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NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

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The National Highway Traffic Safety Administration and Ground Ambulance Crashes

February 2023



Objectives

1

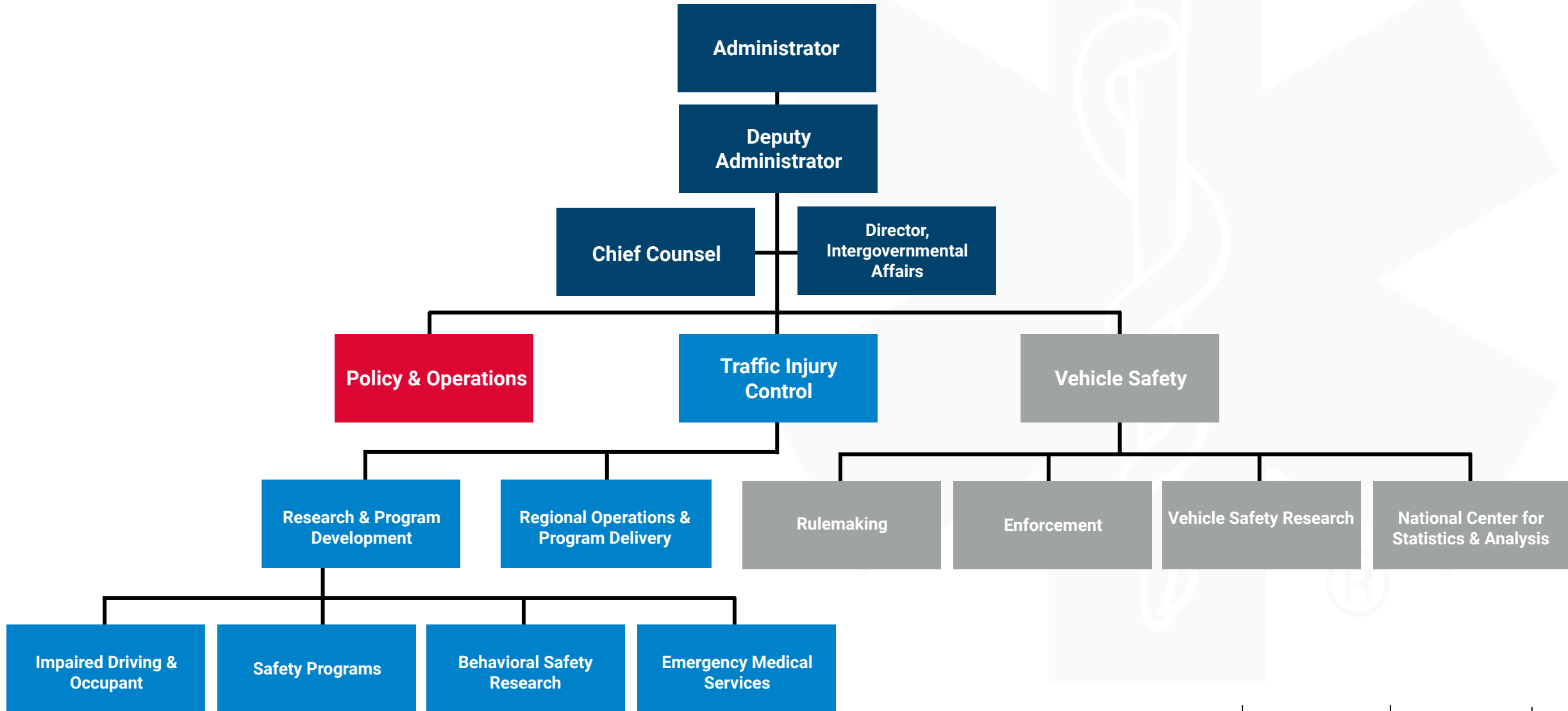
To show how the National Highway Traffic Safety Administration (NHTSA)

- Captures and analyzes data on ambulance crashes
- Investigates ambulance crashes
- Documents and reports on ambulance crashes

2

To provide a summary of ambulance-involved crashes in the United States for 2012 to 2018

National Highway Traffic Safety Administration



The Office of Emergency Medical Services (OEMS)

Mission Statement

To reduce death and disability by providing leadership and coordination to the EMS community in assessing, planning, developing, and promoting comprehensive, evidence-based emergency medical services and 9-1-1 systems.



The NHTSA Approach to Ground Ambulance Safety

- Collect comprehensive traffic crash data and conduct research
- Collaborate with national organizations & Federal partners to provide EMS leaders with the information they need to improve ground ambulance safety
- Foster consensus around strategies to promote safe EMS systems
- Support projects of national significance to accelerate improvements in ground ambulance safety

Comprehensive Traffic Crash Data

Data collected can be used to:

- Identify highway safety problem areas
- Provide a basis for regulatory and consumer information initiatives
- Conduct cost/benefit analyses of highway safety initiatives
- Identify behaviors involved in crashes
- Develop countermeasures to deter unsafe behaviors



Databases Used by this Study



**Fatality Analysis
Reporting System
(FARS)**



**National Automotive
Sampling System:
General Estimates
System (GES)**



**Crash Report
Sampling System
(CRSS)**



**Special Crash
Investigations
(SCI)**

FARS

- A nationwide census of fatal traffic crashes within the 50 States and D.C. and Puerto Rico*

Obtained from many sources including:

- Police crash reports
- Medical examiner reports
- State department of transportation data
- Other Records

*Data from Puerto Rico were not analyzed for this presentation.

GES and CRSS



GES – A nationally representative sample of crashes of all severities selected from police-reported crashes



CRSS - Replaced GES in 2016 and employs an updated sampling method to acquire a national, police-reported sample of all-severity crashes.



Both systems include crash report data from designated U.S. areas, reflecting the country's geography, population, miles driven, and crash distribution.

