ORIGINAL RESEARCH

Transportation-Related Injuries and Fatalities among Emergency Medical Technicans and Paramedics

Brian J. Maguire, DrPH, MSA, EMT-P

2009 Senior Fulbright Scholar, Clinical Associate Professor, Associate Graduate Program Director, Department of Emergency Health Services, University of Maryland, Baltimore County, Baltimore, Maryland USA

Correspondence
Brian J. Maguire, DrPH, MSA, EMT-P
University of Maryland, Baltimore County
1000 Hilltop Circle
Baltimore, Maryland 21250 USA
E-mail: maguire@umbc.edu

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Abbreviations:
EMT: Emergency Medical Technician
EMS: emergency medical services
DOL: US Department of Labor

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Abstract

Introduction: This is the first study using national data to evaluate transportation risks among emergency medical technicians (EMTs) and paramedics (to be referred to hereafter as "EMTs") in the United States.

Hypothesis: This epidemiological study compares the transportation risks for EMTs to the transportation risks for all workers in the US.

Methods: The rates, relative risks, and proportions associated with the 1,050 injury cases with lost work days, and 30 fatalities resulting from transportation incidents occurring to EMTs in the US between 2006 and 2008 are described.

Results: The risk of transportation-related injury for EMTs in the US is about five times higher than the national average. Females were the victims in 53% of the cases yet females only accounted for about 27% of employment in this occupation. Twenty percent of cases resulted in 31 or more lost work days. There were 30 transportation related fatalities.

Conclusions: The US national EMS system is built on the premise of having an unlimited supply of 20 year olds interested in, and dedicated to, the provision of EMS care. Not only do we not have an unlimited supply of 20 year olds, we may be rapidly losing our current workforce through clearly preventable risks such as transportation incidents.

Emergency medical services workers face a rate of occupational injury that is much higher than the national average and transportation-related events are a significant component of that risk. Resources must be devoted to further research, and to the development and evaluation of interventions designed to mitigate these transportation-related hazards.

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Introduction

Emergency medical services (EMS) personnel in the US respond to a total of 30 million calls per year.[1] The major mode of transportation for each call is in a motor vehicle, and yet, research on transportation-related occupational risks is limited. Previous research identifies that there is a serious problem and supports the need for further evaluation of transportation-related occupational risks among these workers.

In 2002, there were approximately 900,000 full-time, part-time, and volunteer EMS personnel in the US.[1] The US Department of Labor (DOL) Bureau of Labor Statistics indicates that: (1) the number of EMS workers has been rising (it is likely to be approximately one million in 2010); and (2) approximately 201,000 are paid.[2]

Reports indicate that both the fatality rate and the injury rate for this occupation are far above the national average. Maguire *et al* found that the EMS transportation-related occupational fatality rate for 1992 to 1997 averaged 9.6 fatalities/100,000 workers/year;[3] this rate is approximately five times higher than the national average. Using DOL data from 2003 to 2007, Maguire and Smith found that 51 of 59 (86.4%) fatalities among EMS workers were transportation-related.[4] Kahn *et al* documented the characteristics of fatal ambulance crashes in the US and found 89 (13.2%) ambulance occupant fatalities and 592 (86.8%) non-fatal ambulance occupant injuries during one 11-year period.[5] Eighteen percent of the 538 EMS fatalities listed by the National EMS Memorial Service for 1993 to 2010 were related to ambulance collisions.[6] Pirrallo found that 69% of fatal crashes occurred during emergency operations.[7]

Maguire *et al* found that: (1) the rate of non-fatal transportation-related injuries/100 full-time workers/year from 1998 to 2002 was approximately 30 times higher than the national average;[8] (2) 15% of all EMS occupational injuries were transportation-related; and (3) most of the cases were classified as "multiple trauma".[9] Maguire and Smith found that the rate of non-fatal transportation-related injuries with lost work days was approximately five times higher for EMTs than the national average.[10] Maguire and Porco reported on injuries to EMS personnel occurring secondary to ambulance collisions in one New York City (NYC) EMS agency between 01 August 1988 and 31 August 1994, and found that approximately 50% of ambulance collisions resulted in injury to EMS personnel.[11]

Saunders and Heye report an overall collision injury rate of 22.2 injuries/100,000 lights and sirens responses (emergency responses as opposed to non-emergency responses for calls such as some inter-facility transfers) among EMS personnel;[12] they also found that a major cause of ambulance crashes in an urban environment was "due to inattention". Elling noted that between 1984 and 1987, 1,894 ambulance occupants were injured in 1,412 ambulance collisions in New York State.[13] Weiss *et al* found that in one state, there were more ambulance injuries in the urban environment, but the severity of the injuries was worse in the rural environments.[14] Schwartz *et al* found that paramedics were more frequently (than EMTs) involved in ambulance collisions.[15]

