

# The Prevalence of Work-related Injuries and Exposures amongst Paramedics and Emergency Medical Technicians: A Literature Review

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## Abstract

**Objectives:** To identify work-related injuries and exposures amongst paramedics and emergency medical technicians, along with their consequences, injury events, and the factors that cause them.

**Methods:** A computerised online literature search for papers published on or after 2013 was conducted on the following databases: AMED, CINAHL, EMBASE, MEDLINE, Delphis, NIHR Journals Library, ProQuest Dissertations & Theses A&I: Health & Medicine, and Science Direct, using the following keywords and their synonyms: 'prehospital staff', 'work-related injuries' and 'prehospital settings'. 1557 studies were identified and reviewed. Inclusion and exclusion criteria were then applied to leave a total of fifteen papers, from which seven duplicates were then removed. The final set of eight papers were appraised and their results coded using thematic analysis.

**Findings:** The eight qualitative, quantitative, and multi-methods papers were critically appraised using three HCPRDU evaluation tools, summarised, and given a grading score; all the papers were rated as yielding either moderate or low-quality evidence.

**Conclusions:** Musculoskeletal injuries are a common occupational injury that can lead to work dissatisfaction, lost workdays, limitations following injuries, and the end of a career. They are caused by: body motion, exposure to harmful substances, accidents during ambulance operations, violence, or slips, trips and falls. Contributory factors include: a lack of expectancy, improper reactions to unexpected situations, inadequate concentration, inexperience, poor fitness, rushing, partner problems, the negative actions of other personnel, low salaries, multiple-jobs, long tours, lack of breaks, ambulance design, a lack of reporting, and weather conditions. These should all be considered when developing preventive solutions. The following recommendations were therefore made: identifying risk factors, holding regular meetings between supervisors and ambulance workers, enhancing the safety culture, following recent safety guidelines and policies, increasing safety awareness, developing positive relationships with other personnel, improving ambulances, improving reporting processes, and using reported data as the basis for further research and training.

**Keywords:** Work-related injuries and exposures; Occupational injuries; Paramedics and emergency medical technicians

## Introduction

When responding to emergency calls, paramedics and emergency medical technicians are susceptible to work-related injuries and exposures that may occur due to physical exertions, slips, falls, ambulance accidents, violence and so on [1-3]. They are more vulnerable to issues that threaten their safety than other emergency personnel [1,2]. For example, research has shown Australian ambulance staff experience a higher proportion of work-related injuries than firefighters and police officers [1], while in the United States, the rate of injuries is three times higher amongst ambulance staff than other emergency personnel [2]. These rates highlight the prevalence of injuries and suggest that preventive measures are needed to avoid shortened career spans and a corresponding drop in the quality of healthcare [3]. Additionally, work-related injuries and exposures may stem from a poor safety culture which leads to negative outcomes among paramedics and emergency medical technicians [4]. Some researchers suggest that the focus should be on changing this culture through research that helps reduce injuries and exposures and informs possible solutions [5]. Therefore, this literature review relied on the following question: "What does the evidence tell us about the prevalence of work-related injuries and exposures amongst paramedics and emergency medical technicians?". This enabled the exploration of evidence from published qualitative, quantitative, and mixed methods papers in order to achieve the objectives of this literature review.

## Methods

The PICO tool was used to formalise the research question

(Table 1), facilitate the search for up-to-date relevant articles, and identify appropriate evidence [6].

A comprehensive literature search was conducted on the following online databases: Scopus, AMED, CINAHL, EMBASE, MEDLINE, Delphis, NIHR Journals Library, ProQuest Dissertations & Theses A&I: Health & Medicine, and ScienceDirect. Published papers were identified by searching for the following combinations of keywords

Definitions	P.I.C.O
Paramedics and emergency medical technicians.	Population
Making recommendations for future research and practice.	Intervention
No comparison- optional.	Comparison
Identifying work-related injuries and exposures, their consequences, events, and the factors that cause them.	Outcomes
What does the evidence tell us about the prevalence of work-related injuries and exposures amongst paramedics and emergency medical technicians?	The research question

**Table 1:** The PICO tool for the research question [6].

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and their synonyms: 'prehospital staff', 'work-related injuries' and prehospital settings' (Table 2).

