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Analysis of Ground Ambulance Crash Data From 2012 to 2018

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16. Abstract This study reviewed ground ambulance crashes that occurred from 2012 to 2018 in the United States. The study queried several national crash databases and reviewed NHTSA's Special Crash Investigation (SCI) reports for ambulance-involved crashes. Data in the Fatality Analysis Reporting System (FARS) revealed that ambulance-involved fatal crashes remained relatively rare from 2012 to 2018 with a national average of 24.7 fatal crashes and 28.4 fatalities per year. Of the individuals killed, 40.2 percent were occupants of the ambulance (i.e., operators/drivers, front seat passengers, clinicians, or patients in the cabin), 52.3 percent were occupants of other vehicles involved in the crash, and 7.5 percent were non-occupants (e.g., pedestrians, bicyclists). Overall, 45.7 percent of the fatal crashes occurred during emergency use and 28 percent occurred when lights and sirens were active (2013 to 2018 data only). Analyses of the National Automotive Sampling System (NASS) General Estimates System (GES) and Crash Report Sampling System (CRSS) data indicated that approximately 36.2 percent of injury crashes occurred when the ambulance was reported to have lights and sirens active (2013 to 2018 data only) and of those injured in crashes involving an ambulance with reported lights and sirens in use, 24.4 percent were occupants inside the ambulance. Similarly, lights and sirens were active in 40.7 percent of the SCI crashes. Almost all (92.6%) of the 27 SCI crashes reviewed involved ambulance operator/driver error. Improper clearing of intersections, traveling against red lights, and operator fatigue were noted as contributing factors in SCI crashes. A key finding in SCI crashes was lack of proper restraint use by both clinicians and patients. Findings suggest priority countermeasures to improve ground ambulance safety: (1) Strengthen organizational safety policies; (2) Reduce operator error through training; (3) Create a culture of safety; (4) Adopt new vehicle safety designs or technologies.			
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Executive Summary

Background and Objectives

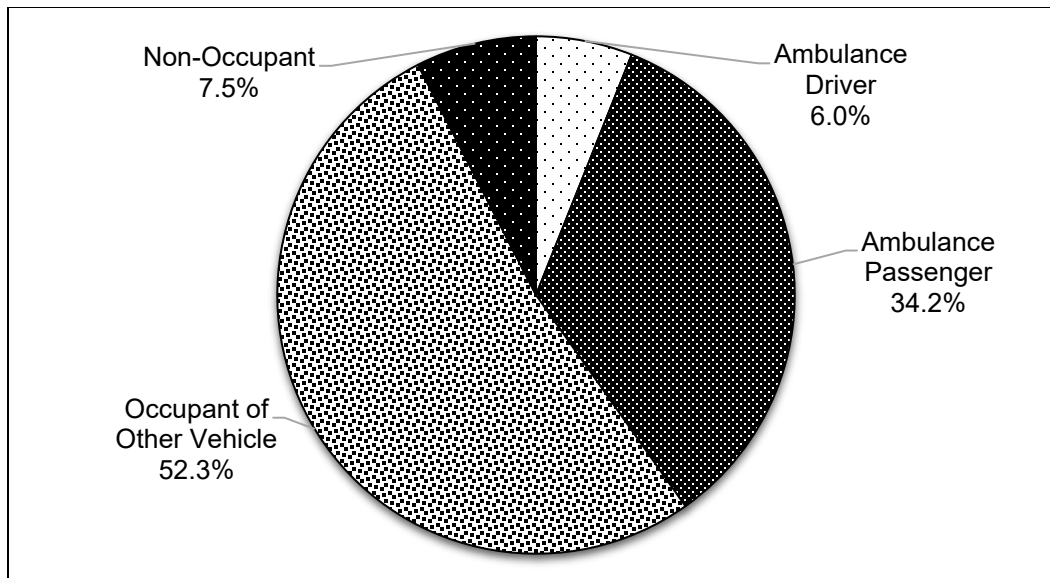
Ground ambulance crashes are the leading cause of death on the job among emergency medical services (EMS) personnel (Reichard et al., 2011; Maguire & Smith, 2013; Bureau of Labor Statistics, 2018). To understand the problem, the National Highway Traffic Safety Administration's (NHTSA) Office of Emergency Medical Services (OEMS), Office of Behavioral Safety Research (OBSR), National Center for Statistics and Analysis (NCSA), and Special Crash Investigations (SCI) unit studied ground ambulance-involved crashes for the years 1992 to 2011 (NHTSA, 2014). The study examined ambulance-involved crashes in national databases and reviewed SCI reports focused on ambulance crashes to identify factors contributing to ambulance-involved crashes and injuries. The current study's objective was to review ambulance crashes that occurred from 2012 to 2018 and identify priority countermeasures to increase ambulance safety.

Methods

This study queried NHTSA's Fatality Analysis Reporting System (FARS), the National Automotive Sampling System (NASS) General Estimates System (GES), and the Crash Report Sampling System (CRSS) for ambulance-involved crashes from 2012 to 2018. The study also included a review of all SCI reports focused on ground ambulance crashes from 2012 to 2018. Experts in crash investigations and ambulance operations reviewed each SCI report and summarized the most critical investigation findings. After reviewing the study findings, the experts and research staff gave priority recommendations on countermeasures to address the identified problems.

Results

Ambulance-involved fatal crashes remained relatively rare from 2012 to 2018 with a national average of 24.7 fatal crashes per year and 28.4 fatalities per year reported in FARS. Of the individuals killed, 40.2 percent were ambulance occupants (operators/drivers, front seat passengers, and clinicians or patients in the cabin), 52.3 percent were occupants of other vehicles involved in the crash, and 7.5 percent were non-occupants (e.g., pedestrians, bicyclists), as shown in Figure 1. In 2013, data began to include lights and sirens status. From 2013 to 2018, some 28 percent of the ambulance-involved fatal crashes occurred when lights and sirens were reported to be active. Analyses of the NASS GES and CRSS data indicated that approximately 36.2 percent of injury crashes occurred when the ambulance was reported to have lights and sirens active (2013 to 2018 data only) and of those injured in crashes involving an ambulance with reported lights and sirens in use, 24.4 percent were occupants inside the ambulance.



Source: FARS 2012-2017 Final File, 2018 Annual Report File (ARF). N = 199.

Figure 1. Crash Position of Each Fatality

The SCI reports ($n= 27$) for 2012 to 2018 showed nearly all crashes (92.6%) involved ambulance operator/driver error. Improper clearing of intersections, traveling against red lights, and operator fatigue were noted as factors in the crashes. Lights and sirens were active in 40.7 percent of the crashes. The expert reviewers noted that lights and sirens were often used in situations that were not recommended according to best-practice guidelines.

A key finding in the SCI crash reports was lack of proper restraint use by clinicians and patients. Only 8.8 percent of clinicians in the patient compartment were properly restrained, and no occupants in the front passenger seat were properly restrained. While 95.7 percent of the patients were restrained in some manner, only 17.4 percent were properly restrained by both lateral belts and shoulder harnesses.

Discussion

The study's results indicate several priority areas to promote and improve ground ambulance safety: (1) Strengthen organizational safety policies; (2) Reduce operator errors through training; (3) Create a culture of safety; and (4) Adopt new vehicle safety designs or technologies.

Countermeasures already exist to address some of the problems identified by this study. NHTSA and other safety partners recommend that all operators complete an emergency vehicle operator course specific to ambulances to reduce operator errors (NHTSA, 1995; Thomas et al., 2019). The *Ambulance Driver Best Practices* guide describes recommended lights and sirens use and how to implement a quality fatigue management program for ambulance operators and clinicians (Boone et al., 2013). Ambulance patient care compartment standards have been rewritten to make it easier for clinicians to remain safely restrained while treating patients (Avery et al., 2015; Green, 2017), but many older ambulances without updates remain in service. Once new vehicle safety designs or technologies are adopted, clinicians will need training on how to properly use the new designs. These countermeasures require commitment at the organizational level to implement good policies and continuous monitoring of operators and clinicians to ensure best practices are always followed. If organizations, operators, and clinicians create a culture of safety, the EMS system and patients served will benefit from safer operations on the roadways.

Introduction

Ground ambulance crashes are the leading cause of death on the job among EMS personnel (Reichard et al., 2011; Maguire & Smith, 2013; Bureau of Labor Statistics, 2018). To understand the problem, OEMS, OBSR, NCSA, and SCI previously researched ground ambulance-involved crashes for the years 1992 to 2011 (NHTSA, 2014). The study examined NASS GES and FARS data for ground ambulance-involved crashes from 1992 to 2011. The estimated number of ambulance-involved property-damage only (PDO), crashes ranged between 2,600 and 3,200 crashes per year. The estimated number of injury crashes trended downward from an average of 1,800 annually between 1997 and 2001 to an average of 1,400 between 2007 and 2011. Analyses of FARS data did not show substantial changes over time as ambulance-involved fatal crashes averaged about 29 per year with an average of 33 fatalities per year.

