Needle Stick Injury among Health Care Workers and Its Aftermath in a Tertiary Care Hospital in East Delhi, India

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Abstract

Needle stick injuries (NSI) present serious occupational threat to healthcare workers (HCW). Due to lack of epidemiological data on NSI in this geographical region, the present study was conducted to estimate incidence rate of NSI, identify factors associated, assess awareness of HCWs and evaluate post-injury sero-reactivity rates. This cross-sectional observational study involved 524 HCWs (151 medical and 373 paramedical staff). A validated questionnaire was filled by investigator using interviewing technique. Blood sample was collected from study subjects who reported NSI within last 28 days, at the time of NSI and subsequently after 1, 3 and 6 months. Screening for HBsAg, anti-HCV and anti-HIV 1/2 antibodies was done using commercially available Enzyme-Linked Immunosorbent Assay Kit. Sixty-three HCWs, comprising mainly of medical staff, gave history of NSI in preceding 28 days. The most frequent procedure leading to NSI included recapping needles and suturing in 28.57%, while commonest root cause was haste in 61.91%. Majority (61.91%, 39/63) suffered from NSI during latter part of their duty hours. None became HBsAg, anti-HCV or HIV seropositive. The proportion of NSI among HCWs who had received training on prevention and management of NSI was significantly lower than those who were untrained. Hence training programs emphasizing on safe techniques must be conducted regularly and HCWs putting in long working hours must be allowed to take breaks.

Needle stick injury among health care workers and its aftermath in a tertiary care hospital in East Delhi, India.

Keywords: Haste, Healthcare workers, Needle stick injury, Recapping, Suturing.

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Introduction

Needle stick injuries (NSI) are wounds caused by sharps such as hypodermic needles, blood collection devices, intravenous cannulas or needles used to connect parts of intravenous delivery systems. They pose grave occupational hazards to the healthcare workers (HCWs) in the transmission of a variety of blood-borne pathogens, of which important ones for the transmission are hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV).

The Centers for Disease Control and Prevention (CDC) estimates that each year 385,000 needle sticks and other sharps-related injuries are sustained by HCWs with an average of 1,000 NSIs per day. A study conducted in a tertiary care hospital in South Delhi estimated that about 80% of healthcare workers have experienced NSI at some point in their careers. Even if the injury does not transmit infection, the worker experiences substantial distress. Due to the lack of epidemiological data on NSI in this geographical area, the present study was conducted to estimate the incidence of needle stick injuries and to assess post-injury sero-reactivity rates in a tertiary care teaching hospital in East Delhi. The following were the objectives of the study:

Primary Objectives

1. To assess the annual incidence rate of NSI in healthcare providers.
2. To find out the factors associated with NSI.
3. To assess the knowledge, attitude and practices towards prevention and management of NSI amongst healthcare providers.

Secondary Objective

To assess the sero-reactivity rates at 0, 1, 3 and 6 months starting from the day of NSI as appropriate in individuals presenting with NSI within the last 28 days.

Material and Methods

This cross-sectional observational study was conducted in the Department of Microbiology of a tertiary care teaching hospital in East Delhi from June 2015 to January 2016.

Approval for the study was obtained from the Institutional Ethics Committee. Written informed consent from the study subjects was obtained in each case.

Case Definition

As defined before in introduction, needle stick injury referred to accidental skin penetrating stab wound caused by sharps such as hypodermic needles, blood collection needles, intravenous catheter stylets, needles used to connect parts of intravenous delivery systems, suture needles and lumbar puncture needles.

Subjects

The study group consisted of 524 healthcare providers including senior residents, postgraduate students, junior residents, medical interns, nursing staff, nursing students and nursing orderly in OT.

Procedure

A validated semi-structured questionnaire to identify predictive factors associated with NSIs was filled by the investigator using a face to face interviewing technique. Questions relating to awareness regarding preventive measures like HBV immunization, use of safety devices and course of action in the event of a NSI were also included.

Six millilitre of blood sample was aseptically collected in plain vial from the study subjects who reported NSI within the last 28 days. Blood sample was collected at the time of NSI, and subsequently after 1, 3 and 6 months following injury. Serum was separated and aliquoted in different vials and stored at −70°C until tested.

