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

NHTSA

DOT HS 813 480 July 2023

Analysis of Ground Ambulance Crash Data From 2012 to 2018

DISCLAIMER

Suggested APA Format Citation:

Graham, L., Thomas, F. D., Finstad, K., Dennert, R., & Southcott, T. (2023, July). *Analysis of ground ambulance crash data from 2012 to 2018* (Report No. DOT HS 813 480). National Highway Traffic Safety Administration.

Technical Report Documentation Page

1. Report No. DOT HS 813 480	**2. Government Accession No.**	**3. Recipient's Catalog No.**
4. Title and Subject Analysis of Ground Ambulance Crash Data From 2012 to 2018		**5. Report Date** July 2023 **6. Performing Organization Code** 335
7. Authors Lindsey Graham, Dennis Thomas, Kraig Finstad, Rachel Dennert, and Tyler Southcott		**8. Performing Organization Report No.** 335-1
9. Performing Organization Name and Address Dunlap and Associates, Inc. 110 Lenox Avenue Stamford, CT 06906		**10. Work Unit No. (TRAIS)** **11. Contract or Grant No.** DTNH2216D00011 693JJ919F000191
2. Sponsoring Agency Name and Address National Highway Traffic Safety Administration Office of Behavioral Safety Research 1200 New Jersey Avenue SE Washington, DC 20590		**13. Type of Report and Period Covered** Final Report 9/24/2019-3/24/2021 **14. Sponsoring Agency Code**
15. Supplementary Notes Dave Bryson was the NHTSA Contracting Officer's Representative.		

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 polices; (2) Reduce operator error through training; (3) Create a culture of safety; (4) Adopt new vehicle safety designs or technologies.

17. Key Words ambulance crashes, emergency medical services, EMS, fatal, injury, operator training		**18. Distribution Statement** Document is available to the public from the DOT, BTS, National Transportation Library, Repository & Open Science Access Portal, https://rosap.ntl.bts.gov.	
19. Security Classif. (of this report) Unclassified	**20. Security Classif. (of this page)** Unclassified	**21. No. of Pages** 41	**22. Price**

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

Acknowledgements

The authors gratefully acknowledge the assistance provided by the subject matter experts in ambulance operations and crash investigations, Raul Almeida, Steven Cohen, Lee Cooper, and Matt Newton. While this study could not have been accomplished without the assistance of these people, the findings and conclusions presented are the responsibility of the authors and do not necessarily reflect the opinions or policies of the other project participants.

Table of Contents

Executive Summary....................1

Background and Objectives....................1
Methods....................1
Results....................1
Discussion....................2

Introduction....................3

Objective....................4

Methods....................5

Fatality Analysis Reporting System....................5
National Automotive Sampling System General Estimates System....................5
Crash Report Sampling System....................6
Special Crash Investigation Reports....................6

Results....................7

Fatal Crashes Involving an Ambulance (FARS Data)....................7
Estimated Property Damage Only and Injury Crashes....................10
Factors Identified in SCI Investigated Crashes....................18

Approaches to Addressing the Identified Issues....................21

Strengthen EMS Organization Safety Policies....................21
Reduce Ambulance Operator Errors Through Training....................22
Create a Culture of Safety....................22
Adopt New Ambulance Safety Designs or Technologies....................22

Discussion....................23

Limitations....................25

References....................26

Appendix A. Contractor Crash Coding Sheets for SCI Reports....................A-1

List of Tables

Table 1. Estimated Annual PDO Crashes by Year 11
Table 2. Estimated Annual Injury Crashes by Year 11
Table 3. Estimated Annual People Injured by Year 12
Table 4. Estimated Ambulance in Emergency Use in Injury Crashes by Year 16
Table 5. Estimated Ambulance Emergency Lights/Sirens Use for Injury Crashes by Year 17
Table 6. Ambulance Operator At-fault in SCI Crashes 19
Table 7. Patient Restraint Use in SCI Crashes 20

List of Figures

Figure 1. Crash Position of Each Fatality 2
Figure 2. Ambulance-Involved Fatal Crashes and Fatalities by Year 7
Figure 3. Crash Position of Each Fatality 8
Figure 4. Emergency use in Fatal Crashes by Year 9
Figure 5. Emergency Lights/Sirens Use in Fatal Crashes by Year 9
Figure 6. Estimated Annual PDO and Injury Crashes by Year 10
Figure 7. Estimated Annual People Injured by Year 12
Figure 8. Estimated Position in Crash of Injured People, 2012 to 2018 13
Figure 9. Estimated Position in Crash of Injured People, 2012 to 2015 14
Figure 10. Estimated Position in Crash of Injured People, 2016 to 2018 14
Figure 11. Estimated Ambulance in Emergency Use in Injury Crashes by Year 15
Figure 12. Estimated Ambulance Emergency Lights/Sirens Use for Injury Crashes by Year 17
Figure 13. EMS Personnel Restraint Use by Seating Position in SCI Crashes 19