As part of the same 2014 research, OEMS reviewed SCI reports for 2005 to 2012 when an ambulance was involved in the crash (Smith, 2015). In the cases reviewed, 78 percent of vehicle drivers wore seat belts but only 16 percent of EMS personnel in the patient compartment wore restraints. While 96 percent of patients were restrained in some manner, only 33 percent were restrained correctly with both lateral belts and shoulder harnesses. Patients who were not properly restrained were more likely to be ejected from ambulances and sustain serious or fatal injuries. Other factors identified as possibly contributing to the crashes were operator fatigue and equipment defects.

Since the 2014 study, several new ambulance technologies (e.g., computer aided dispatch software, road closure notification systems, and electronic navigation systems) have emerged that may affect ambulance crash risk (Hsiao et al., 2018). Guidelines for patient compartment design improvements were developed to reduce EMS clinician injuries in the event of a crash (Avery et al., 2015). These design improvements are being incorporated in national ambulance design standards and should lead to the production of safer ambulances (Green, 2017). With the improved restraint designs, EMS personnel can more readily access essential equipment and provide care while remaining restrained in the patient compartment (Green et al., 2010). In addition, a wide variety of new crash avoidance technologies are entering the passenger vehicle fleet separate from ambulances and many areas of the country are seeing substantial improvements in infrastructure for pedestrians and bicyclists which could affect ambulance-involved crashes.

Given the noted changes in technology, ambulance design, general driving environment, and the creation of the CRSS, this study focused on the most recently available ambulance-involved crash data and SCI reports.

Objective

This study's objective was to examine ground ambulance crashes from 2012 to 2018 by analyzing national level crash data and SCI reports where an ambulance was involved.

Methods

The study queried FARS, NASS GES, CRSS, and SCI databases for ground ambulance crashes from 2012 to 2018. The crash, person, and vehicle variables from each database were selected as described below.

Fatality Analysis Reporting System

FARS data are collected annually through cooperative agreements between NHTSA and the 50 States, the District of Columbia, and Puerto Rico. The data set is a census of police-reported traffic crashes where an involved person died within 30 days of the crash. Analysts in each State enter many crash, person, and vehicle level data points into the system using a standard form. The FARS analysts gather this data from several sources.

- Police crash reports
- State vehicle registration files
- State driver licensing files
- State highway department data
- Vital statistics
- Death certificates
- Coroner/medical examiner reports
- EMS reports

The system has several range checks to make sure valid entries are being made. NHTSA's FARS team then conducts further quality control checks and makes imputations for missing variables (e.g., driver blood alcohol concentration) where appropriate. The result is a standardized database that can be analyzed to examine fatal crashes at both the national and local level. In March 2020 the study team downloaded Statistical Analysis System (SAS)¹ versions of the FARS data for crashes from 2012 to 2018 from the NHTSA File Downloads website at <https://www.nhtsa.gov/file-downloads?p=nhtsa/downloads/FARS>.

The vehicle files contained codes for the types of vehicles involved in each crash. To be included in this study, the crash must have involved a ground ambulance. Furthermore, only crashes where the vehicle was in transit were selected (i.e., crashes were excluded if a parked ambulance was involved). Some variables in the files changed over time as new codes and variables were added which required the study team to conduct recoding to allow comparisons over time for those variables. This report provides notes where appropriate to indicate how variables were recoded to arrive at the measures of interest.

National Automotive Sampling System General Estimates System

NASS GES is a nationally representative probability sample of police-reported crashes ranging from minor property damage to fatalities for the years 1988 to 2015. The dataset is composed of police crash reports selected from 60 areas of the country to reflect the geography, roadway mileage, population, and traffic density of the United States. NASS GES data collectors gathered police crash reports from 400 police jurisdictions within the selected areas. Approximately

¹ SAS Institute Inc, Cary, NC. www.sas.com/en_us/home.html

50,000 reports were randomly sampled each year. Data elements were extracted from the reports and coded in a standardized format.

SAS versions of the NASS GES data files for crashes from 2012 through 2015 were downloaded from the NHTSA File Downloads website at <https://www.nhtsa.gov/file-downloads?p=nhtsa/downloads/GES>.

Crash Report Sampling System

CRSS replaced NASS GES in 2016 and uses a national probability-based crash sampling system that is different than the sampling strategy that was used for NASS GES. CRSS was designed to be more representative of crashes across the country. The database includes fatal, injury, and PDO only crashes. Police crash reports are selected from 60 designated areas reflecting the geography, population, miles driven, and crash distribution in the country. SAS versions of the CRSS data files for crashes from 2016 to 2018 were downloaded from the NHTSA File Downloads website at <https://www.nhtsa.gov/file-downloads?p=nhtsa/downloads/CRSS>.

CRSS uses the same file and variable structure as FARS and NASS GES. As such, the crash and variable selection criteria used for the NASS GES data were applied to CRSS data.

Special Crash Investigation Reports

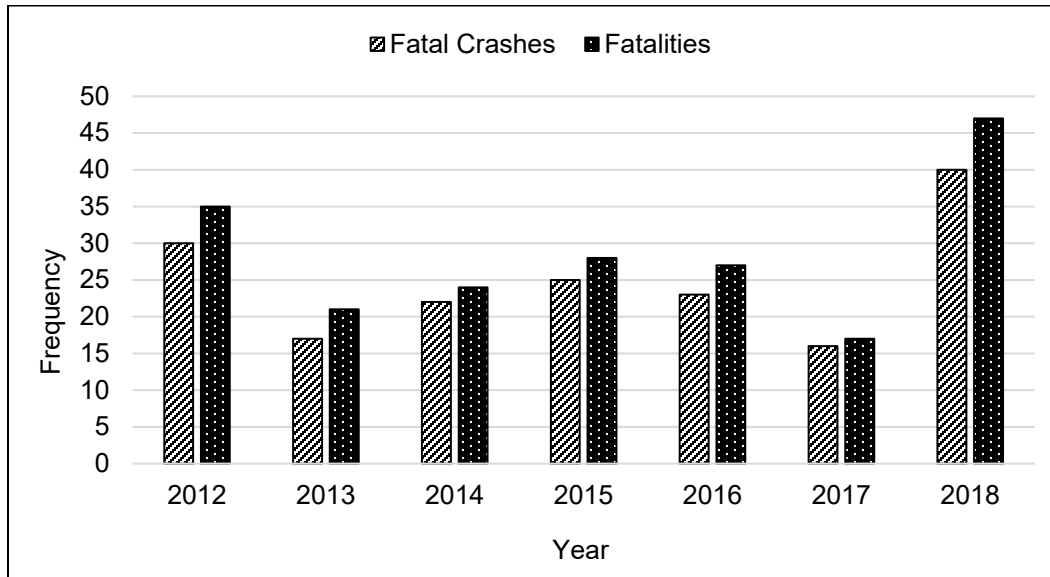
SCI reports are the result of comprehensive motor vehicle crash investigations for a limited number of crashes of special interest to NHTSA each year. Approximately 200 investigations are performed annually. SCI includes extensive follow-up research on a crash including additional collection and assessment of driver and occupant data, in-person vehicle interior and exterior inspections, safety systems inspections, crash scene inspections, and medical record reviews. SCI tends to focus on current hot topics within the highway safety community and are not designed to be generally representative of crashes.

SCI reports that focused on ground ambulance crashes for 2012 to 2018 were accessed from the NHTSA Crash Viewer, Special Crash Investigations at <https://crashviewer.nhtsa.dot.gov>. Searches for ambulance-involved crashes resulted in 27 reports for review. Subject matter experts (SMEs) in crash investigations and ambulance operations reviewed the identified SCI reports and completed the coding document in Appendix A to summarize the most critical findings of each investigation. At least two SMEs reviewed each SCI report and discussed their findings to come to a consensus on how to complete each field in the coding document. A senior SME reviewed all reports to provide additional insights regarding fault and factors contributing to the ground ambulance crashes.

Results

Fatal Crashes Involving an Ambulance (FARS Data)

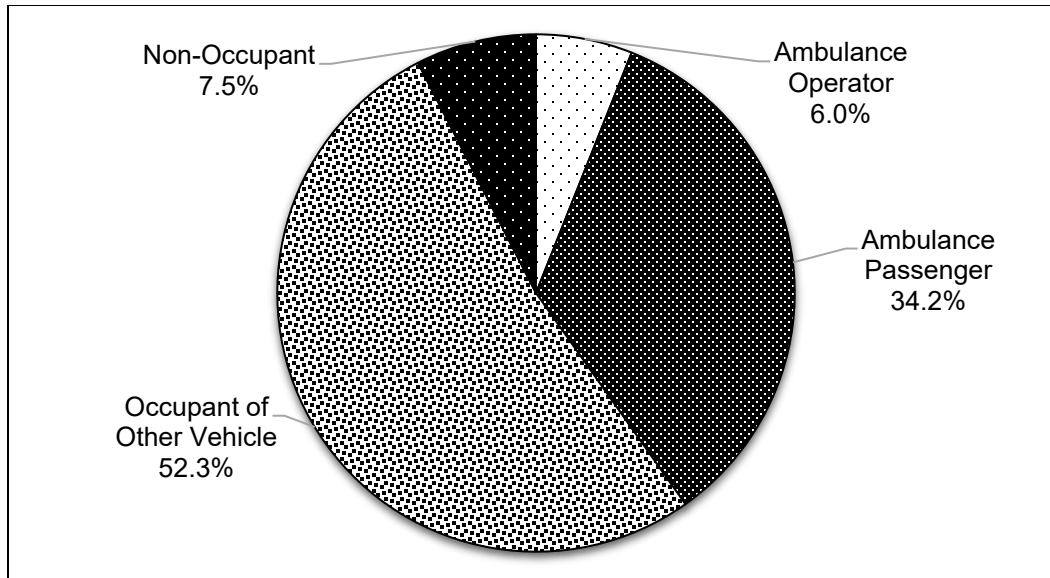
Figure 2 provides FARS-based counts of the annual number of fatal crashes and fatalities when an in-transit ambulance was involved for the years 2012 to 2018. Overall, a total of 173 ambulance-involved fatal crashes resulted in 199 fatalities during these seven years. The years 2012 and 2018 had a higher number of crashes and fatalities than the other years. There was an average of 24.7 fatal ambulance-involved crashes per year from 2012 to 2018 with an average of 28.4 people killed per year in those crashes.