Serological screening for HBV (HBsAg), HCV and HIV 1/2 infections were carried out by employing commercial kits as per manufacturers guidelines. These included enzyme linked immunosorbent assay (ELISA) based kits for HBsAg (Monolisa HBsAg ULTRA assay, Biorad, France) and for detection of antigen and/or anti-HCV antibody for HCV infection (Monolisa HCV Ag-Ab ULTRA assay, Biorad, France) while test for anti HIV-1/2 antibodies was carried out by visual immunochromatography based kits (SD Bioline HIV-1/2 3.0 test, Bio Standard Diagnostics Pvt Ltd, India). Since all samples tested were negative for HIV, in consonance with National Guidelines for HIV testing by National AIDS Control Organization, no further testing was done (Strategy Ш).

Statistical Analysis

Data analysis was done with OpenEpi software. Frequency distributions were obtained and percentages were calculated. Comparisons between groups were
made by the chi-square test. \( P \) value < 0.05 was considered statistically significant.

**Results**

The 524 HCWs participating in the study included 52 senior residents, 82 postgraduate students, 3 junior residents, 14 interns, 162 staff nurses, 210 nursing students, and 1 nursing orderly in OT. In all there were 151 medical and 373 paramedical staffs who participated in the study. Of these, 12.02% (63/524) gave a history of NSI in the preceding 28 days, in which females predominated (65.08%, 41/63) in statistically significant numbers \((P=0.001)\). Medical staff comprised a majority (65.08%, 41/63) of those who suffered NSI and this difference was also statistically significant \((P<0.001)\). Out of the 391 (74.62%) HCWs who were vaccinated against HBV with 3 primary doses, 47 suffered needle stick injury who did not seroconvert over the next 6 months.

All HCWs were wearing gloves at the time of NSI. Immediate action after NSI was taken by majority (98%, 62/63) of the HCW in the form of washing the site (89%, 56/63) and applying mild antiseptic agents (87%, 55/63). Only two HCWs with NSI (both nursing students) took full course of ART drugs following NSI. Thirty four (53.97%) of the needles involved were hollow-bore. The most frequent procedure leading to NSI included recapping needles and suturing in 28.57% (18/63) (Figure 1).

![Figure 1](image.png)

**Figure 1. Procedures leading to needle stick injury in health care workers**

In response to the root cause of their NSI, the most commonly cited reason was haste in 61.91% (39/63) (Figure 2). It was noticed that majority of HCWs (61.91%, 39/63) suffered from NSI during the latter part of their duty hours, while 3.17% were unable to recall the duty-hours during which the injury occurred.

Two HCWs acknowledged receiving NSI from known HBsAg seropositive and anti-HCV antibody positive patient. However, none of the HCWs became HBsAg, anti-HCV or HIV sero-positive over the next 6 months.

The responses to the questions on awareness about prevention and management of NSI are given in table 1. Seventy-two percent of participants were aware of the term post-exposure prophylaxis (PEP).
Figure 2. Reasons responsible for needle stick injury in health care workers

Table 1. Awareness about needle stick injuries, its prevention and management among the health care workers (n=524)

