Original Article

DOI: 10.7860/NJLM/2024/69558.2863

Microbiology Section

Occupational Exposure to Blood and Body Fluids among Healthcare Workers at a Tertiary Care Teaching Hospital: A Retrospective Observational Study

CHIRAG MODI[1], NAIMIKA PATEL[2], ROSHANI DESAI[3], PURVI SHAH[4], NEELA VYASKAR[5], ANKIT THAKOR[6]

ABSTRACT

Introduction: Occupational exposure to Blood and Body Fluids (BBFs) through Needlestick Injuries (NSIs) or mucosal exposure can lead to the transmission of Blood-borne Viruses (BBVs). Such exposures require a robust reporting system followed by a detailed analysis of their root causes.

Aim: To assess occupational exposure incidences and their epidemiological characteristics among Healthcare Workers (HCWs).

Materials and Methods: A retrospective observational study was conducted in the Department of Microbiology, Pramukhswami Medical College and Shree Krishna Hospital, Karamsad, Anand, Gujarat, India. Data regarding the distribution of exposures, the cadre of HCWs involved, the location in the hospital, and Hepatitis B vaccination status were collected by the Hospital Infection Control Committee (HICC) from January 2012 to December 2022. The data analysis was performed in 2023 using Microsoft Excel 2013. The incidence of exposures was calculated as exposures per 1000 inpatient-days, which is the number of accidental exposures per year divided by inpatient days (the sum of the number of inpatients present on each day of that year) multiplied by 1000.

Results: A total of 750 exposures occurred with an incidence density of 0.52 per 1000 patient-days. Nurses, 305 (40.7%) were the most common HCWs affected. The critical care unit, 189 (25.2%) had the highest incidence of exposures. Phlebotomy, 165 (22%) followed by recapping, 140 (18.7%) were the most common modes of exposure. The source was positive for BBVs in 119 (15.8%) cases, whereas it was unknown in 35 (4.6%) cases. Among them, 60 (8%) exposed HCWs had never been vaccinated with the Hepatitis B vaccination.

Conclusion: Accidental exposures continue to be an important occupational health hazard among HCWs, especially nurses. Periodic awareness programs and training to prevent exposures, their reporting, and ongoing data analysis shall help in reducing the incidence of these exposures.

Keywords: Blood and body fluid exposures, Needle stick injury, Prevalence, Vaccination

INTRODUCTION

The HCWs are potentially exposed to chemical, physical and biological hazards during their professional careers. Infected needles and sharps play a major role in spreading infections to HCWs during medical practices [1]. More than 20 blood-borne pathogens have been transmitted through contaminated BBF exposures, including NSIs and mucosal exposure. Of primary significance are infections such as Hepatitis B virus, Hepatitis C virus and Human Immunodeficiency Virus (HIV) [2,3]. The risk of transmission for these pathogens varies from 6-30%, 3-10%, and 0.4%, respectively, through NSI [2,4-7]. A recently published study suggests that more than one in three and two in three HCWs are exposed to blood-borne pathogens annually. Global pooled prevalence data on exposures to BBFs among HCWs throughout their careers accounts for 56.6% [8]. The highest prevalence of BBF exposure was observed in the Southeast Asia region, followed by the Western Pacific region, with the lowest prevalence reported in the European region based on World Health Organisation (WHO) region data [8]. This data indicates a high prevalence of occupational exposure to BBFs among HCWs and underscores the need to improve occupational health and safety services in healthcare systems globally [8]. Published studies mention that the highest rate of NSIs occurs among nurses, followed by medical students, laboratory workers, consultants and cleaners [4,9,10]. The prevalence of NSIs among nursing students varies from 1.60-91.85% in published studies [11]. Factors associated with NSIs include equipment designs, type of procedure, work conditions, needle handling, staff experience, insufficient appropriate resources, non compliance with infection control standards and young age [1,2,12]. Exposure to NSIs leads to psychological distress, fear, tension and anxiety among HCWs, ultimately compromising healthcare services [13]. To prevent the burden associated with NSIs, the Centers for Disease Control and Prevention (CDC) recommended universal precautions in 1987, focusing on careful handling and safe disposal of sharps, and educating HCWs about the dangers of recapping, bending, and breaking used needles [11]. Data on occupational-related injuries is limited in Gujarat and in India because HCWs often underreport exposures [2]. Therefore, the present study was conducted to assess the incidence density of accidental exposure and its epidemiological characteristics among HCWs at the study Institute. Periodic data analysis enables us to identify loopholes in sharp handling practices and allows us to implement interventions that can reduce the incidence of NSIs at the hospital.