Source: FARS 2012-2017 Final File, 2018 ARF.

Figure 2. Ambulance-Involved Fatal Crashes and Fatalities by Year

Figure 3 provides the crash position of those people who were fatally injured in an ambulance-involved crash. Over half (52.3%) of people killed in ambulance-involved crashes were occupants of other vehicles (i.e., not occupants of the ambulance), 34.2 percent were ambulance passengers, 7.5 percent were non-occupants (e.g., pedestrians, bicyclists), and 6% were ambulance operators (drivers). Ambulance passengers could have been patients or EMS personnel in the patient care compartment, or people riding in the front passenger seat.



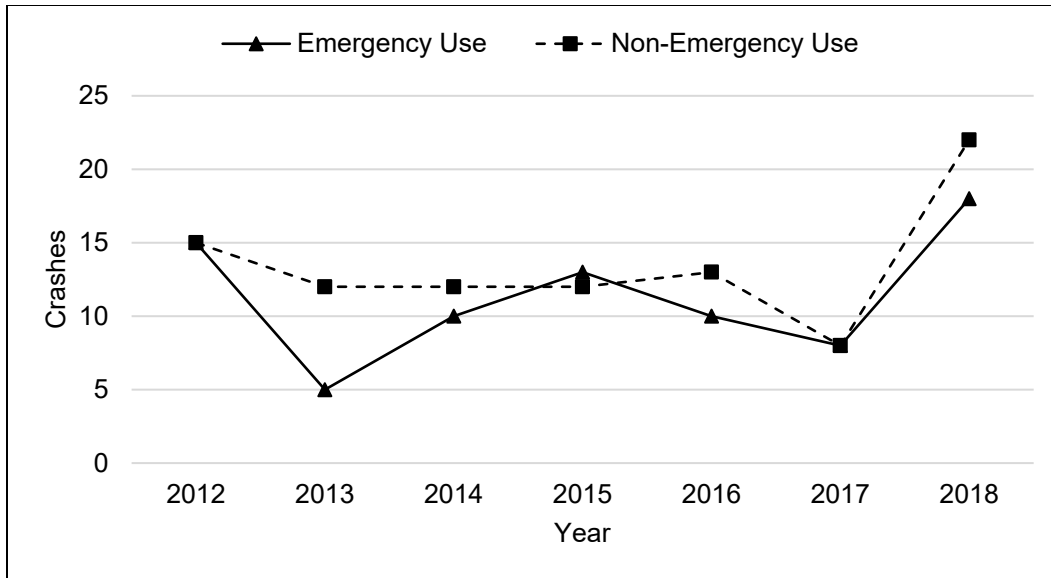
Source: FARS 2012-2017 Final File, 2018 ARF. N = 199.

Figure 3. Crash Position of Each Fatality

Figure 4 shows whether the ambulances were in “emergency use” at the time of the fatal crashes. In 2012, FARS did not differentiate whether emergency use included emergency equipment (lights and sirens) in use versus emergency operation with lights and sirens off. Later years included more data codes for emergency operation that could be selected. To allow for the best comparisons to the 2012 data, researchers combined the following three emergency use codes for the 2013 to 2018 data into “emergency use.”

- Emergency operation, emergency warning equipment in use
- Emergency operation, emergency warning equipment not in use
- Emergency operation, emergency warning equipment unknown

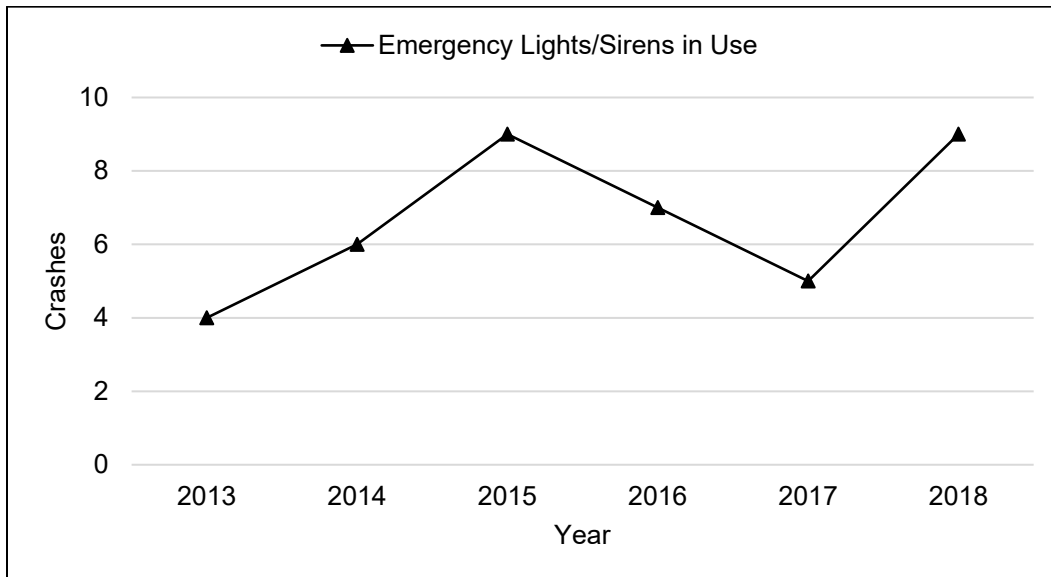
All other emergency use codes for 2013 to 2018 were combined into “non-emergency use” for the purposes of this report, including cases where emergency use was not reported, reported unknown, or listed as not applicable. Combined across 2012 to 2018, 45.7 percent of fatal crashes involved an ambulance reported to be in emergency operation.



Source: FARS 2012-2017 Final File, 2018 ARF.

Figure 4. Emergency use in Fatal Crashes by Year

Starting in 2013, FARS began including codes that indicated whether emergency warning equipment (i.e., lights and sirens) were active when an ambulance crashed during emergency use. Overall, 28 percent of fatal crashes in Figure 5 were reported to have emergency lights and sirens in use by the ambulance at the time of the crash.

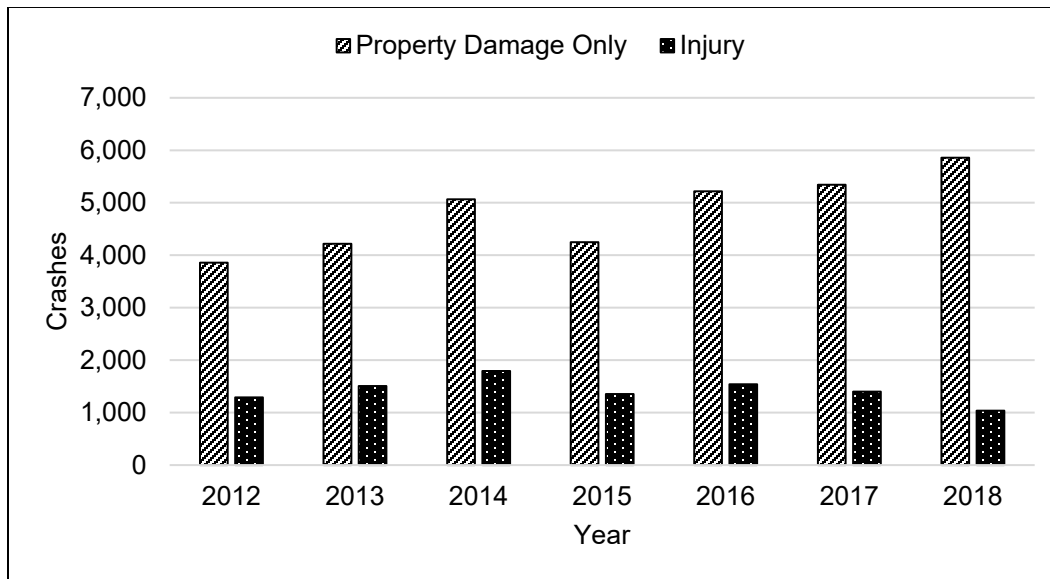


Source: FARS 2013-2017 Final File, 2018 ARF.