1557 papers were identified in total. The title and abstract of each paper were then reviewed by the author. Inclusion and exclusion criteria were applied to exclude articles that were not written in English,

unavailable in a full-text format, published before 2013, did not focus on prehospital settings, and whose sole concern was not paramedics and emergency medical technicians. This reduced the total to fifteen papers. Seven duplicates were removed to leave a final total of eight papers (Figure 1). The papers were then critically evaluated, the

Searching words and phrases	Synonyms	Key words
"prehospital staff" OR paramedic* OR "emergency medical technician*" OR "ambulance officer*" OR "EMS personnel" OR "EMS worker*" OR "emergency caregiver*" OR "emergency care provider*" OR "emergency health professional"	Paramedics, Emergency Medical Technicians, ambulance officers, EMS personnel, EMS workers, emergency caregivers, emergency care providers, and emergency health professionals.	Prehospital staff
AND		
"work-related injur*" OR "occupational injur*" OR "workplace injur*" OR injur* OR wound* OR harm*	Occupational injuries, workplace injuries, injuries, wounds, and harm.	Work-related injuries
AND		
"prehospital setting*" OR "out of hospital" OR "urgent call*" OR "emergency setting*" OR prehospital OR workplace* OR accident* OR incident* OR "during dut"	Out of hospital, urgent scenes, emergency scenes, workplaces, accidents, incidents, and during duties.	Prehospital settings

Table 2: Use of keywords and synonyms.

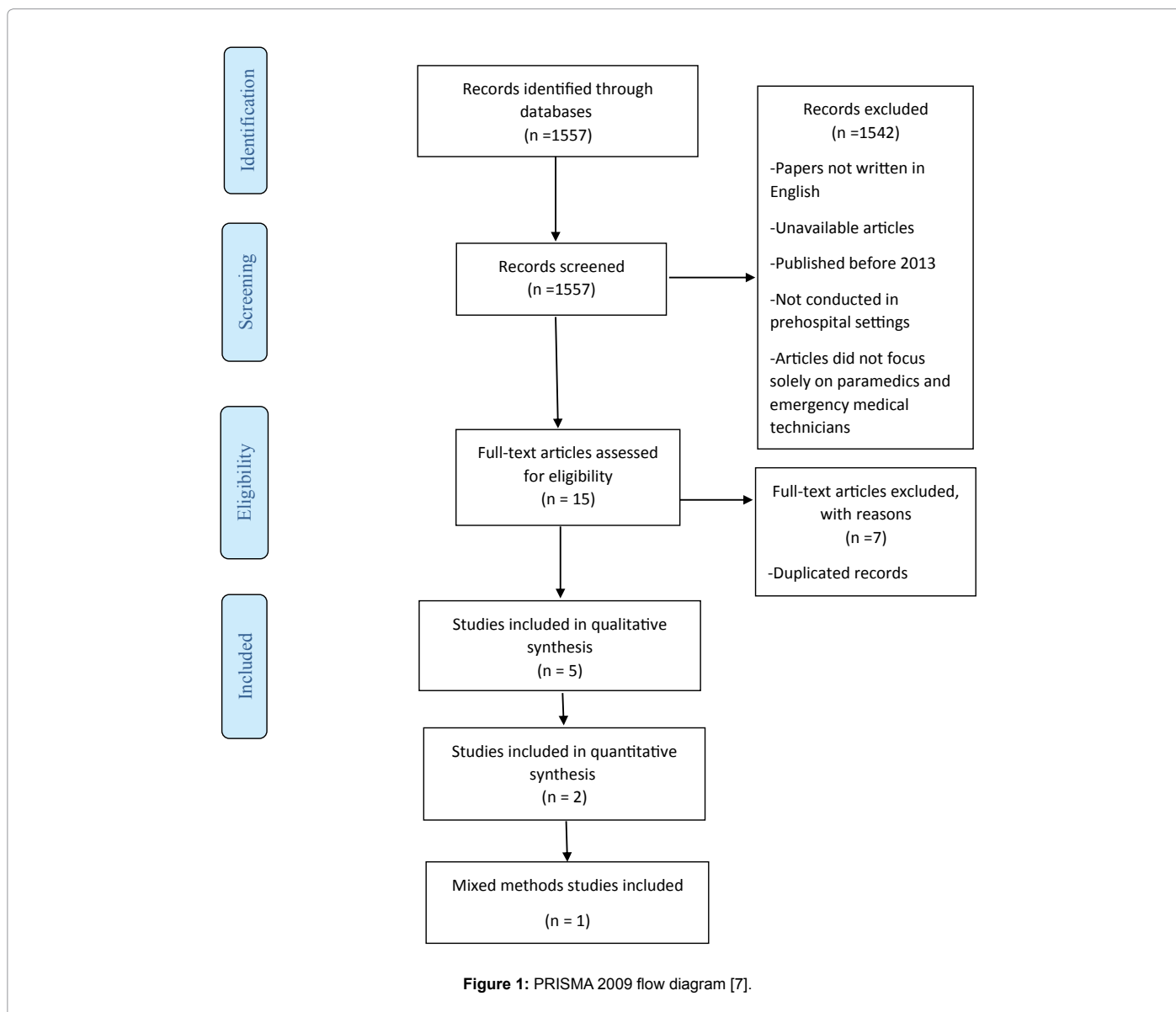


Figure 1: PRISMA 2009 flow diagram [7].

results were coded using thematic analysis and synthesised for further interpretation and discussion.

