AUDIT ARTICLE

Audit of needlestick injuries in dental and dermatology sections: insights and strategies for safer practices

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Abstract

Objective: To assess the incidence of needlestick and sharp injuries among healthcare workers in dental and dermatology sections, to identify root causes, and to evaluate adherence to safety protocols.

Method: The single-centre audit was conducted at the Aga Khan University Hospital, Karachi, and comprised data from the Department of Infection Prevention and Hospital Epidemiology and the institutional Adverse Event Management System from January 1, 2019, to December 31, 2020. The 'Five Whys' technique was used for root cause analysis and a fishbone diagram was generated to identify contributing factors of needlestick and sharp injuries reported in the dental and dermatology sections. Based on the findings, an improvement plan was developed using the Occupational Safety and Health Administration hierarchy of controls, which included workshops and training sessions aimed at enhancing safety practices. A follow-up audit was conducted from January 1, 2021, to December 31, 2022, to evaluate the effectiveness of the implemented measures.

Results: In the first audit, 15 needlestick and sharp injuries were reported, with dental staff experiencing 12(80%) of them. The main causes included improper needle handling and recapping in the dental section, and cuts from surgical blades in the dermatology section. Post-intervention, the incidence of needlestick and sharp injuries decreased to 4 cases, with 3(75%) in the dental section.

Conclusion: Critical gaps in safety protocols were identified in the first round of audit. The significant reduction in needlestick and sharp injuries post-intervention highlighted the effectiveness of quality improvement measures in enhancing occupational safety and reducing exposure to bloodborne pathogens.

Key Words: Needlestick injury, Sharp injuries, Quality improvement, Occupational health, Infection control.

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Introduction

Healthcare workers (HCWs) constitute approximately 12% of the global workforce, including doctors, nurses, assistants and technicians.[1] These professionals face an elevated risk of occupational exposure to infectious diseases due to their close proximity to infected patients and the nature of their work.[2] This risk is further heightened by frequent exposure to contaminated sharps, such as syringe needles, surgical blades, scissors and broken vials, which pose a constant threat of injury and infection in hospital and clinical settings. These injuries, collectively referred to as needlestick and sharp injuries (NSSIs), are a significant source of infection among HCWs, particularly when contaminated.[1]

NSSIs are significant hazards for the transmission of bloodborne pathogens, including human immunodeficiency virus (HIV), hepatitis B virus (HBV) and hepatitis C virus (HCV). The risk of infection following exposure to contaminated sharp is highest for HBV, ranging 6-30%, followed by HCV at 1.8%, and HIV at 0-10%.[3] Globally, NSSIs remain a significant occupational hazard for HCWs, with 32.4-44.5% reporting at least one incident annually.[4] The Centres for Disease Control and Prevention (CDC) estimates approximately 385,000 such incidents among HCWs in the United States each year.[5] The burden is particularly pronounced in Pakistan, where the prevalence reaches 49.7%,[6] indicating the widespread nature of NSSIs, and emphasising the need for increased preventive measures and global attention to this critical occupational health issue.

Dental care providers are at a considerable risk of bloodborne viral infections due to the routine use of sharp instruments during dental procedures. Additionally, dental personnel face potential exposure while cleaning and disposing off instruments, particularly when proper techniques are not followed, or when junior staff members lack sufficient training.[7] Similarly, the field of dermatology is closely linked to various surgical and cosmetic procedures, such as biopsies, excisions and filler injections.[8] These procedures often involve the use of needles and other sharp instruments, placing dermatologists at an equally heightened risk of exposure

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to bloodborne pathogens. Two-handed recapping of needles and unsafe collection and disposal of sharp wastes are among the most common causes of NSSIs[9], emphasising the shared risks faced by dental and dermatology professionals. These shared vulnerabilities underscore the critical need for robust infection control practices, effective training programmes, and continuous monitoring.

To effectively address the risks associated with NSSIs and enhance healthcare practices, it is essential to identify their root causes, implement targetted quality improvement measures, and establish regular audit systems. Recognising the significance of the issue, the Department of Infection Prevention and Hospital Epidemiology (DIPHE) at the Aga Khan University Hospital (AKUH) in Karachi has developed an institutional system for reporting NSSIs. The current study was planned to assess NSSI incidence among HCWs in dental and dermatology sections, which are located on the same floor at AKUH, and to identify root causes to improve adherence to safety protocols.