Defining the People in Ambulance Crashes

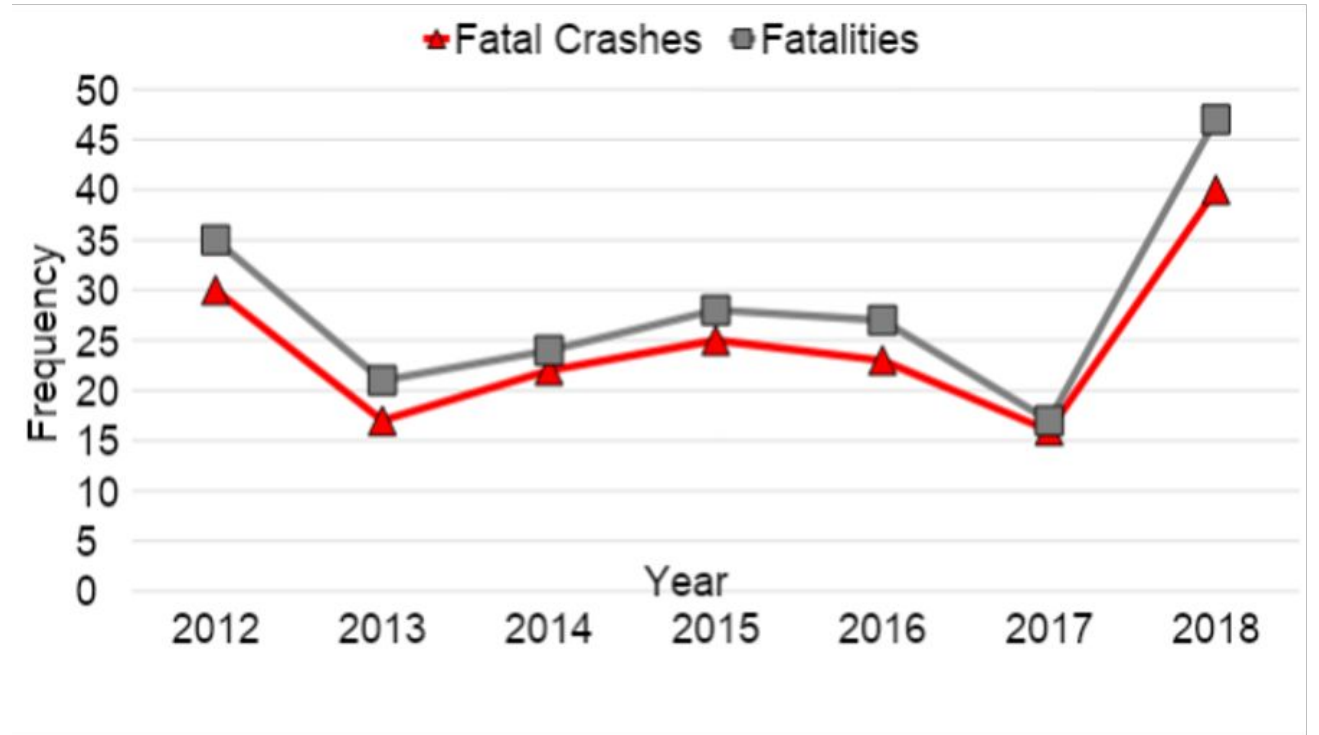


- Ambulance Operator/Driver
 - Person driving ambulance
- Ambulance Passenger
 - Non-driver occupants – EMS personnel, patients, and passengers
- Occupant of Other Vehicle
 - Occupants of other vehicles involved in the crash
- Non-Occupant
 - People outside of a motor vehicle – pedestrians and pedal cyclists