### Analysis of Included Papers

The eight papers were read and reread by the author to determine their relevance to the review question and identify their qualities (Table S1). Analysing the key findings of the papers against the review question ensured the papers were relevant to this specific literature review. The variety of methods employed facilitated the objectives of this literature review and the variety of countries involved provided significant opportunities to compare occupational injuries across nations. Such variation led to valuable outcomes and facilitated appropriate recommendations. However, regarding the quality of evidences, the methodologies of each included paper excluded finding high quality of evidence. The evidence of the included papers range from moderate to lower quality based on the hierarchy of evidence which indicates that the methodologies of included papers provide less reliable and high biased evidence than other reliable approaches (Table S1) [8]. Six studies [9-14] indicated that ethical approvals had been sought, whilst two studies [15,16] did not include this information. Non-compliance with ethical considerations can jeopardise participants' safety and wellbeing, may result in less accurate and reliable outcomes in clinical studies, and provides no guarantee that participants' rights and confidentiality have been protected and respected [17].

### Results

The reference lists of the remaining eight papers were examined to identify any additional papers that could be included; however, none were identified. The eight papers were critically appraised using three HCPRDU evaluation tools designed for qualitative, quantitative, and multi-methods papers [18-20]. These were then summarised (Table S2) as part of the analytical process prior to the development of themes.

Following critical appraisal, papers were given a grading score (high, moderate or low) which showed that six papers [9-14] were rated as yielding moderate quality evidence due to potential limitations and biases while two papers [15,16] yielded lower quality evidence due to potential limitations, biases, and insufficient ethical considerations. The studies were conducted and published in the United States (2), Australia (2), Poland (2), Turkey (1), and Finland (1). Five papers were qualitative [9-11,15,16] two were quantitative [13,14], and one used mixed-methods [12].

### Discussion

A thematic approach was applied as part of the analytical process. This involved reading and rereading the results of each paper and then constructing 46 subthemes based on differences and similarities between the outcomes. The subthemes were then grouped into overarching themes (Figure 2) which were: (1) 'work-related injuries, exposures and affected body parts'; (2) 'consequences of work-related