Materials and Methods

The single-centre audit was conducted at AKUH, Karachi, as part of an internal review within the dental and dermatology sections from January 1, 2019, to December 31, 2020. Data was sourced from DIPHE, which oversees a hospital-based system for reporting NSSIs and patient safety incidents. The hospital employs the Adverse Event Management System (AEMS), an online platform designed to record and document a wide array of incident details. The robust design of AEMS facilitates real-time reporting, and minimises the risk of underreporting or inconsistencies in data.

For the current audit, specific parameters were extracted from the AEMS database, including the date, time, total number of reported incidents during the study period, their distribution across the two sections, the severity of injuries, and adherence to post-exposure protocols. The key information captured through AEMS was readily accessible, enabling a comprehensive analysis.

The dental and dermatology sections were selected for this audit due to their routine procedures in outpatient settings, frequent handling of sharp instruments, and high levels of patient interaction — factors that inherently increase the risk of NSSIs.

After approval from the AKUH Chief Medical Officer, data from the DIPHE and individual form from AEMS databases were analysed using the 'Five Whys' method, a structured problem-solving technique designed to identify the root cause of incidents.[10] The strategy involves iterative questioning, beginning with 'why' or 'what'. The response to each 'why' prompts the next inquiry, continuing until the underlying cause is identified.

To analyse the overall data of NSSIs, the fishbone technique, also known as the Ishikawa or cause-and-effect diagram, was employed.[11] This method is a structured approach to root cause analysis, helping to visually map the relationship between the problem and its potential causes across six domains: Material, Manpower, Method, Machine, Environment and Measurement.[11] The effect — in this case, NSSIs — was represented at the 'head' of the fish, while the causes were systematically categorised along the 'bones' branching out from the spine.

Thirdly, the Occupational Safety and Health Administration (OSHA)[12] hierarchy of controls model was utilised to develop an improvement plan aimed at reducing NSSI incidence. The primary focus was placed on the engineering controls, and administrative controls to modify workplace practices and enhance safety. Engineering controls included the adoption of advanced safety devices, such as retractable, sheathing, or blunting needles, to minimise exposure risks. Administrative measures emphasised proactive strategies, including the development of hazard-limiting policies, comprehensive risk mitigation plans, regular staff training, replacing outdated sharps with safer alternatives, and strategically scheduling high-risk procedures. Beyond these measures, other rungs of the hierarchy of controls, such as personal protective equipment (PPE) and work practice controls, were reinforced to ensure a holistic approach.

To implement this, a series of workshops and seminars were conducted, following the methodology outlined in literature.[13] These sessions involved the active participation of all staff members, encompassing both experienced personnel and newly-recruited individuals. This initiative provided an opportunity for experienced staff to refresh their knowledge while equipping new employees with foundational training on critical aspects of patient safety. The sessions reinforced administrative controls by focusing on practical strategies, such as eliminating two-handed needle recapping and ensuring proper sharps disposal. Additionally, the importance of engineering controls and the effective use of PPE was emphasised to foster a safer and more resilient workplace environment.

Following these interventions, the second round of audit was conducted from January 1, 2021, to December 31, 2022.

Results

In the first audit, [15] NSSIs were reported among HCWs; 8(53.3%) in 2019 and 7(46.7%) in 2020. There were 9(60%) cases involving among doctors, followed by 3(20%) technicians, and 1(6.6%) case each involving registered nurses, students and housekeeping staff. Dental staff experienced 12(80%) of the NSSIs. The primary contributing factors to these incidents for dental staff, as identified using the 'Five Whys' tool, were improper handling or recapping of needles and sharp instruments during various dental procedures. In the dermatology section, the reported causes included cuts from surgical blades and needlestick injuries during procedural tasks.

The fishbone diagram identified key contributors as unsafe needle devices (Material), improper handling of sharps due to inadequate training (Manpower), and non-compliance with sharp disposal protocols (Method) (Figure 1).

Following the identification of gaps, targetted workshops and seminars were conducted to train staff on proper needle handling, recapping techniques, and the immediate disposal of sharps (Figure 2).

Data collected over the two-year period post-intervention revealed a significant reduction in NSSI injuries, with only 3 cases reported in 2021 and a further decline to 1 case in 2022. Of the cases in 2021, 2(66.6%) were in the dental section, and 1(33.3%) in dermatology. The lone case in 2022 was reported from the dental section (Table).

