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REVIEW ARTICLE

Occupational injuries presenting to emergency departments among health care workers: a systematic review

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ABSTRACT

Background: Healthcare workers (HCWs) face a multitude of occupational hazards, leading to a high burden of work-related injuries. Many of these injuries necessitate treatment in emergency departments (EDs), yet a comprehensive understanding of their characteristics within this specific context is evolving. This article aimed to synthesize existing evidence on the types, causes, and characteristics of occupational injuries among HCWs that are treated in or reported from ED settings.

Methods: A literature search through PubMed, Scopus, Web of Science, and Cochrane was performed to select the included studies. Data on study design, setting, participant characteristics, injury types, causes of injury, risk factors, and preventive measures were extracted and synthesized primarily from studies reporting ED-treated injuries.

Results: The included studies, predominantly from the USA with two from the Middle East, varied in design and specific HCW populations [emergency medical services (EMS) personnel, hospital-based HCWs, paramedicine clinicians]. Sprains and strains, and exposures (blood/body fluid, harmful substances) were consistently high-prevalence injury types. Leading causes of injuries included body motion/overexertion, transportation incidents (especially for EMS), and exposures. For HCWs in hospital settings, needlestick injuries and slips, trips, and falls were also prominent. Workplace violence was a significant cause of injury, particularly for hospital staff. Risk factors varied by HCW type and setting but included lifting/patient handling, inadequate personal protective equipment (PPE) use, and environmental hazards.

Conclusion: Occupational injuries requiring ED visits are a significant concern across various HCW groups. Musculoskeletal injuries, exposures, and transportation-related incidents are major contributors, particularly for EMS. Workplace violence and sharps injuries are critical issues within hospital settings. Targeted interventions focusing on ergonomic support, PPE adherence, violence prevention, and enhanced safety protocols are crucial for mitigating these risks. Improved, standardized data collection, especially for ED-treated occupational injuries, is needed globally.

Keywords: Occupational injuries, health care workers, emergency department, emergency medical services, workplace violence.

Introduction

Healthcare workers (HCWs) are indispensable to societal well-being, operating in environments fraught with diverse occupational hazards that predispose them to a higher rate of work-related injuries compared to many other sectors [1,2]. The US Bureau of Labor Statistics (BLS) reported that healthcare recorded the highest number of nonfatal recordable injuries and illnesses in 2022, with an incidence rate substantially exceeding other industries such as construction and manufacturing [3]. These injuries not only impact the physical and psychological health of HCWs but also

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lead to significant absenteeism, modified work, and substantial economic costs to the healthcare system [1,4].

Emergency medical services (EMS) personnel, a critical subset of HCWs, are particularly vulnerable due to the dynamic and often uncontrolled environments in which they operate. They incur occupational injuries at a higher rate than the general worker population [5], with musculoskeletal injuries from patient handling and transportation incidents being prominent causes [6,7]. Studies have shown that EMS professionals experience high rates of both fatal and nonfatal injuries, with motor vehicle incidents and overexertion being the leading causes, respectively [8].

Within hospital settings, HCWs face a spectrum of risks including exposure to biological hazards such as bloodborne pathogens (BBP) from needlestick injuries (NSIs) and other sharps [1,9], chemical and physical hazards, ergonomic stressors from patient lifting and repetitive tasks [1], and an increasing incidence of workplace violence [10]. Globally, millions of HCWs are exposed to BBPs annually, leading to serious infections [11], and musculoskeletal disorders are highly prevalent [12]. Falls, slips, and trips also contribute significantly to injuries among HCWs [1].

Many occupational injuries sustained by HCWs are severe enough to require assessment and treatment in hospital emergency departments (EDs). Data from systems like the National Electronic Injury Surveillance System - Occupational Supplement (NEISS-Work) have been instrumental in characterizing ED-treated injuries among specific HCW groups like EMS personnel [5,13]. However, the overall landscape of ED-treated occupational injuries across the broader HCW population, including different roles and geographical settings, requires continuous synthesis to inform targeted prevention strategies. While individual studies have highlighted specific injury patterns, a systematic consolidation of findings focusing on ED presentations can provide a clearer picture of the acute injury burden.

This systematic review aims to examine and synthesize data from selected studies on the burden, types, causes, risk factors, and preventive measures associated with occupational injuries among HCWs that were treated in, or reported from, EDs or through surveillance systems capturing injuries often requiring ED-level care.

