Published in final edited form as:

Prehosp Emerg Care. 2017 ; 21(4): 420–431. doi:10.1080/10903127.2016.1274350.

Occupational Injuries and Exposures among Emergency Medical Services Workers

Audrey A. Reichard, MPH, OTR,
National Institute for Occupational Safety and Health, Division of Safety Research, Morgantown, West Virginia

Suzanne M. Marsh, MPA,
National Institute for Occupational Safety and Health, Division of Safety Research, Morgantown, West Virginia

Theresa R. Tonozzi, MPH,
National Institute for Occupational Safety and Health, Division of Safety Research, Morgantown, West Virginia

Srinivas Konda, MPH,
National Institute for Occupational Safety and Health, Division of Safety Research, Morgantown, West Virginia

Mirinda A. Gormley, MSPH, NRP
Virginia Commonwealth University, Richmond, West Virginia

Abstract

Objective: Emergency medical services (EMS) workers incur occupational injuries at a higher rate than the general worker population. This study describes the circumstances of occupational injuries and exposures among EMS workers to guide injury prevention efforts.

Methods: The National Institute for Occupational Safety and Health collaborated with the National Highway Traffic Safety Administration to conduct a follow-back survey of injured EMS workers identified from a national sample of hospital emergency departments (EDs) from July 2010 through June 2014. The interviews captured demographic, employment, and injury event characteristics. The telephone interview data were weighted and are presented in the results as national estimates and rates.

Results: Telephone interviews were completed by 572 EMS workers treated in EDs, resulting in a 74% cooperation rate among all EMS workers who were identified and successfully contacted. Study respondents represented 89,100 (95% CI 54,400–123,800) EMS workers who sought treatment in EDs over the four-year period. Two-thirds were male (59,900, 95% CI 35,200–84,600) and 42% were 18–29 years old (37,300, 95% CI 19,700–54,700). Three-quarters of the workers were full-time (66,800, 95% CI 39,800–93,800) and an additional 10% were part-time

Address correspondence to Audrey A. Reichard MPH, OTR, National Institute for Occupational Safety and Health, Division of Safety Research, 1095 Willowdale Road, MS 1808, Morgantown, WV 26505, USA. akr5@cdc.gov.

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

or on-call (9,300, 95% 4,900–13,700). Among career EMS workers, the injury rate was 8.6 per 100 full-time equivalent EMS workers (95% CI 5.3–11.8). Over half of all injured workers had less than ten years of work experience. Sprains and strains accounted for over 40% of all injuries (37,000, 95% CI 22,000–52,000). Body motion injuries were the leading event (24,900, 95% CI 14,900–35,000), with 90% (20,500, 95% CI 12,800–32,100) attributed to lifting, carrying, or transferring a patient and/or equipment. Exposures to harmful substances were the second leading event (24,400, 95% CI 11,700–37,100).

Conclusion: New and enhanced efforts to prevent EMS worker injuries are needed, especially those aimed at preventing body motion injuries and exposures to harmful substances. EMS and public safety agencies should consider adopting and evaluating injury prevention measures to improve occupational safety and promote the health, performance, and retention of the EMS workforce.

Keywords

emergency medical technicians; occupational injuries; occupational exposure; surveys; surveillance

Introduction

Emergency medical services (EMS) workers evaluate and manage the medical care of patients outside the hospital environment, responding to calls involving individual patients as well as large disaster and mass casualty incidents. Inherent in these emergency responses are exposures to hazardous activities and environments that may result in occupational injuries. Between 2003 and 2007, an estimated 99,400 EMS workers sought treatment at emergency departments (EDs) for nonfatal occupational injuries.[1] During the same time period, 21,690 nonfatal occupational injuries and illnesses among EMS workers resulted in a lost work day rate of 3.49 per 100 full-time workers, or nearly three times the rate of all private-industry workers.[2] It is necessary to better understand the nonfatal injuries and illnesses occurring to these workers in order to develop and implement effective prevention efforts needed to preserve this workforce.

Body motion and overexertion has been identified as the most common event leading to nonfatal injuries among EMS workers.[1,2] Compared to all private-industry workers, EMS workers were at higher risk for lost-worktime occupational injuries from overexertion, transportation-related incidents, assaults, and falls.[2] Reichard et al. found that harmful exposures and contact with objects and equipment were other common contributors to injuries among EMS workers treated in EDs.[1] Both studies reported that the most common injury was a sprain or strain, and the most commonly injured body part was the trunk. Other research analyzing data from a voluntary reporting system identified assaults and motor vehicle crashes as the most commonly reported near-miss injury events.[3]

EMS workers fulfill a critical public health and safety function. While the demand for EMS workers is projected to increase by 24% over the next 10 years,[4] there are challenges to worker retention, including injuries, illnesses, and disabilities that contribute to workers leaving the profession.[5] However, a dearth of data on EMS worker illnesses and injuries

makes it difficult to accurately understand how injuries and illnesses impact the workforce.[5] A consensus report from the National Highway Traffic Safety Administration (NHTSA) emphasized the limited knowledge of EMS worker injuries and illnesses and described the ideal components of an EMS worker injury and illness surveillance system.[6] Our study, designed around an existing ED-based surveillance system, was conducted in response to this information gap. The results summarize the characteristics of EMS workers who sought treatment in EDs for occupational injuries, illnesses, and exposures, and characterize the nature, circumstances, and outcomes of these incidents.

Methodology

Study Design

This study was a descriptive surveillance study based on data collected through a follow-back survey of EMS workers identified through the occupational supplement to the National Electronic Injury Surveillance System (NEISS-Work). The National Institute for Occupational Safety and Health (NIOSH) collects NEISS-Work to estimate the number of nonfatal occupational injuries and illnesses treated in U.S. EDs. NEISS-Work data are collected in collaboration with the Consumer Product Safety Commission (CPSC).[a] Cases for NEISS-Work are collected through a cluster sample of visits from a stratified probability sample of approximately 67 U.S. hospital EDs.[7] Cases are identified by medical chart review and determined to be work-related if the information in the medical chart indicates the injury or illness was incurred by a civilian noninstitutionalized worker who was working for pay or compensation, working on a farm, or working as a volunteer for an organized group. Each occupational injury or illness is counted only once, regardless of the number of ED visits required. As most EMS-related illnesses captured in NEISS-Work are better described as exposures because they involved potential contact with harmful substances such as bloodborne pathogens, the term “exposures” will be used henceforth to refer to illnesses and exposures combined.

In 2007, NEISS-Work was identified as a potential surveillance system for enumerating and detailing EMS injuries and exposures.[6] To further assess the feasibility of using NEISS-Work for this purpose, the NHTSA Office of Emergency Medical Services (OEMS) and NIOSH collaboratively conducted a NEISS-Work pilot study that included a telephone interview follow-back survey. The successful pilot study resulted in commitment from both agencies to conduct a full follow-back study. Based on an assessment of EMS worker injuries and exposures collected through NEISS-Work, it was determined that four years of data collection would be needed to produce a sample size large enough to allow detailed reporting of results. Funding was primarily provided by NHTSA and the study was approved by the NIOSH Institutional Review Board.

[a]NIOSH collects NEISS-Work through collaboration with the CPSC, which operates the base NEISS hospital system for the collection of data on consumer product-related injuries. The CPSC product-related injury estimates exclude occupational injuries, whereas NEISS-Work estimates include all occupational injuries regardless of product involvement. There are no implied or expressed endorsements by the CPSC of the results presented herein.