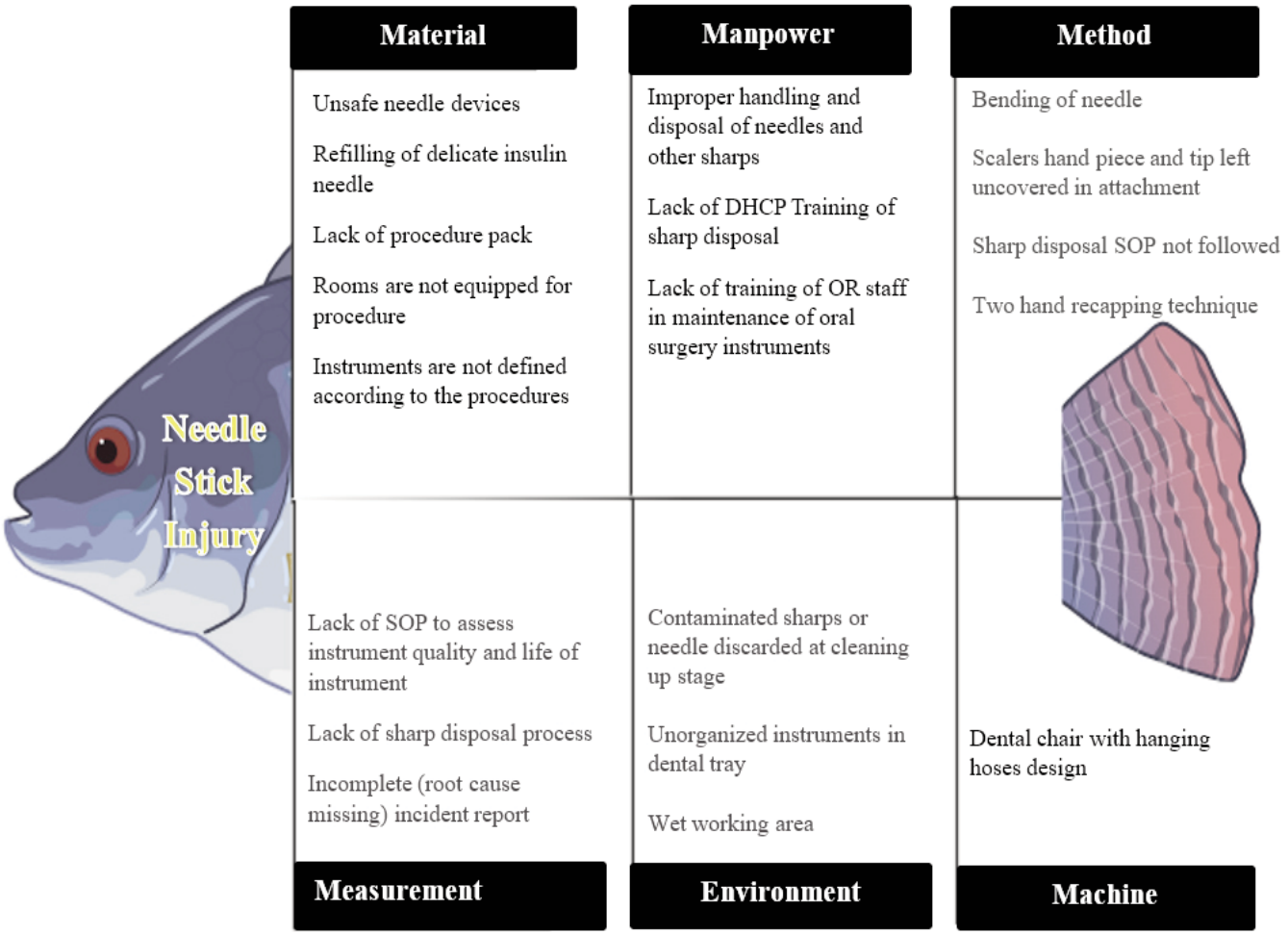

Figure: Fishbone diagram showing root cause analysis of needlestick and sharp injuries (NSSIs).