Methods

Search strategy and study selection

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [14]. A comprehensive literature search was performed to identify studies reporting on occupational injuries among HCWs that were treated in or presented to EDs.

The search strategy involved querying major electronic databases, including PubMed, Scopus, Web of Science, and Cochrane from their inception to June 2025. The search string utilized was as follows: ("work-related injur*" OR "work related injur*" OR "occupational injur*" OR "workplace injur*" OR "job-related injur*" OR "job related injur*" OR "industrial accident*" OR "Occupational Injur*") AND ("emergency department*" OR "emergency room*" OR "emergency service*" OR "accident and emergency" OR "A&E" OR "trauma center*" OR "trauma centre*" OR "Emergency Ward*" OR "Emergency Unit*").

No language restrictions were initially applied during the search phase, though final inclusion was limited to studies published in English for feasibility. The reference lists of identified relevant articles and systematic reviews were also manually screened for additional potentially eligible studies.

Eligibility criteria

Studies were included if they met the following criteria: 1) the target population are HCWs, including but not limited to physicians, nurses, EMS, paramedics, nursing assistants, allied health professionals, and other hospital staff; 2) exposed to occupational injury; and 3) injuries treated in, presenting to, or reported from an ED, or studies using surveillance systems (e.g., NEISS) specifically designed to capture ED-treated occupational injuries. Studies reporting on broader injury categories (e.g., Occupational Safety and Health Administration (OSHA) -recordable, lost-time injuries) were considered if a substantial proportion of these injuries would likely involve ED assessment or treatment, or if ED presentation was a specific focus or outcome measure.

Study screening and selection

Two reviewers independently screened titles and abstracts of the retrieved records against the eligibility criteria. Full-text articles of potentially relevant studies were then obtained and assessed independently by both reviewers for final inclusion. Any disagreements regarding study eligibility were resolved through discussion or consultation with a third reviewer.

Data extraction

Data were extracted independently by two reviewers using a standardized data extraction form. Information collected included: 1) Study characteristics, including first author, publication year, country of study, study design, healthcare setting, data source for injuries, and study period. 2) Participant characteristics, including total sample size, type of HCW population, and gender distribution, where available. 3) Injury details, including types of injuries, causes of injury, identified risk factors, and preventive measures or recommendations reported in the studies.

Quality assessment

The Newcastle-Ottawa Scale [15] was used to evaluate the risk of bias in cohort studies. This tool employs a star-based rating system across three key domains: selection of study groups, comparability of groups, and outcome assessment. Within each domain, specific methodological criteria are assessed, with one star awarded per satisfied criterion (except for comparability, which permits up to two stars). This structured approach allows for a standardized evaluation of study quality.

For non-randomized non-controlled studies, the Risk of Bias in Non-randomized Studies - of Interventions (ROBINS-I) tool [16] was applied. ROBINS-I systematically examines seven critical domains: confounding, participant selection, intervention classification, deviations from intended interventions, missing data, outcome measurement, and selective reporting. Each domain is assessed using targeted signaling questions, enabling reviewers to classify bias risk on a spectrum from "Low" to "Critical." These individual domain evaluations collectively inform the overall bias risk assessment for each studied outcome.

Data synthesis and analysis

A qualitative synthesis approach was employed to summarize the findings from the included studies. Due to anticipated heterogeneity in study methodologies, populations, and outcome reporting, a quantitative meta-analysis was not planned. The focus was on identifying common patterns, trends, and key takeaways from the studies providing data on ED-treated occupational injuries.

Results

Study selection

The initial database search yielded 1,090 records. After removing duplicates, 951 records remained. Screening of titles and abstracts led to the exclusion of 916 records that did not meet the eligibility criteria. The full texts of the remaining 35 articles were assessed for eligibility. This process resulted in the final inclusion of eight studies for this systematic review (Figure 1).

Study characteristics

The characteristics of the eight included studies are detailed in Table 1. A majority of these studies, six in total, were conducted in the USA [5-8,10,13], complemented by one study from Saudi Arabia [17] and one from Lebanon [1]. These investigations were published between 2010 and 2025. The predominant study designs were retrospective analyses of surveillance or existing administrative data. Data sources were varied, encompassing national surveillance systems such as NEISS [5,8,13] and BLS/Department of Labor (DOL) databases [7], specific hospital networks like Occupational Health Safety Network (OHSN) [10], and institutional record systems including Austin Travis County EMS, Exposure Prevention Information Network, and Environmental Health, Safety, and Risk Management incident reports [1,6,17]. The duration of these studies also varied, with data collection periods spanning from the year 2000 up to 2022.