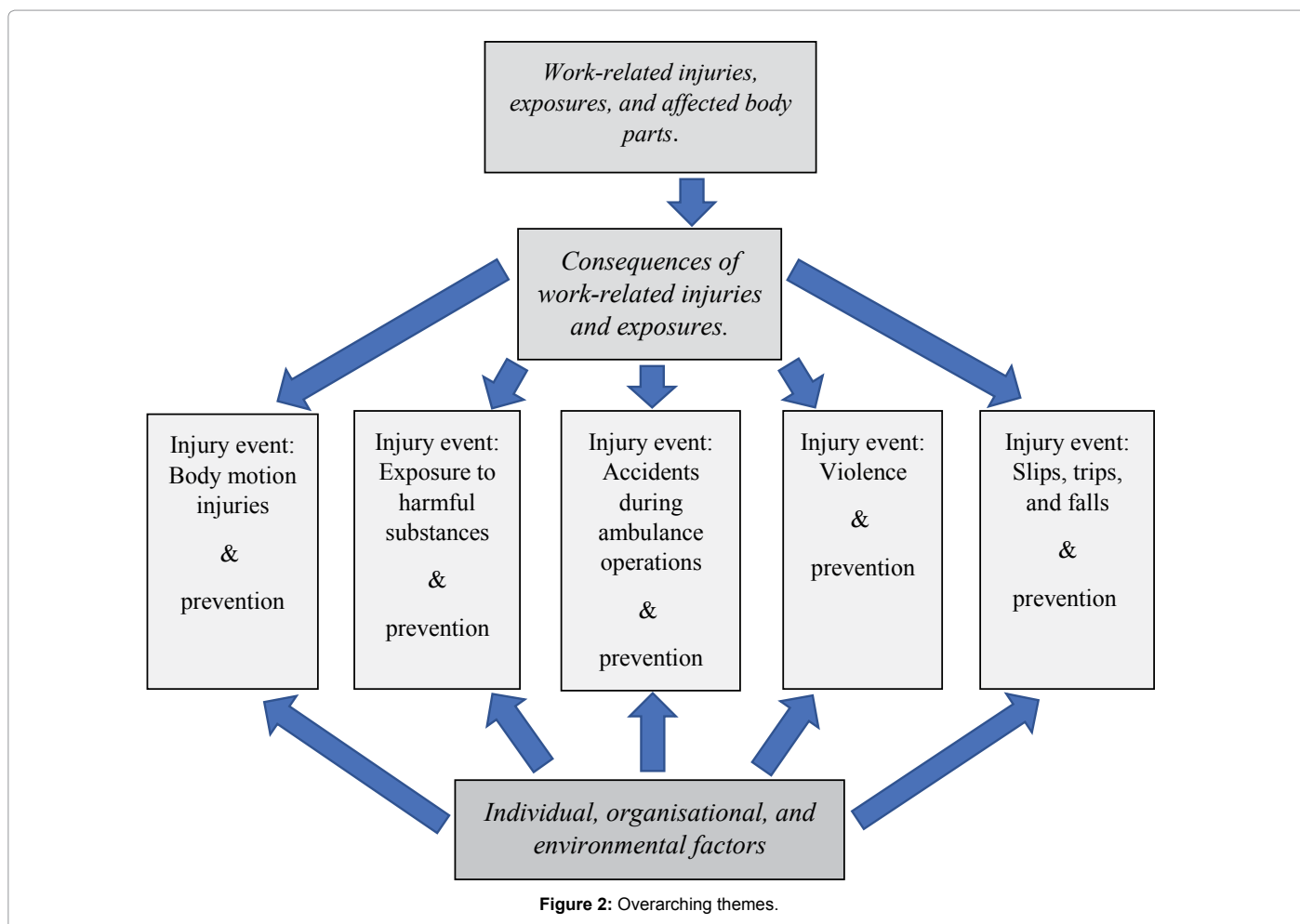


Figure 2: Overarching themes.

injuries and exposures'; (3) 'injury events and prevention for: (a) 'body-motion injuries', (b) 'exposure to harmful substances', (c) 'accidents during ambulance operations', (d) 'violence', and (e) 'slips, trips and falls' and (4) 'individual, organisational and environmental factors'. The results of the papers and the critical appraisal were then incorporated into these themes for interpretation and discussion.

### **Work-related injuries, exposures, and affected body parts**

The large number of work-related injuries and exposures can be estimated by considering: (1) the frequency of these injuries or exposures, and (2) the body parts most affected. Regarding frequency, three studies [9-11] in the United States and Australia found that the most common occupational injuries amongst paramedics were musculoskeletal injuries such as sprains and strains caused by lifting and moving patients. However, two studies [9,10] only recruited a small sample which can limit any generalisations and lead then to unreliability of results, while the third study [11] used data from a system that only reported serious work-related injuries which may have biased the findings. Another study [13] found that most work-related injuries among Polish paramedics were sprains and dislocations. However, this was based on limited data and unpublished results which can lead to unreliable outcomes. In terms of the most affected body parts, two American studies [9,10] found that the most commonly affected areas were the neck, shoulders, and lower back. There were also two studies conducted in Poland; the first [15] found that the body parts most affected by occupational injuries in paramedics were the neck, chest, and trunk while the second paper [13] found that the body parts most affected by injuries and dislocations were the lower and upper extremities. The second study [13] was more reliable than the first [15] as it yielded evidence of a moderate quality. The first [15] yielded low-quality evidence due to an insufficient explanation of data collection and a lack of ethical considerations. Overall, musculoskeletal injuries such as strains and dislocations were frequent [9-11,13] and can affect the neck, shoulder, chest, trunk, back, and upper and lower extremities [9,10,13,15].

### **Consequences of work-related injuries and exposures**

The common consequences of work-related injuries and exposures are work dissatisfaction, lost workdays, limitations following injuries, and career ending injuries [9,10,14]. Gülen et al. [14] found that half the participants (paramedics and emergency medical technicians) were dissatisfied with work due to occupational injuries and exposures, the highest rates of which were due to physical and verbal assaults. Males were more likely to experience physical assaults while females were more likely to experience verbal assaults [14]. These findings are important as many dissatisfied ambulance workers in their jobs due to these workplace issues. However, the sample only represented employees in one city and the investigation focused only on severe occupational injuries. This limits the generalizability of the findings. Additionally, one study [10] found that work-related injuries such as musculoskeletal injuries can result in missed work-days whilst Reichard et al. [9] found that more than half their participants had lost one or more working days due to their injuries: 40 % missed 3 days or fewer, while 16% missed a one month or more. These findings are important as they confirm that work-related injuries can lead to working days being lost. In terms of the limitations following injuries, paramedics and emergency medical technicians may experience severe limitations in their daily activities or work in the month following an occupational injury, such as when lifting, driving, shopping, during physical movement, using the injured body part while at work, and engaging in childcare [9]. This reveals the difficult and enduring effects of work-related injuries. Finally,

assaults can lead to work-related injuries that can end the career of an ambulance worker, especially when they are caused by aggressive patients [10]. This finding highlights how occupational injuries caused by aggressive patients can potentially end the careers of paramedics and emergency medical technicians.