Executive Summary

Background and Objectives

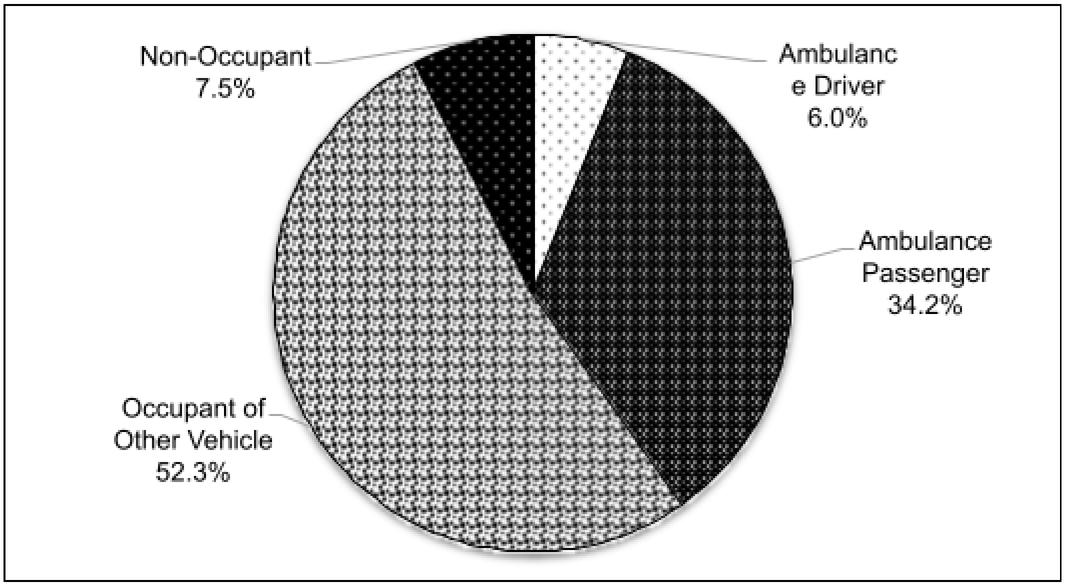
Ground ambulance crashes are the leading cause of death on the job among emergency medical services (EMS) personnel (Reichard et al., 2011; Maguire & Smith, 2013; Bureau of Labor Statistics, 2018). To understand the problem, the National Highway Traffic Safety Administration's (NHTSA) Office of Emergency 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 polices; (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

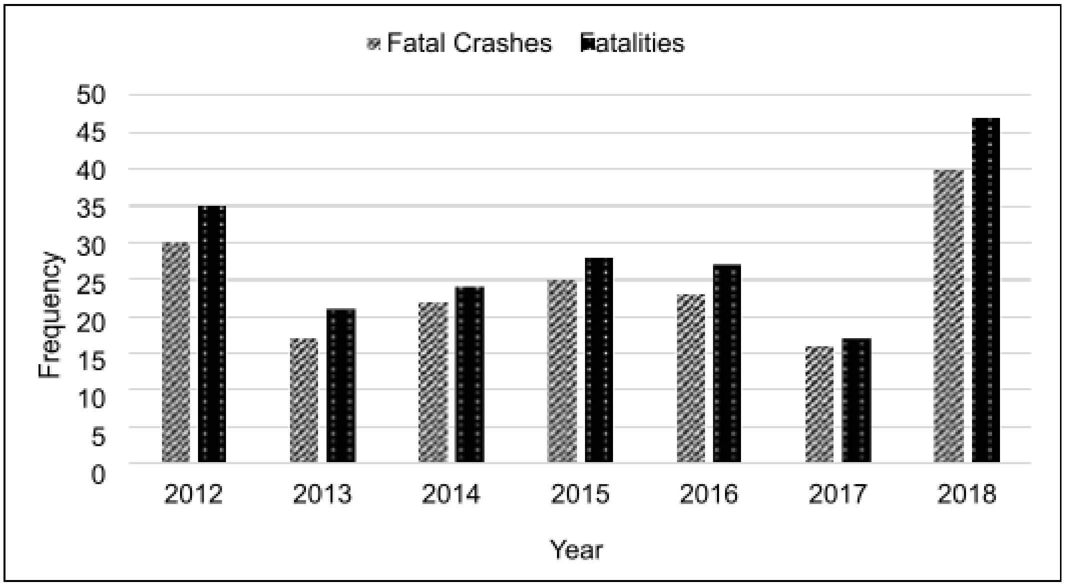
SCI reports are the result of comprehensive motor vehicle crash investigations for a limited number of crashes of special interest to NHTSA each year. Approximately 200 investigations are performed annually. SCI includes extensive follow-up research on a crash including additional collection and assessment 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)

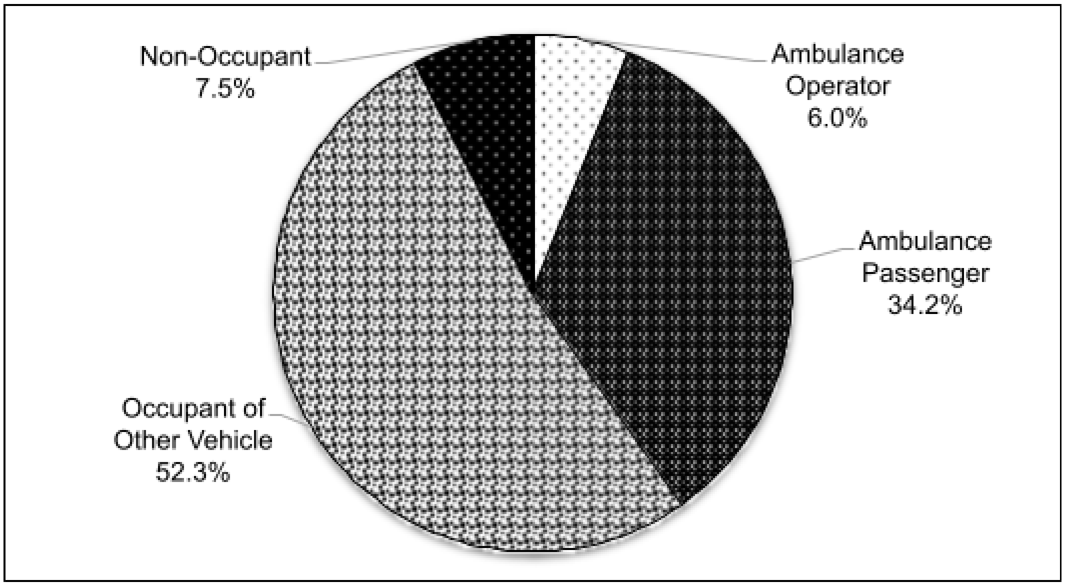
Figure 2 provides FARS-based counts of the annual number of fatal crashes and fatalities when an in-transit ambulance was involved for the years 2012 to 2018. Overall, a total of 173 ambulance-involved fatal crashes resulted in 199 fatalities during these seven years. The years 2012 and 2018 had a higher 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.



