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## Assessment of sharps injuries in healthcare workers: A root cause analysis

### Abstract

**Aim:** This study aimed to identify the incidence and characteristics of sharps injuries among healthcare workers and to propose strategies for reducing biological risks through root cause analysis.

**Materials and Methods:** Incident report forms documenting sharps injuries among healthcare workers at a private hospital in Istanbul between 2014 and 2019 were retrospectively reviewed. Injuries were classified according to occupational group, year of occurrence, type of instrument, and nature of injury. Data were analyzed using IBM SPSS Statistics version 25.0, with results presented as frequency distributions (number and percentage). Root cause analysis was performed to identify active and latent factors contributing to reported incidents.

**Results:** Sharps injuries occurred most frequently in 2016 and least frequently in 2019. By occupational group, auxiliary staff, nurses, and physicians were most commonly affected. Root cause analysis indicated that active errors were primarily related to inattentiveness and insufficient use of personal protective equipment, while latent errors were associated with equipment deficiencies and organizational factors.

**Conclusion:** Prevention of sharps injuries is a critical component of occupational health and safety. Systematic use of incident reporting, targeted occupational safety training, and comprehensive risk analyses are essential to minimize biological hazards and protect healthcare personnel.

**Keywords:** Sharps injuries; root cause analysis; occupational health; biological risk; healthcare safety

## INTRODUCTION

Sharps injuries were first documented in 1983 (1), and needlestick and other sharps injuries remain among the most frequent occupational hazards in healthcare (2,3). Healthcare workers are exposed to biological risks during routine tasks such as venipuncture, administering injections, wound care in outpatient clinics, surgical procedures, and laboratory activities. Additional risks arise during the collection, disposal, and transport of contaminated instruments (4,5). The most common causes of sharps injuries include syringe needles, glass fragments, lancets, and scalpels (6).

These injuries place healthcare workers at risk of acquiring blood-borne infections. Hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) are the most frequently implicated pathogens. Most injuries occur percutaneously, typically from syringe needles, and may result in

infection (7). Moreover, healthcare workers face a substantially higher risk of HBV, HCV, and HIV exposure compared with other occupational groups (8).

Root cause analysis is one of the risk-assessment tools commonly applied in healthcare settings. It is used to identify the underlying causes of adverse events and to develop corrective strategies. Importantly, root cause analysis focuses on systems and processes rather than attributing blame to individuals, thereby facilitating sustainable improvements in safety (9,10).

Failure to address biological risks has significant implications not only for occupational health and safety but also for public health and forensic medicine. Accordingly, this study aimed to characterize sharps injuries among healthcare workers using incident reporting data and to apply root cause analysis to identify preventive strategies.

## MATERIALS AND METHODS

### Study Design

This study employed a retrospective, cross-sectional design. Incident reporting forms documenting sharps injuries among healthcare workers at a private hospital in Istanbul between 2014 and 2019 were reviewed. Root cause analysis was conducted based on the year of occurrence, the clinical unit in which the incident took place, and information about the injured personnel.

### Data Collection and Analysis

Data from incident reports were analyzed using IBM SPSS Statistics version 25.0. Results were expressed as frequency distributions (number and percentage). The Eindhoven Classification Model, applied through the PRISMA method, was used to guide the categorization and interpretation of root causes (11). Root cause analysis was based solely on the information provided in the incident reporting forms submitted to the hospital's occupational safety and quality unit.

### Ethical Considerations

This study received approval from the Istanbul Yeni Yuzyil University Ethics Committee (Approval No: 2020/11-536, 16.11.2020). Institutional permission was also obtained from the hospital administration prior to data collection.

## RESULTS

The distribution of sharps injuries by year between 2014 and 2019 is presented in Table 1. Based on the ratio of total employees to reported cases, the fewest injuries occurred in 2016 and the highest number in 2019. Table 1. Distribution of sharps injuries by year (2014–2019).

**Table 1. Distribution of sharps injuries by year (2014–2019)**

| Year | Total number of employees | Number of cases | Case rate (%) |
|------|---------------------------|-----------------|---------------|
| 2014 | 6.136                     | 44              | 0.73          |
| 2015 | 12.932                    | 59              | 0.46          |
| 2016 | 8.576                     | 72              | 0.84          |
| 2017 | 6.422                     | 49              | 0.76          |
| 2018 | 13.107                    | 47              | 0.36          |
| 2019 | 12.904                    | 45              | 0.35          |

Case rate (%): Number of cases/ Total number of employees x 100

Seasonal analysis indicated that auxiliary staff were more frequently injured in April and June, whereas physicians and nurses sustained more injuries in January and March.

