

Needle Stick Injury Rate and Its Reduction among the Healthcare Workers in A Tertiary Care Teaching Hospital

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Abstract:

Background: Healthcare workers face various occupational hazards, including needle stick injuries (NSIs), which can increase the risk of blood-borne pathogen transmission. Despite the Needle Stick Safety and Prevention Act, an average of 385,000 sharp injuries occur annually among healthcare workers in hospitals worldwide. Underreporting is common due to fear of disease contraction, retrenchment, and inadequate reporting methods. In India, NSI incidence is unknown. NSIs carry an economic burden, and effective interventions include training in personal protective equipment, safe working practices, and introducing safety devices. This study aims to investigate NSI rates, identify causal factors, and develop strategies for prevention to create a safer working environment.

Methods: This study was conducted at a tertiary care teaching hospital, including outpatient department and inpatient wards, a pre-operative room, and an imaging department. It excluded the intensive care unit and operating rooms. The study population comprised of all healthcare workers (HCWs) employed at the hospital during the study period. The study design was prospective, descriptive, and interventional. A convenient random sampling technique was used to observe HCWs during their functional hours. Data was collected through reviewing NSI data for the previous 12 months, and new NSIs were identified through self-reporting using a standard proforma. Continuous and scheduled training sessions were provided, and the NSI rates were presented to clinical department heads. Statistical analysis was performed using the chi-square test.

Results: A tertiary care teaching hospital with a bed capacity of 1500 served 582834 and 765425 patients in 2021-2022 and 2022-2023, respectively, with an 23.8% increase in patient volume. The number of healthcare workers increased from 873 to 892 (2.1%) during the same period. The study reported 445 and 325 needle stick injuries (NSIs) among HCWs in 2021-2022 and 2022-2023, respectively, with a significant decrease in the overall NSI rate from 50.8% to 36.4%. None of the changes in the distribution of NSIs across various departments were statistically significant. The number of bore hole-induced NSIs increased significantly (30.6% to 41.2%), while the percentage of NSIs resulting in mucosal wounds decreased significantly (20.7% to 14.8%).

Conclusion: The study highlights the importance of implementing interventions to reduce NSIs among HCWs and monitoring their effectiveness. The hospital should tailor interventions to specific departments and professions and explore new strategies to further reduce the incidence of NSIs.

Keywords: Needle stick injury, Doctor, Nurse, Hepatitis C, Pareto chart.

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Introduction

Healthcare workers face numerous occupational hazards, such as sharp injuries, exposure to harmful chemicals and drugs, back injuries, violence, and stress. Needle stick injuries (NSIs) are one of the most common hazards in healthcare settings. They occur when a needle or sharp object, which has been in contact with blood, tissue, or other bodily fluids, penetrates the skin. This poses a significant threat to healthcare workers as it increases the risk of transmission of blood-borne pathogens, such as hepatitis B, hepatitis C, and human immunodeficiency virus.[1,2,3] The Needle Stick Safety and Prevention Act, effective since April 2001, mandated employers in the United States to provide safety-engineered devices to reduce NSI exposures in hospitals. However, despite this, a report from the Centers for Disease Control and Prevention (CDC) states that an average of 385,000 sharp injuries occur annually among healthcare workers in hospitals worldwide. The actual incidence is believed to be much higher as many healthcare workers do not report it.[4,5,6] Underreporting of sharp injuries is common due to fear of contracting diseases, retrenchment from the job, and lack of proper reporting methods. In India, the incidence of NSIs is unknown due to the unavailability of data on occupational injuries. Preventive measures to reduce infections due to sharp injuries include training healthcare workers in the usage of personal protective equipment, safe working practices, and safe injection practices.[7,8,9] There is an economic burden associated with sharp injuries, including the cost of post-exposure management, such as laboratory investigations, testing the source patient, counselling, and prophylactic treatment.

Effective interventions proposed to reduce NSIs include introducing sharp devices with integrated safety features, providing disposable containers for sharp objects, and educating healthcare workers on safe work practices.[10,11]

As, NSIs pose a significant threat to healthcare workers, and it is crucial to adopt preventive measures and interventions to reduce the incidence of sharp injuries and their associated costs, the main objective of this study was to investigate the rate of needle stick injuries (NSIs) among different healthcare professionals (HCPs) in a tertiary care hospital. The study also aimed to identify the causal factors and circumstances that lead to NSIs and develop strategies to prevent them.