MATERIALS AND METHODS

The present retrospective observational study was conducted in the Department of Microbiology, Pramukhswami Medical College and Shree Krishna Hospital (SKH) {National Accreditation Board for Testing and Calibration Laboratories (NABL) accredited} in the Microbiology laboratory of the central diagnostic laboratory (NABL accredited) in Karamsad, Anand, Gujarat, India, which is a 1000-bed hospital in Gujarat, India. The study was conducted from 1st January 2012 to 31st December 2022, spanning a period of 11 years and the data analysis was performed in 2023 using Microsoft Excel 2013.

Study was conducted after the approval of the Institutional Ethics Committee (IEC/BU/2023/Ex.70/287/2023). An Infection Control Team (ICT) consisting of an Infection Control Officer (ICO), who is also a Microbiologist, an infection control coordinator, and four Infection Control Nurses (ICNs), is responsible for collecting data related to hospital infection control.

Inclusion criteria: All accidental exposures to BBFs that occurred while working at the study Institute and who reported to the ICT within the study period, were included in the study analysis.

Exclusion criteria: Unreported exposures or instances with insufficient data were not included in the analysis.

There was an established protocol for reporting and managing accidental exposures prepared by the ICO at the hospital. The incidents were reported to the ICNs during working hours and to the Casualty Medical Officer (CMO) during emergency hours.

Study Procedure

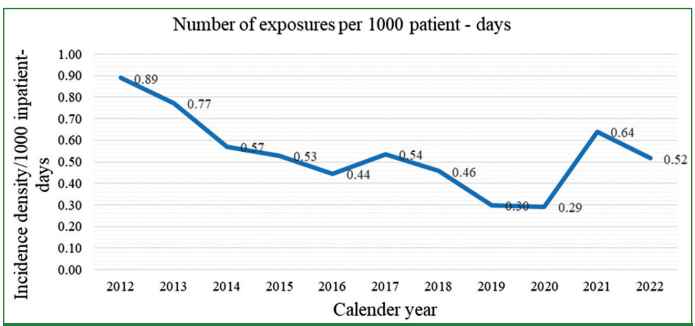
The ICNs collected information from the exposed HCWs following a designed format that included epidemiological characteristics such as their locations in the hospital, designation of HCWs, source seropositive status, and vaccination status of the exposed HCWs. The incidence density of accidental exposures was calculated as the number of accidental exposures to BBFs per 1000 patient-days, a formula that was followed according to the accreditation standards provided by the National Accreditation Board for Hospitals and Healthcare Providers (NABH), 4th edition [14]. The numerator consists of the number of accidental exposures that occurred in a particular time period (in a calendar year). Patient-days are calculated as the sum of the number of inpatients present on each day of the same time period (one calendar year). The ratio is then multiplied by 1000. Percentage distribution of the exposures was done with respect to the cadre of HCWs (Consultant doctor, resident doctor, intern doctor, nurses, housekeeping staff, student), in hospital locations (critical care units, wards, operation theatres, outpatient clinic, etc.,), and the status of Hepatitis B vaccination (fully vaccinated, partially vaccinated, or non vaccinated).

STATISTICAL ANALYSIS

All the data was entered and analysed in Microsoft Excel 2013. Results are presented as numbers and percentages.