### **Injury Events and Prevention**

These events can be classified as: 1-body motion injuries, 2-exposure to harmful substances, 3-accidents during ambulance operations, 4-violence, and 5-slips, trips, and falls [9]. This clarification facilitates the development of preventive measures for each of these events:

#### **Body motion injuries**

This event is one of the most common injuries that can affect paramedics and emergency medical technicians [9,11,13,15]. It accounts for the highest rate of non-fatal injuries commonly occurring among paramedics and emergency medical technicians [11], such as muscular disorders and injuries to the neck, shoulders, and back [9,10]. These can occur when lifting and moving patients or equipment and are caused by: repetitive lifting of overweight patients and heavy equipment, inappropriate body movements during lifting and moving [9], weaker and shorter bodies, and handling patients or equipment in difficult locations, such as on stairs or wet surfaces [10]. Dropkin et al. [10] suggest that, to prevent such injuries, improved physical fitness, regularly eating healthy meals, and using gyms will enable ambulance workers' bodies to withstand prehospital activities and minimise occupational injuries. This finding is important in helping to ensure prehospital tasks are performed safely. Moreover, three studies [9,10,13] also recommend adopting the following; correct lifting strategies, using teamwork principles, relying on mechanical lifts, testing transport equipment, and educating ambulance staff about injury prevention. These strategies are useful elements to incorporate into training and education programmes for paramedics and emergency medical technicians to reduce work-related injuries.

#### **Exposure to harmful substances**

Exposure to harmful substances occurs frequently among paramedics and emergency medical technicians [9,10,14] and can take the following forms: a) exposure to blood and secretions or b) exposure to needlesticks and sharp injuries. The exposure to blood and secretions occurs frequently among paramedics and emergency medical technicians when patients are coughing blood or secretions onto ambulance members' faces, eyes or skin [9,12,14]. The main cause of such exposure is non-adherence to the wearing of personal protective equipment, such as facemasks, goggles and gowns, which can then lead to infections [9,12]. Additionally, exposure to needlesticks and sharp injuries is more common than exposure to blood and secretions [9,13,14] and is caused by sharp instruments [13] that can injure hands and arms during ambulance movements and intravenous cannulations [14]. This can result in open injuries or the transmission of infectious diseases, even when ambulance workers are wearing personal protective equipment during medical tasks [12,14]. Regrettably, the studies [13,14] showed that these types of injury are not reported often enough by paramedics and emergency medical technicians. Regarding prevention, protecting ambulance workers' faces, eyes, and skin is crucial [9,14] and can be achieved by: a) wearing personal protective equipment properly for self-protection [12], b) encouraging leaders to increase paramedics and emergency medical technicians' awareness of the importance of personal protective equipment [9] and c) adopting or improving the reporting policies organisations employ to record exposure to harmful substances [10,13].



## Accidents during ambulance operations

Accidents occur frequently among paramedics and emergency medical technicians [13-15] and can result in serious injuries and death [9,11]. They are caused by: a) ambulance traffic accidents [9,12] due to driving-related factors [9,12,16] and b) accidents during hazardous incidents caused by safety-related factors [12]. Driving-related factors, such as sudden braking, swerving, improper use of seatbelts, siren and lights [9,12,16], are risks that involve both ambulance workers and patients in front or patient ambulance compartments [9,10,16]. One study [16] argues that managing patients when the ambulance is moving can be a challenge as sudden brakes and swerves can cause injuries. This finding is significant, although the research only focused on one setting and lacked ethical considerations which diminished the quality of evidence provided. However, the fact that the collected data were authentic was a notable strength. Regarding seatbelts, paramedics and emergency medical technicians in the patient compartment are more exposed to work-related injuries than those in the front. Reichard et al. [9] argue that this is because ambulance workers are more likely to wear seatbelts in the front compartment than when they are in the patient compartment. This is because workers in the patient compartment release their seatbelts to care for patients which means any sudden stop can cause injuries [16]. Additionally, ambulance sirens and lights should also be used properly when approaching intersections and traffic lights [9]. Reichard et al. [9] state that ambulance lights are often used with a lack of care. However, Taylor et al. [12] argue that some paramedics do use lights properly, but motorists do not respond to them.

Additionally, safety-related factors refer to a lack of personal protective equipment and the misuse of hazard management policies, procedures, and practices [12]. This is because personal protective equipment, such as night-time reflective clothes and traffic vests that should be available on dark highways to protect ambulance members, is not supplied [12]. Furthermore, hazard management policies, procedures, and practices that should be applied alongside other emergency personnel can be misused. For instance, a) when an incident command system is initiated, ambulance workers do not follow the commands correctly by waiting until the scene is safe, or the commander misuses staging policies and permits workers to enter an unsafe scene, or b) paramedics and emergency medical technicians encounter accidents on dark highways with unsafe lanes that are not shut down by emergency personnel [12]. For prevention, it is recommended that driving-related and safety-related factors are addressed [11], training is provided on safe driving [15] and the use of seatbelts and lights [9], a defensive driving strategy is used on highways, personal protective equipment is made available in all emergencies, incident commanders are obeyed, the roles of emergency personnel in shutting down unsafe lanes are clarified, and training is provided on how to drive on highways [12].