Participant characteristics

Participant details from the included studies are summarized in Table 2. The research encompassed diverse HCW populations; five studies specifically focused on EMS personnel or paramedicine clinicians [5-8,13], while three studies examined broader hospital-based HCW groups [1,10,17]. The total number of injuries analyzed showed considerable variation across studies. For instance, among studies explicitly concentrating on ED-treated injuries in EMS workers, Reichard et al. [5] represented an estimated 89,100 such injuries. Reichard and Jackson [13] reported an annual figure of 21,900 ED-treated injuries for EMS personnel, and Reichard et al. [8] estimated a total of 99,400 ED-treated nonfatal injuries over a 5-year period for the same group. In a study of general hospital HCWs, Khairallah et al. [1] identified 208 injuries that necessitated an ED visit. Regarding gender distribution, male HCWs were predominant in EMS-focused studies, ranging from 67% to 74% [5,7,8,13]. In contrast, Groenewold et al. [10] reported that males accounted for 25.9% of hospital HCWs injured due to workplace violence, and Khairallah et al. [1] found that 52.08% of HCWs whose injuries required an ED visit were male.

Occupational injuries treated in EDs

Types of injuries

Several of the reviewed studies provided specific data on ED-treated injuries, as detailed in Table 3. Among EMS workers, analyses of NEISS data consistently identified sprains and strains as the most frequent ED-treated diagnosis. These accounted for a significant portion of injuries, ranging from 38.4% to 41.1%. Other commonly reported ED-treated diagnoses for EMS personnel included exposures, accounting for about 20% [5], contusions, abrasions, or crushing injuries, which represented 14% to 16.6% of cases [5,8,13], and puncture or laceration injuries, accounting for 10% to 14.2% [5,8,13].

For general HCWs within a hospital setting, Khairallah et al. [1] utilized ED visits as a marker for injury severity, identifying 208 such injuries. Other studies captured broader injury categories that would likely encompass ED visits. Maguire et al. [7], using US DOL data for paramedicine clinicians, found that sprains, strains, and tears (50.9%), along with back injuries (31.5%), were major types of injuries that involved lost work time or medical treatment beyond first aid. In a Saudi Arabian hospital context, Zaidi and Behisi [17] reported that blood and body fluid exposures (BBFEs) were