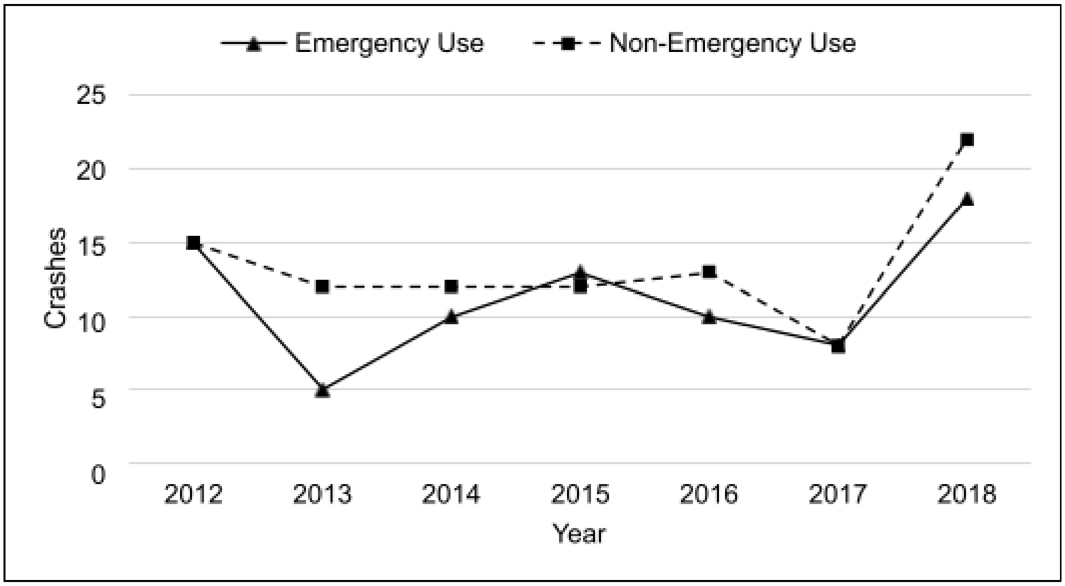
Source: FARS 2012-2017 Final File, 2018 ARF. N = 199.

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

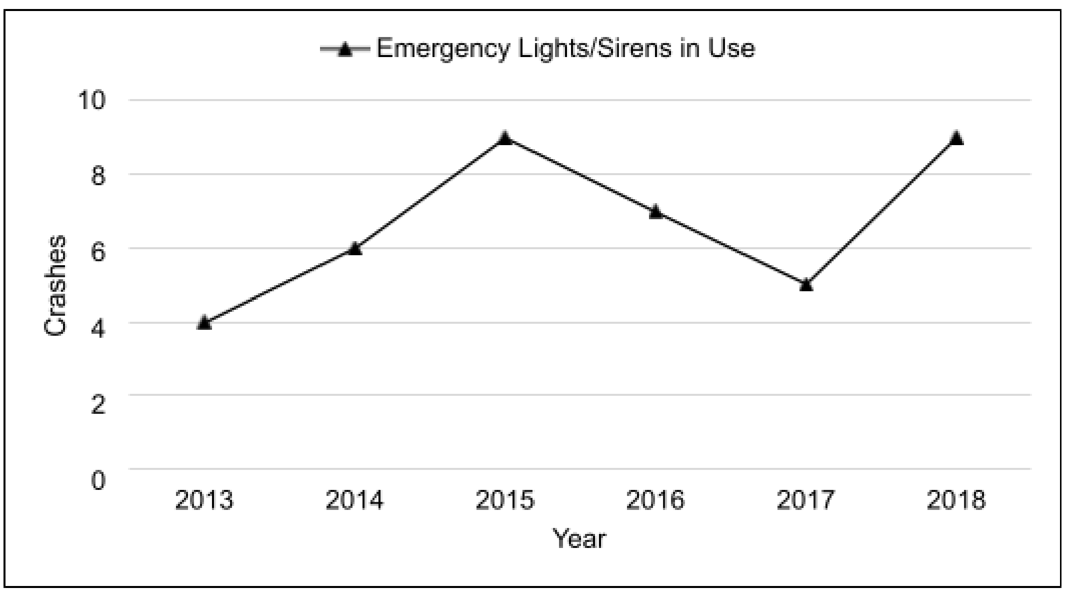
All other emergency use codes for 2013 to 2018 were combined into "non-emergency use" for the purposes of this report, including cases where emergency use was not reported, reported unknown, or listed as not applicable. Combined across 2012 to 2018, 45.7 percent of fatal crashes involved an ambulance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