Ambulance-Involved Crash Data 2012-2018

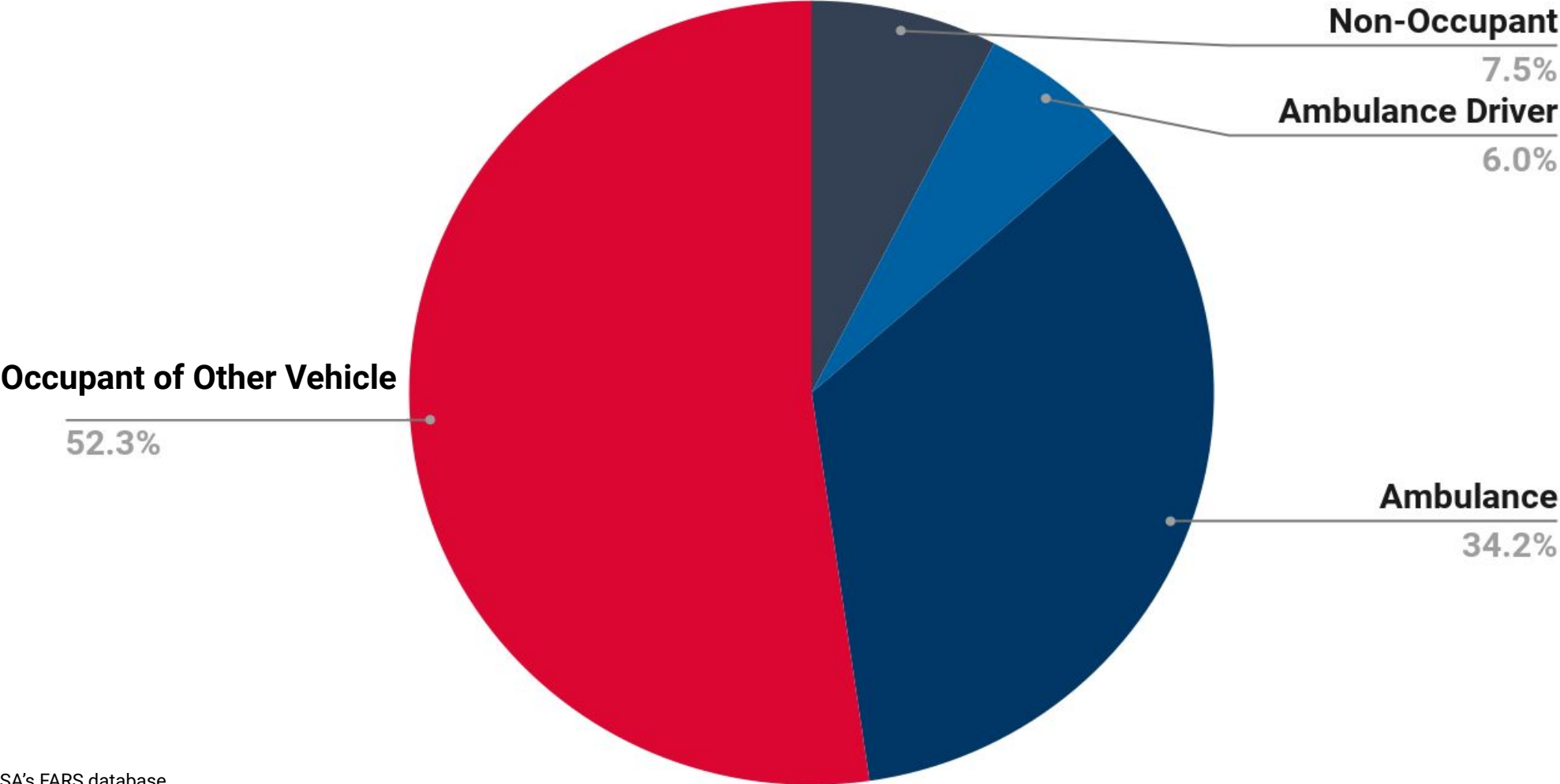
Annual Fatal Crashes

- Average of 24.7 fatal crashes per year
- Average of 28.4 fatalities per year



Position of Persons Killed

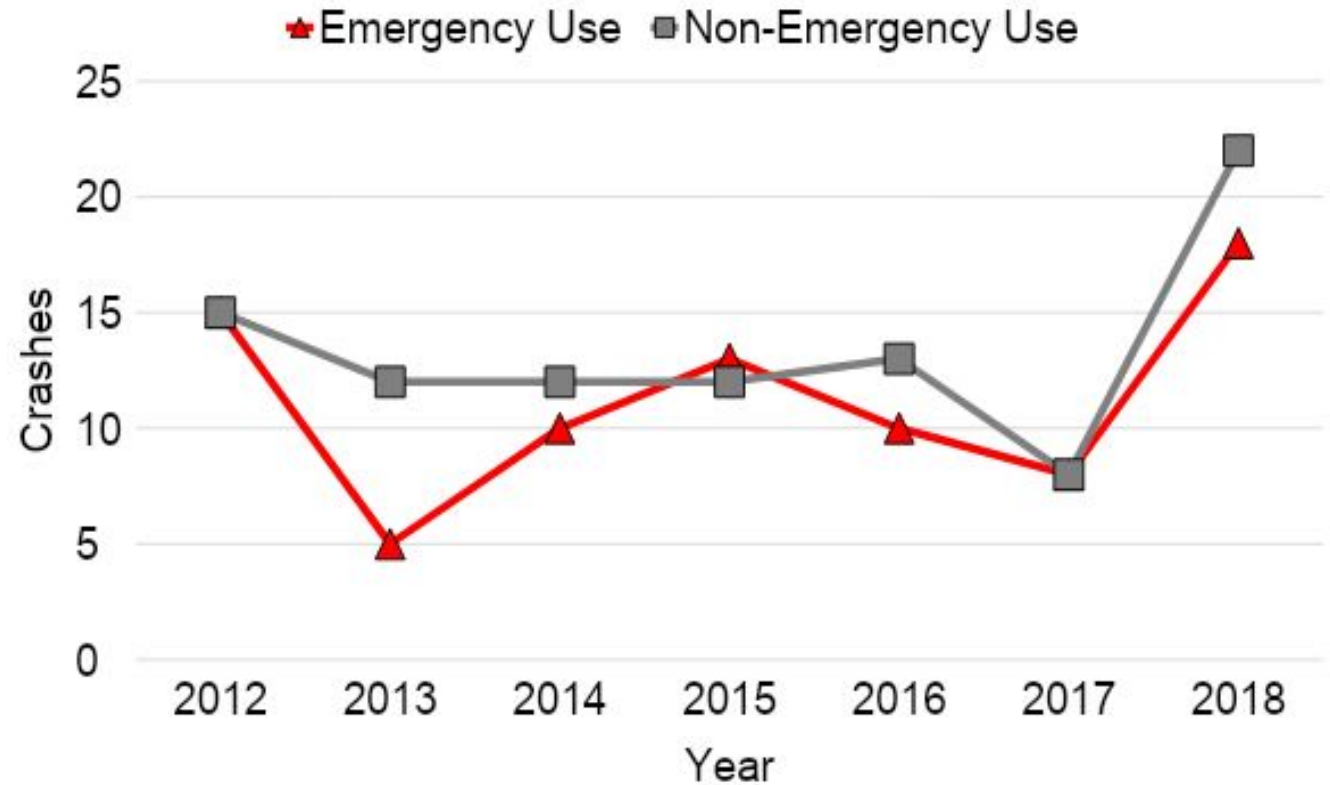
N = 199



Source: NHTSA's FARS database

Emergency Use in Fatal Crashes

- 45.7% of fatal crashes involved ambulance in emergency operation

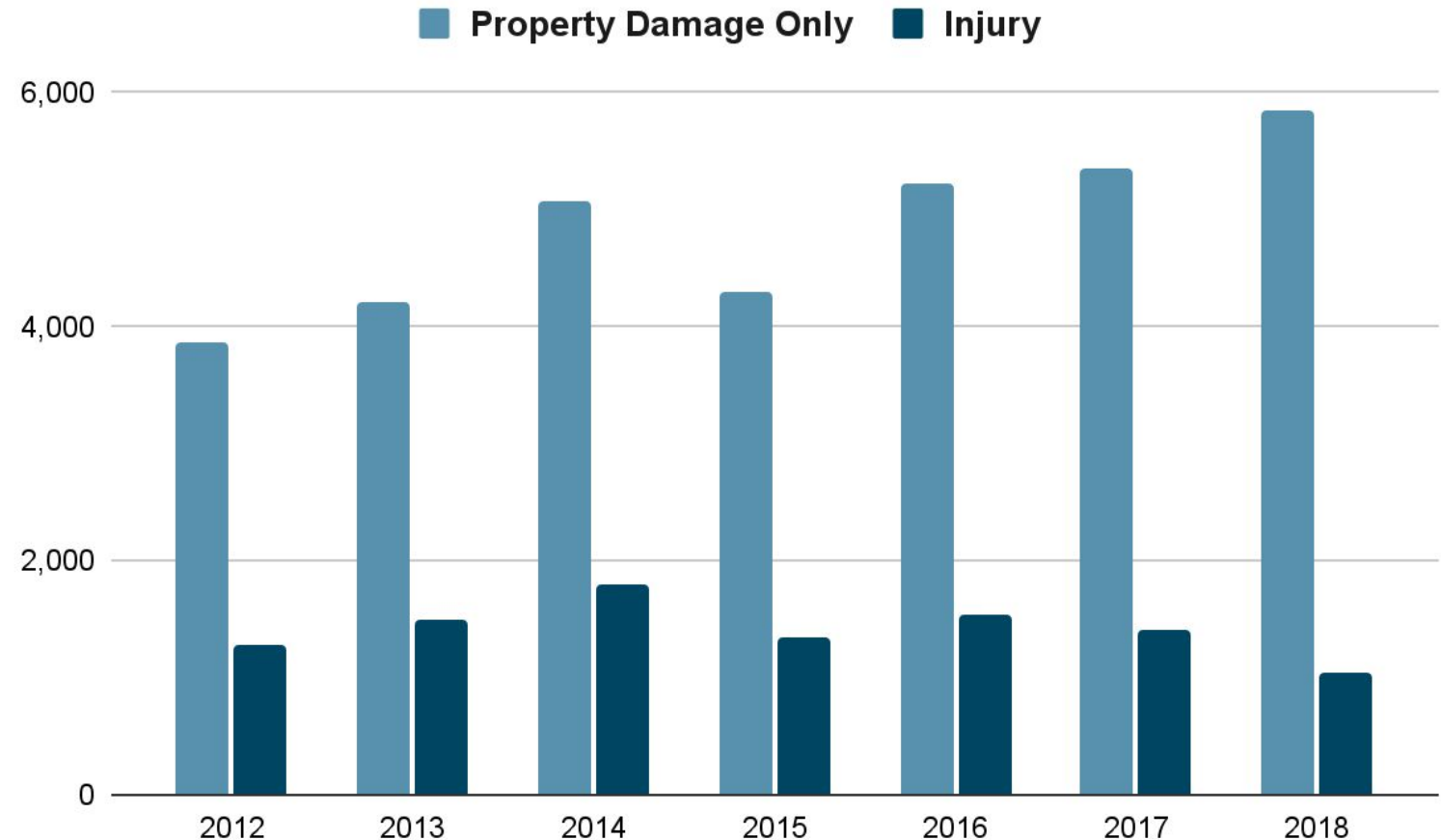


Source: NHTSA's FARS database

Note: Fatality counts include non-occupants (e.g., pedestrians, pedalcyclists)

Property Damage Only & Injury Crashes

- Estimated annual average of 4,830.1 PDO crashes
- Estimated annual average of 1,417.3 injury crashes and 2,504.4 persons injured



Sources: NHTSA's GES and CRSS databases

Note: Does not include data on injured non-occupants of a vehicle (e.g., pedestrians and pedalcyclists)

