Ambulance safety in the United States

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ABSTRACT

This paper reviews the dangers associated with ambulances in the United States. According to the National Highway Traffic Safety Administration (NHTSA) data, vehicle collisions involving ambulances result in twice as many injuries as the national average.

Other dangers include: the safety of the vehicle itself; the lack of sufficient occupant protection in the ambulance patient compartment; distractions of the ambulance operator associated with operating lights, sirens, and communication equipment during emergency responses; drowsiness of the ambulance operator associated with extended work hours; and the lack of standardized or tested emergency vehicle operator training.

Recommendations for improvement include: safety testing for vehicle crashworthiness, testing of diesel fume exposure among emergency medical services (EMS) personnel, and improved safety procedures for EMS personnel. Every effort must be made to make ambulances the safest vehicles on the roads of the United States.

INTRODUCTION

The mission of the National Highway Traffic Safety Administration (NHTSA) is “to save lives, prevent injuries and reduce traffic-related health care and other economic costs.”¹ Ambulances are a mechanism to achieve this goal, and yet ambulances themselves may present grave dangers to emergency medical services (EMS) personnel, their patients, and the general public. According to NHTSA’s Fatality Analysis Reporting System (FARS),² there were 565 case reports associated with 221 ambulance crashes between January 1994, and December 2001 (Table 1). The table also demonstrates a relative risk of ambulance crashes. Ambulance crashes involve more than twice as many victims as the national average.

Although there are no data available to determine the number of ambulances on the road or the number of miles driven by ambulances, the large number of crashes and victims indicates that, mile for mile, ambulances may be associated with more injuries and fatalities than any other type of vehicle. A number of possibilities may account for such a significant problem.

VEHICLE SAFETY

Joseph Neal Sherman, a 25-year-old paramedic, was killed on March 16, 2001, after a loose oxygen cylinder hit him in the head during an ambulance crash.³ He is but one of many individuals who have died due to flying objects, protruding devices, or sharp cabinet corners in ambulance compartments. Other patient compartment occupants may have died due to ineffective seat belts. In fact, the efficacy of seat belts on sideways-facing ambulance benches has yet to be proven.

Vehicle maintenance programs designed largely for personal use vehicles may be inadequate for such a high demand vehicle as an ambulance. Brakes, for example, may wear down much more quickly on an ambulance. As a result, they may become suddenly ineffective. Inside rear ambulance tires are difficult to check and may go long periods without inspection, thus reducing their reliability during critical operations.

The effect of diesel fumes on the health and performance of EMS drivers and personnel remains an unanswered question. The long-term effects of this exposure may include an increased risk of lung cancer, the development of asthma, and the development of central nervous system impediments resulting in consequences such as diminishing muscle coordination. In the short term, exposure has been associated with drowsiness, dizziness, and headache, as well as nausea, wheezing, and irritation of eyes, nose, and throat.⁴ EMS personnel often
spend many consecutive hours in the vehicle. Since the vehicle must be kept running to operate systems such as two-way radios, on-board computers, and heaters, significant exposure may be occurring. This exposure may increase the risk of collision.

**OCCUPANT PROTECTION**

The crashworthiness of ambulances is largely unknown. The following factors probably vary significantly from manufacturer to manufacturer: integrity of vehicle structures, the vehicle’s ability to protect occupants from fatal and serious injuries, the vehicle’s ability to prevent occupant compartment intrusion or ejection of passengers, and the vehicle’s ability to prevent or reduce injuries from occupant impact with interior surfaces (especially sharp cabinet corners, IV holders, and oxygen ports). The compatibility of structural crash performance with occupant restraint systems is also largely unknown. Levick et al. have demonstrated the need for special testing to be done for the ambulance patient compartment.5-7

Maguire and Porco reported 13 EMS occupational injuries occurring among ambulance occupants secondary to collisions in one EMS agency between August 1, 1988, and August 31, 1994.8 The same authors found that 100 percent of the litigation against one EMS agency resulted from transportation-related injuries.9 Kahn documented the characteristics of fatal ambulance crashes in the U.S. and found 89 ambulance occupant fatalities and 392 non-fatal ambulance occupant injuries during one 11-year period; most crashes occurred during emergencies, and most serious and fatal injuries occurred in the patient compartment.10 The Centers for Disease Control (CDC) recently released a Morbidity and Mortality Weekly Report (MMWR) documenting that 58 percent of ambulance occupant fatalities were occupants of the patient compartment.11

High decibel sirens also pose long-term problems for emergency responders. Pepe et al. found that the rate of hearing loss over time was 150 percent higher for EMS personnel than the general population.12 Johnson found significant hearing loss among paramedics and found that those medics with more experience (i.e., more exposure) lost hearing acuity at a faster rate than “normal.”13 Such hearing loss may expose drivers to greater risk of collision.