Study Sample

Potential study respondents were treated in the NEISS-Work sample hospital EDs from July 2010 through June 2014 and were 18 years old or older. We used a multi-step process to identify and verify all EMS workers captured in NEISS-Work. First, cases were identified by CPSC via a keyword search to identify cases where the industry or occupation field indicated probable EMS work and/or the injury description noted possible EMS-related activities at the time of injury or exposure. Activities indicating possible EMS work included provision of first aid or medical care, patient transport, patient rescue or extrication, and riding in or working in an ambulance. NIOSH staff reviewed all of the cases that CPSC identified to verify there was a strong likelihood they were functioning as EMS workers at the time of injury or exposure. Finally, when respondents were contacted by phone, they were asked eligibility screening questions to confirm they were functioning as EMS workers at the time of their injury or exposure. Interviews were discontinued if respondents' answers to the screening questions indicated they were not EMS workers.

Respondents for this study were recruited through a multi-step process. Once the probable EMS workers were identified by CPSC and verified by NIOSH, CPSC requested contact information for all the potential respondents from the NEISS-Work hospitals, except for those treated in eight hospitals that declined to provide contact information for this study. Once contact information was received, initial informed consent was obtained from a pre-interview letter mailed to potential respondents notifying them of the study, explaining their rights as a participant, and giving them an opportunity to opt out of the study. If the potential respondent did not opt out, their contact information was provided to the telephone interviewers trained for this study. The telephone interviewers contacted potential respondents and requested verbal consent for study participation. The number of days from ED treatment to interview ranged from 25 to 316, with a median number of 69 days. All interviews were conducted in English.

Survey Development

Survey questions were developed by NIOSH and NHTSA based on literature review findings, unpublished NEISS-Work data analyses, and feedback from EMS subject matter experts. This survey was initially reviewed by researchers and EMS workers and revised accordingly. It was then pilot tested on nine EMS workers identified from the NEISS-Work data and further revised based on the pilot test findings. The revised version was reviewed by experts knowledgeable about the EMS workforce and job tasks. The final survey was administered using a computer assisted telephone interview (CATI) system. During the 20-minute survey, respondents were asked dichotomous, multiple-choice, and open-ended questions covering items such as event characteristics, injury outcomes, and resultant worker activity limitations; occupation and employment characteristics; and preincident physical condition. Respondents were also asked if their injury or exposure was related to a motorvehicle incident, exposure to a potentially harmful substance, assault or violent act, fall or loss of balance, or reaction to bodily motion. These event categories were based on the Bureau of Labor Statistics (BLS) Occupational Injury and Illness Classification System (OIICS) event and exposure codes.[8] Respondents could identify multiple events. Many events identified by rsepondents corresponded to the OIICS event and exposure definitions.

For example, workers with injuries related to ambulance movement that caused them to lose balance generally identified this type of event as a motor vehicle incident as defined by OIICS coding rules but some respondents identified these events as loss of balance. There were no efforts to reclassify respondent-identified events that did not match OIICS definitions.

Data Processing

Several steps were taken to finalize the interview data prior to analysis. Standardized event and source codes from BLS OIICS version 2.01[8] were assigned to each interview response based on the narrative injury description provided by the injured/exposed worker. In addition, responses to narrative questions were coded by reviewing all responses, identifying common themes or groups and assigning each response to a designated theme or group.

Following methodology used in previous NEISS-Work follow-back studies,[9,10] the interview data were weighted to calculate national estimates of EMS workers treated for occupational injuries and exposures in U.S. EDs. Each NEISS-Work case was assigned a statistical base weight based on the inverse probability of selection. These base weights were adjusted by CPSC to account for issues including hospital non-response and hospital mergers.[11] Then, the base weights assigned to each EMS worker who completed a telephone interview were further adjusted to account for non-response that arose from reasons including failure to reach respondents and respondents refusing to participate. This non-response weight adjustment was performed using a raking method that proportionally adjusted weights in a marginal fashion.[12] This method reduced non-response bias by ensuring the marginal totals of the sample weights matched the marginal totals of the population weights for a particular set of raking variables available for both respondents and non-respondents. These raking variables, including demographic and injury characteristics, were selected to distinguish between the known and unknown respondent eligibility cases or to distinguish between the responses for various telephone survey questions of interest. Once potential raking variables were identified, separate logistic regression models were run using a stepwise variable selection procedure to determine if each variable was significant and whether they should be included in the raking procedure. The raking procedure and the related weight adjustments were conducted using SAS version 9.3 (SAS Institute, Cary, NC). This reweighting process resulted in final weights that were more representative of all EMS workers in NEISS-Work, not just those who completed a telephone interview. These final weights were assigned to completed cases and used to produce national estimates and calculate national rates.

Data Analysis

All estimates represent the summed adjusted weights for the four-year data collection period. Estimates, variances, and 95% confidence intervals (CI) were calculated using PROC SURVEYMEANS in SAS version 9.3 (SAS Institute, Cary, NC). Variances were estimated using Taylor series linearization.[13] Proportion estimates were derived by dividing subgroup estimates by the total estimate.

Rates were calculated only for career EMS workers (i.e., paid full-time and part-time workers) using the Current Population Survey (CPS) from July 2010 through June 2014.[12]

CPS is a household survey that does not comprehensively capture volunteers. These data were used to calculate rates per 100 FTE workers, with one FTE representing 2,000 hours worked per year. The CPS data account for time worked in a primary job as an EMS worker as well as time worked in a second job as an EMS worker if a person had two jobs (N = 909,000 FTE EMS workers during July 2010 – June 2014). An FTE-based rate accounts for any effects on employment numbers from part-time and overtime work, which allows for a standardized comparison between EMS worker injury rates and other FTE-based rates by occupation. The rates calculated using the CPS denominator are likely overestimates as the denominator does not include cross-trained EMS workers who would be classified in CPS as fire fighters. The CPS FTE estimate for people working in first and second jobs as career firefighters from July 2010–June 2014 was 1,583,000 FTE workers.[14] However, there are no data that can be used to accurately adjust the number of fire fighters based on the proportion of time spent performing EMS activities, and including all fire fighters in the denominator would markedly dilute the rate as the numerator includes only a small proportion of fire fighter injuries.

Unlike the rates that are restricted to career workers, estimates and proportions include both career and volunteer workers. Following NEISS-Work reporting guidelines, weighted estimates and proportions were rounded, estimates not meeting reporting guidelines were suppressed, and raw case counts other than the total are not presented to ensure data confidentiality and reliability. In addition, estimates with a coefficient of variation greater than 30% were reported sparingly and are accompanied by a footnote denoting data instability. When reporting guidelines prohibited publication of specific estimates or proportions but the interview data were deemed to offer valuable insight, data are qualified with adjectives to describe the number of responses.

Results

From July 2010 through June 2014, 1,595 probable EMS workers were identified in the NEISS-Work data. We were unable to contact 772 of these workers because of incorrect contact information, lack of contact information, or because they could not be reached. An additional 196 potential respondents declined to participate when contacted. A total of 627 workers agreed to participate. Of these, 55 were declared ineligible based on responses to initial screening questions or other details provided during the interview. These ineligible cases were excluded from response rate calculations. A total of 572 interviews were completed by EMS workers who were deemed to meet all study criteria. Using the American Association for Public Opinion Research (AAPOR) standard method for estimating response,[15] we calculated the overall interview response rate for this study as 37% (572/1540). This response rate reflects the number of completed interviews divided by the number of eligible workers identified in the sample. This response rate is similar to a previous NEISS-Work telephone interview study[10] and higher than two more recent studies that were conducted using the same data and methodology.[9] The cooperation rate, which is the number of completed interviews divided by the number of eligible workers who were actually contacted, was 74% (572/768).

Weighted responses from the telephone interview data represented 89,100 injured and exposed EMS workers[b] treated in EDs from July 2010 through June 2014, of which 76,100 occurred to career EMS workers. Using CPS data as the denominator, and excluding volunteers, the overall rate was 8.6 injuries and exposures per 100 FTE career EMS workers (95% CI 5.3–11.8).