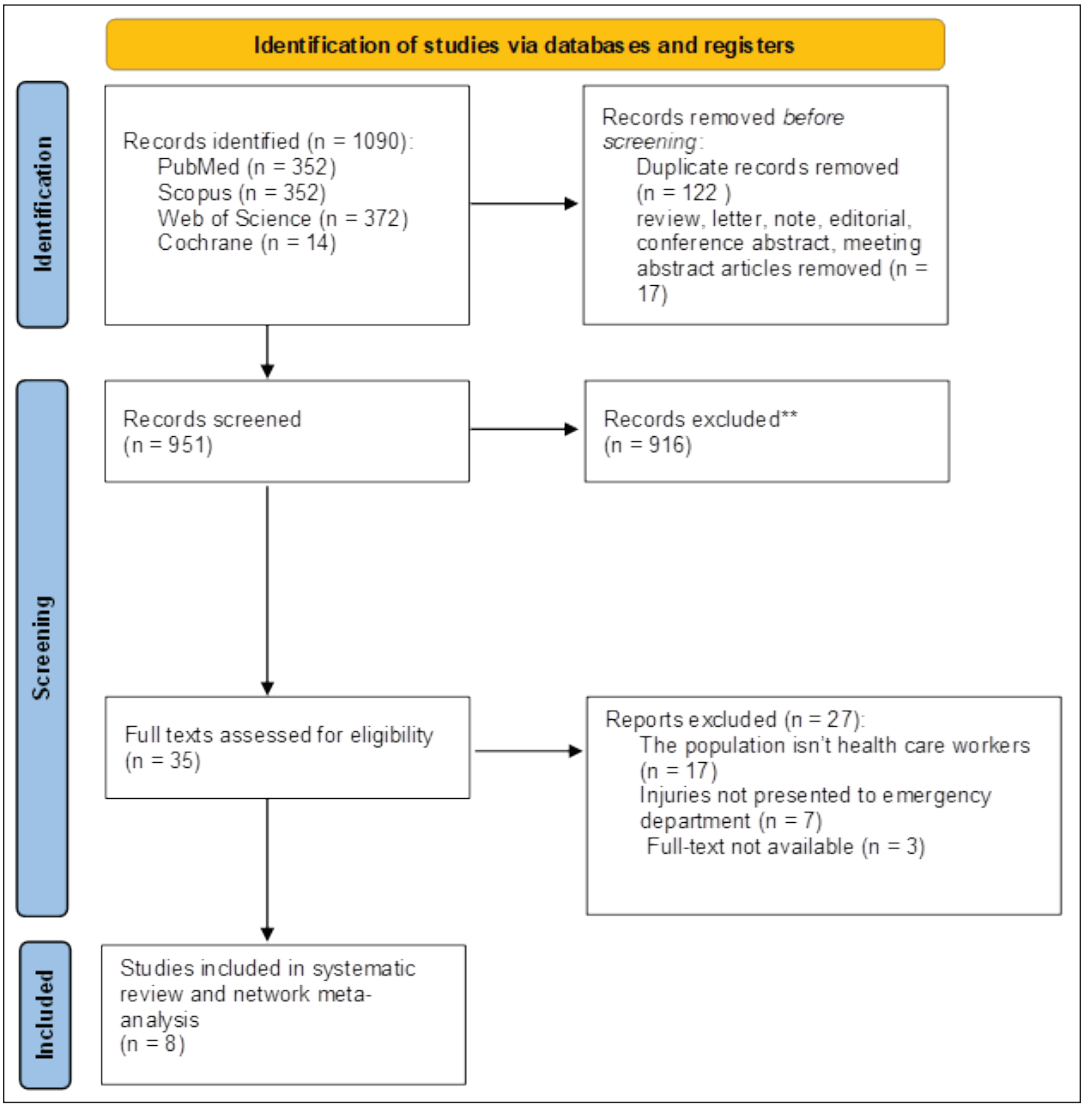

Figure 1. *PRISMA flow diagram.*

the most common overall injury at 56.7%, with NSIs comprising 48.1% of all occupational injuries; many of these would typically require ED assessment for post-exposure management. Groenewold et al. [10], focusing on US hospitals, documented 3,263 OSHA-recordable workplace violence events, a category of injury that by definition could involve ED care. Finally, Studnek et al. [6] highlighted the prevalence of musculoskeletal injuries among EMS staff, particularly strains/sprains (36.9% pre-intervention) and back injuries (20.7% pre-intervention), which frequently lead to ED visits.

Causes of injury

Regarding the causes of ED-treated injuries among EMS workers, body motion or overexertion was consistently reported as a leading factor, responsible for 28% of cases in the Reichard et al. [5] study and 39.3% in the Reichard and Jackson [13] study. Exposures to harmful substances also constituted a significant cause, ranging from 20.5% to 27% [5,13]. While transportation incidents accounted for a smaller proportion of nonfatal ED-treated injuries (8% to 9.6%) [5,13], they were identified by Reichard et al. [9] as the predominant cause of fatalities among EMS personnel, with motor vehicle incidents comprising 45% and aircraft incidents 31%. Slips, trips, and falls were noted as the cause in 16% of ED-treated EMS injuries by Reichard et al. [5].

For general HCWs, Khairallah et al. [1] found that transportation accidents were significantly more likely to result in an ED visit. Workplace violence was identified by Groenewold et al. [10] as the sole cause for all 3,263 OSHA-recordable injuries within the OHSN hospitals they studied, with patients being the primary assailants in most known cases. NSIs were a major direct cause of BBFEs reported by Zaidi and Behisi [17]. Among EMS personnel, Studnek et al. [6] specifically identified the