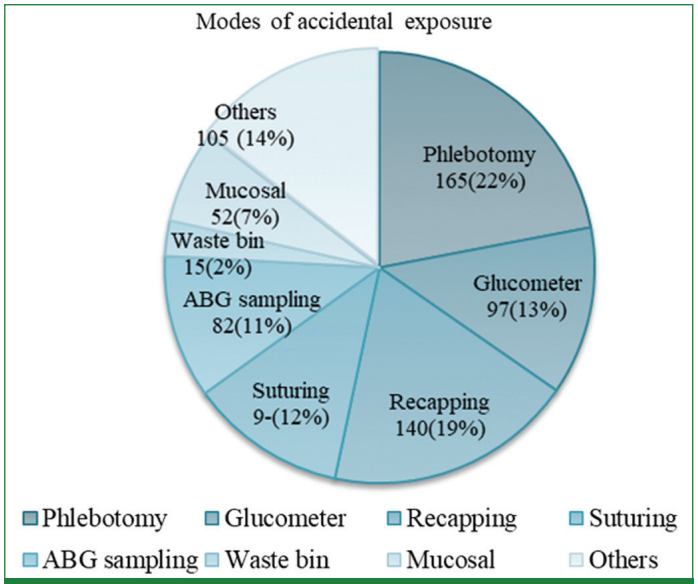
RESULTS

A total of 750 accidental exposures to BBFs occurred among HCWs at an incidence density of 0.52 per 1000 patient-days during the study period. Year-wise incidence density of these exposures is described in [Table/Fig-1]. Out of the 750 exposures, 698 (93.1%) were due to sharp injuries, whereas 52 (6.9%) were due to mucosal exposure to blood/body fluids.



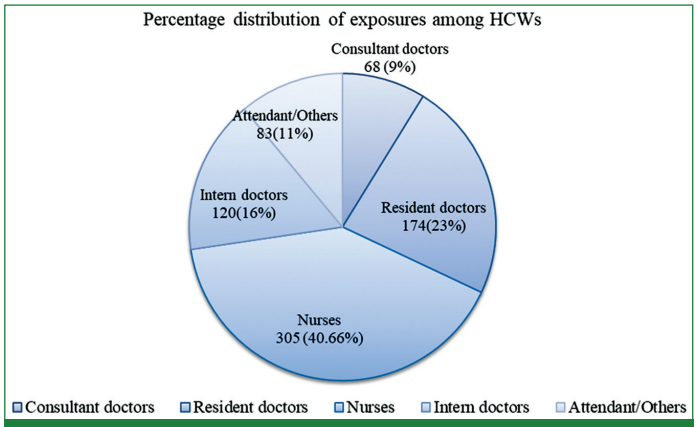
[Table/Fig-1]: Incidence density of exposures per 1000 patient-days.

The distribution of modes of accidental exposures is described in [Table/Fig-2]. The category 'others' in the modes of exposures includes incidents such as a sharp object falling on the foot, improper disposal of sharps, failure to carry sharps in a closed container, dental procedures, administering local anaesthesia, Fine Needle Aspiration Cytology (FNAC), and body fluid tapping.



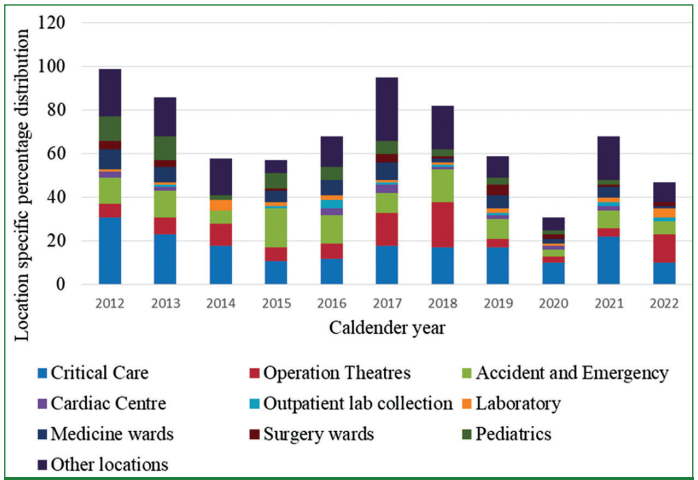
[Table/Fig-2]: Distribution of modes of accidental exposures.

The distribution of exposures among various HCWs is described in [Table/Fig-3]. Nurses were the most common victims of accidental exposures.



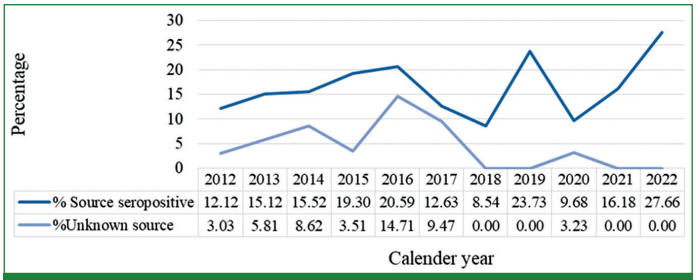
[Table/Fig-3]: Distribution of exposures among Healthcare Workers (HCWs).

The year-wise distribution of exposures among various locations in the hospital is described in [Table/Fig-4]. Out of the 750 exposures, 189 (25.2%) incidents occurred in critical care, followed by 111 (14.8%) in accident and emergency, and 97 (12.93%) in operation theatres, accounting for a total of 52.9% of all exposures.