## Violence

One of the least common events that occur among paramedics and emergency medical technicians [9,11] are aggressive actions involving the threatened or actual use of weapons, knives, hitting, spitting, and insults [9,12,14] from perpetrators who may be patients, family members, or even bystanders [12,14]. Violent events may include physical abuse, verbal abuse, or both [9,14], depending on the society. For instance, in Turkey, verbal abuse against ambulance staff is more common than physical abuse [14], whereas Reichard et al. [9] found that physical assault is more common in the United States, followed by a combination of physical and verbal abuse. Although violence is less common than other events, its impact should not be underestimated.

Three studies [9,11,12] have indicated that although the rate of assaults is low, these can lead to fatalities amongst Australian and American ambulance workers. Furthermore, paramedics and emergency medical technicians may be exposed to bites from aggressive patients with dangerous infections that may then be transmitted to workers [16]. Importantly, assaults on paramedics and emergency medical technicians may also force some to end their careers [10]. Additionally, there are several factors that increase the risks of violence: a) inexperience and no anticipation of assaults, b) the role of the police, and c) the role of alcohol, drugs, and mental illness. Firstly, most assaults take place against ambulance workers who have insufficient experience in dealing with these incidents [9,15]. Furthermore, some ambulance workers do not anticipate encountering any violent threats when responding to emergencies [12,16]. Secondly, the role played by the police in controlling violent scenes so that they are safe for paramedics and emergency medical technicians is also important [12]. However, ambulance workers sometimes attend violent scenes where the police are not present. For example, Reichard et al. [9] found that more than half of the assaults on participants occurred at events where no police were present. Paramedics and emergency medical technicians also have to frequently deal with aggressive patients under the effects of alcohol, drugs, or mental illness [9,12,16]. For prevention, it is important to identify all the factors that lead to work-related assaults [11], improve the role played by the police in controlling violent incidents [12], train paramedics and emergency medical technicians in the application of risk-assessment strategies [9,12], teach workers how to communicate with aggressive patients safely [9], and, finally, teach them how to disarm patients who wield weapons [12].

## Slips, trips and falls

Evidence suggests that this type of event occurs repeatedly among paramedics and emergency medical technicians, often resulting in a loss of balance [9,11,13] that can cause back muscle disorders [10]. They occur most often when lifting and moving patients or equipment [9,10], especially when walking on slippery, wet and confined surfaces or stairs, or in poor weather conditions such as snow, sleet, and rain [9,10]. Cold weather conditions place paramedics and emergency medical technicians at higher risk of such events. This is because rates of work-related injuries among ambulance workers are higher in the winter than in the summer and are also higher at night than during the day [13]. This indicates that the highest risk of injury comes from a combination of winter conditions and dark locations. Moreover, Reichard et al. [9] found that the rates of injuries among those over 40 years old were higher than among younger workers. This is significant as it means that older paramedics are more exposed to such injuries than younger paramedics, despite having substantially more experience. Additionally, Reichard et al. [9] found that falls frequently occur due to rushing. It is therefore important to draw paramedics and emergency medical technicians' attention to the effects of rushing on both themselves and their patients [10,16]. In terms of prevention, Reichard et al. [9] argue that it is difficult to control environmental hazards that result in loss of balance injuries; however, training will help paramedics to avoid trips, slips, and falls when carrying patients. These suggestions are invaluable in highlighting the challenges involved in reducing environmental factors and the training required to avoid these risky events. Furthermore, durable and anti-slippery shoes are recommended for paramedics and emergency medical technicians [9]. Above all, training is required to reduce the impact of rushing [10].