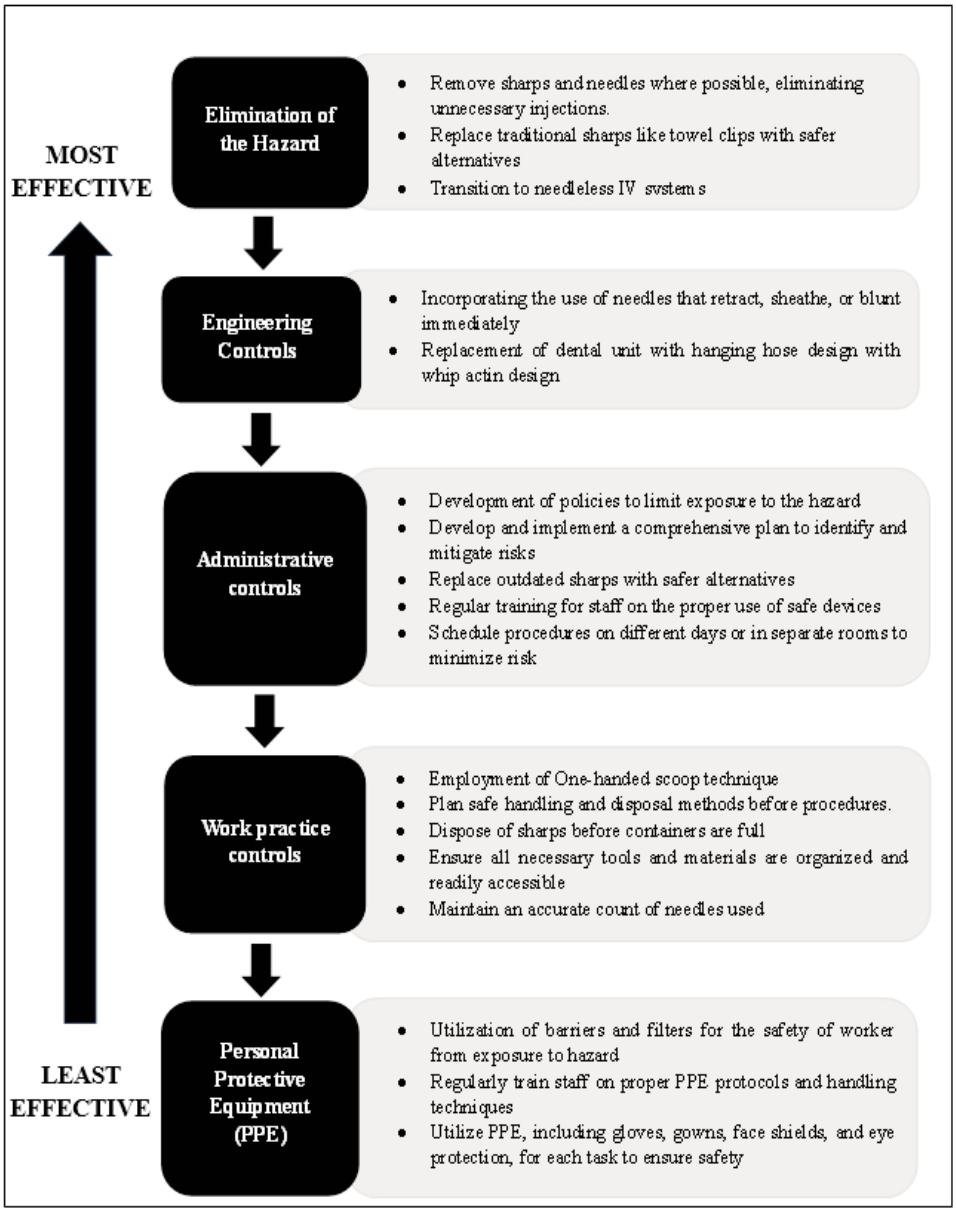

Figure-2: A hierarchy of controls to prevent needlestick and sharp injuries (NSSIs).

Table: Incidence and distribution of needlestick and sharp injuries (NSSIs) across clinical sections before and after intervention.

Year	Total NSSI	Dental	Dermatology
2019	8	7 (88%)	1 (12%)
2020	7	5 (71%)	2 (29%)
Total	15	12 (80%)	3 (20%)
	Year 2021-2022)		
2021	3	2 (67%)	1 (33%)
2022	1	1 (100%)	0 (0%)
Total	4	3 (75%)	1 (25%)

Discussion

NSSI injuries are among the most significant occupational hazards faced by HCWs during their careers.[14] Identifying the incidence and underlying causes of NSSIs in healthcare settings is essential for minimising their occurrence and implementing effective preventive strategies. In recent years, clinical audits have become a cornerstone of quality assurance, serving as an essential tool for evaluating and improving practices across medical, surgical and dental specialties. The resources, time and effort invested in these activities are justified by their benefits they deliver. Though the current audit was

relatively simple, it provided valuable insights into the potential causes of NSSIs, particularly in dental and dermatology sections. The findings highlighted specific areas where targetted interventions could significantly enhance safety measures and reduce the incidence of NSSIs.