Estimated Position of Persons Injured

N= 16,622

Ambulance Driver

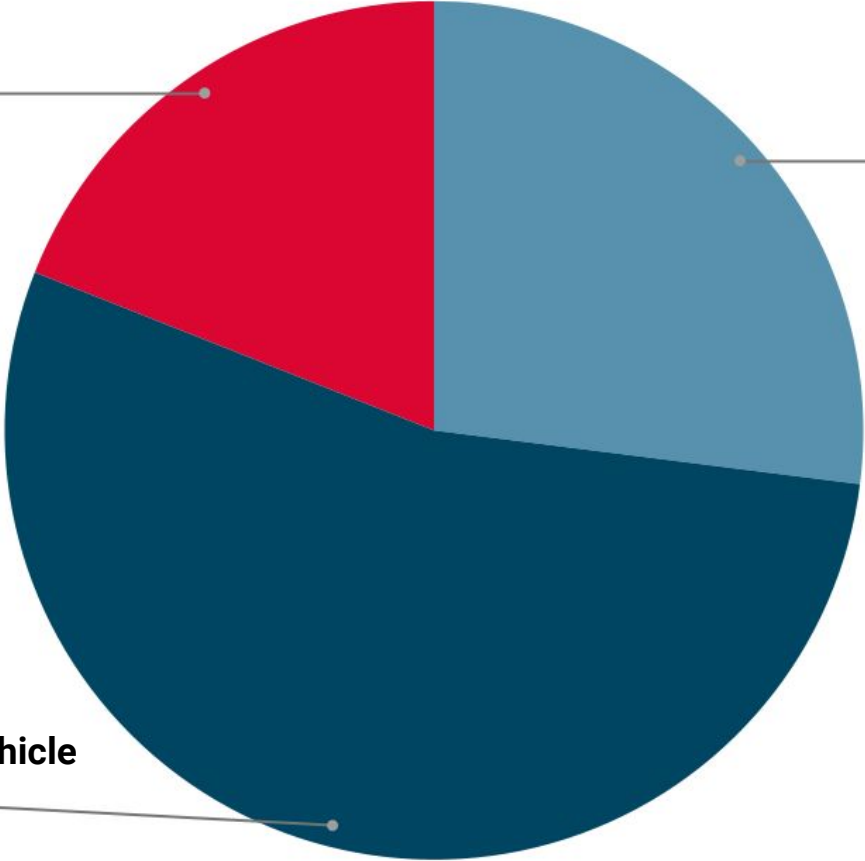
19.0%

Ambulance

27.0%

Occupant of Other Vehicle

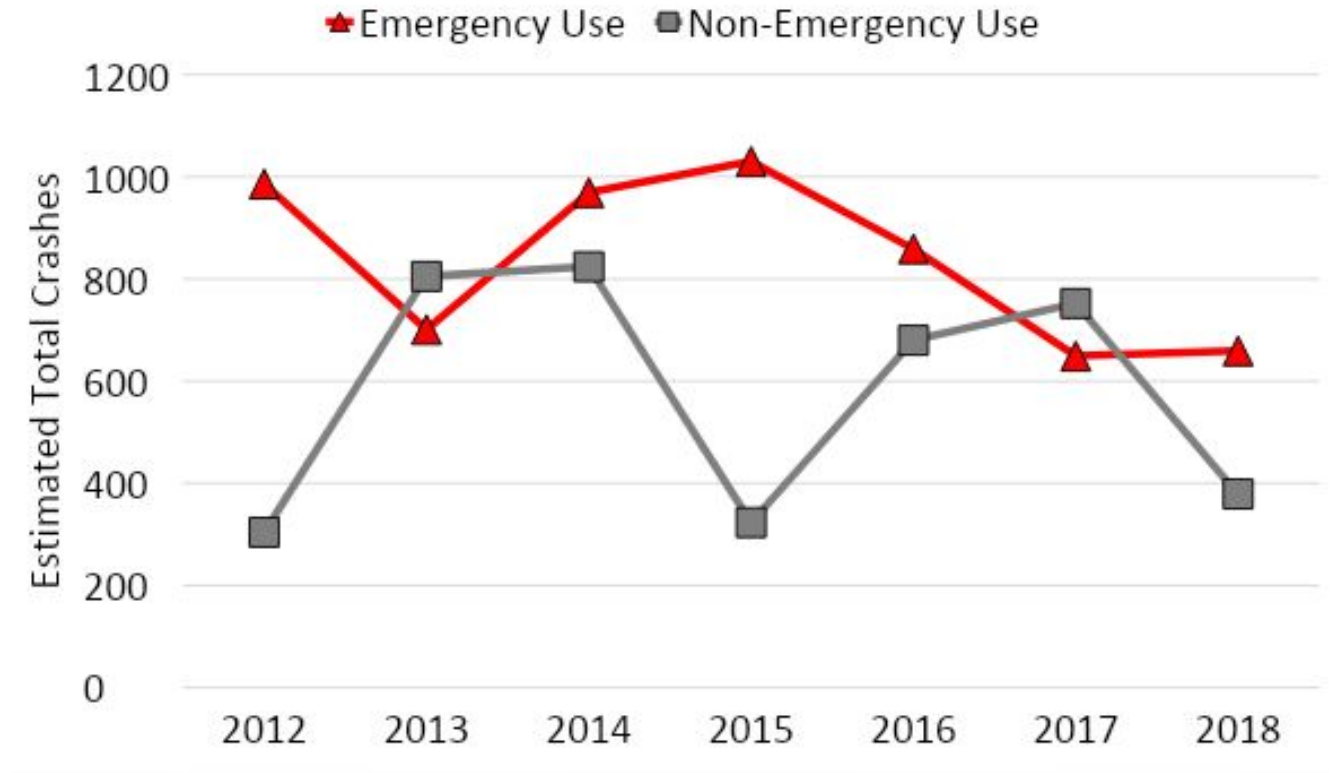
54.0%



Sources: NHTSA's GES (2012-2015) and CRSS (2016-2018) databases
Note: Does not include data on injured non-occupants of a vehicle (e.g., pedestrians and pedalcyclists) because so few were involved in ambulance crashes in the databases that the estimates were not reliable.

Emergency Use in Injury Crashes

- Estimated that 59.0% of injury crashes involved an ambulance reported to be in emergency operation



Sources: NHTSA's GES and CRSS databases

Note: Does not include data on injured non-occupants of a vehicle (e.g., pedestrians and pedalcyclists)

Special Crash Investigations of Ambulance-Involved Crashes 2012-2018

Special Crash Investigations (SCI)

- NHTSA conducts detailed investigations for selected ambulance crashes that result in serious or fatal injury to occupants inside the ambulance



Photo from SCI Report CA12034

The SCI Program

- SCIs examine contributing factors to serious or fatal injuries sustained including:
 - Pre-crash activities of persons involved
 - Environment and roadway
 - Vehicle and equipment
- For 2012 – 2018 NHTSA published reports on 27 ambulance crashes



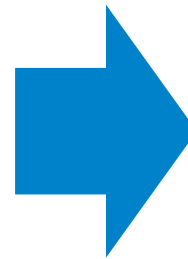
SCI Process

Crash reported to NHTSA OEMS



Photo from SCI Report CA12032

OEMS Checks if Meets Criteria



- Fatality or hospitalization of ambulance occupant
- Failure of ambulance equipment
- Suspected malfunction of ambulance
- Other extenuating crash circumstances

SCI Process

SCI launches Investigation



Photo from SCI Report CA12032

Technical Report Released

CALSPAN ON-SITE AMBULANCE CRASH INVESTIGATION
SCI CASE NO.: CA12032
VEHICLE: 2009 CHEVROLET C4500 / ROADRESCUE TYPE I AMBULANCE
LOCATION: NEBRASKA
CRASH DATE: JULY 2012

BACKGROUND

This on-site investigation focused on the intersection crash and rollover of a 2009 Chevrolet C4500 chassis with RoadRescue Ultramedic Type I ambulance body (Figure 1). All four occupants of the ambulance were transported to a local hospital for reported minor injuries. The crash was identified by the National Highway Traffic Safety Administration's (NHTSA) Office of Emergency Medical Services (OEMS), which provided notification to the Crash Investigation Division (CID). The CID forwarded notification to the Special Crash Investigations (SCI) team on Friday, July 13, 2012. SCI initiated contact with the investigating County Sheriff, and cooperation was established on July 16, 2012 to perform an on-site inspection of the ambulance at impound on July 17, 2012. The on-site portion of this investigation consisted of the detailed inspection and documentation of the ambulance and crash site, with interviews of the ambulance agency's administration and the Emergency Medical Services (EMS) crewmembers involved. The Chevrolet was not equipped with an EDR, as it did not have any supplemental restraint systems. Also inspected was a 2012 Ford Fusion involved in the crash. During the inspection process, the Ford's Event Data Recorder (EDR) was imaged.



Figure 1: Involved ambulance at final rest (image obtained from a local news source).

The Chevrolet C4500 chassis was configured with a forward cab and a rear patient compartment equipped for the treatment of medical emergencies in a mobile environment. It was traveling north while transporting a patient who was involved in a separate traffic crash to a local hospital for an unknown medical problem. An on-going construction project on the physically-divided, four-lane roadway restricted traffic flow to two lanes. As the ambulance approached an intersection while utilizing its emergency warning lights and siren, the electronic traffic control signal cycled to control northbound and southbound traffic. A dump truck traveling west on the intersecting road yielded to the ambulance. The Ford, which was traveling west behind the dump truck, did not yield to the ambulance and proceeded into the intersection to turn right. The ambulance driver also proceeded into the intersection in response to the dump truck providing the right of way. The right aspect of the ambulance's frontal plane impacted the forward aspect of the Ford's left plane. The ambulance then impacted and rode up onto the concrete median barrier and initiated a right side-leading, one quarter-turn rollover. A post-crash fire ensued, and all four occupants were transported to a local hospital for treatment.