To achieve this goal, the study focused on improving training, promoting the use of safety devices, and creating a safer working environment for HCPs.

Materials and Methods

Study Setting

This study was conducted at a tertiary care teaching hospital that includes outpatient department and inpatient wards, a pre-operative room, and an imaging department. The hospital has a functional infection control committee, which requires all needle stick injury (NSI) cases to be reported.

Exclusion Criteria

The intensive care unit, operating rooms and super specialty departments were excluded from the study.

Study Population

The study included all healthcare workers (HCWs) such as doctors, nurses,

laboratory technicians, ward attendants, and ward sweepers who were employed at the hospital during the study period. There was a total of 873 HCWs during May 2021 to April 2022 and 892 HCWs during May 2022 to April 2023 in different departments.

Study Design

The study was a prospective, descriptive, and interventional study.

Sampling Design

A convenient random sampling technique was used to observe HCWs during their functional hours.

Study Duration

The study population was observed over a period of 12 months.

Ethical approval

The study was approved by the hospital ethics committee.

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Data Collection

The NSI data for the previous 12 months was reviewed, from May 2021 to April 2022, for the category of HCWs, training status of HCWs, cause of injury, and circumstances under which NSI occurred. New NSIs during the defined study period were identified through self-reporting using a standard proforma based on the National AIDS Control Organization, Government of India guidelines for each occupational exposure.

The proforma contained information on the demographic characteristics of HCWs, details of the injury, circumstances under which injuries occurred, factors associated with injuries, and actions taken by HCWs following NSIs. Confidentiality of identity was ensured, and a verbal consent was obtained before filling up the questionnaire. Hospital infection control nurses, clinical microbiology residents, and trained technical staff actively followed-up and counselled each exposed

HCW in the hospital's post-exposure prophylaxis (PEP) program.

Intervention

Continuous and scheduled training sessions on waste segregation, handling of sharps and sharps containers, and personal protective equipment (PPE) usage were provided to HCWs. The training was monitored by the infection control nurse and quality team during rounds. Needles with safety devices were made available for the nursing team for sample collection. The NSI rates were presented to the clinical department heads, and awareness was created among doctors to segregate the waste. Corrective action was implemented the following month, and data for next 12 months was continuously monitored (May 2022 to April 2023).

Data Analysis

The collected data was entered into MS Excel office 2010, and statistical analysis was performed using the chi-square test to compare the number of NSIs before and after the introduction of safety devices and training sessions. A p-value below 0.05 was considered statistically significant.

Results

The tertiary care teaching hospital where the study was conducted has a bed capacity of 1500 served 582834 patients in 2021-2022 and 765425 patients in 2022-2023, indicating an increase of 23.8% in patient volume. The hospital employed 873 healthcare workers in various departments from May 2021 to April 2022 and 892 healthcare workers from May 2022 to April 2023, indicating a 2.1% increase in the number of staff. Table 1. displays the distribution of healthcare workers and the annual rate of needle stick injuries (NSIs) at a tertiary care teaching hospital during two consecutive years: 2021-2022 and 2022-2023. The study reported 445 NSIs among HCWs in 2021-2022 and 325 NSIs among HCWs in 2022-2023. The results indicate that the

percentage of NSIs among nurses, doctors, technicians, ward attendants, and housekeeping staff did not significantly differ between the two years ($p>0.05$). However, the overall rate of NSIs

significantly decreased from 50.8% in 2021-2022 to 36.4% in 2022-2023, indicating a positive impact of interventions implemented during the study.