Figure 5. Emergency Lights/Sirens Use in Fatal Crashes by Year

Estimated Property Damage Only and Injury Crashes

Figure 6 shows NASS GES and CRSS annual estimates of ground ambulance PDO and injury (excluding fatalities) crashes for 2012 to 2018. Table 1 provides annual estimated PDO crash counts and averages by data source for the years covered by each and totals across all years combined.² Table 2 provides annual estimated injury crash counts and averages.



Sources: NASS GES 2012-2015; CRSS 2016-2018.

Note: Comparisons over time should be made with caution given changes in sampling criteria between NASS GES and CRSS.

Figure 6. Estimated Annual PDO and Injury Crashes by Year

² NASS GES and CRSS data were combined to provide some measures for the entire period covered by this report to make comparisons to NHTSA's prior research easier, but these results should be interpreted with caution given changes in sampling criteria between NASS GES and CRSS. Similarly, comparisons of NASS GES to CRSS annual estimates should be made with caution.

Table 1. Estimated Annual PDO Crashes by Year

Year	PDO Crashes^a	Annual Mean
2012 NASS GES	3,859	
2013 NASS GES	4,219	
2014 NASS GES	5,065	
2015 NASS GES	4,249	
NASS GES Subtotal	17,392	
2016 CRSS	5,217	
2017 CRSS	5,344	
2018 CRSS	5,858	
CRSS Subtotal	16,419	
Grand Total ^a	33,811	4,830.1

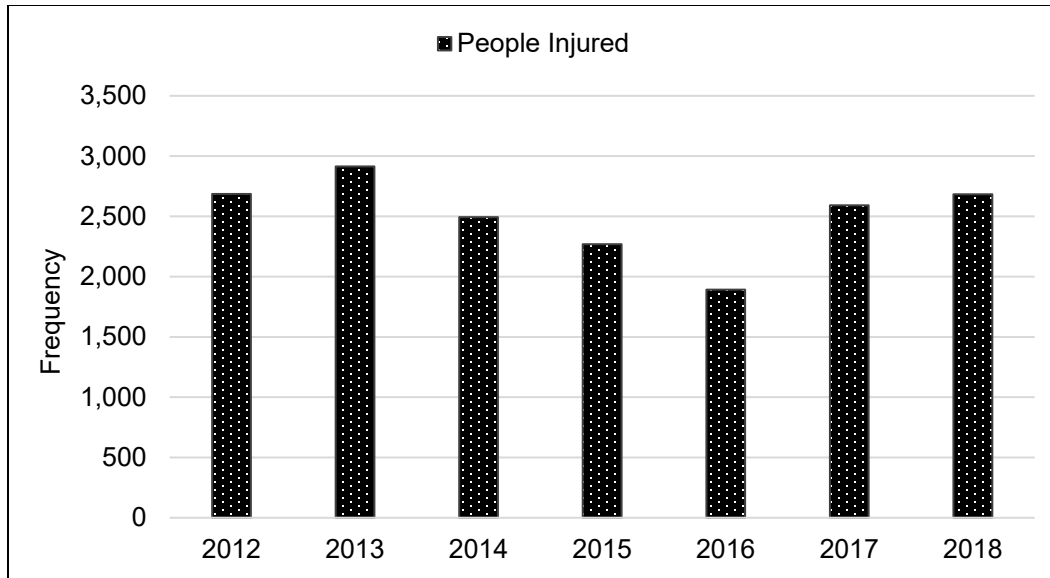
^aTotal PDO crashes and averages that combine data from NASS GES and CRSS databases should be interpreted with caution given changes in sampling criteria between NASS GES and CRSS.

Table 2. Estimated Annual Injury Crashes by Year

Year	Injury Crashes	Annual Mean
2012 NASS GES	1,290	
2013 NASS GES	1,506	
2014 NASS GES	1,794	
2015 NASS GES	1,353	
NASS GES Subtotal	5,943	
2016 CRSS	1,540	
2017 CRSS	1,401	
2018 CRSS	1,038	
CRSS Subtotal	3,979	
Grand Total ^a	9,922	1,417.3

^aTotal Injury crashes and averages that combine data from NASS GES and CRSS databases should be interpreted with caution given changes in sampling criteria between NASS GES and CRSS.

Figure 7 provides the annual estimated number of people injured (excluding fatalities) when an ambulance was involved in a crash for 2012 to 2018. Table 3 provides annual estimated injury counts and averages by data source for the years covered by each and totals across all years combined.



Sources: NASS GES 2012-2015; CRSS 2016-2018.

Note: Comparisons over time should be made with caution given changes in sampling criteria between NASS GES and CRSS.

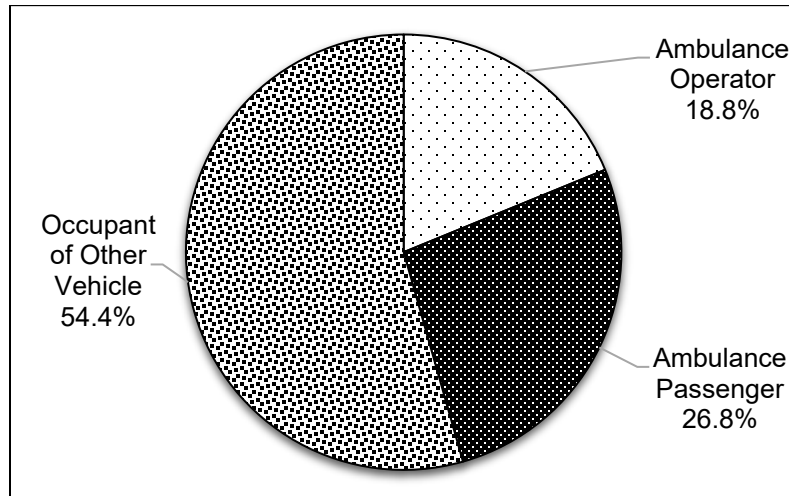
Figure 7. Estimated Annual People Injured by Year

Table 3. Estimated Annual People Injured by Year

Year	Injuries	Annual Mean
2012 NASS GES	2,686	
2013 NASS GES	2,914	
2014 NASS GES	2,494	
2015 NASS GES	2,269	
NASS GES Subtotal	10,363	2,590.85
2016 CRSS	1,892	
2017 CRSS	2,592	
2018 CRSS	2,683	
CRSS Subtotal	7,167	2,389.3
Grand Total ^a	17,530^c	2,504.4 ^c

^aTotal People Injured and averages that combine data from NASS GES and CRSS databases should be interpreted with caution given changes in sampling criteria between NASS GES and CRSS.

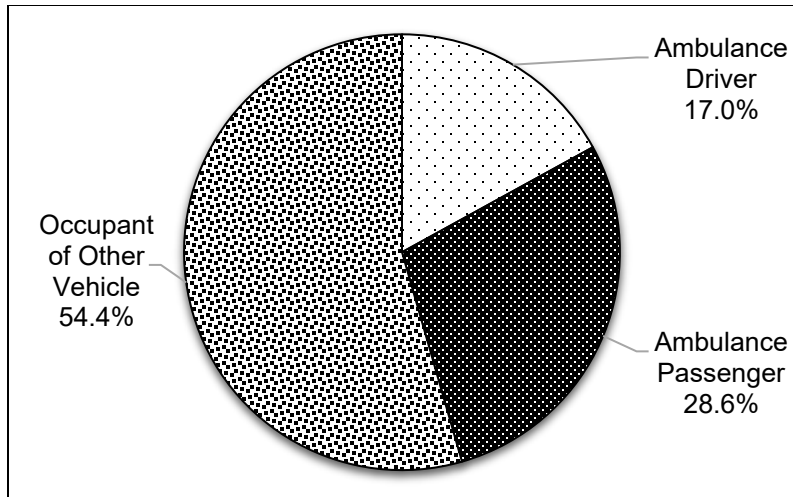
Figure 8 shows the estimated position in crash of injured people from 2012 to 2018 when estimates for all years are combined. Figure 9 provides the position in crash data from NASS GES for 2012 to 2015 combined, and Figure 10 shows the data from CRSS for 2016 to 2018 combined. As shown in the figures, regardless of data source, about half of the injured people are occupants of other vehicles. Consistent with NHTSA's prior study of data from 1992 to 2011, non-occupants of a vehicle (e.g., pedestrians and bicyclists) were not included in these analyses because so few were involved in ambulance crashes in the databases that the estimates were not reliable when the data were broken down in this manner. Cases with unknown or not reported positions in the crash were also excluded from these analyses.



Sources: NASS GES 2012-2015; CRSS 2016-2018.

Note: This figure combines NASS GES and CRSS data ($N = 16,622$). Interpretations of the combined data should be made with caution given changes in sampling criteria between NASS GES and CRSS. Non-occupants and cases with unknown positions were excluded from this analysis to be consistent with the approach used by a prior NHTSA study.