## Individual, organisational, and environmental factors

There are several external factors that can also contribute to work-

related injuries and exposures. Individual factors can include: a lack of expectancy [12,16], improper reactions to unexpected situations, inadequate concentration [13,16], inexperience [9,14-16], a lack of fitness, rushing to finish final calls, partner problems [10], and the negative actions of other emergency responders [9,12]. Regarding the lack of expectancy, one study [12] found that some paramedics do not anticipate dangers during emergency calls and thus need more training while another [16] argues that it is difficult to anticipate these risks during calls. These findings highlight the difficulty of anticipating hazards and the importance of training in reducing this difficulty. In terms of improper reactions to unexpected situations and inadequate concentration, these factors are the main cause of 67% of injuries among Polish ambulance workers [13]. Moreover, insufficient concentration when using ambulance equipment may cause body-motion injuries [16]. These findings are crucial as appropriate reactions to unexpected situations and adequate concentration are required to reduce these injuries. In terms of inexperience, this is a primary cause of workplace injuries [15] as Salminen-Tuomaala et al. [16] found that inexperience results in the incorrect lifting of equipment or patients, Gülen et al. [14] found that needle stick injuries diminish with experience, and Reichard et al. [9] found that violence-related injuries are higher among ambulance workers with less than 4 years of experience. These findings suggest that training in the performance of emergency tasks may be helpful. Additionally, a lack of fitness, rushing to finish final calls, and partner problem, might also cause occupational injuries. Dropkin et al. [10] also found that: a) obesity among paramedics and emergency medical technicians might increase the risk of work-related back and shoulder injuries, b) rushing the last call to sign out from work early can expose paramedics and patients to further injuries, and c) some paramedics and emergency medical technicians look for experienced partners rather than new partners due to their inexperience. These findings are important as all three factors should be considered as potential causes of injuries among workers or patients and therefore need to be resolved. In terms of the negative actions of other emergency responders, some fire fighters and police disregard the ambulance crews' safety as they leave incidents during the night without ensuring ambulance workers on dark highways are safe [12]. Moreover, Reichard et al. [9] found that more than 60% of violent incidents occurred without any police present. These findings are important in highlighting the negative role sometimes played by other emergency personnel which can increase the risk of occupational injuries or deaths. Organisational factors may comprise low salaries, multiple jobs, long tours, lack of breaks [10], ambulance design [9,10], and a lack of reporting [10,13,14]. Regarding the low salaries and multiple jobs, low wages mean that paramedics sometimes take a second job to compensate and are therefore at greater risk of injuries due to overexertion and fatigue [10]. This highlights a key issue regarding low salaries and should be addressed by employers. Regarding long tours and the need for breaks, responses to long distance calls can lead to occupational fatigue and injuries due to increased work hours and extended shifts while a lack of breaks may also increase fatigue and cause workplace injuries [10]. In relation to ambulance design, ambulance workers are exposed to injuries inside the ambulance patient compartment due to accidents caused by unrestrained or loose equipment [9]. This suggests that improvements in ambulance design are needed to ensure that ambulance equipment is appropriately restrained. Regarding the limited reporting of work-related injuries and exposures, effective policies are needed to enable staff to report potential or actual occupational harms [10]. However, the authors of two studies [13,14] argue that, based on their research, most ambulance workers do not report work-related injuries and exposures. This endorses the need to

improve reporting policies or change the safety culture among workers so that they are more inclined to report their injuries and exposures. Finally, environmental factors such as weather conditions can lead to workplace injuries when carrying patients during snow, sleet, and rain as this leads to slippery or wet conditions on confined surfaces or stairs [9,10,13]. Moreover, rates of such injuries are higher at night as darkness makes it more likely that other motorists will pose a risk to ambulance workers [13]. These weather conditions should therefore be taken into consideration as they can increase rates of workplace injuries and sometimes result in occupational deaths.

## Limitations

This literature review has comprehensively addressed the topic area by considering work-related injuries and exposures in terms of consequences, events, suggested forms of prevention, causal factors, and recommended actions. However, there are also several limitations that need to be addressed, which include the following: a) this review was conducted by the author in isolation rather than as part of a team. This may have led to a weaker interpretation of the outcomes and more robust ideas being overlooked; b) there may be other published papers that have come to light since undertaking this review, but these have not been considered. Therefore, the review may lack more recent results that were worthy of inclusion; c) only a small number of countries were focused upon which limits the generalisability of the findings and may not represent issues relevant to workplace harms among paramedics and emergency medical technicians in different countries; d) some valuable articles that were identified did not provide online access which means some valuable results may have been missed; e) some studies that were not written in English were excluded which means some important findings may have been missed. Although such limitations impact the findings of this review, identifying them will be helpful in reducing their impact on future, more substantial work.

## Conclusions and Recommendations

This review has shown that: a) musculoskeletal injuries are the most frequent work-related injuries, commonly involving the neck, shoulder, chest, back, and extremities. b) work-related injuries and exposures can lead to work dissatisfaction, lost workdays, physical limitations following injuries, and career ending injuries. c) Paramedics and emergency medical technicians may encounter the following work-related events: body-motion injuries, exposure to harmful substances, accidents during ambulance operations, violence, and slips, trips and falls. Therefore, each event should be investigated separately in future research to gain deeper knowledge about effective prevention for each event. d) The individual, organisational and environmental factors include a lack of expectancy, improper reactions to unexpected situations, inadequate concentration, inexperience, poor fitness, rushing, partner problems, the negative actions of other emergency responders, low salaries, multiple-jobs, long tours, lack of breaks, ambulance design, a lack of reporting and weather conditions. These should be considered in future research to reduce their impact and develop possible solutions. All these conclusions imply that work-related injuries and exposures are prevalent amongst paramedics and emergency medical technicians. Finally, this review made the following recommendations for future research and practice to reduce rates of work-related injuries and exposures:

- 1) All factors that lead to occupational injuries should be addressed to facilitate the implementation of appropriate preventive solutions.
- 2) Meetings between supervisors and ambulance workers should

be held to discuss individual and organisational factors that lead to workplace injuries and exposures.