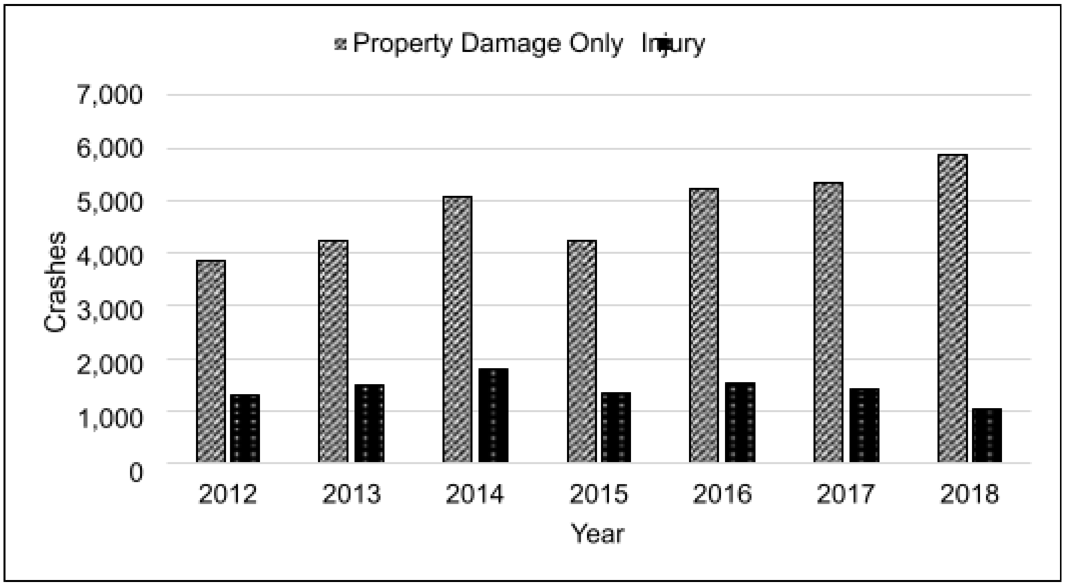


Source: FARS 2013-2017 Final File, 2018 ARF.

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**	4,348.0
2016 CRSS	5,217	
2017 CRSS	5,344	
2018 CRSS	5,858	
CRSS Subtotal	**16,419**	5,473.0
Grand Total [a]	**33,811**	4,830.1

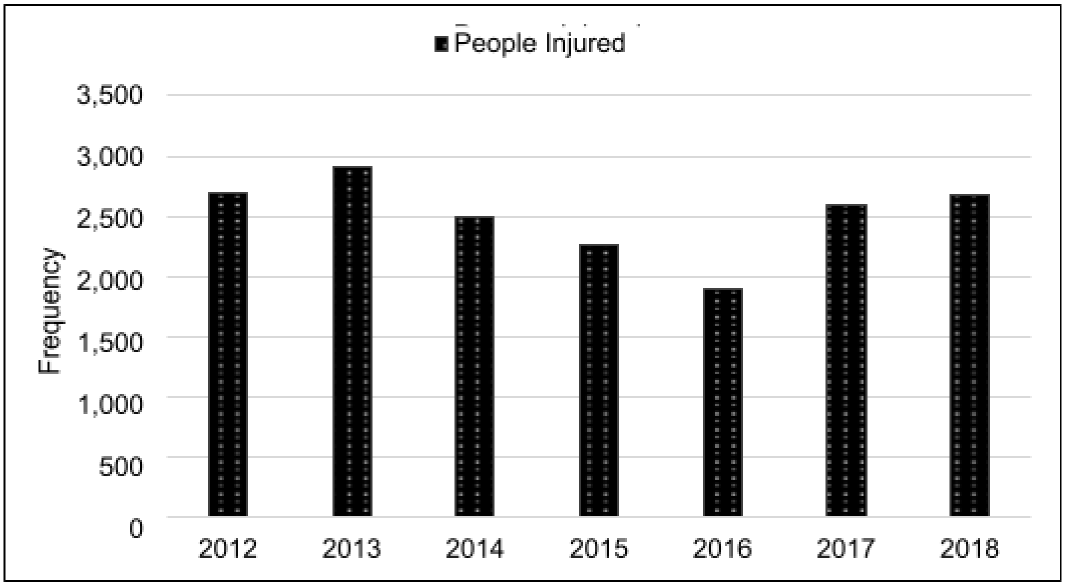
[a]Total PDO crashes and averages that combine data from NASS GES and CRSS databases should be interpreted with caution given changes in sampling criteria between NASS GES and CRSS.

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**	1,485.5
2016 CRSS	1,540	
2017 CRSS	1,401	
2018 CRSS	1,038	
CRSS Subtotal	**3,979**	1,326.3
Grand Total [a]	**9,922**	1,417.3

[a]Total 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.

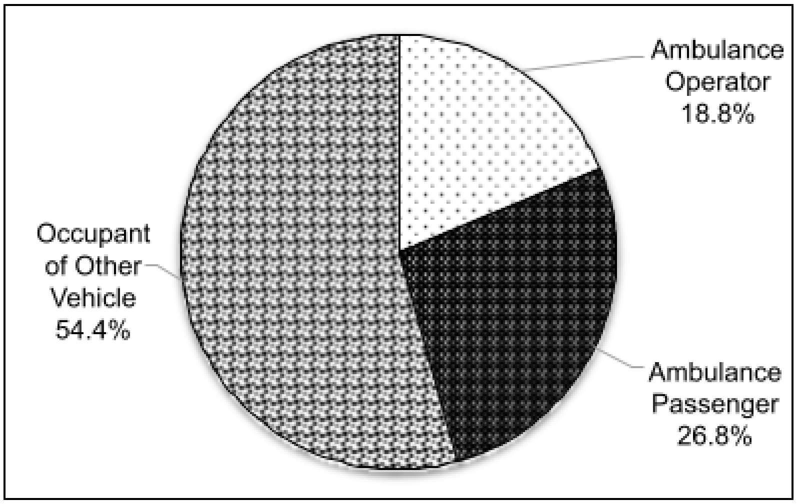
Figure 7. Estimated Annual People Injured by Year

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]

[a]Total 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.