The audit revealed that dental clinics reported the highest incidence of NSSIs. A systematic review[15] found that the prevalence of NSSIs among Pakistani dental HCWs ranged 30-73%, while a study reported that 73.1% of dental practitioners had experienced an NSSI during their careers.[16] In contrast, Donnell et al. observed a prevalence of 37.5% for NSSIs among dermatological surgeons and 27.3% among medical dermatologists.[17] Liasi et al. further highlighted a high prevalence of 56.7% among dermatological surgeons.[18] The data suggests that HCWs in dentistry and dermatology are at an elevated risk of NSSIs, with dental personnel being slightly more prone to injury, as reflected in current audit. Such evidence underscores the importance of investigating specialty-specific risks to develop targeted preventive strategies.

The audit also identified that most of the NSSIs in 2019 and 2020 were associated with needle exposures, surpassing injuries from other instruments. Instruments linked to NSSIs include dental burs, scalpels, periodontal scalers, endodontic files, surgical elevators, curettes, dental explorers, and orthodontic wires.[19] However, syringe needles accounted for the majority of injuries, primarily occurring during surgical procedures and subsequent clean-up processes. This observation aligns with the findings of Cleveland et al., who reported that 53% of NSSIs were related to syringe needles during or after use.[20] Moreover, a 19-year study on dental-care providers in Japan identified syringe needles as the most frequent cause of NSSIs, with suture needles also playing a significant role.[21] The high prevalence of these injuries can be attributed to the routine use of sharp instruments in various dermatological and dental procedures, such as anaesthesia administration, suturing, and cosmetic treatments, which are essential to these specialties.[8]

The high prevalence of NSSIs necessitates the need to address their associated risks, which include transmission of infection, tissue damage, increased healthcare costs, and a negative impact on employment opportunities.[22] HCWs exposed to NSSIs often report elevated levels of anxiety and depression even when no infection is transmitted. The psychological impact can be profound, with post-traumatic stress disorder (PTSD) frequently observed in affected individuals.[23] Additionally, the long-term need for serological monitoring and medical interventions places a significant economic burden on healthcare systems.[19] The ongoing medical need and associated emotional distress contribute to a marked decline in quality of life, affecting job satisfaction, career progression, and, in some cases, the ability to continue in the profession.

To reduce the risk associated with NSSIs, the audit findings stressed upon the need for both engineering controls and effective educational initiatives. The use of safety syringes has been shown to significantly reduce NSSI rates. A study demonstrated that the introduction of safety syringes reduced NSSIs from 11.8 to zero in the intervention group, compared to a modest decrease from 26 to 20 in the control group.[24] Integrating such devices into routine practice is essential for minimising injury rates. Additionally, combining safety devices with training programmes has proven to be more effective. Van der Molen et al. found that the introduction of safety devices alongside interactive workshops led to the greatest reduction in self-reported NSSIs.[25] Moreover, Bijani et al. highlighted that well-designed training programmes and awareness campaigns significantly decreased occupational exposure to NSSIs.[26] Consistent with these findings, the present audit observed a notable decline in NSSI rates two years post-intervention, following the implementation of workshops and seminars. These insights underscore the importance of a multifaceted approach to NSSI prevention. In accordance with OSHA and National Institute for Occupational Safety and Health (NIOSH) guidelines, the current study suggested several strategies (Figure 2) to prevent future incidents, and to strengthen Joint Commission International Accreditation (JCIA) compliance, thereby enhancing overall clinical safety standards.[27, 28]

The current study has limitations. This was a single-centre audit focussing solely on the dental and dermatology sections, which limits the generalisability of the findings to other healthcare settings. The retrospective design, and reliance on existing incident reports may have led to underreporting or inaccuracies in the data. The variability in training programmes and skill levels among HCWs and students in these sections may also differ from those in other clinical environments. Lastly, the types of needles and sharp instruments used in the studied sections may not reflect those in other departments, adding another layer of limitation to the findings.

Conclusion

NSSIs are a significant occupational hazard for HCWs, posing a risk for the transmission of bloodborne pathogens. Gaps in adherence to safety protocols were identified and addressed with planned interventions,

leading to significant improvement. Regular audits and continuous education are crucial for sustaining improvements in safety practices and minimising the incidence of NSSIs, thereby protecting HCWs' health and safety.

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