



Lisa Staes, Director

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