Two-thirds of all injured EMS workers were male and 42% were aged 18–29 years old (Table 1). Three-quarters of respondents were full-time, paid employees. More than half of the workers (52%) had less than ten years work experience as an EMS provider. Among the 41% of respondents who were cross-trained as firefighters, 50% (18,300, 95% CI 10,200–26,400) reported spending more than half of their time performing EMS duties and 46% (16,700, 95% CI 11,300–22,100) reported spending all of their time on EMS duties.

Injury and Incident Characteristics

Most respondents reported being diagnosed with either a sprain/strain or an exposure to a harmful substance (Table 2). Body parts most typically affected included the trunk and neck (31%), upper extremities (excluding hand) (16%), and the hand (16%).

Almost two-thirds (66%) of the workers were injured when they had worked eight or fewer hours of their shift (58,600, 95% CI 29,400–87,900). Half of respondents did not finish their work shift (44,500, 95% CI 24,300–64,800) after the injury occurred. Most respondents (83%) were on a call when they were injured (74,300, 95% CI 44,800–103,700), and 86% of those were 9–1–1 calls (63,900, CI 95% 39,500–88,400).

Treatment and Injury Outcomes

The most common procedures respondents underwent at the time of their ED visits were radiological (i.e., x-rays, MRIs, or CT scans) (Table 2). Almost half of injured EMS workers (45%) reported that they were to follow up with a healthcare provider after their ED visit (39,900, 95% CI 23,500–56,300), and more than 80% of these indicated that they sought follow-up.

More than half (55%) of respondents went back to work the day of their injury or on their next scheduled workday (48,700, 95% 31,300–66,200). Of those who reported that they missed one or more days of work because of their injury (33,700, 95% CI 16,700–50,700), 40% reported that they missed three or fewer days (13,300, 95% CI 7,200–19,400), and 16% indicated they missed 30 or more days (5,500, 95% CI 1,900–9,100)[c].

Injured workers reported experiencing a variety of limitations at home and at work in the 30 days following their injury, most commonly restricted lifting.[d] Other limitations included body motion (e.g., bending or twisting), limited use of the injured body part, and limitations in performing self-care and household activities such as driving, shopping, and childcare. A

[b]The total study population of injured and exposed workers will simply be referred to as “injured workers” henceforth.
[c]Estimate is statistically unreliable with a coefficient of variation of 32%.
[d]Workers who were treated for exposures were not asked about limitations.

few were placed on light duty at work. A majority (85%) of injured or exposed workers, including those who experienced limitations, expected a full recovery (Table 2).

Injury Events

Respondents most often reported that their injuries were related to body motion (e.g., excessive physical effort, awkward body posture, or repetitive movement) (28%), or exposures to harmful substances such as body fluids or chemicals (27%) (Table 3). Other common injury events were slips, trips, falls, and other losses of balance (16%), motor vehicle incidents (8%), and assault or violence (7%).

For career EMS workers, body motion injuries (24,900) occurred at a rate of 2.6 per 100 FTE (Table 3). Workers aged 40 years and older had the highest rate among all age groups at 3.3 per 100 FTE career EMS workers (95% CI 1.6–4.9), and the most body motion injuries among all workers (Table 4). The most commonly injured body parts among all EMS workers were the trunk and neck (16,300, 95% CI 10,900–21,600) and sprains and strains were the most frequently occurring diagnosis (22,000, 95% CI 13,300–30,600). Of the 90% of respondents who were transferring, carrying, or lifting a patient and/or equipment at the time of their injury, 90% were lifting a patient (20,200, 95% CI 12,000 – 28,400). About half of respondents injured while lifting a patient indicated in their narrative injury description that the lift involved a patient who was heavy, overweight, or obese. The most common types of equipment involved in lifting injuries were stretchers, cots, and litters (11,300; 95% CI 6,400–16,300). Over half of all body motion injuries resulted in the worker missing one or more days of work (53%, 13,100, 95% CI 6,400–19,900). More than one-third of respondents (8,600, 95% CI 4,700–12,400) were given pain medication or a muscle relaxant for treatment of their body motion injury.

Exposures to harmful substances to career EMS workers that resulted in ED treatment (24,400) occurred at a rate of 2.1 per 100 FTE (Table 3). For all EMS workers, most exposures involved blood and/or respiratory secretions and the most common means of exposure overall were needlesticks (21%) and being spit on by a patient regardless of intent (14%) (Table 5). In addition, many workers reported they were exposed via a patient coughing. Excluding needlesticks, most exposures occurred to the eyes, skin, and/or face, with the majority of skin exposures occurring on the arms and hands. All those with non-needlestick skin exposures were wearing gloves, but most were not wearing a protective gown. Many EMS workers who incurred eye exposures were not wearing eye protection, and almost all workers who sustained an exposure to the nose or mouth were not wearing a mask or face shield. More than half of exposed EMS workers had laboratory work done at the ED (13,600, 95% CI 6,700–20,500) and less than 10% received post-exposure prophylaxis medication.

Slips, trips, falls, and other losses of balance, henceforth referred to as loss-of-balance injuries (14,000), resulted in 1.4 injuries per 100 FTE career EMS workers (Table 3). Career EMS workers aged 40 years and older had the highest rate of loss-of-balance injuries at 1.8 per 100 FTE (6,200, 95% CI 2,600–9,800). While loss-of-balance injuries were nearly equally distributed between the sexes, the rate was higher for females at 2.2 per 100 FTE career EMS workers (95% CI 1.2–3.2) compared to males at 1.1 per 100 FTE career EMS

workers (95% CI 0.5–1.6). The most common loss-of-balance event for all EMS workers was a fall on the same level (43%, 6,000, 95% CI 3,500–8,500). In 40% of loss-of-balance incidents, the EMS worker was going up or down steps or a curb (5,600, 95% CI 2,400–8,800). Others reported being injured while getting in or out of an ambulance or slipping on wet or slick walking surfaces. Almost half of all EMS workers were pushing, pulling, lifting or carrying at the time of loss-of-balance incidents (6,700, 95% CI 2,800–10,700); 56% of these were performing patient handling activities (3,500, 95% CI 1,800–5,300).

Motor vehicle incidents (7,400), including collisions, sudden stops, and swerving, resulted in 0.8 injuries per 100 FTE career EMS workers (Table 3). Two-thirds of motor vehicle incidents among all workers resulted in one or more lost workdays (66%, 4,900, 95% CI 3,200–6,500), the highest proportion among all event types. Most of these incidents involved ambulances (6,500, 95% CI 400–9,400), and those in ambulances were almost evenly distributed between the front compartment (3,400, 95% CI 1,300–5,600) and the patient compartment (3,100, 95% CI 1,400–4,800). Approximately half of ambulance occupants were wearing a seat belt at the time of injury (2,900, 95% CI 1,900–3,900), with nearly all of the occupants wearing a seat belt located in the front compartment. Emergency lights and sirens were not being used in almost three-quarters of ambulance incidents (4,600, 95% CI 3,300 – 5,900). More than two-thirds of all EMS workers injured as motor vehicle occupants reported involvement in a collision with another motor vehicle (4,700, 95% CI 1,600–7,800)[e] and the majority of these reported that their vehicle was struck by another vehicle as opposed to their vehicle striking another vehicle. Very few respondents identified weather or road conditions, lighting conditions, or problems with the vehicle as contributing to the incident.