SCI Report Analysis Approach

- An EMS subject matter expert and two crash investigation specialists reviewed all 27 SCI reports
- Experts completed extensive crash information code sheets (see next slide) that covered:
 - Roadway and other environmental conditions
 - Ambulance organization type
 - Vehicle description
 - Cot/Stretcher description
 - Crash description
 - Characteristics of involved parties
 - Who was at-fault

SCI Report Coding Sheets

Section A: Crash Location and Conditions				
City/Town nearest Crash:		Crash Date:		# of Vehicles Involved:
Light Condition	Daylight	Dark-Not Lighted	Dark-Lighted	Dark-Unknown Lighting
	Dawn	Dusk	Other	Not Reported
Atmospheric Conditions	Clear	Cloudy	Rain	Fog, Smog, Smoke
	Sleet/Hail	Snow	Blowing Snow	Blowing Sand
	Severe Crosswinds	Other	Unknown	Not Reported
Type of Intersection	Not an Intersection	Four-Way	T-Intersection	Y-Intersection
	Five-Point, or More	Traffic Circle	Roundabout	Not Reported
Relation to Junction	Non-Junction	Intersection	Intersection-Related	Railway Grade Crossing
	Acceleration/Deceleration	Crossover-related	Shared-Use Trail	Through Roadway
Roadway Function Class (Land Use)	Rural-Principal Arterial Interstate		Rural - Minor Arterial	
	Rural - Major Collector		Rural - Minor Collector	
	Rural - Local Road or Street		Urban - Principal Arterial Interstate	
	Urban - Principal Arterial - other Freeways		Urban - Minor Arterial	
	Urban - Collector		Urban - Local Road or Street	
Include Additional Photos	Crash Scene Photos		Detailed Investigation Photos	
	<input type="checkbox"/> Police Crash Scene Photos <input type="checkbox"/> Environment Conditions <input type="checkbox"/> Roadway where crash occurred <input type="checkbox"/> Damage to objects struck during crash <input type="checkbox"/> Ambulance trajectory during crash		<input type="checkbox"/> Ambulance Trajectory <input type="checkbox"/> Evidence/Maneuvering	
Section B: Ambulance Organization				
Ambulance Organization Name:		# of Members:	# of Volunteers:	# of Occupants in Ambulance:
				<input type="checkbox"/> EMS Personnel <input type="checkbox"/> Patient(s) <input type="checkbox"/> Passenger(s)
Organization Status	Volunteer	Non-Volunteer	Mixed	N/R
Organization Type	Community, Non-Profit	Private	Hospital	Government, Non-Fire
	Fire Department	Tribal	Not Reported	
Type of Service Requested	911 Response (Scene)	Mutual Aid	Paramedic Intercept	Interfacility Transfer
	Medical Transport	Standby	Other (describe)	N/R UNK
Primary Type of Service	911 Response	Medical Transport	Rescue	Hazmat
	Specialty Care Transport	Air Medical	Paramedic Intercept	
Organization-Level Drug Testing SOPs	Hiring purposes only	Routine testing	Required after crash	Optional after crash
	Required after incident	Optional after incident	Unknown	
EVOC Training	Yes, required	Yes, optional	No EVOC provided	Unknown

Section C: Ambulance (Vehicle) Information				
Ambulance Type:	Vehicle Identification Number:		State Registration:	
<input type="checkbox"/> Type 1 <input type="checkbox"/> Type 2 <input type="checkbox"/> Type 3				
Ambulance Chassis	Make	Model	Year	
Ambulance Manufacturer	Make	Model	Year	
Video Cameras <input type="checkbox"/> Present, Recorded Crash <input type="checkbox"/> Present, No Record <input type="checkbox"/> Absent <input type="checkbox"/> Unknown <input type="checkbox"/> Not Reported Camera(s) Location/View: _____ GPS Tracking <input type="checkbox"/> Present, Recorded Crash <input type="checkbox"/> Present, No Record <input type="checkbox"/> Absent <input type="checkbox"/> Unknown <input type="checkbox"/> Not Reported Speed Monitor <input type="checkbox"/> Present, Recorded Crash <input type="checkbox"/> Present, No Record <input type="checkbox"/> Absent <input type="checkbox"/> Unknown <input type="checkbox"/> Not Reported				
Include Additional Photos	Crash Scene Photos		Detailed Investigation Photos	
	<input type="checkbox"/> Exterior Damage <input type="checkbox"/> Interior Damage <input type="checkbox"/> Final Resting Position of Vehicle		<input type="checkbox"/> Detailed exterior damage <input type="checkbox"/> Detailed interior damage	
Section D: Ambulance Cot Information				
Patient Cot	Brand	Model	Serial Number	Cot broke during crash?
				<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown <input type="checkbox"/> Not Reported
Cot parts broken during crash:				
Cot Fastening System	Brand	Model	Serial Number	Fastener broke during crash?
				<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown <input type="checkbox"/> Not Reported
Fastener parts broken during crash:				
Cot Restraint Type/Use	Shoulder harness and lateral restraints	Lateral restraints only	Shoulder harness only	Cot came out of fastening during crash?
	No restraints used	N/A (not on cot)		
				<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown <input type="checkbox"/> Not Reported
Cot Shoulder Harness Restraint/Use	Available, used	Available, not used	Available, not attached to stretcher	Cot Involved in Injury/Death?
	Not available for this stretcher	Not Reported	Other: _____	
				<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown <input type="checkbox"/> Not Reported
Include Additional Photos	Crash Scene Photos		Detailed Investigation Photos	
	<input type="checkbox"/> Final Resting Position of Cot		<input type="checkbox"/> Cot in use during crash <input type="checkbox"/> Detailed fastener system damage <input type="checkbox"/> Detailed cot damage <input type="checkbox"/> Close-ups on any damaged parts	

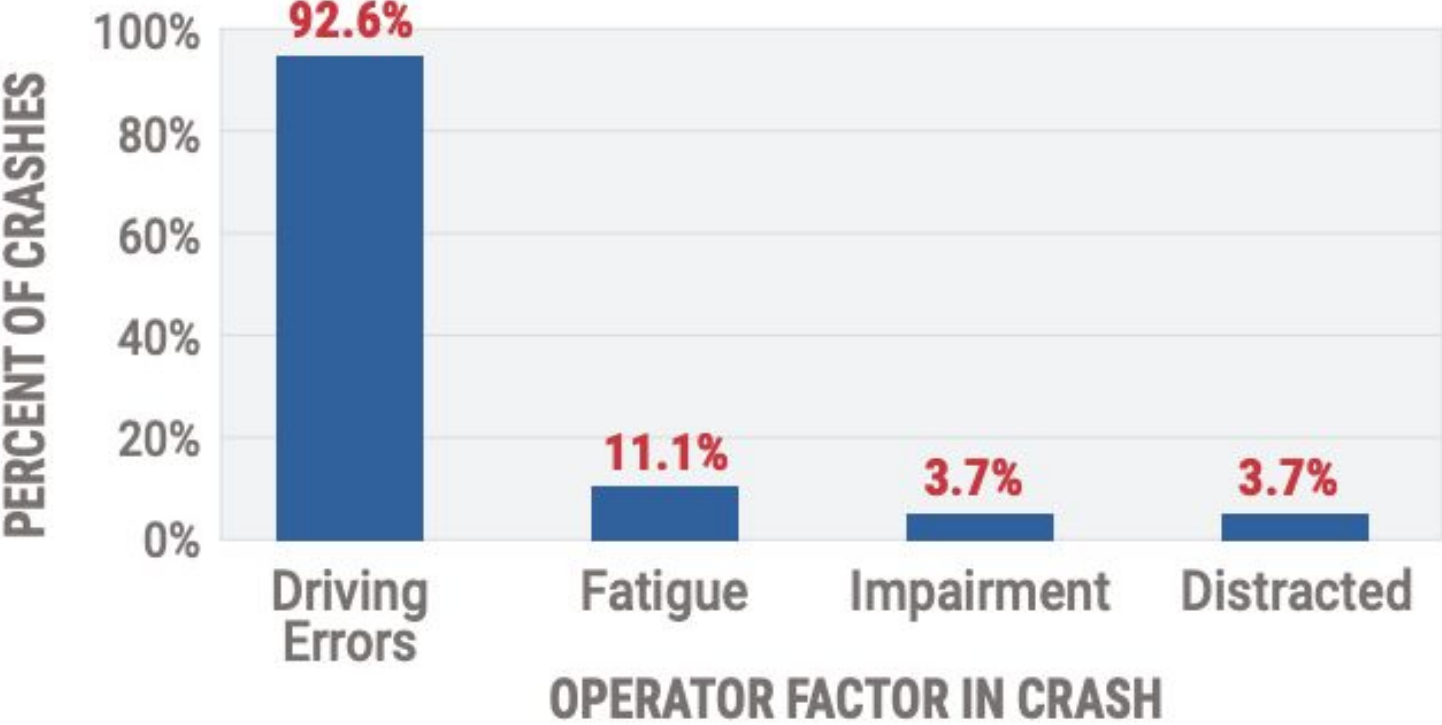
Pre-Crash Factors

- Lights and sirens active (40.7%)
- Dark (33.3%)
- Inclement weather (22.2%)
- Proceeded against red light (7.4%)
- Poor visibility (3.7%)



