

Incidence, Risk Analysis and Recommendations for Needlestick, Sharp, and Splash Injuries at a Tertiary Care Government Hospital Kota, Rajasthan, India

DINESH VERMA¹, NAVEEN SAXENA², ANITA SHARMA³, SAURABH SHARMA⁴

ABSTRACT

Introduction: Needlestick, Sharp, and Splash Injuries (NSSSIs) are the major occupational hazards for the Healthcare Workers (HCWs) risking them for Blood-Borne Viruses (BBVs) such as Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), and Human Immunodeficiency Virus (HIV) and are contributed by factors like work stress, inadequate experience and training.

Aim: To analyse the baseline data and risk factors for developing NSSSI's and to establish the recommendations to prevent them in future.

Materials and Methods: A retrospective cohort analysis was carried out in a tertiary care centre from January 2016 to December 2019. The data of all the HCWs who voluntarily reported NSSSIs like needlestick injury, sharp injuries from cannulas, broken vials, splash injuries on intact skin and mucous membranes by potentially infectious materials such as blood and other body fluids during the study period was analysed. Data was collected and entered into Microsoft Excel 2007 and percentages were calculated.

Results: A total of 202 NSSSI's were reported (85.14% needlestick injuries, 10.80% sharp injuries and 4% splash

injuries). Most injuries of NSSSIs occurred in wards (30.70%), followed by emergency department (14.9%). Females (63.4%) were more affected than males. Doctors (30.2%) and nurses (26.7%) reported the maximum episodes of injuries. Fingers (72.1%) accounted for maximum affected body part during the needlestick and sharp injuries followed by palm (15.9%), while splash injury involved most commonly non intact skin (75%). Hollow needles accounted for maximum (84.3%) of episodes of needlestick injuries whereas most of the other sharp injuries were due to surgical blades (63.63%). Most injuries occurred during the use of device (38.12%) like blood withdrawal, suturing, giving injections, etc.

Conclusion: There was significant incidence of NSSSIs among HCWs. However, with continuous efforts of educating the staff; the problem of underreporting has slightly improved especially among the doctors, but there is significant work to do in case of the paramedics and nurses. Thus continuous education, timely reporting, prevention strategies and emphasis on appropriate Biomedical Waste (BMW) disposal are needed to increase occupational safety for HCWs.

Keywords: Blood-borne viruses, Occupational exposure, Scalpel blade

INTRODUCTION

The NSSSIs are the major occupational hazards among HCWs which pose a significant risk of transmission of BBVs like HBV, HCV, and HIV. The risk of transmission of HBV, HCV, and HIV following NSSSIs is about 3-10%, 3%, and 0.3%, respectively [1]. The level of risk depends on the number of patients with that infection in the health care facility and the precautions the HCWs observe while dealing these patients. Various risk factors implicate in causation of NSSSIs like type and design of needle, recapping activity, avoiding/improper Personal Protective Equipment (PPE), passing/handling devices, improper BMW segregation and failure to dispose the needle in puncture proof containers.

The National Institute for Occupational Safety and Health (NIOSH) USA has defined needle stick injuries as injuries caused by needles such as hypodermic needles, Intravenous (IV) stylets, and needles used to connect parts of IV delivery systems [2]. By definition, any cut or prick to the respondents by a needle or sharp object previously used on a patient called as Needlestick Injury (NSI), it is work related and sustained within the hospital premises. The frequency of such events has been about 600,000-800,000 cases annually in the USA [2], and it is estimated that 100,000 NSSSIs occur annually in the UK [3] and 500,000 annually in Germany [4].

There are few and limited reports about NSSSI in India [5-7]. So, it is very difficult to calculate exactly how many occupational injuries (NSSSIs) occur each year and thus in turn, difficult to estimate the annual incidence. Also, it might be possible that there is marked underreporting of NSSSI incidents acquired by HCWs which could be attributed to different levels of awareness of infection control measures among different categories of HCWs. Thus, this current study was therefore designed and conducted to analyse the baseline data and risk factors for developing NSSSI's among health care workers and to establish the recommendations to prevent these types of injuries in future.