Violence and assaults that resulted in ED treatment (6,400) occurred at a rate of 0.6 per 100 FTE career EMS workers (Table 3). These incidents included intentional or unintentional hitting, spitting, verbal assaults, and threats, and many involved a harmful exposure in addition to violence. Of these incidents among all workers, 43% (2,700, 95% CI 1,100–4,400) were incurred by workers with four years or less of EMS provider experience. More than half of the incidents involved physical violence only (3,300, 95% CI 1,300–5,300) and an additional 34% involved verbal and physical violence (2,200, 95% CI 900–3,400). In 71% of these incidents, the violence was directed at the EMS worker (4,500, 95% CI 2,300–6,800). In almost all events, the sole perpetrator was a patient (6,100, 95% CI 4,600–7,700). EMS workers reported that almost half of patient perpetrators appeared to be under the influence of alcohol (2,800, 95% CI 500–5,000)[f]. Most violent incidents did not involve weapons (6,200, 95% CI 4,400–7,900). Police were not present in 62% of the incidents (4,000, 95% CI 2,800–5,200), and police reports were made in only 42% (2,700, 95% CI 700–4,600)[g]. A police report was more likely to be filed for a violent incident when police were already present.

[e]Estimate is statistically unreliable with a coefficient of variation of 33%.
[f]Estimate is statistically unreliable with a coefficient of variation of 37%.
[g]Estimate is statistically unreliable with a coefficient of variation of 33%.

Discussion

The risk for occupational injuries to EMS workers continues to be higher than that of the total worker population. Our study findings indicated that EMS workers had a rate of 8.6 ED-treated injuries and exposures per 100 FTE career EMS workers, more than four times the rate for ED-treated injuries among all workers 18 years or older (2.1 ED treated injuries per 100 FTE workers (95% CI 1.7–2.5).[16] This is consistent with research that reported a rate of lost-workday injuries for private sector EMS workers that was nearly three times the rate for all workers.[2] Similar to our findings, another survey also found that career providers were twice as likely as volunteers to incur an occupational injury.[17] The survey also found that career providers responded to an average of almost 16 calls per week compared with an average of four calls per week for volunteer providers.[17]

Body Motion Injuries

Our study reaffirmed the findings of previous research that body motion is the most common injury event among EMS workers.[1,2,18–20] Workers over 40 accounted for most of these injuries. The high number of older workers impacted may be related to the cumulative nature of body motion injuries, i.e., repetitive heavy lifting, forceful exertion, and awkward postures over a period of time.[21] Other factors contributing to body motion injuries include worker biomechanics (e.g., heavy lifting and awkward postures); fatigue; spinal tissue loading; psychological factors; preparation to lift (e.g., prior warning); and self-care (e.g., rest, diet, and exercise).[21]

A key activity that leads to many body motion injuries among EMS workers is patient handling. Lavender et al. analyzed common strenuous patient handling tasks among EMS workers and identified that the most biomechanically hazardous tasks involved pulling a patient from bed to stretcher, initializing stair descent when using a stretcher, and lifting a patient on a backboard from floor level.[22] Injury prevention measures related to patient handling that are commonly used in healthcare such as mechanical lifts, zero lift policies, and lift teams, are not realistic in the EMS environment.[17] Various efforts have been made to evaluate equipment used during EMS patient handling activities including equipment used to transport patients down stairs,[23] during lateral transfers,[24] and in transfers from bed to stairchairs.[25] Powered cots have also been found to reduce the occurrence of workers' compensation claims and costs.[26] Specifically, Sommerich et al. recommended use of powered cots that lift and lower the front wheels rather than those which lift and lower all four wheels simultaneously due to lower resulting muscle activity and external forces.[27] Other efforts recommended to prevent body motion injuries include educating workers about injury prevention,[28] eliminating physical risk factors when feasible,[28] and implementing targeted strength and flexibility programs.[29]

Harmful Exposures

The second leading event among EMS workers in our study was exposures. Leiss et al. reported that 22% of paramedics identified an exposure in one year.[30] While past studies of EMS exposures found that approximately 2–7% of all exposures were needlesticks,[30,31]

this was the most common exposure in our study, accounting for more than one-fifth of exposures.

Only a tenth of the EMS workers in our study reported wearing eye protection and very few reported wearing a mask. The high incidence of exposures to the face and facial structures and the low percentage of EMS workers reporting use of eye and face protections highlights the need to address use of personal protective equipment (PPE). Exposures to these areas can be prevented through adherence to existing standard precautions,[32] including the use of PPE such as safety goggles or masks/face shields. However, studies have suggested that EMS workers do not always comply with these precautions. Bledsoe et al. demonstrated that less than half of EMS workers in an urban EMS system were complying with standard precautions upon arrival at the hospital,[33] and Harris and Nicolai concluded that EMS providers working in the prehospital environment were not consistently using standard precautions to reduce risks of infection.[34]

Further research is needed to better understand barriers to the use of standard precautions, including PPE, among EMS workers. Studies have shown that the majority of EMS workers recognize the importance of PPE in reducing exposures,[34,35] and they reported that the PPE needed to prevent exposures is almost always available on the ambulance.[35,36] A decrease in exposures has been shown when adherence to standard precautions was included as a factor in performance evaluations.[36] Educational efforts could be directed toward increasing awareness of the importance of standard precautions, including PPE. Specifically, education and follow-up by EMS managers or supervisors could encourage use of PPE and aid in decreasing exposures in the prehospital environment.

Loss-of-balance Injuries

Injuries due to a loss of balance were the third leading injury event among EMS workers in our study. Consistent with previous EMS studies,[2,20] falls on the same level accounted for the majority of loss-of-balance events. There are multiple environmental and occupational risk factors that can contribute to a loss of balance. Changing surface conditions and variations in surface levels, such as wet or slick walking surfaces or the navigation of stairs, all of which were cited in loss-of-balance events in our study, present challenging walking conditions and require gait changes.[37,38] While not assessed in our study, rushing has also been identified as a factor leading to falls[39,40] and can reasonably be assumed to be an occupational risk factor during emergency responses. Carrying loads while walking can also increase the risk of falling due to decreased stability with loads held at or above waist level[37] and potentially obscured views of changing surface levels[37] or altered surface conditions.[38] It can also increase fatigue which incentivizes rushing through a task.[37] Gershon et al. suggested that EMS workers should assess pathways to patients for hazards and adjust their routes accordingly.[41] While hazards for loss of balance are difficult to eliminate in the uncontrolled EMS work environments, prevention interventions can include use of durable, slip resistant shoes[42,43] and training to reduce fall risks when working in slippery conditions.[42]

Motor Vehicle Incidents

While transportation-related incidents, including ground ambulance and air ambulance crashes, are the leading cause of death among EMS workers,[1,2,44] motor vehicle incidents accounted for only 8% of the nonfatal injuries experienced by EMS workers in our study, a percentage similar to that found in other studies.[2,19] Despite not being a leading injury event among EMS workers, our study rate of 0.8 motor vehicle events per 100 FTE career EMS workers was markedly higher than the rate of 0.04 per 100 full-time workers (95% CI 0.03–0.05) for 2012–3 for all workers.[16]

A study of ambulance crashes in a metropolitan area found that T-bone incidents and collisions at intersections were the most common types of motor vehicle events resulting in an injury to an EMS worker.[45] The Emergency Vehicle Operator Course (Ambulance) National Standard Curriculum instructs ambulance drivers to change siren tones when proceeding through an intersection, to stop and look both ways, or to avoid intersections altogether.[46] Other research has recommended that training programs should emphasize that the driver of the ambulance has primary responsibility for passing safely through an intersection.[45]

Factors contributing to EMS worker injuries that occur in the patient compartment include loose or unrestrained equipment[47] and patient compartment layout.[48] Federal research to enhance patient care and reduce patient and worker injuries in the patient compartment through improved design has been synthesized into a best practices guide.[49] Ambulance crash testing conducted by NIOSH in collaboration with industry partners has led to new test methods or Recommended Practices published by the Society of Automotive Engineers (SAE).[49] Six of the published SAE Recommended Practices have been incorporated into each of the three national ambulance design standards, and another four are expected to be incorporated in the next three years. These changes should lead to the building of safer ambulances.

