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Under-reporting of Needlestick Injuries Among Doctors in Teaching Hospitals in Sudan: A cross-sectional study

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Abstract

Background

Needlestick injuries (NSIs) are a significant occupational hazard for healthcare workers, yet data on their prevalence, under-reporting, and associated factors are limited in conflict-affected, resource-limited settings. This study aimed to assess the 12-month prevalence and under-reporting rate of NSIs among physicians in Sudanese teaching hospitals, evaluate post-exposure management practices and knowledge of prophylaxis, and identify key predictors of reporting behavior.

Methods

A cross-sectional, multicenter study was conducted across six teaching hospitals in six Sudanese states. A validated, pilot-tested, structured questionnaire was used to survey 484 licensed physicians, including house officers, medical officers, residents, specialists, and consultants. Relationships between variables and reporting behavior were analyzed using Chi-square and Mann-Whitney U tests. Predictors were identified through two-stage logistic regression, providing adjusted odds ratios (aORs) with 95% confidence intervals (CIs).

Results

Among the 484 participants, 40.1% (n = 196) reported at least one NSI in the past year, with 49% of these injuries not being formally reported. A lack of awareness of hospital-based reporting systems was noted in 59.5% of respondents, and 18.6% were unvaccinated against hepatitis B. The main barriers to reporting included unfamiliarity with the process and beliefs that prior vaccination negated the need to report. Psychosocial barriers, such as embarrassment and career concerns, were largely rejected. Multivariate analysis showed two independent predictors of reporting: having a known infectious source (aOR 5.41; 95% CI 2.15–13.57; $p < 0.001$) and awareness of the reporting system (aOR 2.06; 95% CI 1.10–3.86; $p = 0.025$). Junior staff had lower reporting rates than senior physicians, but this association weakened after adjusting for awareness and source patient status.

Conclusion

Under-reporting of NSIs among Sudanese physicians is prevalent and mainly driven by infrastructural gaps and knowledge deficits rather than psychosocial factors. The recognition of reporting-system awareness as a modifiable predictor highlights the critical need for standardized, accessible reporting methods and targeted occupational health education—especially for junior physicians—in Sudan's conflict-affected healthcare system.

Background

Needlestick injuries (NSIs) are among the most common occupational hazards faced by healthcare workers (HCWs) worldwide, with WHO estimates stating that more than 2 million incidents occur among 35 million healthcare workers worldwide[1]. Needlestick injuries are also a common source of work-related infections and, according to the WHO, contribute to the spread of infectious diseases among healthcare workers, such as hepatitis B virus (36.7%), hepatitis C virus (39%), and HIV (4.4%).

In developing countries, 90% of healthcare workers' exposure to blood-borne pathogens is attributed to needlestick injuries[2]. However, even with the serious risk that comes from sharp injuries, reporting rates remain low, with a meta-analysis stating that the prevalence of underreporting among healthcare workers reached 59.9%[3]. This finding delays post-exposure prophylaxis (PEP), can conceal the disease burden, and affects the accuracy of surveillance data.

Standard protocols and precautions have been developed by the Centers for Disease Control and Prevention to prevent and reduce the rate of injuries from sharps and handling infectious materials. These precautions include personal hygiene, hand washing, careful techniques when handling sharp instruments and needles, and appropriate disposal of waste[4]. Prevention of needlestick injuries is important; however, adequate preparation requires precise statistics on the prevalence, causes, and steps taken by affected healthcare workers. A safer work environment can only be created through the proper tracking of needlestick injuries.

The incidence of needlestick injuries in Africa is the highest in the world (51%), with weak reporting rates and infrastructure[5]. Sudan's health system, which has been impaired by the ongoing conflict, suffers from overcrowding and resource scarcity; these factors, along with the lack of HBV vaccine coverage[6] and limited occupational health services[7] can compound the challenges already faced in the country. Factors that cause under-reporting of needlestick injuries include a perceived lack of risk, thinking that transmission risk is low, a lack of time to report, and fear of blame and criticism[8]. The lack of detailed data on specific factors in Sudan poses a significant obstacle to developing tailored prevention and training programs to reduce risk.

A crucial step is to identify the determinants of underreporting of needlestick injuries in the Sudanese context and to assess any existing gaps in physicians' knowledge and practice. Establishing a baseline is essential for effectively targeting the root causes of under-reporting, which may stem from knowledge deficiencies, inadequate workplace protocols, or broader systemic challenges. Consequently, this study sought to establish such a baseline by evaluating these factors and concurrently measuring physicians' knowledge and practices regarding needlestick injury incidents and reporting procedures. The findings from this investigation are intended to build a foundational knowledge base to enhance reporting rates and inform the development of educational initiatives to prevent better and manage this critical occupational hazard.