Information regarding exposures involving blood and body fluids is summarized in Table 2. The majority of incidents between 2014 and 2019 involved hand and finger injuries, most commonly caused by needles. Despite regular training on sharps safety, use of PPE was frequently inadequate.

**Table 2. Characteristics of blood and body fluid exposures among healthcare workers (2014–2019)**

| Occupation                  | Instrument      | Injury site | Contaminated instrument | HBV/HCV/HIV status | PPE use | PPE training |
|-----------------------------|-----------------|-------------|-------------------------|--------------------|---------|--------------|
| Nurse                       | Needle          | Hand/finger | Yes                     | Unknown            | No      | Yes          |
| Nurse                       | Needle          | Hand/finger | Yes                     | Unknown            | No      | Yes          |
| Physician                   | Lancet          | Hand/finger | Yes                     | No                 | Yes     | Yes          |
| Nurse                       | Needle          | Hand/finger | Yes                     | Unknown            | Yes     | Yes          |
| Technician                  | Lancet          | Arm         | Yes                     | Unknown            | Yes     | Yes          |
| Physician                   | Sharp tool      | Hand/finger | Yes                     | HCV                | Yes     | Yes          |
| Nurse                       | Needle          | Hand/finger | Yes                     | HBV                | No      | Yes          |
| Nurse                       | Needle          | Hand/finger | Yes                     | HBV                | No      | Yes          |
| Nurse                       | Needle          | Hand/finger | Yes                     | Unknown            | No      | Yes          |
| Nurse                       | Needle          | Hand/finger | Yes                     | Unknown            | No      | Yes          |
| Nurse                       | Lancet needle   | Hand/finger | Yes                     | Unknown            | No      | Yes          |
| Auxiliary medical personnel | Needle          | Leg         | Yes                     | Unknown            | No      | Yes          |
| Auxiliary medical personnel | Needle          | Foot        | Yes                     | Unknown            | No      | Yes          |
| Biologist                   | Medicine bottle | Hand/finger | Yes                     | Unknown            | No      | Yes          |

HBV: Hepatitis B Virus; HCV: Hepatitis C Virus; HIV: Human Immunodeficiency Virus; PPE: Personal Protective Equipment; Unknown: instances in which infection status was recorded as "unknown"

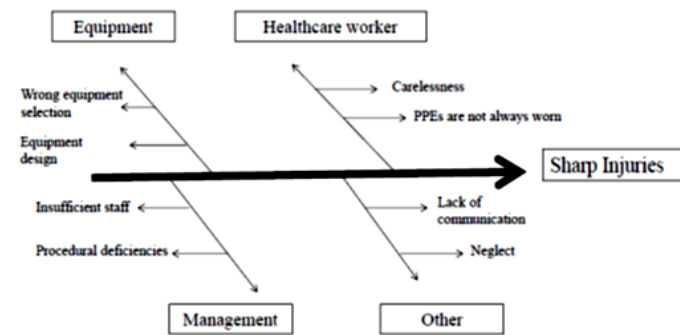
In some cases, it remained unclear whether injured healthcare workers were at risk of HBV, HCV, or HIV transmission following the incident.

Root cause analysis of sharps injuries is presented in Figure 1. Contributing factors were categorized into equipment-related,

personnel-related, administrative, and other causes.

In several cases, injuries were associated with equipment design flaws or inappropriate equipment selection. Personnel-related factors included inattentiveness and insufficient use of PPE. Administrative deficiencies, such as inadequate staffing

levels and incomplete documentation, were also identified. In addition, process-related negligence and communication failures contributed to the occurrence of accidents.



**Figure 1.** Contributing factors were categorized into equipment-related, personnel-related, administrative, and other causes.

## DISCUSSION

Our data also revealed cases of confirmed HBV transmission following injury, as well as The present study examined sharps injuries reported between 2014 and 2019. To ensure data reliability, all case report forms were reviewed by the infection control nursing unit. During this period, fluctuations in the number of cases appeared to reflect staff turnover, including retirement, reassignment, or resignation.