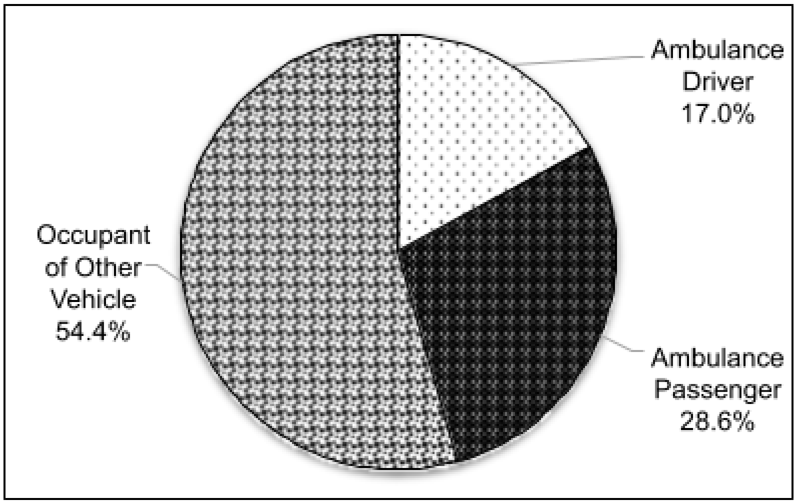
Figure 8 shows the estimated position in crash of injured people from 2012 to 2018 when estimates for all years are combined. Figure 9 provides the position in crash data from NASS GES for 2012 to 2015 combined, and Figure 10 shows the data from CRSS for 2016 to 2018 combined. As shown in the figures, 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.

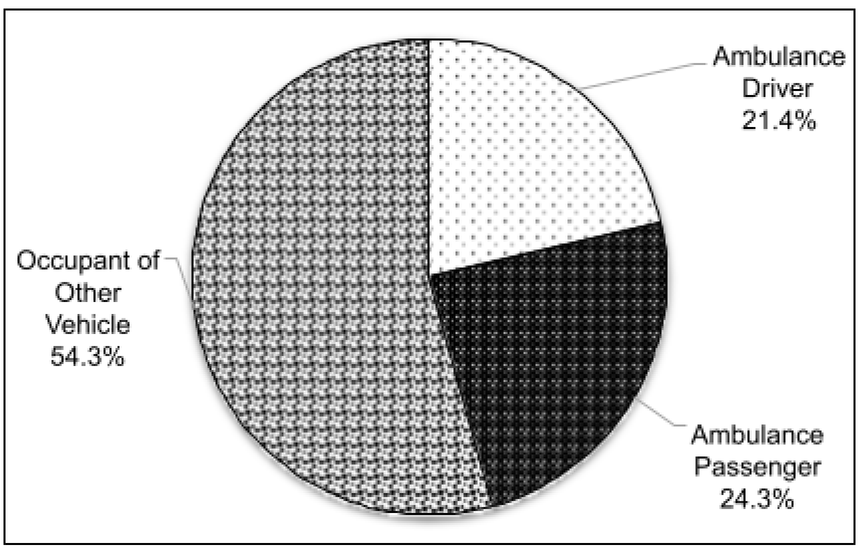
Figure 8. Estimated Position in Crash of Injured People, 2012 to 2018



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.

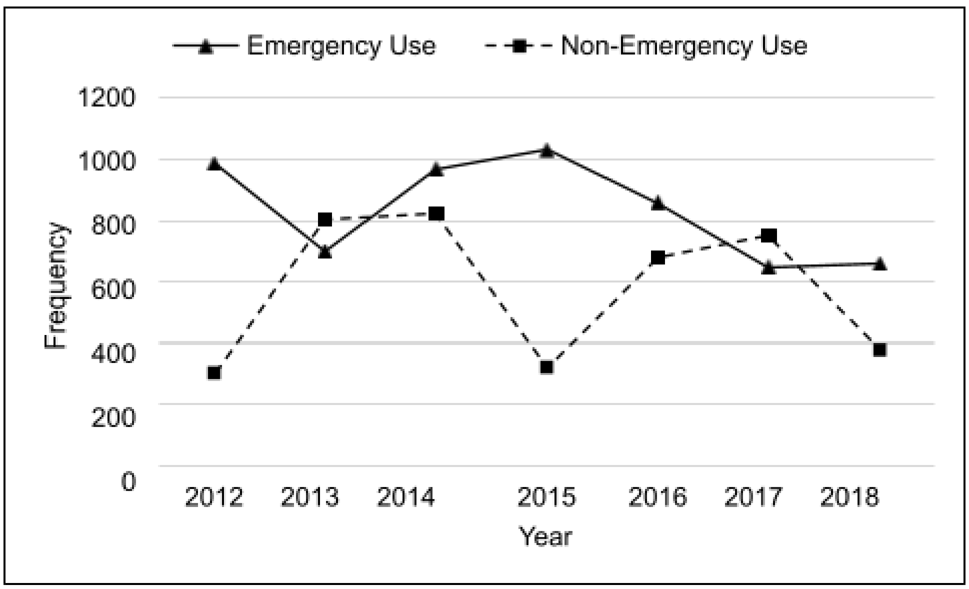
Figure 10. Estimated Position in Crash of Injured People, 2016 to 2018

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.