MATERIALS AND METHODS

A retrospective cohort analysis was conducted from January 2016 to December 2019 at a Tertiary Care Hospital of Kota (Rajasthan). All the categories of HCWs who had a needlestick, sharp and splash injury were included in the study. The Hospital Infection Control Committee (HICC) and ART centre was the main nodal centre of reporting sharp injuries/occupational exposure. The data of all the HCWs who voluntarily reported NSSSIs like needlestick injury, sharp injuries from cannulas, broken vials, splash injuries on intact skin and mucous membranes by potentially infectious materials such as blood and other body fluids during the study period was analysed. A self-reporting questionnaire proforma was

filled at the time of reporting the injury having all the necessary details about the injury like mode and route of injury, type of sharp and other associated factors were obtained. After taking informed written consent, the baseline status of the HCWs for HIV, HCV antibodies and HBsAg was determined. The sample of the source (if known/available) was also tested for HIV and HCV antibodies as well as for HBsAg. Screening for HIV 1 and 2 was done as per NACO guidelines [8] and HBsAg and antibodies against HCV were done immediately by rapid tests (HBV by Reckon diagnostics Pvt., Ltd., Vadodara, India and HCV by Precision biomed Pvt., Ltd., Haryana India).

Calculating the Rate of Injury Per 100 Occupied Beds

Calculation of the rates of needlestick and sharp object injury was done with the total number of sharp injury reported during each year of study as numerator over the number of occupied hospital beds in the same year as denominator [7,9].

Ethical Considerations

To maintain the privacy, dignity and confidentiality of the participants, names of the HCWs were not disclosed. Institutional ethics committee clearance for accessing health worker records was taken (number- No.F.3) (Acad/ethical clearance/2020/04 dated 19/6/2020).

STATISTICAL ANALYSIS

Data was collected and entered into Microsoft Excel 2007 and percentages were calculated.

RESULTS

Total 237 needlestick, sharp and splash injuries were reported between January 2016 and December 2019. A total of 35 cases were not reported properly, they just took advice but never returned to nodal centre for reporting/testing, so were excluded from data analysis.

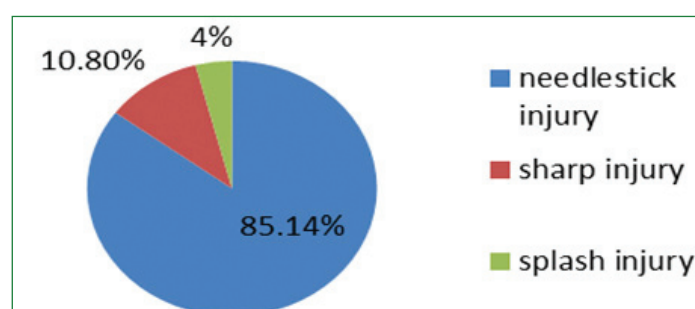
[Table/Fig-1] shows the frequency of needlestick, splash and sharp injuries in the past four years (January 2016 to December 2019).

Year	Frequency of recorded needlestick, sharp object and splash injury	No. of occupied hospital beds	Rate of NSSSI per 100 occupied hospital beds (%)
2016	26	300	8.6
2017	31	300	10.33
2018	64	471	13.5
2019	81	471	17.1
Total	202	1542	12.38

[Table/Fig-1]: Distribution of NSSSI incidents by year.

In the past four years, there were 202 cases of NSSSIs reported to nodal centre/ART centre, and the average rate of NSSSI was 12.38 episodes per 100 Occupied Beds per Year (OBY).

Among the total 202 cases reported, 172 (85.14%) were of needlestick injuries, 22 (10.8%) were sharp injuries and 8 (4%) were splash injuries [Table/Fig-2].



[Table/Fig-2]: Distribution of NSSSI by type.