Lack of seat belt use continues to be a safety concern with an analysis of 48 NHTSA ambulance crash investigations showing that 84% of EMS personnel in the patient compartment were not restrained at the time of the crash,[50] and another analysis showing a significant association between greater risk for severe injury or fatality in a crash and lack of safety restraint use.[51] Research cited barriers to patient care and impeded movement as reasons for not wearing a seat belt in the patient compartment.[52] Subsequent research was conducted to improve restraint design and facilitate the use of restraints in the patient compartment, specifically addressing the need for an EMS worker to provide patient care and access critical equipment while restrained.[53] In addition, Studnek and Ferketich found that organizational policies requiring use of seat belts increased belt use by EMS workers in the front compartment.[54] Adherence to updated recommendations for restraint design, combined with an organizational seatbelt policy, has the potential to further improve seatbelt use in patient compartments.

Violence and Assaults

As found in previous studies,[2,19] violence or assault reported in our study (7%) was less common than other identified injury events. While injuries related to violence or assaults may be fewer, the relative risk for injuries to EMS workers due to violence or assault was found to be two times the risk for all private industry workers.[2] These numbers do not reflect the true incidence of assaults and violence, in part because the data used to generate the estimates largely represent those who experienced physical injuries causing them to seek medical treatment or experience lost work time. A survey of nationally registered EMS workers in the United States revealed that in one year, 67% reported experiencing verbal violence and 44% reported experiencing physical violence.[55] In another sample of EMS workers, 80% reported that they had experienced a work-related physical assault, but only 40% sought care at a hospital.[56] Several studies have reported reasons why EMS workers may underreport incidents of violence and assaults, including: rationalization that such incidents are part of the job;[3, 57, 58] belief that reporting is pointless as no follow-up will be performed;[59] lack of policies or protocols to guide reporting,[57,60] or forms that allow violence reporting;[61] lack of management or organizational support for reporting;[57,61] and fear of repercussions or being seen as unable to manage the situation.[58]

OSHA violence prevention guidelines can assist agencies in establishing a program to prevent and reduce violence in the healthcare workplace.[62] An integral part of these guidelines is frequent employee/employer training that can reduce the likelihood of being assaulted, which has been suggested by EMS workers as a needed intervention.[63] For example, training could focus on risk management strategies that include recognition of types of violent behaviors and de-escalation approaches to consider when providing care to patients prone to assaultive behavior.[64] Preventing violence related to intoxicated patients should involve training which addresses the impact of alcohol on a patient, development of professional confidence, and use of appropriate verbal and non-verbal communication, coupled with organizational policies that emphasize safety of both the worker and the patient.[65]

Additional Prevention Considerations

Other research highlights the role of safety culture, safety climate, and other aspects of the work environment in preventing EMS worker injuries.[66,67] EMS workers' perception of a strong safety climate has been associated with twice the likelihood of adherence to safe work practices[66] and fewer reported injuries.[67] On the other hand, increased injury risk has been associated with modifiable factors such as longer work shifts,[68] less familiarity with teammates,[69] and worker fatigue.[70]

Limitations

This study has several limitations. First, the study population is limited to EMS workers who sought treatment in EDs. While EMS workers are often in the ED as part of their job and may be more likely to seek treatment there, they do seek treatment in other medical venues. In addition, some may treat their injury themselves, while others may seek informal treatment from a co-worker or a colleague working in the ED who does not make a

record of the treatment. Second, some EMS worker injuries that are treated in EDs may not be reported or identified as work-related. Third, the complex survey design allowed the data to be weighted so that national estimates could be calculated. However, these estimates are not precise point estimates, and the small sample results in rather large 95% confidence intervals that indicate the amount of uncertainty around the estimate. Fourth, due to the complex nature of the NEISS-Work sample, the amount of detail that could be presented, especially in regard to multivariable cross-tabulations specific to injury events, was limited by the conservative NEISS-Work reporting requirements that exist to ensure confidentiality and data stability. Finally, the time lapse between the injury occurrence and the telephone interview of the EMS workers may have introduced recall bias.[71] Conversely, the significance of an ED treated injury or exposure may have decreased recall bias.[71]

Rate calculations were restricted to career workers due to limited available denominator data. Sources of obtaining a count of volunteer workers are limited due to the absence of payroll coverage and omission from employment surveys.[5] There is a 2011 estimate of all licensed and credentialed EMT-Basics (EMT-B), EMT-Intermediates, and paramedics of 826,111 EMS professionals,[72] but this estimate includes inactive workers, may over count workers licensed in multiple states, and is limited to one year of data. In addition, this 2011 estimate does not account for hours worked, precluding the calculation of FTEs.

Conclusion

The most frequent types of nonfatal injuries to EMS workers seen in EDs are body motion injuries and harmful exposures and most injuries occur to full-time, career EMS workers. The implementation and evaluation of prevention efforts should focus on educating workers about event-specific injury prevention; using equipment to reduce bodily stress during lifts, carries, and transfers; providing PPE and motor vehicle occupant restraints as well as training on their use; and insuring the work environment supports injury reporting as well as the identification and mitigation of safety and health issues.

Acknowledgments

Preparation of this manuscript was completely funded by the U.S. Government. We thank our study collaborators from the U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Emergency Medical Services who have provided funding and subject matter expertise throughout the life of this project, and specifically acknowledge Gamunu Wijetunge. We thank Daniel Patterson and Brian Maguire for serving as external reviewers for this paper prior to journal submission. We thank Herman Burney, Mary Cowhig, Michelle Finch, Tom Schroeder, and other members of the CPSC Division of Hazard and Injury Data Systems for their management of routine NEISS-Work and the EMS follow-back study, as well as the coders at each NEISS-Work hospital for their diligent medical record abstraction and the telephone interviewers for their collection of the follow-back study data. We thank Susan Derk, T. M. Jackson, and Michele Jones for their efforts in collecting, coding, and editing NEISS-Work data and the follow-back study data. Finally, we thank Erin Leatherman of West Virginia University for her work to reweight the follow-back data. Opinions expressed here do not reflect the opinions of any of these organizations.

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health. In addition, citations to websites external to NIOSH do not constitute NIOSH endorsement of the sponsoring organizations or their programs or products. Furthermore, NIOSH is not responsible for the content of these websites. All web addresses referenced in this document were accessible as of the publication date.

References

Reichard AA, Marsh SM, Moore PH. Fatal and nonfatal injuries among emergency medical technicians and paramedics. Prehosp Emerg Care. 2011;15(4):511–7. [PubMed: 21834620]

Maguire BJ, Smith S. Injuries and fatalities among emergency medical technicians and paramedics in the United States. Prehosp Disaster Med. 2013;28(4):376–82. [PubMed: 23659321]

Taylor JA, Davis AL, Barnes A, Lacovara AV, Patel R. Injury risks of EMS responders: evidence from the National Fire Fighter Near-Miss Reporting System. BMJ Open. 2015;5:e007562.

Bureau of Labor Statistics (BLS). Occupational Outlook Handbook, 2016–17 Edition, EMTs and Paramedics. 2016; http://www.bls.gov/ooh/healthcare/emts-and-paramedics.htm. Accessed September 27, 2016.

National Highway Traffic Safety Administration (NHTSA). EMS workforce for the 21st century: A national assessment. 2008; http://www.ems.gov/pdf/810943.pdf. Accessed September 27, 2016.

Becker LR, Spicer R. Feasibility for an EMS workforce safety and health surveillance system. 2007; DOT HS 810 756: http://ntl.bts.gov/lib/26000/26600/26650/Feasibility_EMS_Workforce_Safety___Health_Surveillance_System__DOT_HS_810_756__June_2007.pdf. Accessed September 27, 2016.