Note: N= 27

Ambulance Operator/Driver Factors



Driving errors mainly consisted of hazard anticipation/avoidance and situational awareness (92.6%), supplemented by issues like speeding, not wearing seat belts, and improper clearing of intersections (14.8%).

Note: N= 27

Other Involved Driver Factors (Non-Ambulance Driver)

- Driving errors (73.7%)
 - Wrong lane (36.8%)
 - Ran red light or stop sign (21.1%)
 - Failed to yield to ambulance (15.8%)
 - Passed another vehicle slowing down, pulling over, or stopping for ambulance (15.8%)
 - Speeding (5.3%)
 - Driving much slower than the speed limit (5.3%)
- Did not hear or see ambulance with lights and sirens on (10.5%)
- Impaired by alcohol or other drugs (5.3%)

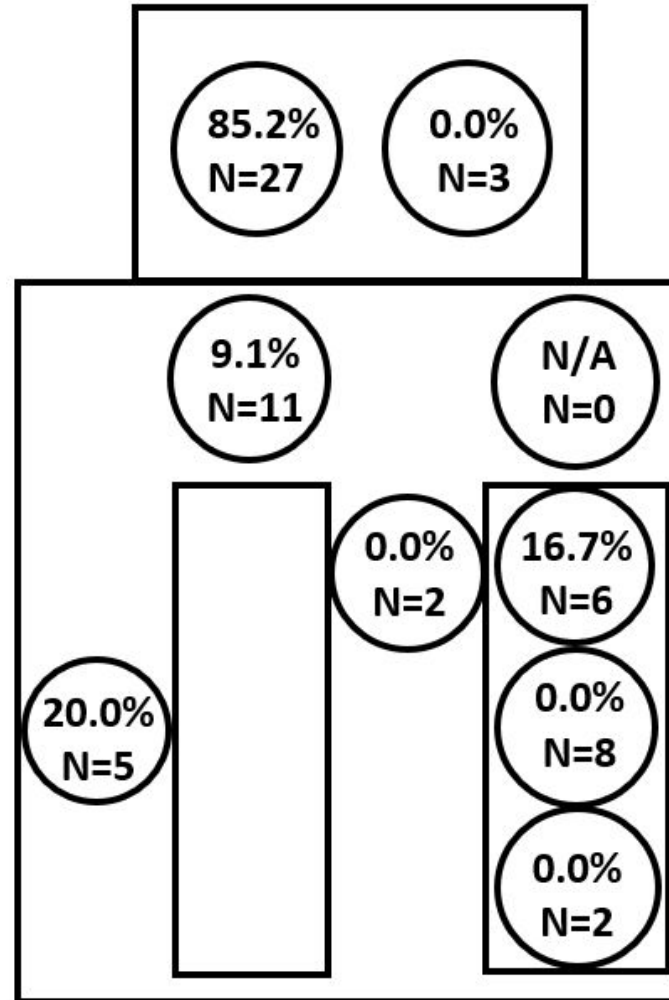
Note: N= 19

EMS Personnel Restraint Use



- 85.2% of operators/drivers used seat belts
- Only 8.8% of EMS providers in the patient compartment used safety restraints
- Unrestrained providers were more likely to sustain serious or fatal injuries

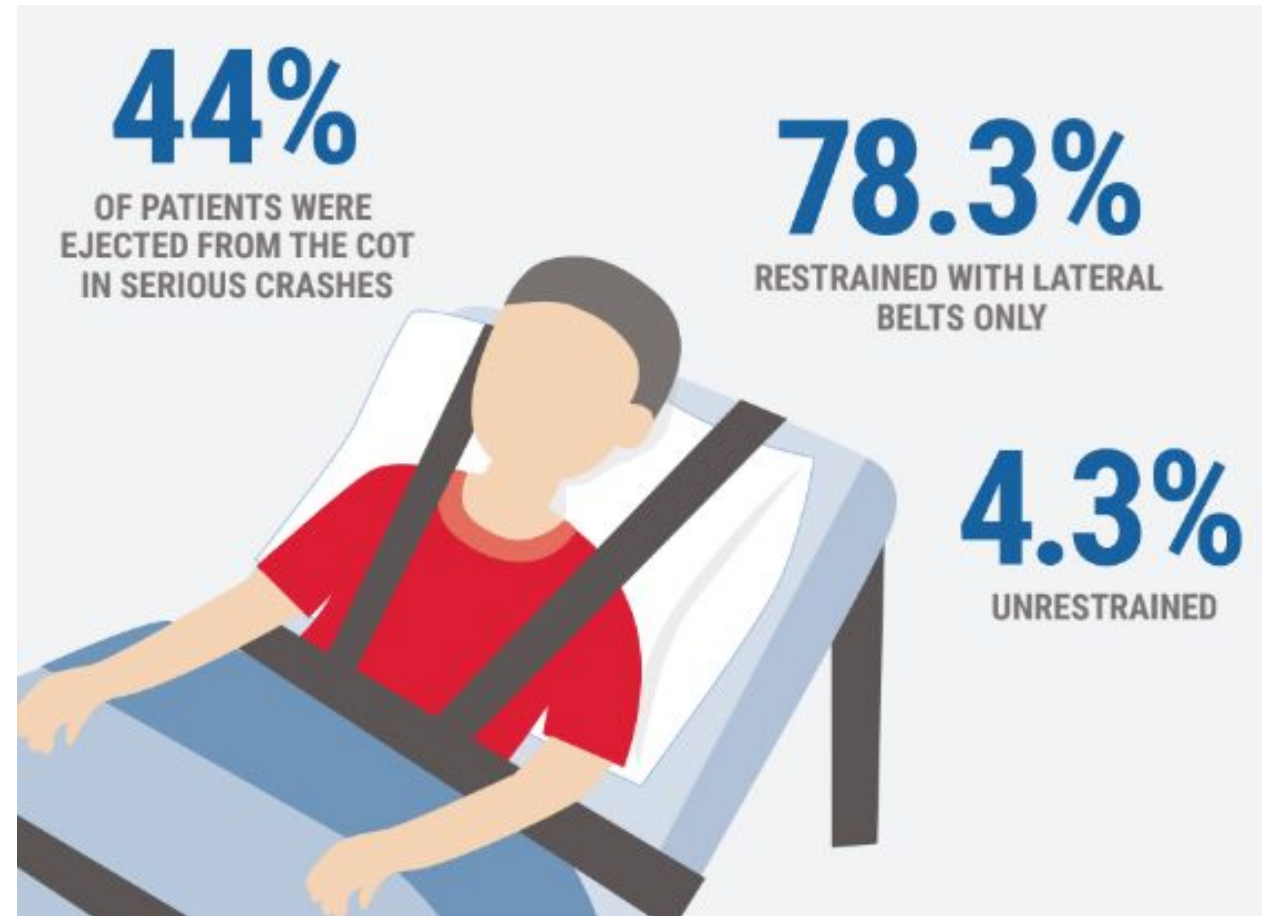
EMS Personnel Restraint Use by Position



Sources: NHTSA Special Crash Investigations Ground Ambulance Crash Reports 2012-2018

Patient Restraint Use

- Lap belt only (78.3%)
 - Harness and lap belt (17.4%)
 - Unrestrained (4.3%)
-
- 44% of patients were ejected from the stretcher



Sources: NHTSA Special Crash Investigations Ground Ambulance Crash Reports 2012-2018
Note. Shoulder harnesses were not available for use in 3 of the crashes.