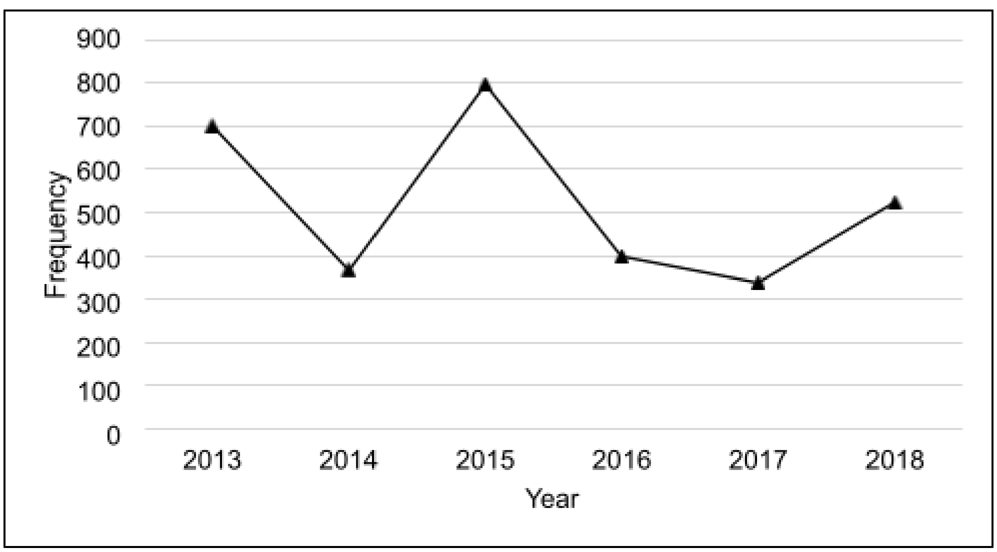
Figure 11. Estimated Ambulance in Emergency Use in Injury Crashes by Year

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

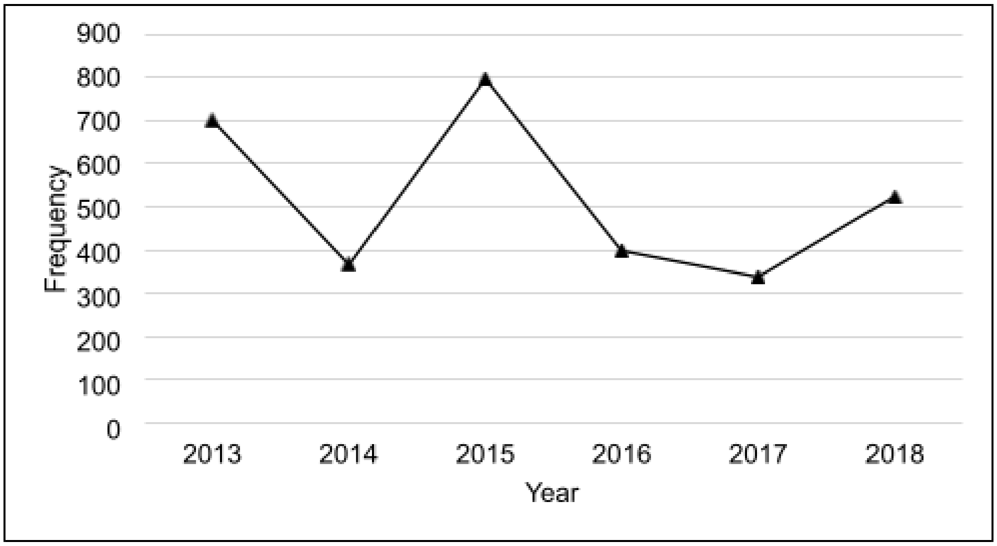
[a]Total injuries and averages that combine data from NASS GES and CRSS databases should be interpreted with caution given changes in sampling criteria between NASS GES and CRSS.

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.

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

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

[a]Total 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%)

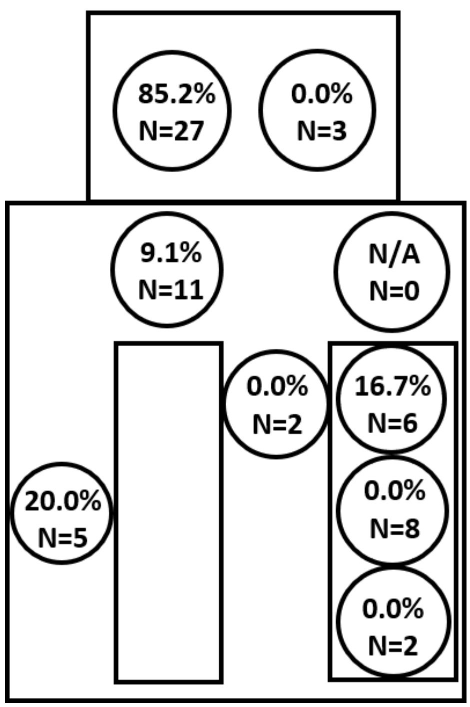
SMEs considered the ground ambulance operator was at fault or partially at-fault in causing 51.8 percent of the SCI crashes, as shown in Table 6.