Table 1: Distribution of needle stick injury among health care workers (HCWs)

Profession	N	%	N	%	p-value
	2021-2022		2022-2023		
Nurses	167	37.5	123	37.8	0.928
Doctors	156	35.1	109	33.5	0.661
Technician	69	15.5	57	17.5	0.451
Ward attendant	11	2.5	7	2.2	0.772
Housekeeping	42	9.4	29	8.9	0.807
Total	445	100.0	325	100.0	-
Annual rate of NSI/1000HCWs	50.8%		36.4%		-

Table 2. presents the distribution of needle stick injuries (NSIs) across various departments in the hospital during the years 2021-2022 and 2022-2023. In the year 2021-2022, General Surgery had the highest percentage of NSIs at 37.1%, followed by General Medicine at 20.9%. The lowest percentage of NSIs was

reported in Psychiatry at 2.9%. In the year 2022-2023, General Surgery still had the highest percentage of NSIs at 39.4%, while Orthopedics had the lower percentage at 6.5%.

However, the p-values show that none of the changes in the percentage of NSIs were statistically significant.

Table 2: Distribution of needle stick injuries according to the various departments

Departments	N	%	N	%	p-value
	2021-2022		2022-2023		
General Surgery	165	37.1	128	39.4	0.515
General Medicine	93	20.9	78	24.0	0.306
Obstetrics and gynecology	47	10.6	34	10.5	0.964
Orthopedics	45	10.1	21	6.5	0.073
Anesthesiology	38	8.5	25	7.7	0.671
Pediatrics	19	4.3	12	3.7	0.687
Psychiatry	13	2.9	7	2.2	0.508
Radiology	6	1.3	6	1.8	0.581
Others	19	4.3	14	4.3	0.979

Table 3 presents the characteristics of needle stick injuries (NSIs) among health care workers (HCWs). The NSIs are categorized based on the cause of injury, including bore hole, solid, and unknown. The results show that the number of NSIs caused by bore hole increased from 136 (30.6%) in 2021-2022 to 134 (41.2%) in

2022-2023 (p -value=0.002). The type of wound due to NSI is also shown in the Table 3, including superficial percutaneous, deep percutaneous, and mucosal. The percentage of NSIs resulting in mucosal wounds decreased from 20.7% in 2021-2022 to 14.8% in 2022-2023 (p -value=0.035).

Table 3: Needle stick injury characteristics among health care workers.

Variables	N	%	N	%	p-value
	2021-2022		2022-2023		
NSI caused by					
Bore hole	136	30.6	134	41.2	0.002
Solid	97	21.8	62	19.1	0.356
Unknown	212	47.6	129	39.7	0.028
Type of wound due to NSI					
Superficial percutaneous	228	51.2	178	54.8	0.332
Deep percutaneous	125	28.1	99	30.5	0.474
Mucosal	92	20.7	48	14.8	0.035

Table 4. shows the distribution of needle stick injuries among healthcare workers during various procedures. In 2021-2022, 27.4% of NSIs were caused by IV Cannula insertion, while 19.6% were due to garbage bag handling, 12.1% due to suture needle handling, 11.7% due to blood withdrawal, 12.6% due to subcutaneous injection, 11.5% due to recapping, and 5.2% due to lancet during dusting. In

2022-2023, the percentage of NSIs caused by IV Cannula insertion increased to 29.5%, while garbage bag handling accounted for 22.8% of NSIs. The percentages for other procedures were lower than the previous year. However, none of the differences between the two years were statistically significant, as indicated by the p-values.

Table 4: Distribution of needle stick injury among HCWs during various procedures

Variables	N	%	N	%	p-value
	2021-2022		2022-2023		
IV Cannula insertion	122	27.4	96	29.5	0.518
Garbage bag handling	87	19.6	74	22.8	0.278
Suture needle handling	54	12.1	35	10.8	0.558
Blood withdrawal	52	11.7	31	9.5	0.342
Subcutaneous injection	56	12.6	36	11.1	0.524
Recapping	51	11.5	32	9.8	0.475
Lancet during dusting	23	5.2	21	6.5	0.445

From the Pareto chart, we can see that the top three causal factors (Unavoidable accident, Improper segregation by trained HCWs, and Improper handling of sharps) contribute to more than 70% of the total

needle stick injuries. Therefore, addressing these three factors can have a significant impact in reducing the number of needle stick injuries in the healthcare facility (Table 5).