[Table/Fig-4]: Year-wise distribution of exposures among various hospital locations.

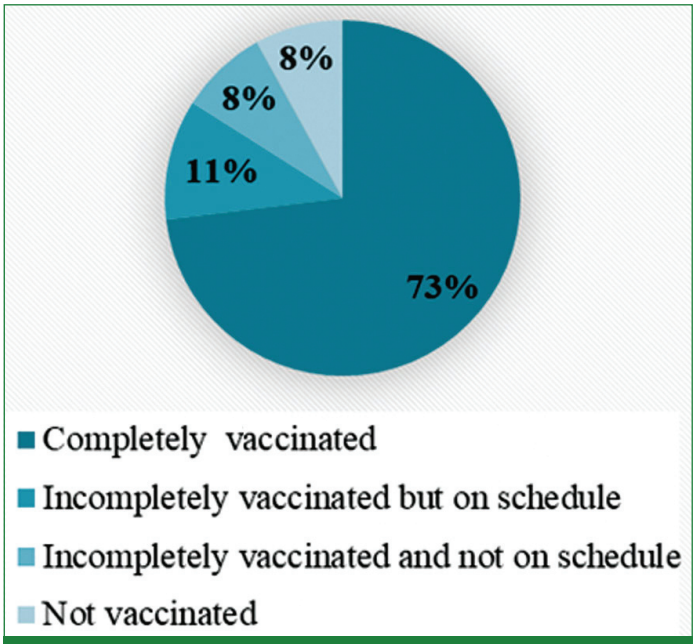
The trend of the percentage of exposures from seropositive, as well as, unknown sources is described in [Table/Fig-5]. Out of the 750 exposures, 119 (15.86%) incidents were from a seropositive source, whereas 35 (4.66%) were from an unknown source.



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
% Source seropositive	12.12	15.12	15.52	19.30	20.59	12.63	8.54	23.73	9.68	16.18	27.66
%Unknown source	3.03	5.81	8.62	3.51	14.71	9.47	0.00	0.00	3.23	0.00	0.00

[Table/Fig-5]: Percentage of exposures from seropositive and unknown source.

Hepatitis B vaccination status among exposed HCWs is described in [Table/Fig-6]. Out of 750 victims, 548 (73%) HCWs were completely immunised with the Hepatitis B vaccine, whereas 82 (10.93%) were already on the immunisation schedule at the time of exposure. The rest of the HCWs, 120 (16%) who did not have any vaccination history at the time of exposure were subsequently vaccinated with the Hepatitis B vaccine.



[Table/Fig-6]: Hepatitis B vaccination status among exposed HCWs.

DISCUSSION

Accidental exposure to BBFs has been recognised as a significant occupational hazard among HCWs due to its association with the transmission of BBVs. The present study was conducted to assess the trend of accidental exposures over the past 11 years and to study the epidemiological characteristics of these exposures.

There were 750 exposures during the study period with an overall incidence density of 0.52 per 1000 patient-days. As shown in [Table/Fig-1], there has been a decreasing trend in the reported incidents of accidental exposure. The study Institute provides induction training on accidental exposures for all staff members, including postgraduate students, at the time of joining, on-the-job training, display of IEC material across the hospital, an efficient incident reporting and post-exposure management system, monthly analysis of reported incidents at HICC meetings, Continuing Medical Educations (CMEs), and incorporation of management and prevention of accidental exposure in the undergraduate curriculum, all of which have increased awareness among HCWs and students. A spike in the trend was noted in the year 2021 when the hospital was overwhelmed with Coronavirus Disease 2019 (COVID-19) patients. The lack of adequate staff members to manage the influx of patients and tremendous work pressure on the existing staff members may have increased the risk of accidental exposures. Chakravarthy M et al., reported an incidence density of 0.43 per 1000 patient-days [15]. In two other studies, the incidence of accidental exposures has been calculated as the number of exposures per 100 occupied bed days per year or the number of exposures per 100 HCWs, so direct comparison with this incidence was not feasible [16,17]. Goel V et al., conducted a study similar to the present study but did not calculate incidence density [18]. Several other studies have been conducted as retrospective surveys and did not include an analysis of actual reported incidents, making direct comparisons with these studies impossible [2,4,19,20]. Despite the efficient reporting system at the Institute, it is believed that a number of exposures may go unreported, a concern that has also been raised in other studies [17].