It is important to identify the factors that contribute to the lack of needlestick injury reporting in Sudan, as well as any knowledge or practice gaps among physicians. Given the importance of timely reporting, a baseline must be established to effectively target the causes of under-reporting, whether due to gaps in knowledge, defective or inadequate workplace policies, or systemic or organizational issues. Thus, this study aimed to establish this baseline by evaluating these factors and measuring physicians' knowledge and practices regarding needlestick injury incidents and reporting. The information gleaned from this study will help provide a knowledge base to improve reporting and create educational programs to reduce and manage this pressing issue.

This cross-sectional study was conducted and reported following the STROBE Guidelines[9].

Methods

Structured Questionnaire

This cross-sectional study used a structured questionnaire developed for this study and administered via a standardized electronic form (Google Form) by trained data collectors across seven teaching hospitals in six states in Sudan (see Supplementary File S1). The form included various sections: demographics, awareness of reporting systems, needlestick injury prevalence, post-exposure management, reporting behavior, and barriers to reporting. Six Sudanese specialists (three general surgeons, one pediatric surgeon, one obstetrician-gynecologist, and one pediatrician) validated the questionnaire before distribution. After validation, a pilot study with 20 participants was conducted, yielding a Cronbach's alpha of 0.8045, and feedback was collected. Data collection was conducted between January and March 2026.

Study Area, Sample Size, and Population

A multicenter approach using convenience sampling was used to target the population, with the inclusion criteria of all licensed physicians, thus including house officers, medical officers, residents, specialists, and consultants. Participants were currently working in departments of teaching hospitals in the cities of Wad Madani, Al-Qadarif, Kassala, Al-Manaqil, Port-Sudan, Sinjah and Sinnar. The exclusion criteria included all physicians who were on leave or had been displaced during the time of data collection, non-physician healthcare workers, and those who refused to participate. The sample size was determined based on the primary goal of estimating prevalence in a population survey using the single-proportion formula.

$$n_0 = \frac{z^2 \bullet p \bullet (1-p)}{e^2}$$

Whereas:

z = Confidence level = 95% = 1.96

e = Margin of error = 5% = 0.05

p = Expected population = 50% = 0.5 (This was used to ensure a good sample size, as specific population metrics of surgical staff are lacking)

n = 385 with a 20% estimated attrition rate = n = 480

This study required at least 385 completed responses. To offset the estimated non-response rate, the final number of responses collected was 484 (100% response rate). This study was adequately powered to detect small-to-moderate effect sizes. At $\alpha = 0.05$, the study had approximately 80% power to detect small differences and 99% power to detect medium-to-large differences between subgroups.

Data Analysis

All statistical analyses were performed using Python. Quantitative variables were summarized using frequencies and percentages. Initial bivariate associations between categorical independent variables and the reporting of needlestick injuries (NSIs) were assessed using chi-square tests. For comparisons between the reporting and non-reporting groups, the Mann-Whitney U test was used, as the data were non-normally distributed.

Data analysis employed a two-stage regression methodology to determine factors linked to the reporting of needlestick injuries (NSIs). The first stage involved conducting bivariate logistic regression to evaluate individual variables. An initial screening p-value threshold of 0.20 was applied to retain all potentially significant predictors and confounders in the subsequent model. During the second stage, a multivariate logistic regression model was developed using variables that satisfied the preliminary criteria. This adjusted analysis facilitated the derivation of Adjusted Odds Ratios (aOR) with their 95% Confidence Intervals (CI), thereby isolating the independent association of each factor while accounting for the influence of others. The overall performance and fit of the final model were assessed using the Likelihood Ratio (LLR) test and McFadden's Pseudo R^2.

A p-value of less than 0.05 was defined as the threshold for statistical significance. All data processing and statistical analyses were performed in the Python programming environment, using relevant scientific libraries.

Results

Socio-demographic characteristics:

A total of 484 healthcare professionals participated in this study. Of the participants, 50.83% were female (n = 246) and 48.76% were male (n = 236), with two participants preferring not to disclose their gender. The majority of respondents were early in their careers, with house officers representing the largest group at 39.46% (n = 191), followed by general practitioners at 31.4% (n = 152). Senior roles accounted for a smaller share of the sample, with specialists at 4.96% and consultants at 1.86%.

