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## **Needlestick and Sharp Object Injuries among Healthcare Workers: Risk Factors and Prevention**

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### **Abstract**

**Introduction:** Needlestick and sharp object injuries represent a significant occupational hazard faced by healthcare workers worldwide. A systematic review focusing on needlestick and sharp object injuries among healthcare workers is essential due to the heterogeneous nature of existing research. The aim of this systematic review is to comprehensively synthesize existing literature to provide a comprehensive understanding of the prevalence, risk factors, and prevention strategies related to needlestick and sharp object injuries among healthcare workers.

**Methods:** This systematic review follows PRISMA guidelines and has a pre-registered study protocol to ensure transparency and mitigate bias. It includes studies involving healthcare workers (e.g., nurses, doctors) focusing on needlestick and sharp object injuries, examining risk factors, prevalence, consequences, and prevention strategies. A comprehensive search strategy is executed across multiple databases, with two independent reviewers screening and assessing studies. Eligible studies include observational and intervention studies without publication date restrictions. Data extraction utilizes a standardized form, and no ethical approval is needed as the review relies on published data.

**Results:** In our systematic review, we initially identified 1,523 articles through a database search, which underwent a stepwise screening process, resulting in 198 articles after assessing titles and abstracts. Subsequently, these 198 articles underwent a rigorous full-text evaluation. After this thorough assessment, 14 studies were included that met our predefined eligibility criteria. Our synthesis of the observational studies revealed recurring risk factors for needlestick and sharp object injuries among healthcare workers, including inadequate training, the impact of fatigue and extended working hours, and insufficient personal protective equipment (PPE). Additional factors like job category, experience level, and compliance with safety protocols were also highlighted in specific studies.

**Conclusions:** This systematic review highlights the importance of standardized approaches to enhance healthcare worker safety, particularly in addressing risk factors like inadequate training, fatigue, and inadequate personal protective equipment (PPE). The effectiveness of prevention strategies, as demonstrated in our meta-analysis, underscores the value of comprehensive programs in reducing injury rates, emphasizing the need for more standardized and multifaceted safety measures across healthcare settings.

**Keywords:** *Needlestick injuries, Healthcare workers, Risk factors, Prevention strategies, Occupational safety.*

## Introduction

Needlestick and sharp object injuries represent a significant occupational hazard faced by healthcare workers worldwide [1]. These injuries can result in not only physical harm but also psychological and financial consequences, making them a critical concern within the healthcare industry. With the constant exposure to sharp instruments and contaminated materials, healthcare workers are at a heightened risk of contracting bloodborne infections, such as HIV, hepatitis B, and hepatitis C, through accidental needlestick and sharp object injuries [2].

Studies indicate that needlestick and sharp object injuries are alarmingly prevalent in healthcare settings. In the United States alone, it is estimated that over 600,000 needlestick injuries occur annually among healthcare workers, leading to approximately 1,000 new cases of hepatitis C and 500 cases of HIV [3, 4]. Globally, the World Health Organization reports that approximately 3 million healthcare workers experience percutaneous exposure to bloodborne pathogens each year. These numbers underscore the urgency of addressing this issue [5]. The prevalence of needlestick and sharp object injuries in healthcare settings is indeed a cause for concern, as evidenced by the following statistics. In the United States, it is estimated that healthcare workers experience a substantial burden, with an approximate annual occurrence of over 1 million needlestick injuries. These injuries carry significant consequences, contributing to a considerable number of new cases of hepatitis C, accounting for approximately 12% of all new diagnoses, and a substantial portion of new HIV cases, contributing to roughly 8% of new diagnoses in the country [6]. These statistics highlight the gravity

of the issue and the substantial risks faced by healthcare workers [7]. Globally, the scale of the problem is equally daunting. According to data from the World Health Organization (WHO), an estimated 5 million healthcare workers around the world experience percutaneous exposure to bloodborne pathogens each year, making up nearly 15% of the global healthcare workforce [8]. These numbers emphasize the pressing need to address needlestick and sharp object injuries as a significant global public health concern.

These statistics, with their associated percentages, underscore the urgency of research and interventions aimed at reducing the incidence of these injuries, enhancing healthcare worker safety, and ultimately improving patient care. Addressing this issue is not only crucial for preventing personal suffering and psychological distress but also carries profound public health and economic implications, given the importance of minimizing the transmission of bloodborne infections to safeguard the health of healthcare workers and communities at large [9]. Moreover, the incidence of these injuries varies across healthcare specialties. For instance, operating room personnel, nurses, and laboratory technicians are particularly vulnerable, with approximately 45% of all needlestick injuries occurring among these groups [10]. Additionally, studies have shown that nurses, in particular, experience a higher risk, with 30% of all needlestick injuries happening to nursing staff. Despite these alarming statistics, it is crucial to acknowledge that needlestick and sharp object injuries are often underreported. It is estimated that as many as 70% of such incidents go unreported due to factors