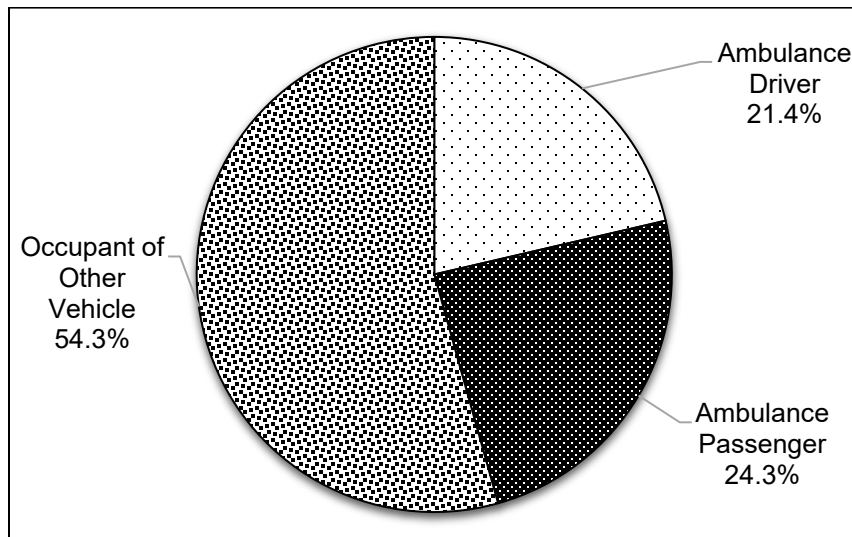
Figure 8. Estimated Position in Crash of Injured People, 2012 to 2018



Sources: FARS 2012-2015 Final Files; NASS GES 2012-2015. N = 9,690.

Note: Non-occupants and cases with unknown positions were excluded from this analysis to be consistent with the approach used by a prior NHTSA study.

Figure 9. Estimated Position in Crash of Injured People, 2012 to 2015



Sources: FARS 2016-2017 Final Files, 2018 ARF; CRSS 2016-2018. N = 6,932.

Note: Non-occupants and cases with unknown positions were excluded from this analysis to be consistent with the approach used by a prior NHTSA study.

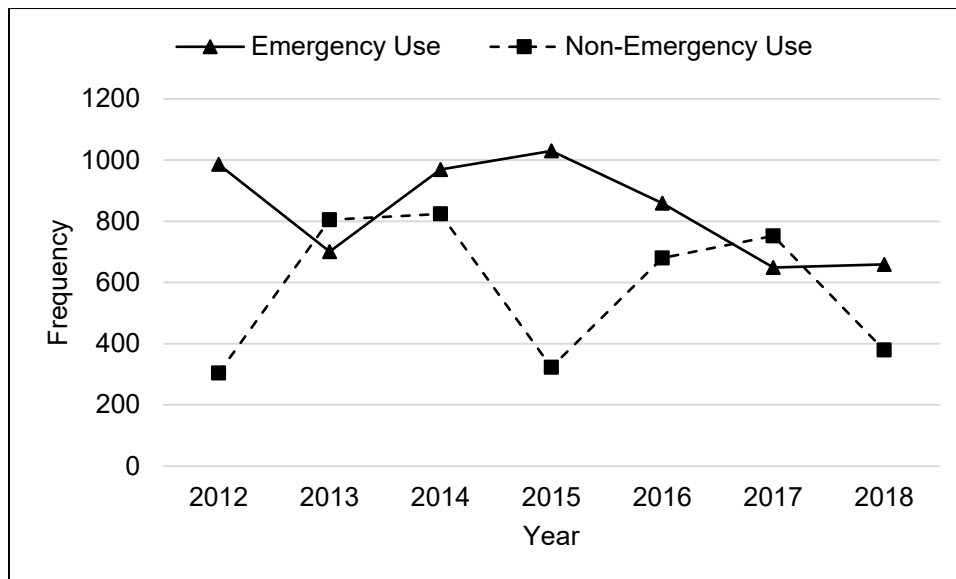
Figure 10. Estimated Position in Crash of Injured People, 2016 to 2018

As with FARS in 2012, NASS GES did not specify whether emergency equipment (lights and sirens) were in use during emergency operation. Later years included more data codes for emergency operation that could be selected. To allow for the best comparisons to 2012 data, researchers combined the following three emergency use codes for the 2013 to 2018 data into “emergency use.”

- Emergency operation, emergency warning equipment in use
- Emergency operation, emergency warning equipment not in use
- Emergency operation, emergency warning equipment unknown.

All other emergency use codes for 2013 to 2018 were combined into “non-emergency use” for the purposes of this report, including cases where emergency use was not reported, reported unknown, or listed as not applicable.

Figure 11 and Table 4 show that reported emergency use for injury crashes fluctuated over time. Combined across 2012 to 2018, some 59 percent of the estimated injury crashes involved an ambulance reported to be in emergency operation.



Sources: NASS GES 2012-2015; CRSS 2016-2018.

Note: Non-emergency use crashes in Figure 11 include unknown, not reported, and not applicable emergency use codes. Comparisons over time should be made with caution given changes in sampling criteria between NASS GES and CRSS.

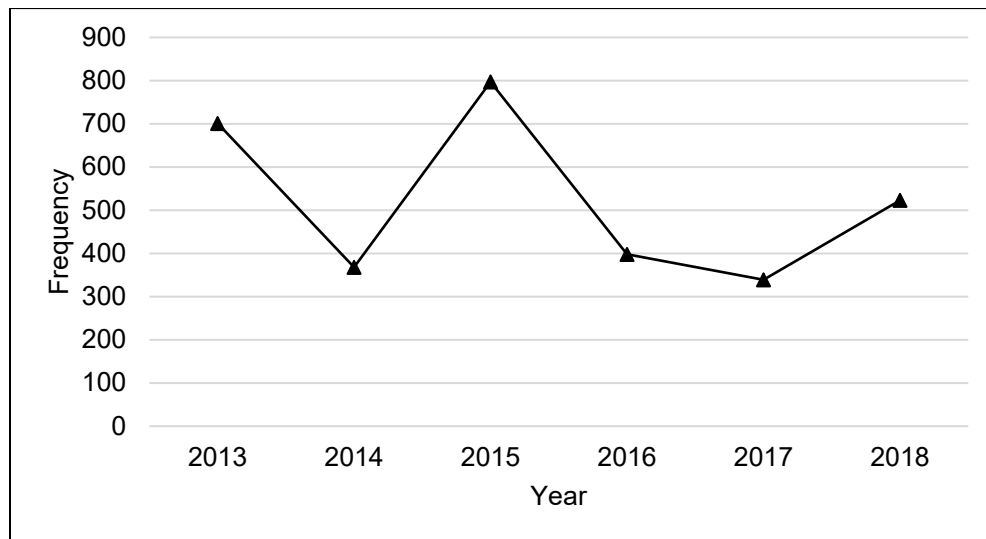
Figure 11. Estimated Ambulance in Emergency Use in Injury Crashes by Year

Table 4. Estimated Ambulance in Emergency Use in Injury Crashes by Year

Year	Emergency Use Crashes	Annual Mean
2012 NASS GES	984	
2013 NASS GES	701	
2014 NASS GES	969	
2015 NASS GES	1,030	
NASS GES Subtotal	3,684	921.0
2016 CRSS	859	
2017 CRSS	649	
2018 CRSS	659	
CRSS Subtotal	2,167	722.7
Grand Total ^a	5,851	836.0

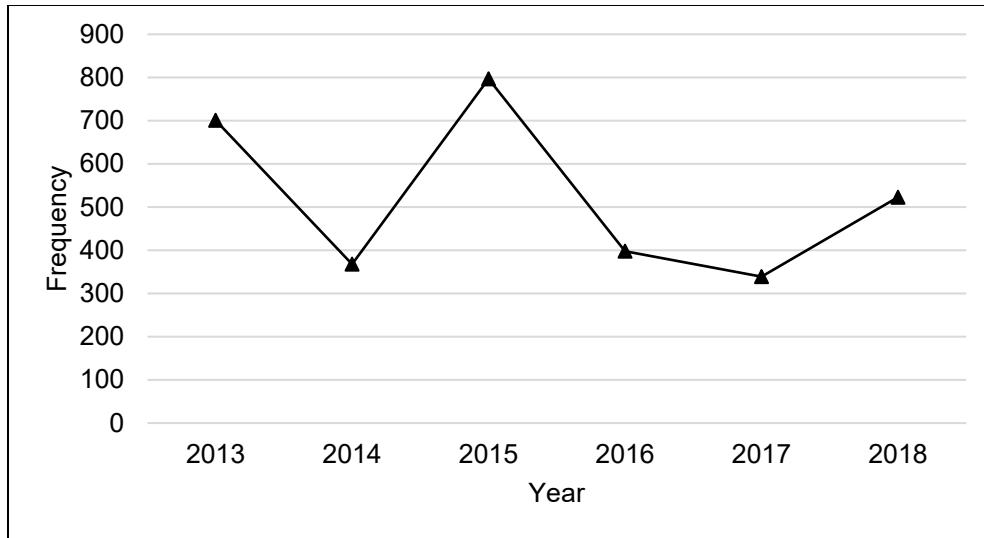
^aTotal injuries and averages that combine data from NASS GES and CRSS databases should be interpreted with caution given changes in sampling criteria between NASS GES and CRSS.