Jackson LL. Non-fatal occupational injuries and illnesses treated in hospital emergency departments in the United States. Inj Prev. 2001;7(Suppl I):i21–6. [PubMed: 11565966]

Bureau of Labor Statistics (BLS). Occupational injury and illness classification manual. 2012; http://www.bls.gov/iif/oshoiics.htm. Accessed September 27, 2016.

Marsh SM, Reichard AA, Bhandari R, Tonozzi TR. Using emergency department surveillance data to assess occupational injury and illness reporting by workers. Am J Ind Med. 2016;59:600–9. [PubMed: 27400439]

Hartley D, Doman B, Hendricks SA, Jenkins EL. Non-fatal workplace violence injuries in the United States 2003–2004: A follow back study. Work. 2012;42(1):125–35. [PubMed: 22635156]

Consumer Product Safety Commission (CPSC). The NEISS sample (Design and Implementation): 1997 to present. 2001; https://www.cpsc.gov/s3fs-public/pdfs/blk_media_2001d011-6b6.pdf. Accessed November 14, 2016.

Lohr SR. Sampling: Design and analysis. 2010; Boston, MA: Brooks/Cole, Cengage Learning.

Wolter KM. Introduction to variance estimation. 2010; New York, NY: Springer Science + Business Media, LLC.

Bureau of Labor Statistics (BLS). Current Population Survey microdata. 2015; http://thedataweb.rm.census.gov/ftp/cps_ftp.html. Accessed September 27, 2016.

American Association for Public Opinion Research (AAPOR). 2011. Standard definitions: Final dispositions of case codes and outcome rates for surveys. 7th edition: AAPOR.

NEISS-Work. Analysis of unpublished 2010–2013 raw data. 2016.

Heick R, Young T, Peek-Asa C. Occupational injuries among emergency medical services providers in the United States. J Occup Environ Med. 2009;51(8):963–8. [PubMed: 19620888]

Maguire BJ, Hunting KL, Guidotti TL, Smith GS. Occupational injuries among emergency medical services personnel. Prehosp Emerg Care. 2005;9(4):405–11. [PubMed: 16263673]

Reichard AA, Jackson LL. Occupational injuries among emergency responders. Am J Ind Med. 2010;53:1–11. [PubMed: 19894221]

Maguire BJ, O'Meara PF, Brightwell RF, O'Neill BJ, Fitzgerald GJ. Occupational injury risk among Australian paramedics: an analysis of national data. Med J Australia. 2014;200: 477–80. [PubMed: 24794611]

Paul G, Hoy BA. An exploratory ergonomic study of musculoskeletal disorder prevention in the Queensland Ambulance Service. J Health Saf Environ. 2015;31(3):255–71.

Lavender SA, Conrad KM, Reichelt PA, Johnson PW, Meyer FT. Biomechanical analyses of paramedics simulating frequently performed strenuous work tasks. Appl Ergon. 2000;31:167–77. [PubMed: 10711979]

Lavender SA, Conrad KM, Reichelt PA, Gacki-Smith J, Kohok AK. Designing ergonomic interventions for emergency medical services workers – Part I: Transporting patients down the stairs. Appl Ergon. 2007;38:71–81. [PubMed: 16530721]

Lavender SA, Conrad KM, Reichelt PA, Kohok AK, Gacki-Smith J. Designing ergonomic interventions for emergency medical services workers – Part II: Lateral transfers. Appl Ergon. 2007;38:227–36. [PubMed: 16750507]

Lavender SA, Conrad KM, Reichelt PA, Kohok AK, Gacki-Smith J. Designing ergonomic interventions for emergency medical services workers – Part III: Bed to stairchair transfers. Appl Ergon. 2007;38:581–9. [PubMed: 17070768]

Wurzelbacher SJ, Bertke SJ, Lampl MP, Bushnell PT, Meyers AR, Robins DC, Al-Tarawneh IS. The effectiveness of insurer-supported safety and health engineering controls in reducing workers' compensation claims and costs. Supplementary online material. Am J Ind Med. 2014;57:1398–1412. [PubMed: 25223846]

Sommerich CM, Lavender SA, Umar RZR, Li J, Park S, Dutt M. A biomechanical and subjective comparison of two powered ambulance cots. Ergonomics. 2015;58(11):1885–96. [PubMed: 26245484]

Fisher TF, Wintermeyer SF. Musculoskeletal disorders in EMS: Creating employee awareness. Prof Saf. July 2012;30–4.

Crill MT, Hostler D. Back strength and flexibility of EMS providers in practicing prehospital providers. J Occup Rehabil. 2005;15(2):105–11. [PubMed: 15844671]

Leiss JK. Management practices and risk of occupational blood exposure in U.S. paramedics: Needlesticks. Am J Ind Med. 2010;53:866–74. [PubMed: 20698019]

Sayed ME, Kue R, McNeil C, Dyer SK. A descriptive analysis of occupational health exposures in an urban EMS system 2007–2009. Prehosp Emerg Care. 2011;15(4):506–10. [PubMed: 21797786]

Centers for Disease Control and Prevention (CDC). Guide to infection prevention for outpatient settings: Minimum expectations for safe care. 2014; http://www.cdc.gov/HAI/settings/outpatient/outpatient-care-guidelines.html. Accessed September 27, 2016.

Bledsoe BE, Sweeney RJ, Berkeley RP, Korey CT, Forred WJ, Johnson LD. EMS provider compliance with infection control recommendations is suboptimal. Prehosp Emerg Care. 2014;18:290–4. [PubMed: 24401023]

Harris SA, Nicolai LA. Occupational exposures in emergency medical service providers and knowledge of and compliance with universal precautions. Am J Infect Control. 2010;38(2):86–94. [PubMed: 19815310]

Mathews R, Leiss JK, Lyden JT, Sousa S, Ratcliffe JM, Jagger J. Provision and use of personal protective equipment and safety devices in the national study to prevent blood exposure in paramedics. Am J Infect Control. 2008;36(10):743–49. [PubMed: 18834754]

Leiss JL. Management practices and risk of occupational blood exposure in U.S. paramedics: non-intact skin exposure. Ann Epidemiol. 2009;19(12):884–90. [PubMed: 19944350]

Davis PR. Human factors contributing to slips, trips, and falls. Ergonomics. 1983;26(1):51–9. [PubMed: 6832133]

Marletta W. Trip, slip and fall prevention. In Hansen DJ (ed.), The Work Environment, Vol. 1. Occupational Health Fundamentals, Chelsea, MI: Lewis Publishers, 1991, pp. 241–76.

Nagata H Occupational accidents while walking on stairways. Safety Sci. 1991;14:199–211.

Bentley TA. Slip trip and falls accidents occurring during the delivery of mail. Ergonomics. 1998;41(12):1859–72. [PubMed: 9857843]

Gershon RRM, Vlahov D, Kelen G, Conrad B, Murphy L. Review of accidents/injuries among emergency medical services workers in Baltimore, Maryland. Prehosp Disaster Med. 1995;10(1):33–7.

Bentley TA, Haslam RA. Identification of risk factors and counter-measures for slip, trip and fall accidents during the delivery of mail. Appl Ergon. 2001;32:127–34. [PubMed: 11277504]

Bell J, Collins JW, Dalsey E, Sublet V. Slips, trips and fall prevention for healthcare workers. Department of Health and Human Services (NIOSH) Publication Number 2011–123.

Maguire BJ, Hunting KL, Smith GS, Levick NR. Occupational fatalities in emergency medical services: a hidden crisis. Ann Emerg Med. 2002;40(6):625–32. [PubMed: 12447340]

Custalow CB, Gravitz CS. Emergency medical vehicle collisions and potential for preventive intervention. Prehosp Emerg Care. 2004;8(2):175–84. [PubMed: 15060853]

National Highway Traffic Safety Administration (NHTSA). Emergency Vehicle Operator Course (Ambulance) National Standard Curriculum. 1995. http://www.nhtsa.gov/people/injury/ems/Participant%20Manual%201995%20EVOC.pdf. Accessed September 27, 2016.