In the present study, out of 750 exposures, 698 (93.9%) exposures were due to sharp injuries, whereas 52 (6.9%) were due to mucosal exposure to blood/body fluids. Sastry AS et al., and Goel V et al., reported 90.9% and 86.1% of exposures, respectively, were due to percutaneous injuries [17,18]. According to the two retrospective surveys, 93.6% and 96% of exposures were due to percutaneous injuries [7,18]. Percutaneous injuries/ sharp injuries remain the predominant type of accidental exposures.

In the present study, phlebotomy, 165 (22%) was the most common mode of injury, whereas recapping, 140 (18.66%) was the second most common mode of injury. Goel V et al., reported 47.7% of injuries during blood sample collection, whereas Sastry AS et al., reported 14% of injuries due to recapping of needles [17,18]. In the retrospective surveys, 2.8-55% of exposures occurred during phlebotomy [2,21-23], whereas 6.4-34% were due to recapping of needles [20-22]. At the present study's Institute, a dedicated phlebotomy team was not present and hence the phlebotomy was performed by nurses, resident doctors, and intern doctors, totaling around 1000 individuals. To reduce the risk of injury during phlebotomy, due to the high number of individuals exposed to the procedure and with variable skill levels, it is advisable to have a dedicated phlebotomy team that is highly skilled and consists of a limited number of individuals. This will help in reducing accidental exposures during the phlebotomy procedure. Recapping continues to be another important mode of injury. Lack of awareness or negligence has been identified as important reasons for recapping [17]. Prevention of injuries due to recapping needs the strengthening of strategies such as availability of safety devices, easy accessibility to sharp disposal containers, and persistently raising awareness through various training programs.

Nurses (n=305) and resident doctors (n=174), together (n=479), comprised 479 (63.86%) accidental exposures in the present study. Nurses were identified as the most common HCWs to be victims of accidental exposure in the majority of studies, including the Exposure Prevention Information Network (EPINet) report 2021 [5,15,20-22,24,25]. Whereas doctors were the most common group in a few other studies [17,18,23]. At the present study's Institute, the majority of invasive procedures at the bedside are performed by nurses and resident doctors, with few exceptions, such as measuring blood glucose by a glucometer, which is done by intern doctors. With such high involvement in invasive procedures, coupled with work-related pressure and negligence in handling sharps appropriately, they are at a higher risk of exposure.

In the present study, the Critical Care Unit (n=189), Accident and Emergency (n=111), and Operation Theatres (n=97) together accounted for 397 (52.9%) total accidental exposures. In previous studies, exposures have commonly been reported from

Intensive Care Units, Emergency Rooms and Operation Theatres [5,17,18,25]. Whereas exposures at the bedside in wards were more common in other studies [8,20,23,26]. Intensive care units, Accident and Emergency, and Operation Theatres are highly demanding areas with a higher number of invasive procedures performed compared to wards, contributing to a higher risk in these areas.

In the present study, 119 (15.86%) exposures were from a seropositive source, whereas 35 (4.66%) exposures were from an unknown source. Goel V et al., reported 10.11% of exposures happening from a seropositive source, whereas 31.4% were from an unknown source [18]. Sastry AS et al., reported 6.9% of exposures from a seropositive source, whereas 33.8% of exposures were from an unknown source [17]. At the present Institute, there is an electronic health record system named SOLACE where the entire patient-related information, including laboratory test results, is available on this platform. Every HCW (doctors, nurses, and laboratory technicians) has access to the system. Following an injury, HCWs are able to access the reports of a patient for blood-borne pathogens, and if found to be negative, they may avoid reporting the incident. When the reports are positive for any of the blood-borne pathogens, the HCW would report the incident to the ICT as they would benefit from free-of-cost baseline investigations, as well as, antiretroviral therapy when indicated, thereby reflecting a higher rate of exposure from seropositive or unknown sources.

In the present study, out of 750 victims, 548 (73%) HCWs were completely immunised with the Hepatitis B vaccine, whereas 82 (10.93%) were already on the immunisation schedule at the time of exposure. The rest of the HCWs, 120 (16%) who did not have any vaccination history at the time of exposure were subsequently vaccinated with the Hepatitis B vaccine. Goel V et al., reported an immunisation rate of 97.5%, whereas Sastry AS et al., reported complete immunisation of 40.9% among the victims [17,18]. The Hepatitis B vaccine can successfully protect from Hepatitis B virus infection following an accidental exposure to BBFs, and hence all HCWs should be encouraged to take the vaccine and have their anti-HBs antibody titres verified. Therefore, analysing this data enables us to identify loopholes in the practices of handling sharps and allows us to implement interventions such as requiring training that can reduce the incidence of NSIs at the present hospital.