Maguire reported that "the crashworthiness of ambulances is largely unknown"; the same author reported that there were 565 case reports associated with 221 ambulance crashes between January 1994 and December 2001 and that crashes involving ambulances produced twice as many casualties as the national average.[16] One hundred percent of the litigation against one EMS agency resulted from transportation-related injuries.[17]

Becker *et al* found that "relative to police cars and fire trucks, ambulances experienced the highest percentage of fatal crashes where occupants are killed and the highest percentage of crashes where occupants are injured."[18] Ray and Kopas found that the most common cause of crashes was operator error.[19] Levick *et al* evaluated ambulance patient compartments under crash conditions; they demonstrated the need for special testing to be done for the compartment.[20, 21,22] Maguire and Kahn note that fatigue may be associated with the risk of crashes.[23]

Medical residents working on ambulances also are at risk of ambulance crash-related injuries.[24] The community is at risk both of crashes with ambulances (16) and crashes related to the "wake-effect" of ambulance responses.[25]

The goal of this epidemiological study was to use data from the US Department of Labor (DOL) Bureau of Labor Statistics to determine the transportation-related risks for EMTs and to compare these rates to the national average.

Methods

The DOL methods and criteria as well as rate calculation formulas have been previously described.[4] The rates, relative risks, and proportions associated with the 1,050 injury cases with lost work days and 30 fatalities resulting from transportation incidents occurring to EMTs and paramedics (collectively referred to as EMTs) in the US between 2006 and 2008 were calculated and described. The University of Maryland Baltimore County (UMBC) Institutional Review Board certified the project as exempt (protocol number Y11BM08024).

Results

Of the 1,050 cases abstracted, 46% occurred to workers 25 to 34 years of age. Females were the victims in 53% of the cases yet females only accounted for 27% of employment in this occupation in 2007 (Table 1).[26] More than 20% of cases resulted in ≥31 lost work days. The leading injury type was "sprains, strains and tears". The number of cases and median days away from work for the 1,050 transportation-related injury cases involving days away from work for EMTs employed in private industry from 2006 to 2008 are in Table 1.

Fifty-two percent of the cases occurred to employees with 1 to 5 years of service with their current employer; 30% of cases occurred to employees in their first year of service. Twenty percent of the EMT cases resulted in ≥31 lost work days, compared to 34% for all workers in the US. The median of the days lost varied from eight in 2007 to four in 2008; the median days lost for all occupations in the US was 12 in 2008.

The number of non-fatal occupational injuries and illnesses involving days away from work by selected worker and case characteristics for EMTs in private industry from 2006 to 2008 and US worker injuries in 2008 are in Table 2.

The lowest percentage of cases occurred on Saturdays and between midnight and 04:00 hours. The highest percentages occurred on Mondays and Thursdays, and between 04:00 and 20:00 hours. The highest percentage of cases by hours worked took place between eight and 10 hours after the start of the shift.

The rate of transportation-related injury for EMTs ranged from 24 to 39 cases/10,000 full-time workers/year. The risk of transportation related injury for EMTs is about five times higher than the US. national average (Table 3). The incidence rates for transportation-related injuries with days away from work per 10,000 full-time employees for EMTs and private industry for the years 2006 to 2008, with relative risk (RR) and 95% confidence interval (CI) are in Table 3.

Forty-five percent of all transportation-related injuries are sprains, strains, or tears. Twenty-six percent of injuries occur to the trunk and 13% to the back; 36% affect multiple body parts. The transportation-related injury and illness cases resulting in days away from work for EMTs from 2006 to 2008 by nature of injury and body part are described in Table 4.

There were 30 transportation-related fatalities among EMTs between 2006 and 2008. Of these, 14 were highway incidents and 13 were aircraft incidents (3 were unknown) 13 aircraft incidents, nine (60%) were associated with helicopter operations. Twenty of the cases occurred to males and 17 occurred among private industry employers. Table 5 lists the number of fatal transportation related occupational injuries among public and private EMTs in the United States between 2006 and 2008.

Discussion

The findings corroborate earlier reports that EMS workers face risks of transportation-related injuries that are above the national average. In addition, these data support a growing body of evidence that female EMS workers may face a disproportionately high risk of occupational injuries.