Kibira D, Lee YT, Marshall J, Feeney AB, Avery L, Jacobs A. Simulation-based design concept evaluation for ambulance patient compartments. Simulation. 2015;91(8):691–714.

Hignett S, Crumpton E, Coleman R. Designing emergency ambulances for the 21st century. Emerg Med J. 2009;26:135–40. [PubMed: 19164631]

U.S. Department of Homeland Security (USDHS). Ambulance Patient Compartment Human Factors Design Guidebook. 2015. http://www.firstresponder.gov/TechnologyDocuments/Ambulance%20Patient%20Compartment%20Human%20Factors%20Design%20Guidebook.pdf. Accessed September 27, 2016.

Smith N A national perspective on ambulance crashes and safety. EMS World. September 2015;44(9):91–94. [PubMed: 26521402]

Higgins JS, Gormley M, Farnstrom E. The use and impact of safety restraints among EMS workers and patients in ground ambulance crashes. Prehosp Emerg Care. 2015;19(1):154.

Larmon B, LeGassick TF, Schriger DL. Differential front and back seat safety belt use by prehospital care providers. Am J Emerg Med. 1993;11:595–9. [PubMed: 8240560]

Green JD, Yannaccone JR, Current RS, Sicher LA, Moore PA, Whitman GR. Assessing the performance of various restraints on ambulance patient compartment workers during crash events. Int J Crashworthines. 2010;15(5):517–41.

Studnek JR, Ferketich A. Organizational policy and other factors associated with emergency medical technician seat belt use. J Safety Res. 2007;38:1–8. [PubMed: 17316688]

Gormley MA, Crowe RP, Levine R, Bentley MA. A national description of violence experienced by emergency medical services personnel. Prehosp Emerg Care. 2016;20(4):439–47. [PubMed: 26836247]

Furin M, Eliseo LJ, Langlois B, Fernandez WG, Mitchell P, Dyer KS. Self-reported provider safety in an urban emergency medical system. Western J Emerg Med. 2015;16(3):459–64.

Cheryl Pozzi. Exposure of prehospital providers to violence and abuse. J Emerg Nurs. 1998;24:320–3. [PubMed: 9814235]

Grange JT, Corbett SW. Violence against emergency medical services personnel. Prehosp Emerg Care. 2002;6:186–90. [PubMed: 11962565]

Suserud BO, Blomquist M, Johansson I. Experiences of threats and violence in the Swedish Ambulance Service. Accident Emerg Nurs. 2002;10:127–35.

Corbett SW, Grange JT, Thomas TL. Exposure of prehospital care providers to violence. 1998. Prehosp Emerg Care. 1998;2:127–31. [PubMed: 9709332]

Bigham BL, Jensen JL, Tavares W, et al. Paramedic self-reported exposure to violence in the EMS workplace: A mixed-methods cross-sectional survey. Prehosp Emerg Care. Oct–Dec 2014;18(4):489–94. [PubMed: 24830544]

Occupational Safety and Health Administration (OSHA). Guidelines for preventing workplace violence for healthcare and social services workers. 2015. https://www.osha.gov/Publications/osha3148.pdf. Accessed September 27, 2016.

Taylor JA, Barnes B, Davis AL, Wright J, Widman S, LeVasseur M. Expecting the unexpected: a mixed methods study of violence to EMS responders in an urban fire department. Am J Ind Med. 2016;59:150–63. [PubMed: 26725756]

Flannery RB. Safety and the violent person: guidelines for emergency services. Int J Emerg Ment Health. 2012;14(3):151–6. [PubMed: 23894795]

Cork A, Ferns T. Managing alcohol related aggression in the emergency department (Part II). Int Emerg Nurs. 2008;16:88–93. [PubMed: 18519059]

Eliseo LJ, Murray KA, White LF, Dyer S, Mitchell PA, Fernandez WG. EMS providers' perceptions of safety climate and adherence to safe work practices. Prehosp Emerg Care. 2012;16(1):53–8. [PubMed: 22128907]

Weaver MD, Wang HE, Fairbanks RJ, Patterson PD. The association between EMS workplace safety culture and safety outcomes. Prehosp Emerg Care. 2012;16(1):43–52. [PubMed: 21950463]

Weaver MD, Patterson PD, Fabio A, Moore CG, Freiberg MS, Songer TJ. An observational study of shift length, crew familiarity, and occupational injury and illness in emergency medical services workers. Occup Environ Med. 2015;72:798–804. [PubMed: 26371071]

Patterson PD, Weaver MD, Landsittel DP, et al. Teammate familiarity and risk of injury in emergency medical services. Emerg Med J. 2016;33:280–5. [PubMed: 26614096]

Patterson PD, Weaver MD, Frank RC, et al. Association between poor sleep, fatigue, and safety outcomes in emergency medical services providers. Prehosp Emerg Care. 2012;16(1):86–97. [PubMed: 22023164]

Coughlin SS. Recall bias in epidemiologic studies. J Clin Epidemiol. 1990;43(1):87–91. [PubMed: 2319285]

Federal Interagency Committee on Emergency Medical Services (FICEMS). 2011 National EMS Assessment, 2012. http://www.ems.gov/pdf/2011/National_EMS_Assessment_Final_Draft_12202011.pdf. Accessed September 27, 2016.

Table 1.

Work and demographic characteristics of emergency medical services (EMS) workers with ED-treated occupational injuries or exposures from July 2010 through June 2014.

Characteristic	Estimate*	95% Confidence Interval	Percentage of total
Total	89,100	(54,400–123,800)	100
Sex			
Male	59,900	(35,200–84,600)	67
Female	29,200	(17,400–41,000)	33
Age groups (years)			
18–24†	15,800	(5,900–25,600)	18
25–29	21,500	(11,700–31,200)	24
30–34	11,700	(6,100–17,400)	13
35–39	9,300	(5,100–13,400)	10
40–44	13,100	(7,900–18,400)	15
45 and over	17,800	(9,100–26,400)	20
Type of EMS worker			
Full-time	66,800	(39,800–93,800)	75
Part-time/on call	9,300	(4,900–13,700)	10
Volunteer‡	11,200	(600–21,700)	13
Practice level			
First responder§	3,500	(1,200–5,800)	4
EMT-Basic	48,800	(23,600–74,100)	55
EMT-Intermediate§	7,500	(2,600–12,500)	8
Paramedic	26,900	(19,000–34,900)	30
Cross-trained as a firefighter			
Yes	36,500	(22,900–50,300)	41
No	51,700	(24,500–78,800)	58
Years in EMS			
0–4	24,200	(12,800–35,700)	27
5–9	22,100	(12,400–31,800)	25
10–14	13,400	(7,500–19,300)	15
15–19	11,400	(6,400–16,400)	13
20–24	10,400	(5,300–15,400)	12
25 or more	7,600	(3,300–11,800)	8
Self-rated health			
Excellent	33,100	(19,700–46,500)	37
Good	48,700	(28,800–68,600)	55
Fair	6,700	(2,600–10,700)	7
Self-rated physical fitness			
Excellent	27,400	(15,800–38,900)	31

Characteristic	Estimate*	95% Confidence Interval	Percentage of total
Good	51,700	(30,800–72,600)	58
Fair	9,500	(5,400–13,600)	11

*May not sum to the total as only results meeting NEISS-Work reporting requirements are displayed and all numbers are rounded.

†Estimate is statistically unreliable with a coefficient of variation of 31%.

‡Estimate is statistically unreliable with a coefficient of variation of 46%.

§Estimates are statistically unreliable with a coefficient of variation of 32%.

Table 2.