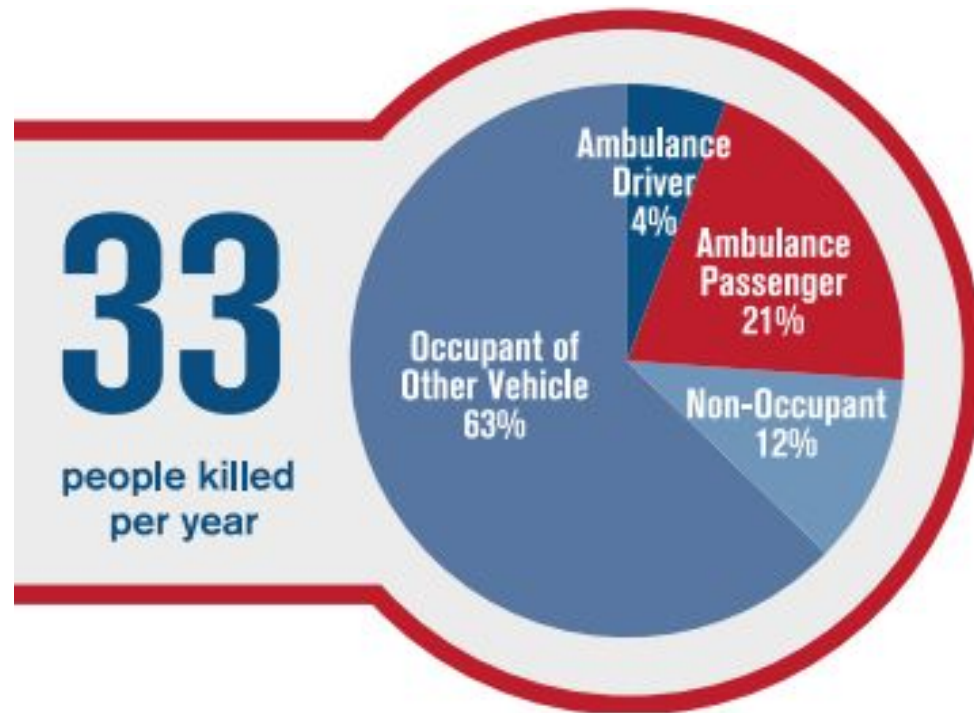
Limitations of the Data and Analyses

- Included only crashes on a roadway customarily open to the public
- Not all crashes are reported to the police
- Did not distinguish between ambulance types
- Did not include exposure data for miles driven by ambulances or time on road
- Data sources did not differentiate ambulance occupants in the passenger seat or patient compartment of the ambulance until 2013
- SCl reports are a limited set of “extreme” crashes

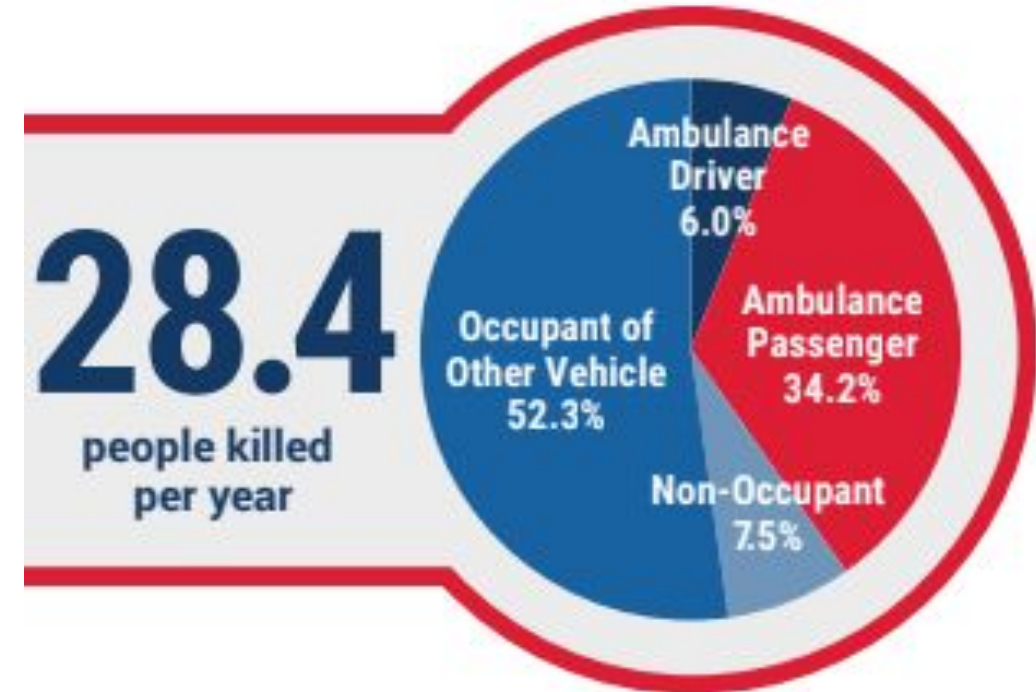
Comparisons and Key Takeaways: Infographics