Non-occupant protection must also be evaluated; specifically, the risk EMS personnel have of being struck by moving vehicles while caring for patients. Maguire et al. noted that six of 33 EMS workers killed in ground transportation incidents were struck by moving vehicles.14

**DISTRACTION**

It is difficult to imagine a ground-based vehicle
with more potential distractions than an ambulance. The driver’s compartment may include multiple radios, a computer screen and input console, separate controls for emergency lights and sirens, as well as all the usual controls found in a typical vehicle. The driver of the ambulance may be monitoring multiple radio frequencies (e.g., police, fire, EMS), activating emergency lighting systems, and operating a siren, all while driving through red lights on busy streets with a vehicle full of distraught patients and family members. If distractions account for 20 to 30 percent of crashes in the relatively sedate environment of a passenger car, they may account for a larger percentage of ambulance crashes. Saunders and Heye found that a major cause of ambulance crashes in an urban environment was “due to inattention.”

**DROWSINESS**

Although NHTSA data suggest that approximately 100,000 crashes per year, including 1,357 fatal crashes and approximately 71,000 injury crashes, involved drowsiness, EMS personnel continue to be scheduled for 16, 24, or more consecutive hours of work. Such shift lengths may be acceptable for firefighters who might respond to one or two fires in a 24-hour period. However, such shift schedules may be very dangerous for EMS personnel who respond to 15 or more calls spread out over a 24-hour period. In addition, due to low pay, many EMS personnel may be working multiple jobs, leading to further sleep deficits and increased risk of a drowsiness-related collision in the ambulance (there are no data to calculate the number of EMS lives lost or careers ended as a result of falling asleep while driving home after a long, busy shift).

**OTHER FACTORS**

Current driver training programs for EMS personnel vary widely from state to state and from agency to agency. No studies have been done on the relative efficiency, or even effectiveness, of these various programs. Finally, a variety of environmental factors may influence the rate and severity of ambulance collisions. One such factor is that most communities lack traffic light control systems that will change intersection lights when approached by an emergency vehicle.

Ambulance crash-related injuries: Case studies

To characterize risk factors for EMS workers involved in ambulance crashes, the National Highway Traffic Safety Administration (NHTSA) and the National Institute for Occupational Safety and Health (NIOSH) investigated three case reports, which are summarized below. Federal agencies are currently working to identify and test alternative measures to reduce crash-injury risk for EMS workers.

**Case 1.** In May 2001, an Emergency Medical Technician (EMT) aged 26 years died when her ambulance was struck head-on by a pick-up truck. The EMT had been riding unrestrained in the patient compartment while attending a patient during a nonemergency transport. The patient and pick-up driver also suffered fatal injuries.

**Case 2.** In July 2001, an EMT aged 27 years died when her ambulance struck an elevated train-track support column. She had been riding unrestrained in the patient compartment while attending a patient during a nonemergency transport. Both the driver and patient were hospitalized; the EMT was transported to a hospital, where she was pronounced dead.

**Case 3.** In March 2002, an EMT aged 22 years and a paramedic aged 37 years were injured when their ambulance struck an oncoming vehicle head-on and overturned. The paramedic was riding unrestrained on the patient compartment squad bench while attending a patient during a nonemergency transport. A relative of the patient was seated in the rear-facing attendant’s seat and was wearing a seatbelt. During the collision, the unrestrained EMT driver sustained minor injuries. The EMT and the paramedic were transported to a hospital, where the EMT was treated and released; the paramedic was hospitalized and released 2 days later. The patient’s relative sustained minor internal injuries.

From 1991-2000, 300 fatal crashes occurred involving occupied ambulances, resulting in the deaths of 82 ambulance occupants and 275 occupants of other vehicles and pedestrians. The 300 crashes involved a total of 816 ambulance occupants. (Source: MMWR Weekly, February 28, 2003, pp. 154-156.)
RECOMMENDATIONS

Sufficient data exist to suggest that ambulance operations may pose significant threats to EMS personnel, patients, and the general public. Specific and comprehensive research must be undertaken to identify and quantify specific risks, to develop interventions, and to evaluate the results of those interventions. Ambulance vehicles must be subject to stringent tests to evaluate and improve crashworthiness. In addition, resources must be devoted to designing and evaluating patient compartment passenger restraints and other passenger safety devices.

An entire generation of EMS personnel may already be suffering from prolonged exposure to diesel fumes. Immediate efforts must be made to quantify and mitigate the threats associated with diesel fume exposure.

New research projects must include specific efforts to evaluate the relationships between prolonged exposure to high decibel sirens, hearing loss, and subsequent risk of collision; the risk of personnel being struck by moving vehicles while caring for patients; the relative efficacy of the various EMS driver training programs; and other factors that may contribute to increased risk of EMS transportation-related injuries and fatalities.

CONCLUSION

EMS personnel may treat 25 million patients a year in the United States. In addition, our citizens depend on EMS personnel to respond to natural and man-made disasters. In order to “save lives, prevent injuries, and reduce traffic-related health care and other economic costs,” NHTSA must take a more active role in developing ambulance design specifications and national EMS policy criteria such as maximum shift length standards and driver training. EMS administrators must carefully evaluate policies such as shift lengths and training requirements that affect the risk of collision, and EMS professionals must be active participants in efforts to improve ambulance safety. Resources must be devoted to ensuring that ambulances are not only there in time of need, but that they change from being possibly the most dangerous vehicles on the road to being the safest.

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REFERENCES