Injury characteristics of emergency medical services (EMS) workers treated in EDs for an occupational injury or exposure from July 2010 through June 2014

Characteristic	Estimate*	95% Confidence Interval	Percent
Total	89,100	(54,400–123,800)	100
Diagnosis			
Sprain/strain	37,000	(22,000–52,000)	41
Exposure†	17,400	(6,300–28,500)	20
Contusions/abrasions/crushing‡	12,400	(6,700–18,200)	14
Puncture/laceration	9,100	(4,700–13,500)	10
Fracture/dislocation	4,200	(2,200–6,200)	5
Other	9,000	(4,800–13,200)	10
Injured body part			
Trunk/neck	27,200	(15,700–38,700)	31
Upper extremity (UE), except hand	14,200	(6,400–22,000)	16
Shoulder (part of UE)	*5,500*	*(2,100–8,900)*	*6*
Hand, including fingers	14,400	(8,600–20,200)	16
Lower extremity (LE)	11,900	(6,300–17,500)	13
Knee†(part of LE)	*6,100*	*(2,300–10,000)*	*7*
Ankle (part of LE)	*3,100*	*(1,400–4,700)*	*3*
Face/eye/mouth†	10,200	(3,700–16,700)	11
Head†	4,600	(1,700–7,400)	5
Time of injury (24-hour clock)			
6:00–11:59	18,400	(12,200–24,600)	21
12:00–17:59	31,600	(16,800–46,400)	35
18:00–23:59	25,500	(13,200–37,800)	29
24:00–5:59	8,200	(3,300–13,100)	9
Unknown	5,300	(2,100–8,600)	6
ED treatment			
Radiology	31,700	(18,600–44,900)	36
Medication	24,800	(12,200–37,300)	28
Laboratory work	15,100	(7,400–22,800)	17
Examined only	8,100	(3,600–12,700)	9
Follow-up performed§			
General medical provider care	27,400	(15,200–39,500)	69
Diagnostic testing/test results	10,000	(3,900–16,200)	25
Rehabilitation	8,700	(4,100–13,400)	22
Long-term prognosis			
Full recovery	75,600	(48,300–103,000)	85
Permanent impairment/Don’t know	13,400	(5,500–21,300)	15

[*] May not sum to the total as only results meeting NEISS-Work reporting requirements are displayed and all numbers are rounded.

[†] Estimates are statistically unreliable with a coefficient of variation of 31%.

[‡] Incidents of crushing did not identify fracture involvement.

[§] Limited to respondents who sought recommended follow-up (n = 39,900, 95% CI 23,500–56,300). Of these, some had multiple follow-up procedures.

Table 3.

Weighted estimates and rates per 100 career FTE by event type for emergency medical services (EMS) workers treated in EDs for an occupational injury or exposure from July 2010 through June 2014

Event (respondent identified)	Estimate*	95% Confidence Interval	Percent	Rate for FTE career EMS worker†	95% Confidence Interval
Body motion	24,900	(14,900–35,000)	28	2.6	(1.5–3.7)
Exposures to harmful substances	24,400	(11,700–37,100)	27	2.1	(1.0–3.1)
Slips/trips/falls/loss of balance	14,000	(8,200–19,800)	16	1.4	(0.9–2.0)
Motor vehicle incidents	7,400	(4,300–10,400)	8	0.8	(0.4–1.1)
Assaults/violence	6,400	(2,800–10,100)	7	0.6	(0.2–0.9)

*Estimates do not sum to the total as some respondents did not identify an event related to their injury. In most cases, this was correct as their injuries resulted from contact with an object or piece of equipment. Also, some workers identified multiple events related to their injury. Estimates include all EMS workers (i.e., career and volunteer).

†Rate calculations are limited to career EMS workers. Denominator data are from the CPS data (BLS, 2015).

Table 4.

Work and demographic characteristics of emergency medical services (EMS) workers with ED-treated injuries related to body motion* from July 2010 through June 2014

Characteristic	Estimate†	95% Confidence Interval	Percent
Total	24,900	(14,900–35,000)	100
Sex			
Male	17,100	(9,200–25,100)	69
Female	7,800	(4,200–11,400)	31
Age groups (years)			
18–29	8,000	(4,300–11,600)	32
30–39	6,800	(4,100–9,500)	27
≥40	10,200	(5,200–15,200)	41
Practice level			
EMT-B	13,800	(6,300–21,300)	55
Paramedic	6,800	(4,100–9,500)	27
Years of service			
0–4	6,300	(3,100–9,400)	25
5–9	6,700	(3,800–9,600)	27
10–19	6,600	(3,100 –10,000)	26
≥20	5,400	(2,300–8,500)	22
Movement at the time of injury			
Transfer/carrying/lifting	22,500	(12,800–32,100)	90
Twisting	7,700	(4,600–10,900)	31
Awkward posture/movement	5,500	(3,100–7,900)	22
Working above shoulder level	4,800	(2,000–7,600)	19
Navigating stairs/steps/curb‡	4,000	(800–7,100)	17
Number of people assisting§			
1	14,400	(7,700–21,200)	64
2 or more‖	4,400	(1,500–7,400)	20
Prior sprain/strain/repetitive motion injury to injured body part			
Yes	3,300	(1,400–5,200)	13
No	21,400	(13,300–29,500)	86

*Includes excessive physical effort, awkward body posture, and repetitive movement.

†Not all estimates sum to the total as only results meeting NEISS-Work reporting requirements are displayed and all numbers are rounded.

‡Estimate is statistically unreliable with a coefficient of variation of 39%.

§Limited to respondents who were lifting carrying or transferring a patient or equipment at the time of injury.

‖Estimate is statistically unreliable with a coefficient of variation of 33%.

Table 5.

Work and demographic characteristics of emergency medical services (EMS) workers treated in emergency departments for occupational exposures from July 2010 through June 2014

Characteristic	Estimate*	95% Confidence Interval	Percent
Total	24,400	(11,700–37,100)	100
Sex			
Male	18,400	(8,800–28,000)	75
Female†	6,000	(1,300–10,700)	25
Age group (years)			
18–29†	12,800	(4,200–21,500)	53
30–39	5,200	(3,000–7,400)	21
≥40†	6,400	(2,200–10,600)	26
Practice level			
EMT-B†	11,400	(3,800–19,100)	47
Paramedic	8,900	(4,100–13,800)	37
Years of service			
0–4	7,500	(2,900–12,100)	31
5–9†	6,100	(2,200–10,000)	25
≥10	10,800	(5,500–16,000)	44
Exposed part of body‡			
Eyes†	5,600	(1,900–9,300)	23
Skin†	5,300	(1,300–9,300)	22
Face??	5,000	(1,400–8,600)	20
Mouth and nose	4,100	(1,800–6,400)	17
Substance involved			
Blood	15,500	(7,000–24,100)	64
Respiratory secretions†	5,600	(1,700–9,600)	23
How exposure occurred			
Stuck by needle	5,200	(3,200–7,100)	21
Spit on‖	3,500	(1,600–5,300)	14
Activity at the time of exposure			
Patient handling/restraint	4,300	(2,000–6,700)	18
Patient care†#	3,900	(1,200–6,600)	16
PPE used at time of exposure			
Medical gloves	22,100	(12,000–32,200)	91
Gown	10,200	(4,900–15,400)	42
Eye protection†#	2,300	(700–4,000)	10

*May not sum to the total as only results meeting NEISS-Work reporting requirements are displayed and all numbers are rounded.

[†] Estimates are statistically unreliable with a coefficient of variation >30% and <39%.

[‡] Analysis excludes those exposed via needlesticks. Some respondents had multiple body parts exposed.

[§] Includes only those respondents who did not identify exposure to a specific facial orifice.

[//] I Includes both intentional and unintentional spitting.

[#] Includes taking vitals, assessing patients, and caring for wounds. Does not include more skilled procedures such as CPR, intubation, suctioning, or IV line procedures.