Fatigue—Anecdotal reports indicate that EMS workers are scheduled for both extended shifts (even >24 hours) and rotating shifts (e.g., day shifts one week, then evenings, and then nights). Maguire and Kahn noted that 21 hours of wakefulness produces

	EMTs and Paramedics							
Characteristic	2006		2007		2008			
Age	Number of cases	Median days	Number of cases	Median days	Number of cases	Median days	Total Cases	Per cent
16–19	–	–	–	–	–	–		
20–24	120	5	90	2	50	2	260	25.5
25–34	170	8	150	20	150	4	470	46.1
35–44	100	2	60	2	60	5	220	21.6
45–54	30	2	20	1	20	6	70	6.9
55–64	20	1	–	–	–	–		
≥65	–	–	–	–	–	–		
Gender								
Male	220	4	110	9	160	4	490	47.1
Female	210	8	220	3	120	5	550	52.9
Total	430	5	330	8	290	4	1050	

Table 1—Number of cases and median days away from work for transportation-related injuries involving days away from work for emergency medical technicians (EMTs) from 2006– 2008 n = 1,050

	EMTs and paramedics					All occupations 2008	
Characteristic	2006	2007	2008	EMS total	% of total	US total	% of total
Transportation incidents	430	330	290	1050		48,610	
Length of service with employer							
<3 months	50	–	–	50	4.9	5,690	11.9
3–12 months	120	80	60	260	25.5	10,070	21.1
1 year–5 years	190	180	160	530	52.0	19,800	41.4
>5 years	70	50	60	180	17.6	12,260	25.6
Number of days away from work							
Cases involving 1 day	80	60	40	180	17.3	5,230	10.8
Cases involving 2 days	90	70	50	210	20.2	5,080	10.5
Cases involving 3–5 days	100	30	100	230	22.1	8,500	17.5
Cases involving 6–10 days	40	50	40	130	12.5	4,600	9.5
Cases involving 11–20 days	20	30	–	50	4.8	4,950	10.2
Cases involving 21–30 days	30	–	–	30	2.9	3,860	7.9

Table 2—Number of non-fatal, occupational injuries and illnesses involving days away from work by selected worker and case characteristics for emergency medical technicians (EMTs), 2006–2008 compared to all of the United States in 2008 (private industry only) (*Continues*)

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	EMTs and paramedics					All occupations 2008	
Characteristic	2006	2007	2008	EMS total	% of total	US total	% of total
≥31days	80	90	40	210	20.2	16,390	33.7
Median days away from work	5	8	4			12	
Day of Week							
Sunday	70	80	30	180	17.1	2470	5.1
Monday	50	110	40	200	19.0	9100	18.7
Tuesday	80	30	20	130	12.4	9570	19.7
Wednesday	40	20	40	100	9.5	8510	17.5
Thursday	80	20	100	200	19.0	8890	18.3
Friday	80	30	40	150	14.3	7260	14.9
Saturday	40	30	20	90	8.6	2820	5.8
Time of Day							
00:01 hours (h)–04:00 h	–	–	20	20	1.9	2230	4.6
04:01 h–08:00 h	30	–	20	50	4.8	5450	11.2
08:01 h–12:00 h	50	80	90	220	21.2	13170	27.1
12:01 h–16:00 h	50	70	50	170	16.3	13010	26.8
16:01 h–21:00 h	140	70	40	250	24.0	5710	11.7
21:00 h –00:00 h	60	70	20	150	14.4	2300	4.7
Not reported	100	30	50	180	17.3	6740	13.9
Hours Worked							
Occurred before shift began	–	–	–	0	0.0	550	1.1
<1 hour	30	50	–	80	8.2	4310	8.9
1–2 hours	30	50	20	100	10.3	4800	9.9
2–4 hours	70	–	50	120	12.4	9310	19.1
4–6 hours	40	40	70	150	15.5	6960	14.3
6–8 hours	50	30	20	100	10.3	7530	15.5
8–10 hours	70	70	40	180	18.6	4630	9.5
10–12 hours	40	20	–	60	6.2	1490	3.1
12–16 hours	–	–	20	20	2.1	690	1.4
≥16 hours	–	–	–	0	0.0	410	0.8
Not reported	100	–	60	160	16.5	7940	16.3

Table 2 (*Continued*)—Number of non-fatal, occupational injuries and illnesses involving days away from work by selected worker and case characteristics for emergency medical technicians (EMTs), 2006–2008 compared to all of the United States in 2008 (private industry only)

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Year	EMTs	Private industry	% Rel. Error	RR	CI
2008	24.3	5.1	11.3	4.76	3.71–5.82
2007	26.2	5.6	10.4	4.68	3.72–5.63
2006	38.9	6.1	8.3	6.38	5.34–7.41

Table 3—Incidence rates for transportation related injuries with days away from work/10,000 full-time employees for emergency medical technicians (EMTs) and private industry for the years 2006–2008 by relative risk (RR) and 95% confidence interval (CI)