Table 5: Pareto chart analysis for the causation of needle stick injury among HCWs

Causal factor	N	%	Cumulative %
Unavoidable accident (cannula insertion or suturing)	176	39.6	39.6
Improper segregation by trained HCWs	94	21.1	60.7
Improper handling of sharps	52	11.7	72.4
Recapping by HCWs	51	11.5	83.9
Untrained HCWs	28	6.3	90.2
Needle with safety device not used for collection	22	4.9	95.1
Improper segregation by untrained HCWs	9	2.0	97.1
Improper handling of sharp container by HCWs	7	1.6	98.7
Lack of patient counselling	6	1.3	100.0

Discussion

The study aimed to investigate the incidence of needle stick injuries (NSIs) among healthcare workers (HCWs) at a tertiary care teaching hospital in two consecutive years, 2021-2022 and 2022-2023, and to evaluate the effectiveness of interventions implemented to reduce NSIs. The study reported a decrease in the overall rate of NSIs among HCWs from 50.8% in 2021-2022 to 36.4% in 2022-2023, indicating a positive impact of the interventions. Similar incidence was observed in the studies by Radha et al., Jaybhaye et al., Gupta et al., Husain et al., Bhattacharya et al., and Talwar et al.[12,13,14,15,16,17] However, the percentage of NSIs among nurses, doctors, technicians, ward attendants, and housekeeping staff did not significantly differ between the two years. The hospital had a bed capacity of 1500 and served 582834 patients in 2021-2022 and 765425 patients in 2022-2023, indicating an increase of 23.8% in patient volume. The hospital employed 873 HCWs in various departments from May 2021 to April 2022 and 892 HCWs from May 2022 to April 2023, indicating a 2.1% increase in the number of staff.

The incidence of NSIs was highest among Nurses during 2021-2022 (37.5%) and 2022-2023 (37.8%). which was similar to most of the Indian studies by Talwar et al., Gita et al., and Sharma et al.[17,18,19] General Surgery had the highest percentage of NSIs in both years, followed by General Medicine in the first year and Orthopedics in the second year. However, none of the changes in the percentage of NSIs were statistically significant. The number of NSIs caused by bore hole increased, while the percentage of NSIs resulting in mucosal wounds decreased in the second year, and was in accordance with the various studies conducted in India by Ingole et al., Pawar et al., and Angadi et al.[20,21,22]

In our study, 27.4% of NSIs were caused by IV Cannula insertion, while 19.6% were due to garbage bag handling, 12.1% due to suture needle handling, 11.7% due to blood withdrawal, 12.6% due to subcutaneous injection, 11.5% due to recapping, and 5.2% due to lancet during dusting. However, it was in contrast to the various studies by Jaybhaye et al., Bhattacharya et al., Talwar et al., and Sharma et al., who reported that recapping was a major problem causing NSIs.[13,16,17,23]

The findings of the study have several implications. The decrease in the overall rate of NSIs among HCWs suggests that the interventions implemented to reduce NSIs were effective. The interventions could include educational programs, the use of safety-engineered devices, strict adherence to standard precautions, and the implementation of reporting and follow-up systems. The hospital could continue these interventions and identify new strategies to further reduce the incidence of NSIs. The lack of statistically significant changes in the percentage of NSIs across departments and professions indicates that interventions should be tailored to specific departments and professions, taking into account the nature of the work, the devices used, and the frequency of exposure to blood and body fluids.[24,25,26]

The increase in patient volume and the number of HCWs in the second year could have had an impact on the incidence of NSIs. The hospital should monitor the incidence of NSIs regularly, especially during periods of high patient volume and staff turnover. The increase in NSIs caused by bore hole could be related to the type of devices used in the hospital, and the hospital should explore the use of safety-engineered devices that minimize the risk of NSIs caused by bore hole. The decrease in NSIs resulting in mucosal wounds could be related to improved compliance with the use of personal protective equipment (PPE), and the hospital could continue to

promote and enforce the use of PPE.[10,11,27]

Conclusion

The study highlights the importance of implementing interventions to reduce NSIs among HCWs and monitoring their effectiveness. The hospital should tailor interventions to specific departments and professions and explore new strategies to further reduce the incidence of NSIs. The hospital should also monitor the incidence of NSIs regularly, especially during periods of high patient volume and staff turnover, and explore the use of safety-engineered devices that minimize the risk of NSIs caused by bore hole.

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