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 polices; (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.

References

Avery, L., Jacobs, A., Moore, J., Boone, C., & Malone, T. (2015, January 13). *Ambulance patient compartment human factors design guidebook*. U.S. Department of Homeland Security. www.dhs.gov/publication/st-ambulance-patient-guidebook

Boone, C. M., Avery, L. W., & Malone, T. B. (2013, August 15). *Ambulance driver best practices*. U.S. Department of Homeland Security. www.nasemso.org/wp-content/uploads/Ambulance-Driver-Best-Practices-Report.pdf

Bureau of Labor Statistics. (2018). *Census of fatal occupational injuries*: *2017*. www.bls.gov/iif/oshcfoi1.htm

Green, J. D. (2017, September). *Improving EMS worker safety in the patient compartment*. U.S. Department of Homeland Security. www.dhs.gov/sites/default/files/publications/R-Tech_Improving-EMS-Worker-Safety-Patient-Compartment_%20Sept2017-508.pdf

Green, J. D., Yannaccone, J. R., Current, R. S., Sicher, L. A., Moore, P. A., & Whitman, G. R. (2010). Assessing the performance of various restraints on ambulance patient compartment workers during crash events. *International Journal of Crashworthiness*, *15*(5), 517–41. https://doi.org/10.1080/13588265.2010.489402

Hsiao, H., Chang, J., & Simeonov, P. (2018). Preventing emergency vehicle crashes: Status and challenges of human factors issues. *Human Factors*, *60*(7), 1048–1072. https://doi.org/10.1177/0018720818786132

Kupas, D. F. (2017). *Lights and siren use by emergency medical services (EMS): Above all do no harm.* National Highway Traffic Safety Administration. www.ems.gov/assets/Lights_and_Sirens_Use_by_EMS_May_2017.pdf

Maguire, B. J. & Smith, S. (2013). Injuries and fatalities among emergency medical technicians and paramedics in the United States. *Prehospital Disaster Medicine*, *28*(4), 376–82. https://doi.org/10.1017/s1049023x13003555

National Highway Traffic Safety Administration. (2014) *The National Highway Traffic Safety Administration and ground ambulance crashes*. www.ems.gov/assets/GroundAmbulanceCrashesPresentation.pdf

NHTSA. (1995). *1995 Emergency vehicle operators course (ambulance): National standard curriculum* (Instructor Manual and Participant Manual). https://one.nhtsa.gov/people/injury/ems/95%20EVOC%20Instructor%20Guide.pdf

NHTSA. (2012, September). *Working group best-practice recommendations for the safe transportation of children in emergency ground ambulances* (Report No. DOT HS 811 677).

Patterson, P. D. & Robinson, K. (2018). *Implementation guidebook: 2018 Fatigue risk management guidelines for emergency medical services*. National Association of State EMS Officials. www.nasemso.org/wp-content/uploads/Fatigue-Guidebook-FINAL-2018Oct.pdf

Ray, A. F., & Kupas, D. F. (2005). Comparison of crashes involving ambulances with those of similar-sized vehicles. *Prehospital Emergency Care*, 9(4), 412–415. https://doi.org/10.1080/10903120500253813

Reichard, A. A., Marsh, S. M., & Moore, P. H. (2011). Fatal and nonfatal injuries among emergency medical technicians and paramedics. *Prehospital Emergency Care*, *15*(4), 511–517. https://doi.org/10.3109/10903127.2011.598610

Smith, N. (2015). A national perspective on ambulance crashes and safety: Guidance from the National Highway Traffic Safety Administration on ambulance safety for patients and providers. *EMS world, 44*(9), 91–94.

Thomas, F. D., Graham, L. A., Wright, T. J., Almeida, R., Blomberg, R. D., & Benlemlih, M. (2019, December). *Characterizing ambulance driver training in EMS systems* (Report No. DOT HS 812 862). National Highway Traffic Safety Administration. https://doi.org/10.21949/1525969

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

	Crash Scene Photos	Detailed Investigation Photos
Include Additional Photos	☐ Police Crash Scene Photos ☐ Environment/Conditions ☐ Roadway where crash occurred ☐ Damage to objects struck during crash ☐ Ambulance trajectory during crash	☐ Ambulance Trajectory ☐ Evidence/Maneuvering

Section B: Ambulance Organization

Ambulance Organization Name:	# of Members:	# of Volunteers:	# of Occupants in Ambo:
______	______	______	☐ ____ EMS Personnel ☐ ____ Patient(s) ☐ ____ 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

SCI Report #:__________________

Section C: Ambulance (Vehicle) Information

Ambulance Type:	Vehicle Identification Number:	State Registration:
[ ] Type 1 [ ] Type 2 [ ] Type 3	____________	____________

	Make	Model	Year
Ambulance Chassis	____________	____________	____________
Ambulance Manufacturer	____________	____________	____________

Extent of Damage
- ☐ No Damage
- ☐ Minor Damage
- ☐ Functional Damage
- ☐ Disabling Damage
- ☐ Not Reported
- ☐ Unknown

Pre-crash Vehicle Maintenance
- ☐ Well Maintained
- ☐ Not Maintained
- ☐ Not Reported
- ☐ Unknown

Video Cameras ☐ Present, Recorded Crash ☐ Present, No Record ☐ Absent ☐ Unknown ☐ Not Reported

Camera(s) Location/View:

GPS Tracking ☐ Present, Recorded Crash ☐ Present, No Record ☐ Absent ☐ Unknown ☐ Not Reported