Nature of injury or illness	2006	2007	2008	%
Sprains, strains, tears	170	150	110	45
Fractures	–	–	20	2
Surface wounds and bruises	40	40	50	14
Bruises, contusions	–	40	50	9
Multiple traumatic injuries	30	40	20	9
Soreness- pain- hurt- except the back	100	40	50	20
Part of body affected				
Head	–	–	20	2
Trunk	150	20	100	26
Back—including spine and spinal cord	70	20	50	13
Shoulder—including clavicle and scapula	30	–	20	5
Upper extremities	30	20	30	8
Lower extremities	–	70	–	7
Knee	–	40	–	4
Multiple body parts	170	120	80	36

Table 4—Transportation-related injury and illness cases resulting in days away from work for emergency medical technicians (EMTs) from 2006 to 2008 by nature and body part, n = 1,040

Characteristic	Transportation	Highway	Aircraft
Total	27	14	13
Gender			
Men	20	10	9
Women	10	4	4
Age			
20–24 years	–	–	–
25–34 years	12	6	4
35–44 years	11	3	8
45–54 years	4	4	–
55–64 years	–	–	–
Source			
Air Vehicle	13	–	13
Aircraft-powered fixed wing	4	–	4
Propeller-driven aircraft	3	–	3
Aircraft-powered rotary wing	9	–	9
Helicopter	9	–	9
Highway vehicle, motorized	16	14	–
Truck	4	–	–
Private Industry	17	5	11
Local Government	12	9	–

Table 5—Number of fatal transportation-related occupational injuries among emergency medical technicians. All US (public and private employers), 2006–2008, n = 30

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impairment of the same magnitude as a 0.08% blood alcohol concentration (the legal limit for civilian drivers and twice the legal limit for commercial drivers).23 Sofianopoulos *et al* found that "almost half of paramedic (respondents) answered yes to having nodded off or fallen asleep whilst driving".[27] Studnek and Fernandez found that the two variables associated with increased risk of ambulance collision were young age and fatigue.[28]

Gender—Fifty-three percent of the cases in this study involved females, yet females make up just 27% of the study population. Baker *et al* found that male and female pilots crash for different reasons.[29] Perhaps male and female paramedics crash for different reasons and get injured under different circumstances. If so, this topic should be further researched and training programs should address all risk factors.

Distractions—Saunders and Heye noted that a major cause of ambulance crashes in an urban environment was "due to inattention".[11] McEvoy found that distractions contributed to 13.6% of all crashes studied.[30]

Restraints—Larmon found that seatbelt use in the rear of the ambulance during emergency runs was rare (median, 0%), and that 68% of respondents stated their reason for non-use of safety belts in the patient compartment was that it "inhibited patient care".[31] Johnson found that "two-thirds of respondents reported not wearing their seatbelt on the squad bench while treating patients, and half believe that wearing a seatbelt interferes with patient care".[32]

The US Centers for Disease Control and Prevention (CDC) report that "(26%) of the EMS workers killed were drivers who were not wearing a restraint, and two (7.4%) were unrestrained in the front right seat".[33] Auerbach *et al* found that "the variable most strongly associated with the probability of an injury-accident was use of a passenger restraint device".[34] Studnek *et al* noted that "participants reporting no organizational seat belt policy had lower odds of seat belt usage when compared to individuals that do have a seat belt policy".[35]

Driver—Custalow and Gravitz found that in 71% of the studied collisions, the responsible ambulance driver had a history of multiple collisions.[36] Driver performance feedback and monitoring devices have been found to improve ambulance safety.[37,38]

Other—Maguire notes that Haddon's Matrix "allows us to look at multiple causal, contributing and associated factors" for risks such as collisions.[39] This perspective suggests other areas for future research such as vehicle design, and analyses of the effectiveness of current driver training programs as well as emphasizing the importance of recording more complete and consistent data.

Future Research

Based on these findings, some promising areas for future research include: fatigue, gender disparities, distractions, occupant restraint, and human factors related to the drive.

Limitations

The data abstracted lack EMS-specific information such as call volume, miles travelled, driver training, agency policies (e.g., related to seatbelt use and vehicle speed), vehicle type, type of call and call cycle (e.g., en route to scene, en route to hospital). Such data are owned by EMS agencies and tend to be inconsistently recorded. However, analyses of those data are critical before interventions can be developed, implemented, and evaluated; those data must be made available for future research.

Furthermore, the data in this study are limited to EMS-related transportation risks for EMS workers and do not address the risks for EMS patients or for the community.

Conclusions

The US national EMS system is built on the premise of having an unlimited supply of 20-year-old persons interested in, and dedicated to, the provision of EMS care, and who are willing to work long hours for a small salary. Not only is there not an unlimited supply of 20 year olds, the current workforce may be being depleted through preventable risks such as transportation incidents.

The practice of prehospital emergency medical care is more dangerous than the national average, and transportation-related events are a significant component of that risk. Resources must be devoted to further research and to the development and evaluation of interventions designed to mitigate these hazards. Prospective studies must be conducted and interventions developed, implemented, and evaluated in statistically rigorous projects.

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