Figure 12 and Table 5 show the estimated number of injury crashes when the ambulance had emergency equipment in use (i.e., lights and sirens) during emergency operation for 2013 to 2018. Combined across 2013 to 2018, 36.2 percent of estimated injury crashes were reported to involve an ambulance with lights and sirens in use.



Sources: NASS GES 2012-2015; CRSS 2016-2018.

Note: Non-emergency use crashes in Figure 11 include unknown, not reported, and not applicable emergency use codes. Comparisons over time should be made with caution given changes in sampling criteria between NASS GES and CRSS.



Note: Comparisons over time should be made with caution given changes in sampling criteria between NASS GES and CRSS.

Sources: NASS GES 2013-2015; CRSS 2016-2018.

Figure 12. Estimated Ambulance Emergency Lights/Sirens Use for Injury Crashes by Year

Table 5. Estimated Ambulance Emergency Lights/Sirens Use for Injury Crashes by Year

Year	Lights/Siren Use Crashes	Mean
2013 NASS GES	701	
2014 NASS GES	368	
2015 NASS GES	797	
NASS GES Subtotal	1,866	621.7
2016 CRSS	398	
2017 CRSS	339	
2018 CRSS	523	
CRSS Subtotal	1,260	420.3
Grand Total ^a	3,126	521.0

^aTotal injuries and averages that combine data from NASS GES and CRSS databases should be interpreted with caution given changes in sampling criteria between NASS GES and CRSS.

Factors Identified in SCI Investigated Crashes

A wide variety of factors related to the ambulance operator/driver, clinician, environment, and drivers of other involved vehicles appeared to play a part in the crashes covered by the SCI reports. The summary below provides the percentages of the 27 SCI crashes that a given factor was identified by the SMEs as possibly contributing to the crash. Non-ambulance vehicles were involved in 19 of the crashes reviewed.

Pre-Crash Factors (*n* = 27)

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

Ambulance Operator/Driver Related Factors (*N* = 27)

- Driving errors (92.6%)
 - Hazard awareness/avoidance (92.6%)
 - Situational awareness (92.6%)
 - Speeding (14.8%)
- Unbelted (14.8%)
- Improper clearing of intersection (14.8%)
- Fatigue (11.1%)
- Impaired by alcohol or other drugs (3.7%)
- Medical condition (3.7%)
- Distracted (e.g., GPS or cell phone use) (3.7%)

Ambulance Passenger Restraint Use

- Clinician (*N* = 37) unrestrained (91.9%)
- Patient (*N* = 23)
 - Shoulder harness and lateral belt restraints used (17.4%)
 - Lateral belt only used (78.3%)
 - Unrestrained (4.3%)

Driver of Other Involved Vehicle(s) Factors (*N* = 19)

- Driving errors (73.7%)
 - Wrong lane (36.8%)
 - Ran red light or stop sign (21.1%)
 - Failed to yield to ambulance (15.8%)
 - Passed 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 lights and sirens (10.5%)
- Impaired by alcohol or other drugs (5.3%)

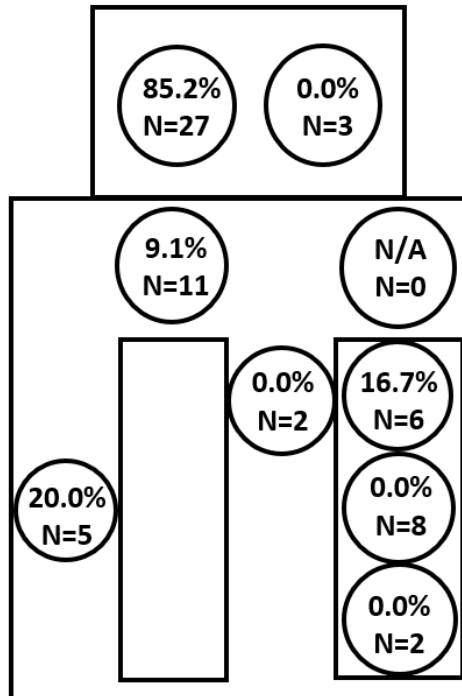
SMEs considered the ground ambulance operator was at fault or partially at-fault in causing 51.8 percent of the SCI crashes, as shown in Table 6.

Table 6. Ambulance Operator At-fault in SCI Crashes

Ambulance Operator Fault	Number	%
Yes	11	40.7
Partially	3	11.1
No	13	48.1

Source: SCI Crash Reports, 2012-2018.

Figure 13 shows EMS personnel seat belt/restraint use rate by seating position in the ambulance for the 27 SCI crashes. The great majority of operators/drivers (85.2%) were wearing seat belts at the time of the crashes. However, belt use was lower when lights and sirens were in use (8 of 11 operators belted; 72.7%) versus when they were off (15 of 16 operators belted; 93.8%). Overall, only 8.8 percent of clinicians in the patient compartments were properly restrained and none (0 out of 3) of the clinicians riding in the front passenger seats were restrained during the crashes. None (0 out of 18; 0.0%) of the clinicians were restrained when lights and sirens were in use and only a few (3 out of 19; 15.8%) were restrained when lights and sirens were off during the crashes.



Source: SCI Crash Reports, 2012-2018.

Figure 13. EMS Personnel Restraint Use by Seating Position in SCI Crashes

While 95.7 percent of patients were restrained in some manner, only 17.4 percent were fully restrained with lateral belts and shoulder harnesses. Forty-four percent of patients were ejected from the cots and none of those ejected had shoulder harnesses on. Table 7 shows patient restraint use when lights and sirens were in use versus off.

Table 7. Patient Restraint Use in SCI Crashes

	Lights and Sirens (N = 10)	No Lights and Sirens (N = 13)	Total (N = 23)
Type	%	%	%
Shoulder harness & lateral belt	20.0	15.4	17.4
Lateral belt only	70.0	84.6	78.3
Unrestrained	10.0	0.0	4.3

Source: SCI Crash Reports, 2012-2018. Note: Shoulder harnesses were not available for use in 3 of the crashes.

Approaches to Addressing the Identified Issues

The SMEs and research staff discussed possible countermeasures that could address issues identified in the crash data analyses and SCI report reviews. Four priority areas were identified to improve ground ambulance safety: (1) Strengthen EMS organization safety policies; (2) Reduce ambulance operator errors through training; (3) Create a culture of safety; and (4) Adopt new vehicle safety designs or technologies. Below is a list of these countermeasures; references to existing resources on a given topic are provided when possible.

Strengthen EMS Organization Safety Policies

1. Occupant Restraint Use
 - A. Require all occupants to be properly restrained when the vehicle is motion
 - B. Require clinicians in the patient compartment to use restraints even when providing care to patients
 - i. Treat patients prior to transport when possible
 - ii. Position and secure equipment that may be needed prior to transport
 - iii. If it is absolutely necessary to get up while the vehicle is in motion to provide care, return to seat and proper restraint use as soon as possible
 - C. Require all patients to be secured to the stretcher with both lateral belts and shoulder harnesses
 - D. Secure child patients as recommended given the situation – *Working Group Best-Practice Recommendations for the Safe Transportation of Children in Emergency Ground Ambulances* (NHTSA, 2012)
 - E. Check the condition and tension of belts as part of routine vehicle maintenance checks
 - F. Submit complaints about restraint defects (and other vehicle defects) to the NHTSA Office of Defects Investigations at www.nhtsa.gov/report-a-safety-problem
2. Ambulance Operation
 - A. Develop a detailed policy on when to use lights and sirens – *Lights and Siren Use by Emergency Medical Services (EMS): Above All Do No Harm* (Kupas, 2017)
 - i. Reduce overall lights and siren use
 - ii. Only use lights and sirens during patient transport when the patient’s clinical outcome may be improved by the estimated time saved
 - iii. Require a full stop at all stop signs or red traffic signals before proceeding with caution when using lights and sirens
 - B. Limit speed to the maximum posted speed limit at all times
 - C. Require pre-planning route before the ambulance is in motion
 - D. No phone or other handheld electronic device use while the ambulance is in motion
3. Fatigue Management
 - A. Develop a fatigue risk management plan – *Implementation Guidebook – 2018 Fatigue Risk Management Guidelines for Emergency Medical Services* (Patterson & Robinson, 2018)
 - B. Measure and monitor fatigue using fatigue or sleepiness survey instruments
 - C. Limit shift duration to less than 24 hours
 - D. Educate and train personnel on fatigue mitigation strategies

- i. Caffeine should be accessible as a fatigue countermeasure
 - ii. Give EMS personnel the opportunity to nap while on duty
- E. Evaluate the impact and monitor the progress following fatigue management recommendations

Reduce Ambulance Operator Errors Through Training

1. Require all operators to complete an ambulance-focused emergency vehicle operator course (e.g., Emergency Vehicle Operators Course (Ambulance): National Standard Curriculum [NHTSA, 1995]) that covers various topics
 - A. Hazard anticipation and avoidance
 - B. Situational awareness
 - C. Defensive driving skills
 - D. Proper clearing of intersections
 - E. Inclement weather driving skills
 - F. State-specific driving laws as applied to ground ambulances
2. Require recurring training specific to the ambulance being used

Create a Culture of Safety

1. Consistently enforce safety policies – Review and revise current standard operating procedures to meet current guidance
2. Make safety improvements an ongoing effort
3. Conduct ongoing personnel safety checks and screenings
 - A. Operator/driver license
 - B. Physical fitness
 - C. Mental fitness

Adopt New Ambulance Safety Designs or Technologies

1. Patient compartment redesign – *Ambulance Patient Compartment Human Factors Design Guidebook* (Avery et al., 2015) and *Improving EMS Worker Safety in the Patient Compartment* (Green, 2017)
 - A. Make sure patient and supplies are within arms-reach of clinician while properly restrained
 - B. Increase clearance space around clinician’s head to reduce risk of severe head trauma
2. Adopt new safety technologies when possible
 - A. Automatic emergency braking
 - B. Backup cameras
 - C. Lane centering/keeping
 - D. Blind spot monitoring
 - E. Collision warnings
 - F. Integrated GPS navigation

Discussion

This study examined national crash data from several sources and conducted detailed reviews of reports from NHTSA's special crash investigations of ambulance crashes to provide a snapshot of ambulance-involved motor vehicle crashes for the years 2012 to 2018. The study showed that ambulance-involved fatal crashes remained relatively rare events with national averages of 24.7 fatal crashes and 28.4 fatalities per year reported in FARS for 2012 to 2018. This suggests the average number of annual fatalities is down from the 33 per year reported in NHTSA's prior study that covered 1992 to 2011.