Fatal Crash Comparison

Data collected between 1992-2011



Data collected between 2012-2018



Clinician Restraint Comparison

Data collected between 1992-2011

Data collected between 2012-2018

84%

**OF EMS PROVIDERS
IN THE PATIENT COMPARTMENT**



WERE NOT RESTRAINED*

91.9%

**OF THE 37 EMS CLINICIANS IN
THE PATIENT COMPARTMENT**



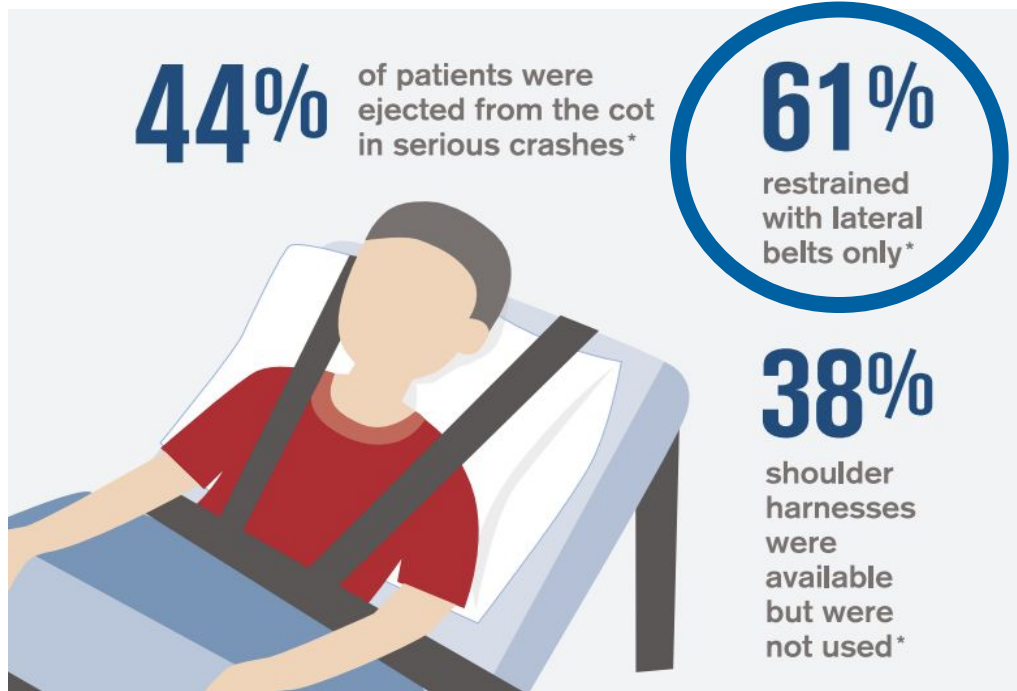
WERE NOT RESTRAINED

Patient Restraint Comparison

ONLY 33%
OF PATIENTS

WERE SECURED*

WITH SHOULDER AND LAP RESTRAINTS

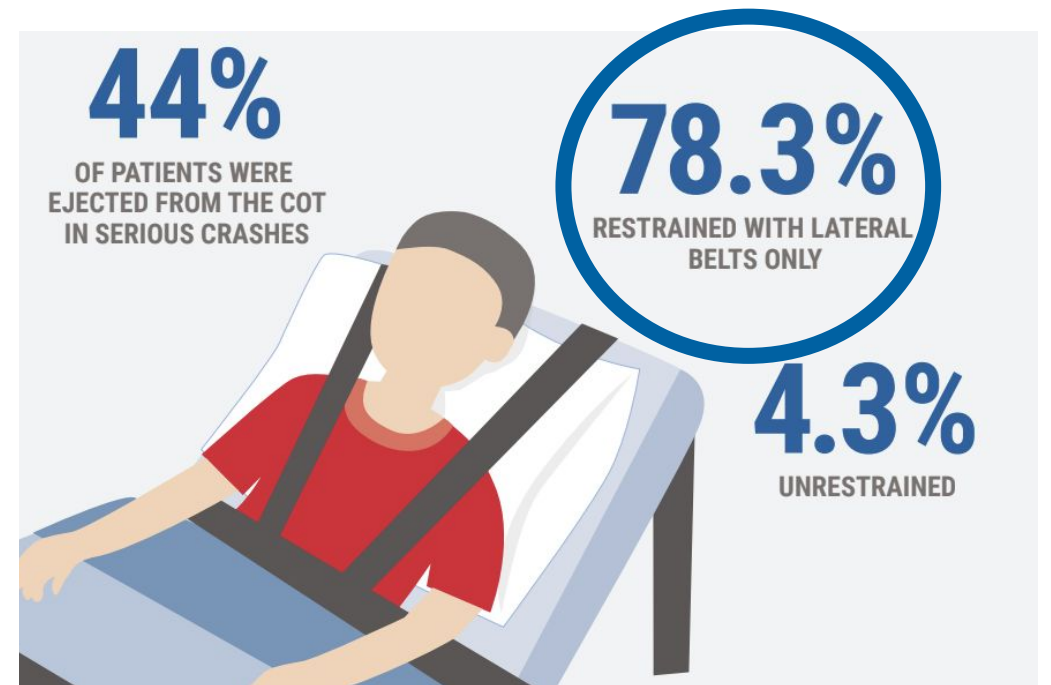


Data collected between 1992-2011

ONLY 17.4%
OF THE 23 PATIENTS

WERE SECURED

WITH SHOULDER AND LAP RESTRAINTS



Data collected between 2012-2018

Recommendations to Improve Ambulance Safety



Increase Proper Seat Belt and Other Restraint Use

- Ensure operators, providers, and patients use restraints properly when the vehicle is in motion; secure patients to the cot using lap and shoulder belts
- Secure the cot in the patient compartment and upgrade to SAE-compliant cot mounting and patient restraint systems
- Include belt condition and tension checks in routine vehicle maintenance
- Submit complaints about ambulance defects (e.g., restraints) to NHTSA's Office of Defects Investigations (ODI)

Develop Policies for Operating the Vehicle

- When and when to not use lights and sirens
 - Reduce lights and siren use
 - Require a full stop at all stop signs or red traffic signals before proceeding with caution when using lights and sirens
- Limit speed to the maximum posted speed limit including during lights and sirens use
- Pre-plan route before the vehicle is in motion
- No phone or other electronic device use while the vehicle is in motion

Fatigue Management



Develop a fatigue management plan
Measure and monitor fatigue using survey instruments



Allow naps while on duty



Limit shift duration to less than 24 hours
Caffeine should be accessible



Train personnel on ways to mitigate fatigue



Reduce Driving Errors with Training

- Complete a specialized ambulance operator course including:
 - Hazard management
 - Situational awareness
 - Defensive driving skills
 - Intersection handling
 - Adverse weather driving
- Require recurring training specific to vehicle used

Create Safety Culture

- Monitor and enforce safety policies
- Review standard operating procedures and revise as needed
- Make safety improvements an ongoing effort
- Ongoing checks and screenings
 - Operator/driver license
 - Physical fitness
 - Mental fitness

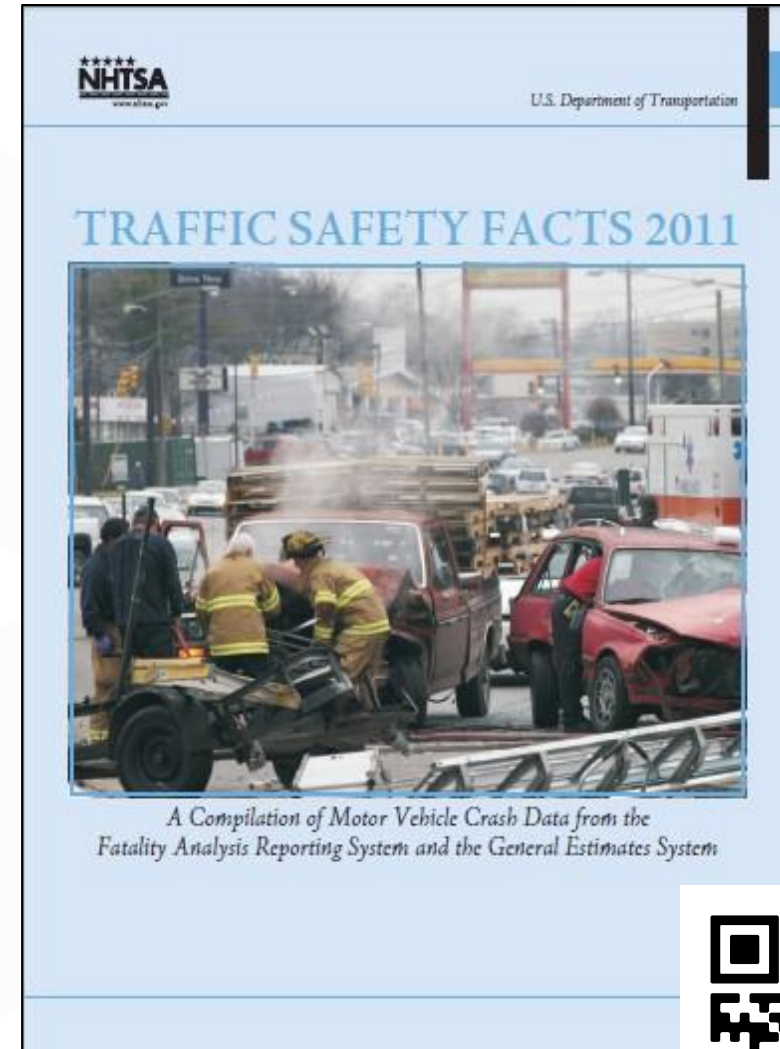
NHTSA Data Sources

[FARS](#)

[GES](#)

[CRSS](#)

[SCI Reports](#)



Resources

[NHTSA Office of Defects Investigations \(ODI\)](#)

[Lights and Siren Use by Emergency Medical Services \(EMS\): Above All Do No Harm](#)

[2018 Fatigue Risk Management Guidelines for Emergency Medical Services](#)

[Fatigue in EMS](#)

[1995 Emergency Vehicle Operators Course \(Ambulance\): National Standard Curriculum](#)

[Strategy for a National EMS Culture of Safety](#)



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THANK YOU!

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