Table 1. *General characteristics of the included studies.*

Study	Country	Study design	Setting	Data source for injuries	Study duration
Reichard et al. [8]	USA	Retrospective cohort	National surveillance	BLS CFOI and NEISS	2003-2007
Reichard and Jackson [13]	USA	Retrospective cohort	U.S. hospital EDs	NEISS	2000-2001
Studnek et al. [6]	USA	Non-randomized non-controlled trial	Urban EMS system (A/TCEMS)	A/TCEMS Record Management System and Worker Compensation database	Pre-intervention: 1999-2006; post-intervention: 2007-Apr 2008
Maguire et al. [7]	USA	Retrospective cohort study	National surveillance	US DOL, BLS	2010-2020
Reichard et al. [5]	USA	Retrospective cohort	National sample of hospital EDs	NEISS	July 2010-June 2014
Groenewold et al. [10]	USA	Retrospective cohort	106 US hospitals participating in OHSN	OHSN	2012-2015
Zaidi and Behisi [17]	Saudi Arabia	Retrospective cohort	Tertiary care hospital (Johns Hopkins Aramco Healthcare)	EPINet, Datix reporting system	Jan 2017-Dec 2020
Khairallah et al. [1]	Lebanon	Retrospective cohort	Tertiary care hospital (American University of Beirut Medical Center)	Incident reports to EHSRM department.	Jan 2018-Dec 2022

A/TCEMS = Austin Travis County EMS; CFOI = census of fatal occupational injuries; EPINet = Exposure Prevention Information Network; EHSRM = Environmental Health, Safety, and Risk Management.

Table 2. *A summary of participant characteristics.*

Study	Total sample size	Total number of injuries	HCW type	Males n (%)
Reichard et al. [8]	99,400 nonfatal injuries; 65 fatal injuries		EMTs	Fatal: 48 (74%); nonfatal: 68,700 (69%)
Reichard and Jackson [13]	21,900		EMS	14,900 (68%)
Studnek et al. [6]	Pre-intervention: 1,275 injuries Post-intervention 203 injuries		EMS	NR
Maguire et al. [7]	1,289,000	43,020	Paramedicine clinicians	411,288 (67%)
Reichard et al. [5]	89,100 injuries		EMS workers	59,900 (67%)
Groenewold et al. [10]	3,263 injuries		HCWs (nurses, nursing assistants, non-patient care)	844 (25.9%)
Zaidi and Behisi [17]	187 injuries		HCWs (nurses, physicians, allied health, students, housekeeping)	NR
Khairallah et al. [1]	208 Injuries required ED visit		HCWs (nurses, allied health, residents, physicians)	375 (52.08%)

EMT = emergency medical technician (including paramedics. ambulance drivers, and attendants).

tasks of lifting and lowering patient stretchers as a key cause of musculoskeletal injuries.

Identified risk factors

A variety of risk factors contributing to these injuries were identified across the studies, with full details available in Table 3. Specific to EMS personnel, patient handling tasks such as lifting, carrying, and transferring, particularly involving heavy patients, were prominent risks, alongside inadequate use of personal protective equipment (PPE) during exposures, having less work experience, being actively engaged on a 911 call, and an age of 40 years or older for body motion injuries [5,13]. For general HCWs and those in hospital settings, occupying roles such as nursing assistant or nurse correlated with the highest rates of workplace violence [10]. Nurses were also noted as the group most affected by BBFEs in one study [17], while another hospital-based study found male sex to be a risk factor for injuries requiring an ED visit [1]. Certain work environments, such as operating theaters and EDs, were identified as high-risk locations for BBFEs [17]. For paramedicine clinicians with injuries requiring medical attention or lost work time, female gender was associated with higher injury rates, and