Most fatalities in this study (52.3%) were occupants of other vehicles, which is lower than the 63 percent reported for 1992 to 2011. This study found a higher percentage (34.2%) of those killed were ambulance passengers (i.e., front seat passengers, clinicians, or patients in the cabin) compared to 21 percent reported for 1992 to 2011. Ambulance operators/drivers still represented a small percentage (6%) of fatalities for 2012 to 2018, which is like the 1992 to 2011 finding of 4 percent. Based on these results, developing approaches to preventing fatalities among non-driver occupants of ambulances (patients and clinicians in the cabin) and helping to avoid crashes with other vehicles to protect occupants of those vehicles could lead to notable gains in terms of fatality prevention for ambulance-involved crashes.

The FARS data also showed that, for 2012 to 2018, some 45.7 percent of fatal crashes occurred during "emergency use" which is lower than the 58 percent reported for 1992 to 2011. The addition of new data codes starting in 2013 allowed a more detailed look at the 2013 to 2018 FARS data and revealed that 28 percent of the ambulance-involved fatal crashes were reported to have an ambulance with lights and sirens active at the time of the crash. These findings suggest that most ambulance-involved fatal crashes involve ambulances that are not in emergency use and when lights and sirens are not active.

Analyses of PDO and injury (excluding fatalities) crash estimates from NHTSA's NASS GES and CRSS databases showed patterns of results that were like those found in NHTSA's prior study of data from 1992 to 2011. As noted throughout this report, however, the change from the NASS GES to CRSS data system limits comparisons over time and any results that combine data from the two sources should be interpreted with caution. With these limitations in mind, there was still clear evidence that most persons injured in ambulance-involved crashes were occupants of other vehicles or non-driver ambulance occupants. This finding is not surprising given the size of an ambulance compared to most passenger vehicles and what is known from previous research that has found crashes involving ambulances result in more injuries than crashes among similar-sized vehicles (Ray & Kupas, 2005). The current study also found very low estimated counts of non-occupants in crashes involving ambulances.

The injury data did show that about 59 percent of the estimated injury crashes involved an ambulance in emergency use at the time of the crash, which is like the 59 percent reported for the 1992 to 2011 data. Reported emergency use was slightly lower in the later years included in this study, but the reduction could be the result of the CRSS (nationally representative sample of police-reported traffic crashes) redesign in 2016. When lights and sirens use data became available in 2013 to 2018, the current study found that about 36.2 percent of the estimated injury crashes were reported to have lights and sirens active at the time of the crash. Like the fatality data, the injury crash findings suggest the biggest gains in injury prevention are to be had by

focusing on ways to improve safety for non-driver occupants of the ambulance to avoid crashes with other vehicles to prevent injuries among those occupants.

To get a more detailed look at the issues involved with selected crashes, SMEs in ambulance operations and crash investigations completed extensive reviews of 27 SCI reports published on ambulance crashes that occurred from 2012 to 2018. The results showed that almost all (92.6%) of the crashes involved some form of ambulance operator/driver error that factored into the crash. Lights and sirens were active in 40.7 percent of the crashes, which reinforces the notion that most of the crashes are taking place when the ambulance was not using lights and sirens. The experts did note, however, that emergency lights and sirens were often used in situations that are not recommended according to current best-practice guidelines such as during an interfacility transfer or medical transport of a non-critical patient. Improper clearing of intersections, traveling against red lights, and operator fatigue were also noted as factors that appeared in the special reports.

A key problem identified in the SCI report review was a lack of proper restraint use by clinicians and patients in the patient cabin at the time of the crash. Only 8.8 percent of clinicians were properly restrained during the crashes covered by the SCI reports. While 95.7 percent of patients were restrained in some manner, only 17.4 percent of the patients were properly restrained using both lateral belts and shoulder harnesses. This appears to be an issue that has persisted, or even become worse, since NHTSA last looked at SCI reports for 1992 to 2011. The prior study found 30 percent of patients had shoulder and lateral harnesses in use and 16 percent of the care providers were restrained. While the small sample size of SCI report cases limits the generalizability of these findings, the low observed belt use across the two studies suggests this is an area that needs additional attention to improve safety for patients and clinicians.

Overall, the issues identified by this study are not new and some countermeasures already exist to address many of the problems. NHTSA and others have long recommended that all operators complete an emergency vehicle operator course that is specific to ambulances (NHTSA, 1995; Thomas et al., 2019). Guides exist on when to use lights and sirens and how to implement a quality fatigue management program for ambulance operators and clinicians (Boone et al., 2013). Ambulance patient care compartment standards have been redesigned to make it easier for clinicians to remain safely restrained while treating patients but many older ambulances without these updates remain in service. Once new vehicle safety designs or technologies are adopted, clinicians will need training on how to properly use the new designs. All these countermeasures, however, require a commitment at the organizational level to implement good policies and continuous monitoring of operators and clinicians to ensure best practices are always followed. If organizations, operators, and clinicians all buy-in to creating a culture of safety, the entire EMS system and the patients served will benefit from all-around safer operations on the roadways.

Limitations

While FARS is a census of fatal crashes in the United States, NASS GES and CRSS only provide estimates of crashes and injuries using a sample of crashes. The actual number of ambulance-involved crashes across the country could be much higher or lower than the estimates provided in this report. A more accurate count would require reviewing the entirety of each State's crash data system for the period of interest, which would be both costly and time consuming. Also, the move from NASS GES to CRSS during this study's period could have impacted the findings because of the different sampling procedures used to obtain the crash reports included in each database. In addition, the SCI reports reviewed for this study cover a subset of severe crashes which limits the generalizability of the findings.

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Appendix A. Contractor Crash Coding Sheets for SCI Reports

The contractor used subject matter experts in crash investigations and ambulance operations to review the identified SCI reports and they completed the following coding sheet to summarize the most critical findings of each investigation. *(These coding sheets for Ground Ambulance Crash Investigations were not created by SCI).*

SCI Report Coding Sheet for Ambulance Crash Investigations

Section A: Crash Location and Conditions										
City/Town nearest Crash:			Crash Date:			Crash Time:			# 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 Ambo:	
_____			_____			_____			<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: [] Type 1 [] Type 2 [] Type 3		Vehicle Identification Number: _____		State Registration: _____
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				Extent of Damage <input type="checkbox"/> No Damage <input type="checkbox"/> Minor Damage <input type="checkbox"/> Functional Damage <input type="checkbox"/> Disabling Damage <input type="checkbox"/> Not Reported <input type="checkbox"/> Unknown Pre-crash Vehicle Maintenance <input type="checkbox"/> Well Maintained <input type="checkbox"/> Not Maintained <input type="checkbox"/> Not Reported <input type="checkbox"/> Unknown
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 <input type="checkbox"/> Exterior Damage <input type="checkbox"/> Interior Damage <input type="checkbox"/> Final Resting Position of Vehicle		Detailed Investigation Photos <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? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown <input type="checkbox"/> Not Reported
	No restraints used		N/A (not on cot)	
Cot Shoulder Harness Restraint/Use	Available, used	Available, not used	Available, not attached to stretcher	Cot involved in Injury/Death? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown <input type="checkbox"/> Not Reported
	Not available for this stretcher	Not Reported	Other: _____	
Include Additional Photos	Crash Scene Photos <input type="checkbox"/> Final Resting Position of Cot		Detailed Investigation Photos <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	