Regarding the distribution across departments, the largest share was from the surgical department, accounting for 32.64% of respondents (n = 158), followed by internal medicine (18.39%, n = 89) and pediatrics (17.56%, n = 85). Participants were drawn from seven teaching hospitals, with the highest contribution being from Kassala Teaching Hospital (22.73%) and Wad Madani Teaching Hospital (19.42%); the other hospitals had equal percentages of participants. (Table 1).

[Table 1 goes here]

Prevalence, characteristics, and institutional management of NSIs:

Assessment of the prevalence of needlestick injuries revealed that 40.08% (n = 196) of the respondents had experienced a needlestick injury within the past 12 months. Regarding hepatitis B prophylaxis, just over half of the respondents (52.69%, n = 255) had completed the full three-dose vaccine series, while 18.6% remained completely unvaccinated. Of the 484 participants, 59.50% (n = 288) reported being unaware of any established NSI reporting system in their hospital, 23.97% (n = 116) were aware, and 16.53% (n = 80) did not know. Among the 116 participants who were aware, the majority rated the process as neutral (36.36%) or difficult (27.84%), with only 3.41% finding it very easy to access.

Among those who experienced an NSI, the majority of injuries were due to syringes (43.88%) and suture needles (38.27%), and were mainly during tool usage or application (56.63%). Following their most recent injury, 32.88% of participants took no action. 53.06% of source patients were confirmed negative for bloodborne pathogens; however, a significant portion (25.51%) had unknown infectious status, and 13.27% were positive for hepatitis B, 4.59% for Hepatitis C, and 3.57% for HIV. Formal post-exposure prophylaxis protocols were infrequently used: only 12.20% of exposed individuals received it, and 7.09% attended follow-up appointments. (Table 2).

[Table 2 goes here]

Perceived barriers to the reporting of NSIs:

A total of 106 participants identified a lack of knowledge about how to file a report as the most common primary barrier to under-reporting, cited by 22.84% of respondents. This aligns with Likert-scale responses, where approximately 30% of participants strongly agreed that they were unfamiliar with the reporting procedure. Other frequently mentioned primary barriers included the perception that reporting was unnecessary due to prior vaccinations (14.87%) and the lack of accessible reporting personnel or facilities (14.22%).

In contrast, psychological and social barriers were less prominent. The majority of participants disagreed or strongly disagreed that embarrassment (63.02%), fear of career impact (46.90%), or the perception that the risk was too low (60.13%) influenced their decision not to report. Similarly, the views that reporting was unimportant or that no action would follow were rejected by over 60% of the respondents. Although 11.21% cited workload as their primary barrier, more than half of all respondents (50.62%) strongly disagreed that being busy was a factor. (Table 3).

[Table 3 goes here]

Knowledge of NSI risks and PEP protocols:

The evaluation of knowledge revealed a high awareness of transmission risks but notable gaps in specific clinical knowledge. The majority of participants (94.63%) correctly identified that NSIs can transmit bloodborne pathogens, and 85.74% were aware that needlestick injuries must be reported.

Knowledge of specific post-exposure protocols was also variable. While 68.60% of respondents correctly identified the vaccine plus immunoglobulin as the standard protocol for hepatitis B exposure in an unvaccinated individual, only 51.65% were aware that a combination of three antiretroviral drugs was required for HIV PEP. A critical knowledge gap was observed for hepatitis C: only 38.84% of participants correctly identified that no effective vaccine currently exists, while 30.37% incorrectly believed a vaccine was available and 30.79% were unsure (Table 4)

[Table 4 goes here]

Factors associated with NSI reporting behavior:

Of the 196 participants who had experienced an NSI in the past 12 months, 100 (51.02%) reported the injury, while the rest did not. Bivariate analysis identified three variables that were statistically significantly associated with reporting behavior. The infectious status of the source patient demonstrated the strongest association ($p < 0.001$, Cramer's V = 0.352), with healthcare workers substantially more likely to report when the source patient was known to be infectious. In cases where the source patient had a positive status, 83.33% of individuals reported; this figure dropped to 46.15% for those with a negative status and further decreased to 34.00% for those with an unknown status. Awareness of the NSI reporting system was the second significant variable ($p = 0.003$, Cramer's V = 0.209): 63.53% of aware participants reported their injury, compared with 41.44% of those who were unaware. Professional level also showed a significant association ($p = 0.015$, Cramer's V = 0.228), with reporting rates increasing with seniority—from 44.62% among house officers and 47.62% among general practitioners to 83.33% among specialists and 100% among consultants. A dichotomized staff-level variable (senior vs. supervised) likewise yielded significance ($p = 0.005$, Cramer's V = 0.199).