Table 3. *Summary of the included articles.*

Study (author, year)	Injury type	Causes of injury	Identified risk factors	Preventive measures/ recommendations
Reichard et al. [5]	Sprains/strains: 37,000 (41%); Exposure (diagnosis): 17,400 (20%); Contusions/ abrasions/crushing: 12,400 (14%); Puncture/ laceration: 9,100 (10%); Fracture/dislocation: 4,200 (5%); Other: 9,000 (10%)	Body motion: 24,900 (28%); Exposures (harmful substances): 24,400 (27%); Slips/trips/falls: 14,000 (16%); Motor vehicle incidents: 7,400 (8%); Assaults/ violence: 6,400 (7%)	Less work experience, being on a call (911 calls), lifting/carrying/ transferring patients or equipment (especially heavy patients), inadequate PPE use for exposures, age 40+ (for body motion injuries), working >8 hours in a shift, patient handling activities during loss of balance	New and enhanced efforts to prevent body motion injuries and harmful substance exposure. EMS and public safety agencies should consider adopting and evaluating injury prevention measures (e.g., training on safe lifting, proper PPE use, violence prevention strategies)
Maguire et al. [7]	Sprains, strains, and tears: 39,350 (50.9%); Back injuries: 24,350 (31.5%); Multiple traumatic injuries: 1,010 (1.3%)	Over-exertion and bodily reaction: 42,340 (54.8%); Falls, slips, and trips: 10,760 (13.9%); Transportation-related injuries: 5,800 (7.5%); Violence-related injuries: 4,260 (5.5%)	Female gender (50% higher injury rate than men), older age (35-54 showed increased risk), healthcare patient as source of injury, fatigue, stress, multiple jobs	Need for EMS-specific research to develop evidence-based risk-reduction interventions. Enhanced data systems for tracking injuries. Potential interventions include ergonomic equipment (powered stretchers), training (strength, flexibility, de-escalation), PPE use, and seat belt use
Groenewold et al. [10]	Total injuries reported: 3,263	All injuries were due to violence	Nursing assistants and nurses (highest rates). Patient as assailant (94.8% of reported). Publicly owned hospitals had lower rates	Improved and more complete data collection on severity, assailant, and type of assault. Comprehensive, data-driven prevention programs (educational, organizational, medical, structural). Hazard control matrix
Reichard and Jackson [13]	Sprains/strains: 9,000 (41.1%); Contusions/ abrasions: 2,800 (12.8%); Puncture: 1,700 (7.8%); Laceration: 1,200 (5.5%); Other diagnoses (incl. unspecified pain, exposures as diagnoses): 6,300 (28.8%)	Bodily motions: 8,600 (39.3%); Harmful exposure: 4,500 (20.5%); Contact with objects/ equipment: 3,400 (15.5%); Transportation incidents: 2,100 (9.6%); Falls: 1,700 (7.8%); Assaults and violent acts: 1,100 (5.0%)	Physical demands of emergency response, lifting/moving patients (EMS), fires/explosions (firefighters), assaults (police). Volunteer status (potentially lower apparent rates due to exposure differences)	Training on safer body postures/movements, ergonomically appropriate equipment, improved physical fitness, policy interventions, reducing traffic safety hazards, assault/violence prevention
Khairallah et al. [1]	208 injuries required ED visits	Transportation accidents were more likely to require an ED visit	Male sex	Engineering controls (safety devices, ergonomic design), Safe Patient Handling and Motility programs, improved occupational health documentation, psychosocial support, behavioral change interventions
Studnek et al. [6]	All injuries were musculoskeletal injuries	Tasks involving the lifting and lowering of patient stretchers	Manual lifting and lowering of stretchers	Implementation of electrically powered patient stretchers. Evidence-based ergonomic approach

Continued

Study (author, year)	Injury type	Causes of injury	Identified risk factors	Preventive measures/ recommendations
Reichard et al. [8]	Nonfatal injuries: Sprains and strains: 38,200 (38.4%); Contusions and abrasions: 16,500 (16.6%); Lacerations and punctures: 14,100 (14.2%) Fatal injuries: 65	Nonfatal injuries: Bodily reaction and exertion: 32,500 (32.7%); Exposure to harmful substances or environments: 20,800 (20.9%); Contact with objects and equipment: 17,800 (17.9%) Fatal injuries: Motor vehicle incidents (highway incidents): 29 (44.6%); Aircraft crashes (air transportation incidents): 20 (30.8%); Other transportation incidents (e.g., struck by vehicle): 8 (12.3%); Other nontransportation causes: 8 (12.3%)	Fatalities: Motor vehicle incidents (collisions, failure of other vehicle to yield, lack of seat belt, adverse weather), air transportation incidents (adverse weather, mountainous terrain). Nonfatal: Lifting/moving patients, exposure to bodily fluids/needles. Female EMTs face similar risks to males	Targeted efforts to prevent ground and air transportation incidents. Development and evaluation of interventions to prevent bodily stress and overexertion injuries (patient handling equipment/techniques, safety culture assessment)
Zaidi and Behisi [17]	BBFE: 106 (56.7%); Slips, trips, and collisions: 28 (15.0%); Other sharps injury: 19 (10.2%); Injury caused by physical or mental strain: 12 (6.4%); Injury caused by workplace violence or assaults: 9 (4.8%); Traffic accident (outside the organization performing organizational duty): 6 (3.2%); Manual handling: 4 (2.1%); Dermatitis: 3 (1.6%)		Being a nurse (most affected by BBFEs). High-risk locations: operating theaters, emergency room (for BBFEs)	Strict safety protocols, regular training on handling sharp instruments, use of PPE, safe patient handling protocols, adherence to standard precautions, enhancing workplace ergonomics, environmental safety measures

EMT = emergency medical technician.

older age (35-54 years) also posed an increased risk [7].