<table>
<thead>
<tr>
<th>Knowledge regarding information on needle stick injuries</th>
<th>Percentage of subjects aware</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 20 pathogens (disease causing organisms) can be transmitted by NSI</td>
<td>51.53</td>
</tr>
<tr>
<td>HBV carries maximum risk of transmission amongst HIV, HBV &amp; HCV post NSI</td>
<td>72.52</td>
</tr>
<tr>
<td>Percentage of transmission of HIV through NSI</td>
<td>0.38</td>
</tr>
<tr>
<td>Standard work precautions to be followed while collecting blood</td>
<td>80.92</td>
</tr>
<tr>
<td>Double gloves should be used while collecting blood from an individual known to be HIV, HBV and HCV sero-positive</td>
<td>88.93</td>
</tr>
<tr>
<td>Aware of guidelines to be followed post NSI</td>
<td>67.37</td>
</tr>
<tr>
<td>NACO guidelines are to be followed for HIV &amp; CDC/WHO guidelines to be followed for HBV &amp; HCV</td>
<td>45.80</td>
</tr>
<tr>
<td>Will milk out more blood in case of NSI</td>
<td>18.13</td>
</tr>
<tr>
<td>Aware of the term PEP</td>
<td>72.14</td>
</tr>
<tr>
<td>Know whom to contact in our hospital for PEP</td>
<td>52.67</td>
</tr>
<tr>
<td>PEP should be initiated as soon as possible following NSI</td>
<td>65.84</td>
</tr>
<tr>
<td>ART-PEP is provided free of cost under NACP</td>
<td>63.74</td>
</tr>
<tr>
<td>PEP for NSI will vary according to nature of injury</td>
<td>42.37</td>
</tr>
<tr>
<td>HIV testing is recommended post NSI</td>
<td>47.52</td>
</tr>
<tr>
<td>Exact time intervals when HIV testing is recommended post NSI</td>
<td>2.09</td>
</tr>
<tr>
<td>Protocol to be followed for disposal of waste sharps</td>
<td>92.75</td>
</tr>
<tr>
<td>Sharps container should be disposed off when its 3/4th full</td>
<td>78.63</td>
</tr>
<tr>
<td>Use needle removers or cutters before disposing sharps</td>
<td>85.50</td>
</tr>
<tr>
<td>Use of hollow bore needles is associated with maximum risk of transmission of pathogens following NSI</td>
<td>73.85</td>
</tr>
</tbody>
</table>
Regarding the measures taken currently in the hospital to prevent occurrence of NSI, it was observed that the proportion of NSI among the HCWs who had already received training on prevention and management of NSI was lower than those who had not received the training (Table 2).

**Discussion**

Needle stick injuries pose a significant occupational risk for health care workers. Approximately 12% of the HCWs had a needle stick injury in the preceding 28 days.

It was found that medical staff were more prone to NSI in comparison to the paramedical staff and this difference was statistically significant, contrasting with other studies from India, Japan and UK, where paramedical staff (particularly nurses) were found to be more vulnerable.\(^1\)\(^-\)\(^11\) However few studies from Japan and Australia have also reported medical staff to be more susceptible to NSI.\(^12\)\(^-\)\(^13\)

The statistically significant predominance of females among the HCWs presenting with NSI in the present study correlates with findings of Jahangiri et al and Pilli et al.\(^1\)\(^-\)\(^14\) Salekar et al have also documented higher female susceptibility to NSI.\(^15\) This feature highlights the necessity of paying more attention to females while contemplating preventive strategies for NSIs. Only 74.62% HCWs who participated in the present study were vaccinated against HBV with 3 primary doses. Efforts need to be made to improve this coverage to 100% in HCWs to minimize the risk of HBV post NSI.

Wearing gloves is known to be an important line of defense, and in the present study all HCWs, including the paramedical staff, had been wearing them at the time of NSI. Most (98.41%) of the HCWs in this study had enlisted a satisfactory performance in adherence to protocol after NSI; 88.89% reported washing the site as the first treatment after the injury. This fares better than various studies and reflects adequate awareness among the HCWs regarding management of NSIs.\(^2\)\(^-\)\(^15\)

Although majority (53.97%, 34/63) of the needles involved in the present study were hollow-bore, none of the participants became sero-positive for the 3 most common blood-borne pathogens (HBsAg, anti-HCV antibody, anti-HIV 1/HIV 2 antibodies) over the next six months. Most other studies also report NSI with hollow-bore needles, although they did not test their seropositivity status after the NSI.\(^1\)\(^,\)\(^2\)\(^,\)\(^7\)\(^-\)\(^15\) Due to higher blood carrying capability and pathogen load, hollow-bore needles are more efficient in transmitting blood-borne infections than solid needles such as suture needles.\(^2\)\(^-\)\(^16\)\(^-\)\(^18\)