[Table/Fig-3] shows that patient ward was the most common place of occurrence of NSSSIs (30.70%), followed by emergency department (14.9%), then the operation theatres (13.4%).

Location	Frequency	(%)
Ward	62	30.70
Emergency Department	30	14.9
Operation room	27	13.4
ICU/ critical care unit OPD	22	10.9
Laboratory/sample collection area	19	9.4
Labour and delivery room	15	7.4
Disposal site	10	4.9
Dialysis facility	5	2.5
Others	12	5.9

[Table/Fig-3]: Distribution of NSSSI's by location.

[Table/Fig-4] shows various epidemiological characteristics of documented NSSSIs. Female HCWs more often reported the injury to the nodal centre (63.4%) as compared to male HCW's (36.6%). Young HCWs, of age group between 20-30 years of age reported maximum injuries (54.4%). Among various categories of HCW's, doctors reported the maximum episodes (30.2%), followed by nurses (26.7%) and lab technicians (18.8%). The various student categories suffered the major brunt of injuries. Amongst the doctors, interns and PG students suffered the maximum injuries while

Characteristics	n (%)
Total injuries occurred (n=237)	
Injuries reported to nodal centre	202 (85.2)
Injuries underreported	35 (14.8)
Sex (n=202)	
Male	74 (36.6)
Female	128 (63.4)
Job category (n=202)	
Doctors	61 (30.2)
Nurses	54 (26.7)
Lab technicians	38 (18.8)
Ward Attenders	31 (15.3)
Others	18 (8.9)
Age (n=202)	
<20 years	7 (3.4)
20-30 years	110 (54.4)
31-40 years	56 (27.8)
>41 years	29 (14.4)
Site of Needlestick and sharp injury (n=194)	
Fingers	140 (72.1)
Palm	31 (15.9)
Upper arm and forearm	11 (5.6)
Legs	8 (4.1)
Others (thigh, buttock etc.,)	4 (2.06)
Splash injury (n=8)	
Non intact skin	6 (75)
Eye splash	2 (25)
Type of needle used in Needlestick injury (n=172)	
Hollow needles	145 (84.30)
Solid needle	27 (15.7)
Sharp other than needle (n=22)	
Blades	14 (63.63)
Others	8 (36.36)

[Table/Fig-4]: Epidemiological characteristics of NSSSIs.

nursing students and DMLT students were most suffered among nurses and lab technicians respectively. Fingers (72.1%) accounted for maximum affected body part during the needlestick and sharp injuries followed by palm (15.9%); while some other rarely noted sites (2.06%) are thighs, buttocks etc., which are mainly due to careless activities like putting used syringes in pockets while routine nursing care and tendency to dispose at last, or putting used syringes inadvertently on chairs/beds which unknowingly affects others. Splash injury involved most commonly non intact skin (75%) followed by conjunctiva (25%). Analysis of the needles involved in NSIs revealed that hollow needles accounted for maximum (84.3%) episodes of NSIs whereas most of the other sharp injuries were due to surgical blades (63.63%).

As shown in [Table/Fig-5], most injuries occurred during the use of device (n=74, 38.12%) like blood withdrawal, suturing, giving injections etc., followed by accidental injuries caused by leaving the device on inappropriate location (n=54,27.83%) like patient bed, table tops, inappropriate biowaste bin, floor etc. This study showed that in 24 (12.37%) cases, recapping was the main cause of injury.

Activity	Number	Percent
During the use of item (sample collection)	74	38.14
Device left on inappropriate place	54	27.83
Recapping	24	12.37
Handling of Biomedical Waste (BMW)	19	9.79
During disposal at final disposal site	8	4.12
Not properly recorded	15	7.73

[Table/Fig-5]: Activities during which needlestick and sharp injuries occurred (n=194).

DISCUSSION

Analysis of NSSSI's incidents during the period of study from January 2016 to December 2019 represented that 202 NSSSIs were voluntarily reported (12%). This data is comparatively slightly higher as compared with other studies [10]. This difference may be because of under-reporting of injuries as most of the studies are based on voluntary reporting of NSSSIs, which varies from institute to institute.