Preventive measures and recommendations

The preventive measures and recommendations proposed by the included studies, detailed in Table 3, consistently advocated for multifaceted approaches to enhance HCW safety. There was a strong emphasis on ergonomic solutions and engineering controls, such as training in safer body mechanics, the use of ergonomically appropriate equipment such as powered stretchers (which demonstrated a reduction in stretcher-related injuries [6], safety-engineered sharps devices, and overall ergonomic workplace design [1,5,6,13,17]). Training and protocol adherence were also key, with recommendations for education on safe lifting techniques, correct PPE usage, proper sharps handling, de-escalation techniques to manage violence, and adherence to standard precautions [1,5,10,13,17]. Furthermore, administrative and policy interventions were highlighted, including the development and evaluation of comprehensive injury prevention programs, Safe Patient Handling and Motility programs, robust violence prevention policies, improved occupational health documentation systems, and the cultivation of a strong safety culture within healthcare organizations [1,5,8,10]. The importance of improved data collection and surveillance systems was a recurring theme, particularly for better understanding injury severity, details of violent incidents, and generally enhancing injury tracking capabilities [7,10]. Specific hazard-focused recommendations included targeted efforts to prevent transportation incidents for EMS personnel [8] and the implementation of strict safety protocols for the prevention of BBFEs [17].

Quality assessment

The methodological quality of the included cohort studies was predominantly good, with most demonstrating robust selection, exposure ascertainment, and outcome assessment (Table 4). The single non-randomized interventional study, however, faced a serious risk of bias, primarily due to potential confounding factors inherent in its pre-post design without a control group [6].

Discussion

This systematic review, drawing upon eight studies of occupational injuries among various HCW populations, underscores the significant and multifaceted risks these professionals face, particularly those injuries necessitating ED care or otherwise meeting criteria for significant medical attention.

Table 4. *Summary of quality assessment of the included cohorts.*

Study title	Representativeness of the exposed cohort	Selection of the non-exposed cohort	Ascertainment of exposure	Demonstration that outcome of interest was not present at the start of the study	Comparability of cohorts on the basis of the design or analysis	Assessment of outcome	Was follow-up long enough for outcomes to occur	Adequacy of follow-up of cohorts	Quality score	Quality
Reichard et al. [8]	*	*	*	*	**	*	*	*	8	Good
Reichard and Jackson [13]	*	*	*	*	*	*	*	*	8	Good
Maguire et al. [7]	*	*	*	*	**	*	*	*	8	Good
Reichard et al. [5]	*		*	*	*	*	*	*	7	Good
Groenewold et al. [10]	*		*	*	*	*	*	*	7	Good
Zaidi and Behisi [17]	*		*	*		*	*	*	6	Fair
Khairallah et al. [1]	*		*	*	*	*	*	*	7	Good

The high prevalence of musculoskeletal injuries, especially sprains and strains resulting from body motion and overexertion, particularly among EMS personnel, aligns with extensive previous research. As discussed by Reichard and Jackson [13], the physical demands of emergency response inherently led to such injuries, suggesting that interventions focusing on safer body mechanics, ergonomic equipment, and physical fitness could offer cross-occupational benefits within emergency response. The evaluation by Studnek et al. [6] of electrically powered stretchers pointed toward the potential of ergonomic interventions to reduce specific injury types, a sentiment echoed in the nursing literature regarding mechanical lifts [18-20]. The continued high rates of these injuries, as reported by Maguire et al. [7] using more recent national data, indicate that effective risk-reduction strategies for overexertion remain a critical need.