Certain procedures such as recapping needles and suturing were more prone to cause NSI comparable to other studies, signifying inadequate training of HCWs or reluctance of the HCWs to follow correct procedures.\(^2\)\(^-\)\(^12\)\(^-\)\(^15\)\(^-\)\(^19\)\(^-\)\(^20\) Several studies have condemned the practice of recapping needles.\(^1\)\(^,\)\(^2\)\(^,\)\(^11\)\(^-\)\(^12\) Although recapping needles has been prohibited by the USA Occupational Safety and Health Administration’s (OSHA) blood-borne pathogen standards, this practice is reported to be very high in many studies.\(^2\)\(^-\)\(^12\)\(^-\)\(^13\)\(^-\)\(^15\) NSIs during recapping may be prevented by placing sharps-disposal containers at convenient places to facilitate effective and safe sharps disposal.\(^11\) Training programs often emphasize that recapping of needles after use is not to be done.\(^7\) The training programs dealing with needles and sharps usually underscore precautions during the use and safety while discarding the needles. Hence, more emphasis must be laid on the need to maintain utmost caution during and in-between handling of sharps as well.\(^7\) Regular training programs must be conducted that include specific instructions on safe techniques.\(^15\)

In the present study, the fundamental reason leading to procedures involving NSI was found to be haste, similar to a study in Johns Hopkins University.\(^2\)\(^5\) Further, it was seen that most of the injuries (61.91%, 39/63) occurred during the 2\(^{nd}\) half of duty, with progressive exhaustion and fatigue in the long duty hours leading to a stressful working environment. Heavy workload and fatigue were found to be the major reasons of NSI in 2 studies by Jahangiri et al and Sharma et al at Iran and central Delhi respectively.\(^2\)\(^,\)\(^7\) Several studies have concluded that adverse working environments, such as long working hours, can lead to fatigue as well as mental and physical stress, which in turn increase the chance of human error and the risk of needle stick injuries.\(^2\)\(^,\)\(^26\)\(^-\)\(^27\) Hence as suggested by Sharma et al, hospital authorities must ensure that HCWs putting in long hours continuously...
are allowed to take short breaks in between to refresh themselves. 

Almost 89% of the study subjects were aware that double gloves should be used while collecting blood from an individual known to be HIV, HBV or HCV sero-positive contrasting with several Indian studies. 

Double-gloving can reduce the risk of blood contamination by a factor of 7 to 8.

Among the HCWs studied, 72.14% were aware of the term post-exposure prophylaxis (PEP), which is better than 55.5% as reported by Salelkar et al. 

Approximately 52.67% knew whom to contact in the hospital for PEP. This is higher than the figures reported by Muralidhar et al and by Chacko and Isaac signifying greater awareness in the HCWs of the present study. 

Though most of the HCWs were aware that post NSI, HBV carries the maximum risk of transmission among the triad of HIV, HBV and HCV, few HCWs were aware that more than 20 pathogens are linked to NSI. Only 0.38% were aware of the percentage of transmission of HIV through NSI as against 87.8% in a study from Iran. 

It was observed that among all steps taken to avert the NSIs, training programs on prevention and management of NSI were the most effective. Thus, increasing staff awareness and educating them on NSI through regular training programmes are the need of the hour.

According to the findings in the present study, recapping needles, suturing and haste were the major factors responsible for the occurrence of NSIs. These findings highlight the need for assiduous strategies to reduce NSI in an organized way. Based on the study findings, effective prevention of NSI incidents among the HCWs can be accomplished through following supportive measures:

- Planning of structured training programs targeted at prevention of NSIs and PEP. Provision of an adequate number of safety devices such as puncture-resistant disposal containers.
- The modification of work schedule by limiting working hours and allowing the HCWs to take breaks in-between.

There is much scope for improvement in safety protocols for protecting the HCWs from NSI, which can be achieved through a combination of compendious programmes, ensuring adequate training in safe use and disposal of needles, and following preventive practices like vaccinations for hepatitis B, as also stressed by Muralidhar et al. Issues requiring attention include training of HCWs in handling and disposal of sharps, and ensuring a responsible attitude among HCWs. Training in standard work precautions, proper sharps disposal and procedures to be followed post NSI must be given to all categories of health care workers.

Conclusions

Needle stick injuries represent an occupational hazard that HCWs encounter in their day to day practice. The risk of disease transmission through NSI remains, along with the lack of awareness of these dangers and the correct actions to be taken post NSI. Taking the above into account, it thus becomes imperative to address this issue with utmost priority. HIV, HBV, and HCV infections have repercussions for personal relationships, future employment, and insurance coverage. Prevention of NSI is the best way to prevent several occupation-related infections in HCWs. Hence preventive programs in healthcare systems should be an integral part and training of HCWs on safety practices must be an ongoing activity at every hospital.

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Conflict of Interest: None

References