Limitation(s)

As this study was conducted in a single centre, generalisability of the results is not possible. Larger multicentre studies can provide better insights.

CONCLUSION(S)

Accidental exposure to BBFs continues to be a significant occupational health hazard among HCWs. The incidence has been showing a downward trend over a period of 11 years, a result of persistent trainings and awareness programs for HCWs. Nurses continue to be at the highest risk of exposure due to their constant involvement with patients and day-to-day basic invasive procedures. Areas that are more demanding in terms of work and where more invasive procedures are performed pose a higher risk for exposures. Phlebotomy should be performed by designated phlebotomists rather than by every nursing staff or doctors to minimise variations in the procedure and thereby reduce the risk of exposure. Hepatitis B can be effectively prevented by vaccination, and all HCWs, including students, involved in patient care should be vaccinated with the Hepatitis B vaccine.

REFERENCES

[1] Papadopoli R, Bianco A, Pepe D, Pileggi C, Pavia M. Sharps and needle-stick injuries among medical residents and healthcare professional students: Pattern and reporting in Italy-A cross-sectional analytical study. Occup Environ Med. 2019;76(10):739-45.

[2] Hussain JS, Ram SM, Galinde J, Jingade RR. Occupational exposure to sharp instrument injuries among dental, medical and nursing students in Mahatma Gandhi Mission's Campus, Navi Mumbai, India. Journal of Contempary Dentistry. 2012;2(2):01-10.

[3] American Nurses Association. Needlestick prevention guide. 2002. Available from: https://www.academia.edu/36029502/American_Nurses_Associations_Needlestick_Prevention_Guide.

[4] Honda M, Chompikul J, Rattanapan C, Wood G, Klungboonkrong S. Sharps injuries among nurses in a Thai regional hospital: Prevalence and risk factors. Int J Occup Environ Med. 2011;2(4):215-23.

[5] Sharma S, Gupta A, Arora A. Knowledge, attitude and practices on needle-stick and sharps injuries in tertiary care cardiac hospital: A survey. Indian J Med Sci. 2010;64(9):396-401.

[6] Bekele T, Gebremariam A, Kaso M, Ahmed K. Factors associated with occupational needle stick and sharps injuries among hospital healthcare workers in Bale Zone, Southeast Ethiopia. PLoS One. 2015;10(10):e0140382. Available from: https://doi.org/10.1371/journal.pone.0140382.

[7] Valsan C, Paul J, Kuttichira P, Varghese R, Joseph S. Economic impact of needle sticks injuries – A retrospective study from a tertiary care hospital. Kerala Medical Journal. 2018;11(3):60-65.

[8] Mengistu DA, Dirirsa G, Mati E, Ayele DM, Bayu K, Deriba W, et al. Global occupational exposure to blood and body fluids among healthcare workers: Systematic review and meta-analysis. Can J Infect Dis Med Microbiol. 2022;2022:5732046.

[9] Lachowicz R, Mathews PA. The pattern of sharps injury to health care workers at Witbank Hospital. South African Family Practice. 2009;51(2):148-51.

[10] Suliman M, Al Qadire M, Alazzam M, Aloush S, Alsaraireh A, Alsaraireh FA. Students nurses' knowledge and prevalence of Needle Stick Injury in Jordan. Nurse Educ Today. 2018;60:23-27.

[11] Handiyani H, Kurniawidjaja LM, Irawaty D, Damayanti R. The effective needle stick injury prevention strategies for nursing students in the clinical settings: A literature review. Enfermería Clínica. 2018;28(Suppl 1):167-71.

[12] Wang C, Huang L, Li J, Dai J. Relationship between psychosocial working conditions, stress perception, and needle-stick injury among healthcare workers in Shanghai. BMC Public Health. 2019;19(1):874.

[13] Gheshlagh RG, Aslani M, Shabani F, Dalvand S, Parizad N. Prevalence of needlestick and sharps injuries in the healthcare workers of Iranian hospitals: An updated meta-analysis. Environ Health Prev Med. 2018;23(1):44.