Distribution of voluntarily reported NSSSI'S shows an increasing trend with peak in 2019 (17.1 per 100 OBY). In previous years in our institution, many of the NSSSI's were underreported because of lack of proper knowledge. But because of continuous health educational activities and awareness about the hazards caused by NSSSI's, the HCWs were compelled to take appropriate preventive measures and report timely to the nodal centre in case of any injury.

Among NSSSI's, commonest reported was NSI followed by other sharp injuries like scalpel blade etc., and least were splash injuries. The NSI were more frequently reported in females (63.4%) than in males (36.6%). This is in concordance with few other studies where female HCW's are more affected [11,12]. However, as the gender distribution is not equal in the health care facility, it cannot be relied upon and so this may not be true. In contrast to these findings, some

studies have also reported male HCWs being the most common group to sustain NSI [10].

Among the NSI, most of the injuries were due to hollow bore needles (84.30%) like blood collection needles, butterfly needles and IV catheter stylets. Hollow needles are likely to contain certain amount of residual blood and are associated with an increased risk for blood borne virus transmission, thus are of particular concern [13]. Sharp injuries by solid bore needles in this study were 15.70% which is in concordance with a study done by Sastry AS et al., (13.3%) [7] in contrast to 20.9% that was reported by Jayanth ST et al., [14] and Goel V et al., (8.9%) [10].

In the present study, ward, emergency department, operation room, ICU, and laboratory are the common locations for NSSSIs. Maximum number of cases were reported from the wards (30.70%) which is consistent with the finding of other studies [8,15,16] probably reflecting the bed strength, occupancy and work load. In emergency wards, immediate life-saving procedures are required on an urgent basis which increases the chances of NSSSIs. Also mostly, resident doctors, interns and junior nursing staff have to perform emergency procedures in emergency which also make them prone to NSSSIs because of lack of experience. Whereas, higher reporting in ICUs, operation theatre was due to various factors such as increased work load mainly in government set up like ours, lack of staff, sudden medical emergencies, which increases the chances of injuries. However, operation theatres were observed to be the most common site of NSI to occur in many studies [17,18].

Fingers were the most common site reported as concurred by several other studies [10]. It was observed that exposures were more commonly reported from doctors (30.2%) followed by nurses (26.7%) and lab technicians (18.8%). Several studies from India reported doctors as the most common group to sustain NSSSIs [8,14,15]. In most of the studies including ours, junior doctors like residents mainly encounter/report NSSSIs. This could be a reflection of the larger number of exposure prone procedures conducted by resident doctors. This may also be due to lack of experience, handling the heavy workload of patients under pressure situations and lack of knowledge regarding safe injection practices. Also, a higher awareness for reporting NSSSIs than nurses could be the possible reason which accounted for their increased rate of exposures.

Most injuries occurred during device use (38.12%) like blood withdrawal, injections, and suturing. Similar results were seen with several other studies [8,10,19,20]. Most common reasons behind these injuries were malpractice in handling sharp instruments. Other reasons might be unavailability of safety devices and understaffing. Recapping was recognised as one of the important factor in causing NSSSIs which ranges from 5-15% [8,14] or even higher (34.0%-65%) in some studies [17,18,20]. However, 12.37% association of recapping with NSSSIs was observed in this study, the primary reason being lack of awareness or negligence.