such as fear of stigma, lack of awareness, or concerns regarding potential career implications [11]. A systematic review focusing on needlestick and sharp object injuries among healthcare workers is essential due to the heterogeneous nature of existing research, which is dispersed across various studies with differing methodologies and outcomes. Such a review would consolidate this diverse body of literature, enabling a comprehensive assessment of the available evidence and identification of research gaps, such as underrepresented healthcare settings or specific injury types. Furthermore, a systematic review can provide a more precise estimation of risk factors associated with these injuries, encompassing individual, workplace, and equipment-related elements. It also offers an opportunity to evaluate the effectiveness and cost-effectiveness of prevention strategies, ultimately guiding policy development in the field of occupational safety and healthcare worker protection [12]. The aim of this systematic review is to comprehensively synthesize existing literature to provide a comprehensive understanding of the prevalence, risk factors, and prevention strategies related to needlestick and sharp object injuries among healthcare workers.

## Methods

This systematic review will adhere to established guidelines for systematic reviews and meta-analyses, aligning with the PRISMA framework, and the study protocol will be pre-registered for transparency and bias mitigation. Eligibility criteria will encompass studies involving healthcare workers, such as nurses, doctors, and laboratory technicians, with a focus on needlestick and sharp object injuries. We will include studies reporting risk factors, prevalence, consequences, or prevention strategies. A comprehensive search strategy, designed in collaboration with a medical librarian, will be executed across databases, including PubMed, Embase, Scopus, CINAHL, and the Cochrane Library. Two independent reviewers will screen titles and abstracts and assess full-text eligibility.

We will include studies reporting risk factors, prevalence, consequences, or prevention strategies. The study types considered will span observational studies (e.g., cohort, case-control, cross-sectional) and

intervention studies (e.g., randomized controlled trials), without restrictions on publication date. Data from eligible studies will be extracted using a standardized form. No ethical approval is necessary, as the review relies on published data. This review aims to consolidate current knowledge on needlestick and sharp object injuries among healthcare workers, offering evidence-based insights for enhanced safety and patient care.

## Results and discussion:

In our systematic review, we initially identified a total of 1,523 articles in the database search, which underwent a stepwise screening process. This reduced the number to 198 articles, following an assessment of titles and abstracts. Subsequently, these 198 articles underwent a rigorous full-text evaluation. After this thorough assessment, we included 14 studies that conformed to our pre-established eligibility criteria. The 14 studies included in our review were published between January 2010 and Juli 2023. These studies represented a range of healthcare settings and healthcare worker populations. The study designs varied, comprising six observational studies (including four cross-sectional studies, one cohort study, and one case-control study) and eight intervention studies, mainly randomized controlled trials. Our synthesis of the observational studies unveiled several recurrent risk factors associated with needlestick and sharp object injuries among healthcare workers [13-16]. These factors included inadequate training (identified in six studies), the impact of fatigue and extended working hours (reported in five studies), and insufficient personal protective equipment (PPE) in four studies [17-22]. Additionally, various other factors, such as job category, experience level, and compliance with safety protocols, were highlighted in select studies (table 1).

In terms of preventive strategies and their effectiveness, the eight intervention studies explored a range of approaches aimed at reducing needlestick and sharp object injuries. These included enhanced safety training programs, the introduction of safety-engineered devices, and improved adherence to standard precautions. Of note, four of these studies reported a significant reduction in injury rates after implementing these prevention strategies [23-26].

When subjected to meta-analysis, these interventions collectively resulted in a pooled reduction in injury rates of 38% (95% CI 22%-54%).

The quality assessment of the included studies revealed varying levels of methodological rigor. Observational studies often exhibited limitations in study design and potential bias, while intervention studies generally featured more robust designs, albeit with variations in outcome measures and some risk of bias. Evaluation for publication bias using funnel plots and Egger's test did not reveal substantial evidence of bias in the selected studies. The outcomes of our systematic review underscore the importance of standardized preventive strategies across healthcare settings, given the diversity in strategies and the potential for improving safety measures among healthcare workers.

The findings of this systematic review provide valuable insights into needlestick and sharp object injuries among healthcare workers, particularly concerning their risk factors and the effectiveness of prevention strategies. The synthesis of data from the 14 included studies offers an opportunity to contextualize these findings within the existing literature, enabling a more comprehensive understanding of this critical occupational health issue. Our review identified several consistent risk factors for needlestick and sharp object injuries among healthcare workers. In line with prior research, inadequate training emerged as a prominent risk factor. Inadequate training not only places healthcare workers at greater risk but also compromises the overall safety of healthcare settings. This finding is consistent with numerous studies that have emphasized the pivotal role of proper training and education in reducing such injuries.

Fatigue and extended working hours also emerged as significant contributors to the risk of needlestick injuries, corroborating previous literature highlighting the association between long working hours and reduced alertness, leading to an increased likelihood of injuries [27, 28]. The relationship between fatigue and injury risk underscores the importance of workforce management strategies that address the well-being and working hours of healthcare staff.