[14] Accreditation Standards for Hospitals. 4th ed, National Accreditation Board for Hospitals and Healthcare Providers (NABH). 2015 Dec. Available from: https://kgmu.org/download/NABH-Book.pdf.

[15] Chakravarthy M, Rangaswamy S, Harivelam C, Pargaonkar S, Hosur R, Pushparaj L, et al. Cost of postexposure management of occupational sharp injuries in an Indian tertiary health care facility: A prospective observational study in a tertiary care hospital. J Natl Accred Board Hosp Healthcare Prov. 2015;2:47-52.

[16] Zafar A, Habib F, Hadwani R, Ejaz M, Khowaja K, Khowaja R, et al. Impact of infection control activities on the rate of needle stick injuries at a tertiary care hospital of Pakistan over a period of six years: An observational study. BMC Infect Dis. 2009;9:78. Available from: https://doi.org/10.1186/1471-2334-9-78.

[17] Sastry AS, Rajshekhar D, Bhat P. Needlestick, sharp, and splash injuries in a tertiary care government hospital of South India. Journal of Current Research in Scientific Medicine. 2017;3(2):94-101.

[18] 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(01):20-55.

[19] Lakbala P, Azar FE, Kamali H. Needlestick and sharps injuries among housekeeping workers in hospitals of Shiraz, Iran. BMC Res Notes. 2012;5:01-05.

[20] Rampal L, Zakaria R, Sook LW, Zain AM. Needle Stick and Sharps Injuries and Factors Associated among Healthcare Workers in a Malaysian Hospital. European Journal of Social Science. 2010;13(3):354-62.

[21] Gholami A, Borji A, Lotfabadi P, Asghari A. Risk factors of needlestick and sharps injuries among healthcare workers. International Journal of Hospital Research. 2013;2(1):31-38.

[22] 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(3):405-10.

[23] Bashir H, Qadri SS. A study on needle stick injuries among health care workers in a tertiary care hospital in India. Int J Res Med Sci. 2019;7:1032-38.

[24] Chakravarthy M, Singh S, Arora A, Sengupta S, Munshi N. The EPINet data of four Indian hospitals on incidence of exposure of healthcare workers to blood and body fluid: A multicentric prospective analysis. Indian J Med Sci. 2010;64(12):540.

[25] International Healthcare Worker Safety Center, University of Virginia. U.S. EPINet Sharps Injury and Blood and Body Fluid Exposure Surveillance Research Group. Sharps Injury Data Report; 2021.

[26] Sriram S. Study of needle stick injuries among healthcare providers: Evidence from a teaching hospital in India. J Family Med Prim Care. 2019;8(2):599-603.

PARTICULARS OF CONTRIBUTORS:
1. Professor, Department of Microbiology, Pramukhswami Medical College and Shree Krishna Hospital, Bhaikaka University, Karamsad, Anand, Gujarat, India.
2. Assistant Professor, Department of Microbiology, Pramukhswami Medical College and Shree Krishna Hospital, Bhaikaka University, Karamsad, Anand, Gujarat, India.
3. Resident Doctor, Department of Microbiology, Pramukhswami Medical College and Shree Krishna Hospital, Bhaikaka University, Karamsad, Anand, Gujarat, India.
4. Infection Control Nurse, Department of Microbiology, Pramukhswami Medical College and Shree Krishna Hospital, Bhaikaka University, Karamsad, Anand, Gujarat, India.
5. Infection Control Nurse, Department of Microbiology, Pramukhswami Medical College and Shree Krishna Hospital, Bhaikaka University, Karamsad, Anand, Gujarat, India.
6. Infection Control Nurse, Department of Microbiology, Pramukhswami Medical College and Shree Krishna Hospital, Bhaikaka University, Karamsad, Anand, Gujarat, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Naimika Patel,
C60, Sona Township, Near Kansa Cross Road, Opposite Doctor House, Visnagar, Mehsana-384315, Gujarat, India.
E-mail: drnaimikapatel@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Jan 13, 2024
- Manual Googling: Apr 19, 2024
- iThenticate Software: Apr 23, 2024 (10%)

ETYMOLOGY: Author Origin

EMENDATIONS: 6

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? No
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Jan 13, 2024**
Date of Peer Review: **Mar 16, 2024**
Date of Acceptance: **Apr 24, 2024**
Date of Publishing: **Jul 01, 2024**