Exposures to harmful substances, notably BBFEs, including NSIs, are a persistent hazard, particularly within hospital settings. Zaidi and Behisi [17] highlighted BBFEs as the most common occupational injury in their tertiary hospital setting, with nurses disproportionately affected. This is consistent with global concerns about BBFEs and the risk of pathogen transmission [21]. While Khairallah et al. [1] found that BBFEs were less likely to result in an ED visit compared to other mechanisms, they acknowledged the substantial psychological burden and the necessity of established post-exposure protocols. The low use of PPE for some exposures, as noted by Reichard et al. [5] for EMS workers, underscores the ongoing need for adherence to standard precautions and availability of appropriate PPE [22,23].

Transportation incidents remain a critical area of concern, especially for EMS personnel, being a leading cause of fatalities as detailed by Reichard et al. [8]. In agreement with their findings, previous literature emphasized the need for continued safety improvements in both ground and air medical transportation, including vehicle design, operator training, and policy [24,25]. The finding by Khairallah et al. [1] that transportation-related injuries were more likely to be severe and require ED visits for general HCWs, particularly in low- and middle-income countries' contexts with potentially challenging commuting conditions, broadens this concern beyond just on-duty emergency vehicle operations.

Workplace violence is a serious and increasingly recognized hazard. Groenewold et al. [10] focused entirely on this issue in US hospitals. Previous literature also discussed the underappreciated disparity in injury rates between nurses and nursing assistants compared to other staff and the predominance of patient-perpetrated violence [26]. Their call for improved data collection to understand the nuances of these events is crucial for developing effective prevention programs, as current surveillance often lacks detail on assailants and specific circumstances [10]. The need for comprehensive, data-driven violence prevention programs, including de-

escalation training and organizational support, is echoed by recommendations for EMS personnel as well [5].

Several studies discussed the importance of a robust safety culture and organizational support in mitigating injury risks. Reichard et al. [8] suggested that assessing workplace safety culture could provide valuable insights for agency-based prevention efforts.

Strengths and limitations

This review synthesizes data from a range of studies, providing an overview of ED-treated and other significant occupational injuries among HCWs. The inclusion of studies from different geographical regions (USA, Middle East) and HCW types offers a broader perspective.

However, there are limitations. The heterogeneity in study designs, populations, injury definitions, and data sources makes direct comparison of rates challenging. Most studies relied on retrospective data, which can be subject to reporting biases and missing information. The limited region distribution, where most of the articles were US-based studies, limits generalizability, though the inclusion of two Middle Eastern studies begins to address this.

Recommendations and implications

The findings reinforce the need for healthcare organizations to prioritize HCW safety. Policies should mandate the use of engineering controls, support comprehensive training programs, and foster a non-punitive reporting culture. Investment in ergonomic equipment, adequate staffing levels to reduce overexertion, and robust violence prevention programs are essential. For EMS, continued focus on vehicle and transportation safety is paramount. Standardized post-exposure prophylaxis protocols and easy access to them are crucial for mitigating the consequences of BBFEs.

Future research should aim for more standardized definitions and reporting of occupational injuries, particularly for those treated in EDs, across diverse geographical and healthcare settings. Prospective studies are needed to better understand risk factors and the effectiveness of interventions. The long-term consequences of nonfatal ED-treated injuries, including psychological impacts and return-to-work challenges, warrant further investigation. More research from low- and middle-income countries is also critically needed to understand local contexts and develop appropriate interventions.

Conclusion

Occupational injuries requiring ED treatment or other significant medical intervention are a persistent and serious problem for HCWs globally. EMS personnel frequently experience ED-treated musculoskeletal injuries from overexertion and transportation-related incidents, while hospital-based HCWs face high risks of exposures such as NSIs, slips, trips, falls, and workplace violence. Effective prevention requires a multi-pronged approach involving engineering and administrative controls, comprehensive training, and fostering a strong organizational safety culture. Continued surveillance and research are essential to monitor trends, evaluate interventions, and ultimately protect the health and well-being of the vital healthcare workforce.

List of Abbreviations

BBFE	blood and body fluid exposures
BBP	bloodborne pathogens
BLS	Bureau of Labor Statistics
DOL	Department of Labor
ED	emergency department
EMS	emergency medical services
HCW	health care workers
NEISS	National Electronic Injury Surveillance System
NSIs	needlestick injuries
PPE	personal protective equipment
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
ROBINS-I	Risk of Bias in Non-Randomized Studies - of Interventions

Conflict of interests

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