Several contextual factors influenced the incidence of sharps injuries. Training, professional orientation, and job experience appeared to reduce the frequency of cases, whereas inattentiveness, low morale, and decreased motivation were associated with increases. Analysis of incident reports showed that the highest number of injuries occurred in 2016, while the fewest were recorded in 2019 (Table 1). These findings may be explained by annual variations in staffing and workload.

Comparisons with the literature reveal differences in occupational distribution. One study reported that 61.7% of sharps injuries occurred among nurses, 34.0% among auxiliary staff, and only 4.3% among physicians (12). In contrast, our findings indicated that auxiliary personnel accounted for the highest proportion of injuries (4.17%), followed by nurses (3.03%) and physicians (2.41%).

A 2017 study reported that 82.6% of sharps injuries were caused by needles, 6.0% by scalpels, 3.1% by lancets, and 2.0% by suture needles (13). Another study conducted in the same year found that most injuries were percutaneous, of which 75.7% were superficial and 24.3% were deep. The distribution of instruments included scalpels (5.1%), catheters (3.4%), and slides (3.9%), with 39.5% of injuries occurring during vascular access procedures; in 85.9% of cases, the causative instrument was a needle (14).

Consistent with these findings, our study showed that

percutaneous injuries predominated, with 92.86% caused by needle tips. Other instruments included catheters, lancets, scalpels, and broken glass. Nurses were most frequently injured while performing routine clinical procedures such as inserting or removing intravenous sets, drawing blood at the bedside, handling syringe caps, and establishing vascular access (Table 2).

These gaps highlight the need for systematic post-exposure testing and follow-up to mitigate infectious disease risks. From both public health and forensic perspectives, thorough documentation is essential to distinguish accidental exposures from those potentially attributable to negligence or intent. In this context, occupational safety specialists, quality managers, and hospital administrators must implement preventive measures and ensure strict compliance with reporting protocols.

The present study conducted a root cause analysis of sharps injuries (Figure 1). Incident report forms included details of where and how the accident occurred, immediate response, post-incident follow-up, and the identified cause (e.g., personnel, management, equipment). These reports also guided the development of corrective actions and preventive measures.

Our findings indicate that the majority of sharps injuries resulted from carelessness or failure to use PPE. To address these factors, regular in-service training and reinforcement of safe practices are essential, particularly interventions designed to promote lasting behavioral change. The underreporting of injuries further underscores the importance of robust reporting systems, as unrecorded cases may lead to more severe consequences.

In some cases, injuries were linked to equipment design flaws or inappropriate equipment selection, which could be mitigated through stricter purchasing policies and safety-based procurement decisions. Additionally, staffing shortages were identified as a contributing factor, leading to increased workload, inattention, negligence, and communication failures.

These findings are consistent with other studies that have reported similar contributing factors to sharps injuries (15–19). In line with the Eindhoven Classification Model, active errors were primarily attributed to lapses in attention and insufficient PPE use, whereas latent errors included equipment deficiencies and management-related shortcomings. Because latent errors often remain undetected until adverse events occur, proactive use of risk analysis methods such as root cause analysis is critical for early identification and resolution of systemic vulnerabilities (20–22).

This study has several limitations. It was conducted in a single private hospital in Istanbul and relied on data from the hospital's occupational health and quality improvement units. The analysis covered a six-year period, during which some near-miss incidents were not formally documented. Moreover, despite ongoing training initiatives, compliance with PPE use remained suboptimal, contributing to continued injury risk.

## CONCLUSION

Preventing sharps injuries among healthcare workers requires a multifaceted approach. Regular occupational safety training should be provided to all employees, while administrative measures—such as improving communication, ensuring the availability of appropriate equipment, and addressing staffing shortages—are equally important. The application of root cause analysis to healthcare processes can help identify underlying risks and support the implementation of targeted safety interventions to minimize biological hazards.

### Conflict of Interests

*The authors declare that there is no conflict of interest in the study.*

### Financial Disclosure

*The authors declare that they have received no financial support for the study.*

### Ethical Approval

*This study was approved by the Ethics Committee of Istanbul Yeni Yüzyıl University (Approval number: 2020/11-536; date: 16 November 2020).*

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