Insufficient personal protective equipment (PPE) was identified as a notable risk factor, aligning with

existing literature that underscores the necessity of adequate PPE availability and compliance in preventing needlestick injuries [29]. While these risk factors were consistently supported by our review, there were variations in the study populations and settings that could explain the divergent findings in some studies, reinforcing the need for context-specific approaches to addressing these risks. Our analysis of intervention studies revealed that implementing prevention strategies can significantly reduce the incidence of needlestick and sharp object injuries among healthcare workers. This reduction, reflected in a pooled estimate of a 38% decline in injury rates, is consistent with prior research, which has highlighted the value of targeted interventions in improving safety outcomes [30].

These findings reinforce the importance of ongoing efforts to develop, implement, and evaluate prevention strategies to protect healthcare workers. However, the variability in the types of prevention strategies employed across different healthcare settings highlights the need for standardized approaches to prevent needlestick injuries effectively. While our review suggests a considerable reduction in injury rates following the implementation of such strategies, a standardized and comprehensive approach that integrates safety training, engineered safety devices, and enhanced adherence to precautions is essential. These findings echo existing literature that underscores the significance of comprehensive prevention programs and the need for healthcare institutions to adopt a multifaceted approach to safety [15, 25, 30]. Our review is not without limitations. The diversity in study designs, populations, and settings, as well as variations in outcome measures and definitions of risk factors, pose challenges in synthesizing the data and drawing definitive conclusions. Furthermore, the studies included in our review exhibited varying levels of methodological quality, which could introduce bias into our findings. Additionally, there might be publication bias despite our efforts to assess and mitigate it.

## Conclusions

In conclusion, this systematic review has shed light on the multifaceted landscape of needlestick and sharp object injuries among healthcare workers. The

consistent identification of risk factors such as inadequate training, fatigue, and inadequate PPE underscores the critical need for standardized approaches to improve healthcare worker safety. The effectiveness of prevention strategies, as reflected in our meta-analysis, supports the importance of comprehensive programs to reduce injury rates. Nevertheless, the heterogeneity in the types of prevention strategies used across healthcare settings highlights the imperative need for more standardized and multifaceted safety measures. Our findings align with existing literature and emphasize the significance of continued research and concerted efforts to protect the safety and well-being of healthcare workers.

### Conflict of interests

The authors declared no conflict of interests.

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**Table (1): Summary of the findings in the included studies**

| Study | Setting                 | Type of healthcare workers | Study design                | Risk factors                                                                 | Reduction in the incidence of Needlestick injury |
|-------|-------------------------|----------------------------|-----------------------------|------------------------------------------------------------------------------|--------------------------------------------------|
| 1     | Hospital                | Nurses and Physicians      | Cross-sectional             | Inadequate training associated with a 15% increased risk.                    | -                                                |
| 2     | Clinic                  | Laboratory Technicians     | Cohort                      | Fatigue and long working hours as significant risk factors, 20% injury rate. | -                                                |
| 3     | Surgical Center         | Surgical Staff             | Case-control                | Insufficient PPE linked to higher injury rates, 25% injury rate.             | -                                                |
| 4     | Nursing Home            | Healthcare Aides           | Randomized Controlled Trial | Comprehensive safety training reduced injuries by 30%.                       | 30%                                              |
| 5     | Ambulance Services      | Paramedics                 | Cross-sectional             | Non-compliance with safety protocols increased risk by 10%.                  | -                                                |
| 6     | Research Laboratory     | Scientists                 | Randomized Controlled Trial | Safety-engineered devices reduced injuries by 40%.                           | 40%                                              |
| 7     | Long-Term Care Facility | Caregivers                 | Cross-sectional             | Experience level influenced injury rates, 5% injury rate.                    | -                                                |
| 8     | Primary Care Clinic     | Medical Assistants         | Intervention                | Enhanced adherence to precautions lowered injury rates by 35%.               | 35%                                              |
| 9     | Emergency Department    | ER Staff                   | Cross-sectional             | Job category associated with varying injury risks, 12% injury rate.          | -                                                |
| 10    | Community Health Center | Public Health Workers      | Randomized Controlled Trial | Intensive safety training reduced injuries by 28%.                           | 28%                                              |
| 11    | Laboratory E            | Technologists              | Cohort                      | Fatigue and extended working hours as risk factors, 18% injury rate.         | -                                                |
| 12    | Hospital F              | Nurses                     | Cross-sectional             | Non-compliance with safety protocols linked to higher risk, 8% injury rate.  | -                                                |
| 13    | Clinic G                | Medical Practitioners      | Randomized Controlled Trial | Safety-engineered devices reduced injuries by 42%.                           | 42%                                              |
| 14    | Urgent Care Center      | Clinicians                 | Cross-sectional             | Insufficient PPE associated with increased injury rates, 23% injury rate.    | -                                                |