3) Enhancing the safety culture among paramedics and emergency medical technicians to provide safer work environments.

4) Ensuring paramedics and emergency medical technicians follow the most up to date guidelines and traffic policies on the use of ambulance seatbelts and personal protective equipment.

5) Increasing awareness of the safety and workplace risks that need to be considered during each emergency call.

6) Enhancing relationships with other emergency responders such as firefighters and police during ambulance operations.

7) Improving ambulance design so that ambulances are safer for workers and patients.

8) Effective policies for reporting work-related injuries and exposures are required to facilitate the reporting process.

9) Using data gathered on work-related injuries and exposures in future research and training programmes in order to estimate these occupational issues and develop proactive solutions.

10) Paramedics and emergency medical technicians need to be educated and trained to apply preventive solutions appropriately and should be supervised regularly to benefit from these solutions.

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#### References

1. Gray SE, Collie A (2017) The nature and burden of occupational injury among first responder occupations: A retrospective cohort study in Australian workers. *Injury* 48: 2470-2477.
2. Maguire BJ, Hunting KL, Smith GS, Levick NR (2002) Occupational fatalities in emergency medical services: A hidden crisis. *Ann Emerg Med* 40: 625-632.
3. Maguire BJ, Hunting KL, Guidotti TL, Smith GS (2005) Occupational injuries among emergency medical services personnel. *Prehospital Emerg Care* 9: 405-411.
4. Weaver MD, Wang HE, Fairbanks RJ, Patterson D (2012) The association between EMS workplace safety culture and safety outcomes. *Prehospital Emerg Care* 16: 43-52.
5. Roberts MH, Sim MR, Black O, Smith P (2015) Occupational injury risk among ambulance officers and paramedics compared with other healthcare workers in Victoria, Australia: Analysis of workers' compensation claims from 2003 to 2012. *Occup Environ Med* 72: 489-495.
6. da Costa Santos CM, de Mattos Pimenta CA, Nobre MR (2007) The PICO strategy for the research question construction and evidence search. *Rev Lat Am Enfermagem* 15: 508-511.
7. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group (2009) Preferred Reporting items for Systematic Reviews and Meta Analysis: The PRISMA Statement. *PLoS Med* 6: e1000097.
8. Evans D (2003) Hierarchy of evidence: A framework for ranking evidence evaluating healthcare interventions. *J Clin Nurs* 12: 77-84.
9. Reichard AA, Marsh SM, Tonozzi TR, Konda S, Gormley MA (2017) Occupational Injuries and Exposures among Emergency Medical Services Workers. *Prehospital Emerg Care* 21: 420-431.
10. Dropkin J, Moline J, Power PM, Kim H (2015) A qualitative study of health problems, risk factors, and prevention among Emergency Medical Service workers. *Work* 52: 935-951.
11. Maguire BJ, O'Meara PF, Brightwell RF, O'Neill BJ, Fitzgerald GJ (2014) Occupational injury risk among Australian paramedics: an analysis of national data. *Med J Aust* 200: 477-480.
12. Taylor JA, Davis AL, Barnes B, Lacovara AV, Patel R (2015) Injury risks of EMS responders: Evidence from the National Fire Fighter Near-Miss Reporting System. *BMJ Open* 5: 1-8.
13. Garus-Pakowska A, Szatko F, Ulrichs M (2017) Work-related accidents and sharp injuries in paramedics—illustrated with an example of a multi-specialist hospital, located in central Poland. *Int J Environ Res Public Health*.
14. Gülen B, Serinken M, Hatipoğlu C, Özaşır D, Sönmez E, et al. (2016) Work-related injuries sustained by emergency medical technicians and paramedics in Turkey. *Ulus Travma Acil Cerrahi Derg* 22: 145-149.
15. Gałazkowski R, Binkowska A, Samoliński K (2015) Occupational injury rates in personnel of emergency medical services. *Ann Agric Environ Med* 22: 680-684.
16. Salminen-Tuomaala M, Leikkola P, Paavilainen E (2014) Patient and Staff Safety Incidents and Near Misses in Out-Of-Hospital Emergency Care. *Emergency Med* 4: 219.
17. Vijayanathan A, Nawawi O (2008) The importance of Good Clinical Practice guidelines and its role in clinical trials. *Biomed Imaging Interv*.
18. Long A, Godfrey M, Randall T, Brettle A, Grant, MJ (2002) HCPRDU evaluation tool for qualitative studies.
19. Long A, Godfrey M, Randall T, et al. (2002) HCPRDU evaluation tool for quantitative studies.
20. Long AF, Godfrey M, Randall T, Brettle A, Grant, MJ (2002) HCPRDU evaluation tool for mixed methods studies.