Study	Period	NSSSIs reported	Category of staff maximally exposed	Activity involved in maximum exposure	Site	Type of needle	Department
Randive M et al., [6]	January 2014-June 2015	105	Class IV workers (67.74%) Intern doctors (36.48%)	Recapping syringes (20%)	-	Hollow bore (82.85%)	Ward
Sastry AS et al., [7]	December 2014-November 2016	452	Doctors (32.5%) Nurses (21.9%)	Blood sample collection	Fingers	Hollow bore (86.7%)	Ward
Goel V et al., [10]	January 2011-December 2013	476	Doctors (73%)	Blood sample collection	Fingers	-	Emergency, ICU
Jayanth ST et al., [14]	July 2006-June 2007	296	Nurses (28.4%) Doctors (21.6%)	Blood sample collection	Fingers	Hollow bore (77.7%)	Ward
Salekar S et al., [21]	January 2007-August 2007	200	Resident doctors (55%), Junior resident (47.20%)	Sharp disposal (31.70%), Operative procedures (21.8%)	Fingers	Hollow bore (77%)	-
Present study	January 2016-December 2019	202	Doctors (30.2%)	Blood sample collection	Fingers	Hollow bore (84.30%)	Ward

[Table/Fig-6]: A comparison of reports of NSSSIs from different studies [6,7,10,14,21].

Also, 27.83% of injuries were due to inappropriately placing the sharps elsewhere while 9.79% were during handling of BMW. Thus, strict adherence to proper BMW segregation and disposal must be emphasised. [Table/Fig-6] showed the comparative analysis of the study with various other institutions. Most of the studies showed that hollow needles are mainly implicated in causing NSIs while blood collection is the main activity indulged in maximum exposure [6,7,10,14,21].

All medics and paramedics including the new recruits should be taught, trained and sensitised on a regular basis about standard precautions and safe injection practices by interactive methods like showing them preventive videos and demonstrating how to discard sharp instruments by the Hospital Infection Control (HIC) committee. Training should also cover the knowledge about infection/occupational health hazards contracted by NSSSIs. An active surveillance program/policy for NSSSIs should be formed and implemented so as to minimise the underreported cases. Proper signage and posters should be displayed at important locations giving information regarding what to do and whom to consult after NSI. BMW auditing for proper segregation and disposal should be on regular basis.

In due course of time this multifaceted approach will definitely improve the knowledge, attitude and response of HCWs towards NSSSIs, which will help in reducing the burden of diseases that can be spread by NSSSIs and to make the workplace safe for them.

Limitation(s)

The data does not express the real extent of problem as the data depends on HCW who voluntarily reported to art centre/microbiology department after NSSSI.

CONCLUSION(S)

The present study showed that, there was significant incidence of NSSSIs among HCWs. However with continuous efforts of educating the staff the problem of underreporting has slightly improved especially among the doctors, but there is significant work to do in case of the paramedics (nurse, ward attendants etc.) as most of them lack awareness. The study necessitates the need for repetitive and regular training for safe injection practices including proper disposal of needles and emphasising the extreme precaution in handling the sharps and proper BMW segregation.