Section E: Crash

Response Mode at time of Crash <input type="checkbox"/> Lights and Sirens <input type="checkbox"/> No Lights and Sirens <input type="checkbox"/> Unknown		# Injured Persons: <input type="checkbox"/> ___ EMS Personnel <input type="checkbox"/> ___ Patient(s) <input type="checkbox"/> ___ Passenger(s)		# Fatalities: <input type="checkbox"/> ___ EMS Personnel <input type="checkbox"/> ___ Patient(s) <input type="checkbox"/> ___ Passenger(s)		# of Motor Vehicles involved: _____ _____ _____
Manner of Collision	Front-to-Rear	Front-to-Front	Sideswipe-Same Direction			
	Angle	Rear-to-Side	Sideswipe-Opposite Direction			
	Rear-to-Rear	Other (describe)	Not a Collision with a Motor Vehicle in Transport			
First Harmful Event	Rollover/Overturn	Fire/Explosion	Immersion	Jackknife		
	Motor Vehicle In-Transport		Collision with Fixed Object:			
	Motor Vehicle in Motion outside the Traffic way					
	Motor Vehicle In-Transport Struck by Cargo, Persons or Objects set in motion from another MV in transport					
Rollover	No Rollover	Rollover, Tripped by Object/Vehicle	Rollover, Untripped	Rollover, Unknown Type		
Crashed En Route to	Hospital-Destination	Other-Destination	Incident	Available on Radio		
	Base	Unknown	Other (describe)			
Short Description of Collision:						

Ambulance at Fault		Reason for Fault				
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially ___% <input type="checkbox"/> Not Reported <input type="checkbox"/> Unknown		<input type="checkbox"/> Relinquished/Lost Control		<input type="checkbox"/> Atmospheric Conditions		
		<input type="checkbox"/> Impaired		<input type="checkbox"/> Other: _____		
		<input type="checkbox"/> Failed to Yield		<input type="checkbox"/> N/A - Other driver at fault		
		<input type="checkbox"/> Ambulance Malfunction				
How could this crash have been avoided?						
Include Additional Photos	Crash Scene Photos		Detailed Investigation Photos			
	<input type="checkbox"/> Final Resting Position of Vehicles		<input type="checkbox"/> Roadway where crash occurred			
			<input type="checkbox"/> Skid marks or other evidence of maneuvering			

Section F: Driver Statistics				
Driver total length of service with company (years): _____		Driver took EVOC: <input type="checkbox"/> Yes <input type="checkbox"/> No		Describe emergency vehicle operations course/training: _____ _____
Total Ambulance Driving Experience (years): _____	How long between Shifts (hours): _____	How long on Shift (hours): _____	Violations Charged: _____ _____ _____	
Condition (Impairment) at time of Crash:		None/Normal	Ill, Blackout	Asleep/Fatigued
		Impaired (prior injury)	Deaf	Blind
		Emotional (depressed)	Under the influence of alcohol, drugs, or medication	
Other Driver Contributing Factors (e.g., hours slept)		_____		
Alcohol or Drug Testing	Tested, Result: _____		Suspected but not tested	
	Not suspected and not tested		Unknown	Not Reported
Driver Maneuvered to Avoid	Did not maneuver to avoid	Object	Poor Road Conditions (Puddle, Ice, Pothole, etc.)	
	Live Animal	Motor Vehicle	Pedestrian, Pedalcyclist, or Non-Motorist	
	Unknown			
Driver Distracted by	_____ _____			
Driver Previous Recorded Crashes: _____ _____			Driver Previous Recorded Suspensions and Revocations: _____ _____	
Driver Previous Speeding Convictions: _____ _____			Driver Previous Other Harmful MV Convictions: _____ _____	

Section G: EMS Personnel Characteristics

Person Primary Role: <input type="checkbox"/> Driver <input type="checkbox"/> Primary Patient Care Provider <input type="checkbox"/> Secondary Patient Care Provider		Personnel Certification Level <input type="checkbox"/> First Responder <input type="checkbox"/> EMT <input type="checkbox"/> EMT-Intermediate <input type="checkbox"/> Nurse <input type="checkbox"/> Advanced EMT <input type="checkbox"/> Paramedic <input type="checkbox"/> Physician		Sex: <input type="checkbox"/> Male <input type="checkbox"/> Female <input type="checkbox"/> UNK <input type="checkbox"/> N/R	Age (years): _____	Weight (kg): _____ Height (cm): _____
Total Length of Service for Agency (years): _____						
Ambulance Seating Position		1 Front seat, driver				
		2 Front seat, passenger				
		3 Second middle				
		4 Second right				
		5 Third, middle (standing)				
		6 Third, right (forward bench)				
		7 Fourth, left (EMT seat side)				
		8 Fourth, middle (patient/cot)				
		9 Fourth, right (center, bench)				
		10 Other, right (rear bench)				
Providing Patient Care at Time of Crash		<input type="checkbox"/> Yes <input type="checkbox"/> No				
Headphones/Devices		<input type="checkbox"/> Work Communication Headphones <input type="checkbox"/> Non-Work Headphones (e.g., AirPods)	<input type="checkbox"/> Hearing Protection <input type="checkbox"/> Radio/Loud Speaker	<input type="checkbox"/> Unknown <input type="checkbox"/> Not Reported		
Restraint Use		<input type="checkbox"/> Not Used – MV Occupant <input type="checkbox"/> Shoulder Belt Only Used <input type="checkbox"/> Restraint Used – Type Unknown	<input type="checkbox"/> Shoulder and Lap Belt Used <input type="checkbox"/> Lap Belt Only Used <input type="checkbox"/> Unknown if Restraint Used <input type="checkbox"/> N/R			
Ejection		<input type="checkbox"/> Not Ejected <input type="checkbox"/> Totally Ejected	<input type="checkbox"/> Partially Ejected <input type="checkbox"/> Unknown <input type="checkbox"/> N/R			
Ejection Path		<input type="checkbox"/> Not Ejected – N/A <input type="checkbox"/> Through Windshield	<input type="checkbox"/> Through Side Door <input type="checkbox"/> Through Back Door	<input type="checkbox"/> Through Side Wind <input type="checkbox"/> Other: _____		
Extrication		<input type="checkbox"/> Not Extricated <input type="checkbox"/> Extricated	<input type="checkbox"/> Unknown <input type="checkbox"/> Not Reported			
Injury Severity		<input type="checkbox"/> No Injury <input type="checkbox"/> Incapacitating Injury <input type="checkbox"/> Died Prior to Crash	<input type="checkbox"/> Possible Injury <input type="checkbox"/> Fatal Injury <input type="checkbox"/> Unknown	<input type="checkbox"/> Non-incapacitating Evident Injury <input type="checkbox"/> Injured, Severity Unknown <input type="checkbox"/> Not Reported		
Died at Scene/en Route		<input type="checkbox"/> Died at Scene <input type="checkbox"/> Not Applicable	<input type="checkbox"/> Died en Route <input type="checkbox"/> Unknown	<input type="checkbox"/> Died within 30 days of the crash <input type="checkbox"/> Not Reported		
Serious Injuries			Source of Serious Injuries			
_____ _____			_____ _____			
Cause of Death			Source of Death			
_____ _____			_____ _____			

Section H: Patient/Passenger Characteristics

Person Role: <input type="checkbox"/> Patient <input type="checkbox"/> Passenger <input type="checkbox"/> Secondary Patient Care Provider		Patient Position During Transport <input type="checkbox"/> Fowlers <input type="checkbox"/> Semi-Fowlers <input type="checkbox"/> Prone <input type="checkbox"/> Sitting <input type="checkbox"/> Not Reported <input type="checkbox"/> Lateral <input type="checkbox"/> Supine <input type="checkbox"/> Car Seat <input type="checkbox"/> Unknown <input type="checkbox"/> Other		Sex: <input type="checkbox"/> Male <input type="checkbox"/> Female <input type="checkbox"/> UNK <input type="checkbox"/> N/R	Age (years): _____	Weight (kg): _____ Height (cm): _____					
Ambulance Seating Position		1 Front seat, driver									
		2 Front seat, passenger									
		3 Second middle									
		4 Second right									
		5 Third, middle (standing)									
		6 Third, right (forward bench)									
		7 Forth, left (EMT seat side)									
		8 Forth, middle (patient/cot)									
		9 Forth, right (center, bench)									
		10 Other, right (rear bench)									
Receiving Patient Care at Time of Crash		Yes									
		No									
Restraint Use		Not Used – MV Occupant		Shoulder and Lap Belt Used							
		Cot Shoulder Harness and Lateral Restraints Used		Cot Lateral Restraints Used							
		Shoulder Belt Only Used		Lap Belt Only Used							
		Restraint Used – Type Unknown		Unknown if Restraint Used			N/R				
Ejection		Not Ejected		Totally Ejected		Partially Ejected		Unknown		N/R	
Ejection Path		Not Ejected – N/A		Through Side Door		Through Side Wind					
		Through Windshield		Through Back Door		Other: _____					
Extrication		Not Extricated		Extricated		Unknown		Not Reported			
Injury Severity		No Injury		Possible Injury		Non-incapacitating Evident Injury					
		Incapacitating Injury		Fatal Injury		Injured, Severity Unknown					
		Died Prior to Crash		Unknown		Not Reported					
Died at Scene/en Route		Died at Scene		Died en Route		Died within 30 days of the crash					
		Not Applicable		Unknown		Not Reported					
Serious Injuries _____ _____						Cause of Death/Serious Injuries _____ _____					
Cause of Death _____ _____						Source of Death _____ _____					

SCI Report #: _____

DOT HS 813 480
July 2023



U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