Speed Monitor ☐ Present, Recorded Crash ☐ Present, No Record ☐ Absent ☐ Unknown ☐ Not Reported

Include Additional Photos	Crash Scene Photos	Detailed Investigation Photos
	☐ Exterior Damage ☐ Interior Damage ☐ Final Resting Position of Vehicle	☐ Detailed exterior damage ☐ Detailed interior damage

Section D: Ambulance Cot Information

	Brand	Model	Serial Number
Patient Cot	____________	____________	____________

Cot broke during crash?
- ☐ Yes
- ☐ No
- ☐ Unknown
- ☐ Not Reported

Cot parts broken during crash:

	Brand	Model	Serial Number
Cot Fastening System	____________	____________	____________

Fastener broke during crash?
- ☐ Yes
- ☐ No
- ☐ Unknown
- ☐ Not Reported

Fastener parts broken during crash:

Cot Restraint Type/Use						
		Shoulder harness and lateral restraints		Lateral restraints only		Shoulder harness only
		No restraints used		N/A (not on cot)		

Cot came out of fastening during crash?
- ☐ Yes
- ☐ No
- ☐ Unknown
- ☐ Not Reported

Cot Shoulder Harness Restraint/Use						
		Available, used		Available, not used		Available, not attached to stretcher
		Not available for this stretcher		Not Reported		Other: ____________

Cot Involved in Injury/Death?
- ☐ Yes
- ☐ No
- ☐ Unknown
- ☐ Not Reported

Include Additional Photos	Crash Scene Photos	Detailed Investigation Photos
	☐ Final Resting Position of Cot	☐ Cot in use during crash ☐ Detailed fastener system damage ☐ Detailed cot damage ☐ Close-ups on any damaged parts

Section E: Crash

Response Mode at time of Crash	# Injured Persons:	# Fatalities:	# of Motor Vehicles involved:
☐ Lights and Sirens ☐ No Lights and Sirens ☐ Unknown	☐____ EMS Personnel ☐____ Patient(s) ☐ ___ Passenger(s)	☐____ EMS Personnel ☐____ Patient(s) ☐ ___ Passenger(s)	____________________ ____________________ ____________________

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
☐ Yes ☐ No ☐ Partially ____% ☐ Not Reported ☐ Unknown	☐ Relinquished/Lost Control ☐ Impaired ☐ Failed to Yield ☐ Ambulance Malfunction ☐ Atmospheric Conditions ☐ Other: ____________________ ☐ N/A - Other driver at fault
How could this crash have been avoided?	

Include Additional Photos	Crash Scene Photos	Detailed Investigation Photos
	☐ Final Resting Position of Vehicles	☐ Roadway where crash occurred ☐ Skid marks or other evidence of maneuvering

Section F: Driver Statistics

Driver total length of service with company (years): ____________________	**Driver took EVOC:** ☐ Yes ☐ 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	____________________ ____________________

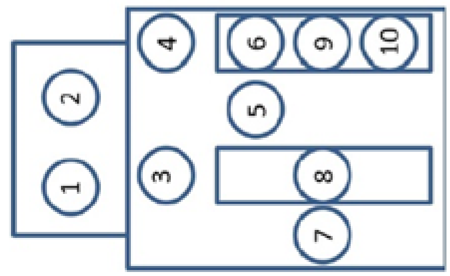
Driver Previous Recorded Crashes: ____________________ ____________________	**Driver Previous Recorded Suspensions and Revocations:** ____________________ ____________________
Driver Previous Speeding Convictions: ____________________ ____________________	**Driver Previous Other Harmful MV Convictions:** ____________________ ____________________

Section G: EMS Personnel Characteristics

Person Primary Role:	Personnel Certification Level		Sex:	Age (years):	
☐ Driver	☐ First Responder	☐ EMT	☐ Male		Weight (kg): ________
☐ Primary Patient Care Provider	☐ EMT-Intermediate	☐ Nurse	☐ Female		Height (cm): ________
☐ Secondary Patient Care Provider	☐ Advanced EMT	☐ Paramedic	☐ UNK		
	☐ Physician		☐ N/R	______	

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	☐	Yes
	☐	No



Headphones/Devices	☐	Work Communication Headphones	☐	Hearing Protection	☐	Unknown
	☐	Non-Work Headphones (e.g., Airpods)	☐	Radio/Loud Speaker	☐	Not Reported

Restraint Use	☐	Not Used – MV Occupant	☐	Shoulder and Lap Belt 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

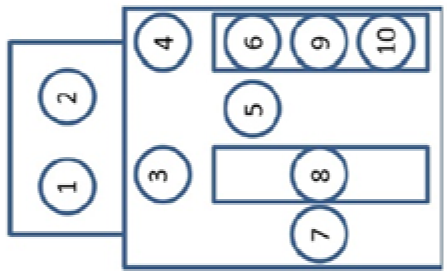
Serious Injuries	Source of Serious Injuries
____________________	____________________
____________________	____________________

Cause of Death	Source of Death
____________________	____________________
____________________	____________________

Section H: Patient/Passenger Characteristics

Person Role:	Patient Position During Transport		Sex:	Age (years):	
☐ Patient	☐ Fowlers	☐ Lateral	☐ Male		Weight (kg): ________
☐ Passenger	☐ Semi-Fowlers	☐ Supine	☐ Female		
☐ Secondary Patient Care Provider	☐ Prone	☐ Car Seat	☐ UNK		Height (cm): ________
	☐ Sitting	☐ Unknown	☐ N/R	______	
	☐ Not Reported	☐ Other			

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

15947-062923-v2