REFERENCES

- [1] Wilburn SQ, Eijkemans G. Preventing needlestick injuries among healthcare workers: A WHO-ICN collaboration. *Int J Occup Environ Health*. 2004;10:451-56.
- [2] NIOSH. Preventing needle stick injuries in health care settings. Cincinnati: Department of Health and Human Services, DHHS (NIOSH) Publication; 1999.
- [3] Hofmann FKN, Beie M. Needle stick injuries in health care - frequency, causes and preventive strategies. *Gesundheitswesen* 2002;64:259-66.
- [4] O Connor MB. Needle stick injury advices in the UK and Ireland. *J Hosp Infect*. 2009;71(2):185-86.
- [5] Mehta A, Rodrigues C, Ghag S, Bavi P, Shenai S, Dastur F. Needlestick injuries in a tertiary care centre in Mumbai, India. *J Hosp Infect*. 2005;60:368-73.
- [6] Randive M, Ramchandran A, Turbadkar D, Baveja S. An audit of sharp injuries at a tertiary care hospital in Mumbai, India. *Int J Curr Microbiol App Sci*. 2017;6(1):201-06.
- [7] Sastry AS, Rajshekhar D, Bhat P. Needlestick, sharp, and splash injuries in a tertiary care government hospital of South India. *J Curr Res Sci Med*. 2017;3:94-101.
- [8] Post Exposure Prophylaxis (PEP) | National AIDS Control Organization | MoHFW | Government of India. Available from: <http://www.naco.gov.in/post-exposure-prophylaxis-pep>.
- [9] Memish ZA, Assiri AM, Eldalaton MM, Hathout HM, Alzoman H, Undaya M. Risk analysis of needle stick and sharp object injuries among health care workers in a tertiary care hospital (Saudi Arabia). *J Epidemiol Global Health*. 2013;3(3):123-29.
- [10] Goel V, Kumar D, Lingaiah R, Singh S. Occurrence of Needlestick and Injuries among Health-care Workers of a Tertiary Care Teaching Hospital in North India. *J Lab Physicians*. 2017;9(1):20-25.
- [11] Mbaisi EM, Ng'ang'a Z, Wanzala P, Omolo J. Prevalence and factors associated with percutaneous injuries and splash exposures among health-care workers in a provincial hospital, Kenya, 2010. *Pan Afr Med J*. 2013;14:10.
- [12] Wood AJ, Nadershahi NA, Fredekind RE, Cuny EJ, Chambers DW. Student occupational exposure incidence: Perception versus reality. *J Dent Educ*. 2006;70:1081-88.
- [13] Adams D. Needlestick and sharps injuries: implications for practice. *Nursing Standard*. 2012;26(37):49-58.
- [14] Jayanth ST, Kirupakaran H, Brahmadathan KN, Gnanaraj L, Kang G. Needle stick injuries in a tertiary care hospital. *Indian J Med Microbiol*. 2009;27:44-47.
- [15] Sharma A, Gur R, Bhalla P. Study on prevalence of needle stick injury among health care workers in a tertiary care hospital in New Delhi: A two-year review. *Indian J Public Health*. 2012;56:101-03.
- [16] Cervini P, Bell C. Brief report: Needlestick injury and inadequate post-exposure practice in medical students. *J Gen Intern Med*. 2005;20:419-21.
- [17] Sharma R, Rasania S, Verma A, Singh S. Study of prevalence and response to needle stick injuries among health care workers in a tertiary care hospital in Delhi, India. *Indian J Community Med*. 2010;35(1):74-77.
- [18] Jahangiri M, Rostamabadi A, Hoboubi N, Tadayon N, Soleimani A. Needle stick injuries and their related safety measures among nurses in a university hospital, Shiraz, Iran. *Saf Health Work*. 2016;7:72-77.
- [19] Rele M, Mathur M, Turbadkar D. Risk of needle stick injuries in health care workers- A report. *Indian J Med Microbiol*. 2002;20:206-07.
- [20] Muralidhar S, Singh PK, Jain RK, Malhotra M, Bala M. Needle stick injuries among health care workers in a tertiary care hospital of India. *Indian J Med Res*. 2010;131:405-10.
- [21] Salekar S, Motghare DD, Kulkarni MS, Vaz FS. Study of needle stick injuries among health care workers at a tertiary care hospital. *Indian J Public Health*. 2010;54(1):18-20.

PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Microbiology, Government Medical College, Kota, Rajasthan, India.
2. Senior Professor, Department of Microbiology, Government Medical College, Kota, Rajasthan, India.
3. Senior Demonstrator Department of Microbiology, Government Medical College, Kota, Rajasthan, India.
4. Assistant Professor, Department of Microbiology, Government Medical College, Kota, Rajasthan, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Saurabh Sharma,
H. No-107, Dadabari Extension, Kota-324009, Rajasthan, India.
E-mail: drsaurabhsharma09@gmail.com

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Mar 05, 2020
- Manual Googling: Jul 27, 2020
- iThenticate Software: Sep 24, 2020 (03%)

ETYMOLOGY: Author Origin

Date of Submission: **Feb 28, 2020**
Date of Peer Review: **Apr 03, 2020**
Date of Acceptance: **Jul 28, 2020**
Date of Publishing: **Oct 01, 2020**