Other factors, such as gender ($p = 0.498$), specialty ($p = 0.250$), hospital site ($p = 0.265$), vaccination status ($p = 0.618$), knowledge score ($p = 0.748$), and system accessibility ($p = 0.394$), did not show statistically significant associations with reporting behavior, although descriptive differences were noted; orthopedics had the highest non-reporting rate (77.78%), and surgery had the highest reporting rate (61.04%). (Table 5).

[Table 5 goes here]

Logistic regression analysis:

The bivariate and multivariate logistic regression results are presented in Table 6. Variables entering the multivariate model were those with a bivariate p-value < 0.20: gender, age, staff level, awareness of the NSI reporting system, and the infectious status of the source patient. The final multivariate model was statistically significant (LR test $p < 0.001$) and demonstrated a McFadden Pseudo R^2 of 0.144, indicating an acceptable model fit.

Two predictors remained independently significant in the adjusted model. The infectious status of the source patient was the strongest predictor: healthcare workers were 5.41 times more likely to report an NSI when the source patient was known to be infectious (aOR = 5.41; 95% CI: 2.15–13.57; $p < 0.001$). Awareness of the NSI reporting system was the second significant predictor, with aware healthcare workers having approximately twice the odds of reporting compared to those who were unaware (aOR = 2.06; 95% CI: 1.10–3.86; $p = 0.025$).

Staff level (supervised vs. senior) was significantly associated with lower reporting odds in the bivariate model (OR = 0.13; 95% CI: 0.03–0.59; $p = 0.008$), but this association was attenuated and did not reach significance in the adjusted model (aOR = 0.19; 95% CI: 0.03–1.33; $p = 0.095$), suggesting confounding by other variables. Gender, age, specialty, vaccination status, knowledge score, NSI frequency, and system accessibility were not significantly associated with reporting behavior in either model (all $p > 0.05$).

[Table 6 goes here]

Discussion

Needlestick injuries are a major hazard in the professional lives of healthcare workers, as they directly cause the transmission of bloodborne pathogens. This issue is further exacerbated by the lack of occupational health and safety policies. This study investigated the perceived primary factors leading to the non-reporting of needlestick injuries, barriers that had a visible contribution, and any link between healthcare workers' experience, age, seniority, and their under-reporting rate.

Key findings in this study show that 49% of needlestick injuries were unreported, compared to the global meta-analytic estimate of 59.9%[10]. Another study conducted in China showed that 28.5% of needlestick injuries were unreported, compared to the 75% under-reporting rate in low-income countries exhibited in Behzadmehr et al.'s meta-analysis. The high rate of non-reporting can be attributed to many factors, which can be divided into infrastructure and physician factors. In Sudan, the ongoing conflict has severely affected the health sector, leading to a shortage of personal protective equipment due to financial challenges[11]. Overcrowding in hospitals can also cause accidental injuries, as the increased workload on physicians makes them more prone to errors. Sudan's occupational health infrastructure was already weak before the conflict, with unenforced legislation and multiple overlapping occupational health functions weakening the application of a safe work environment and preventing the establishment of clear guidelines and policies relating to workplace injuries, including needlestick incidents[12]. Without a dedicated hospital-level occupational safety framework, the risk of unreported

needlesticks increases. The self-reported NSI prevalence rate of 40.5% exceeds the 35.7% reported in a systematic review of 13 articles from developing countries[13] and is similar to that of Ethiopia, which had a pooled prevalence of 40.5%[14]. A study in Ethiopia identified factors such as reusing/recapping needles, poor waste management and disposal, a lack of boxes specifically for sharps, and a lack of occupational health training for healthcare workers. These factors form a significant cause of needlestick injuries due to institutional causes, which is one of the two distinct categories of needlestick injury causes along with behavioral causes[15] and requires an overhaul of Sudan's occupational health and safety system to alleviate.

Regarding awareness of the next steps after a needlestick injury, our study showed that most participants were unfamiliar with the reporting process or system at their respective hospitals, and those who were familiar reported that it was difficult to navigate. Two studies in Ethiopia and one in Somalia corroborate these findings, indicating that complex reporting pathways and a lack of institutional safety nets influence non-reporting rates[16–18]. Many healthcare workers report that time constraints are a major factor in how convoluted or time-consuming the reporting process is, making it more likely that a busy physician will opt not to report an injury they perceive as minor. This is also directly related to the percentage of physicians in our study who presumed that being vaccinated made reporting unnecessary. Although many disagree that being too busy is a factor in non-reporting, it is not unreasonable to assume that a tough reporting process may contribute to the non-prioritization of timely reporting.

Physician knowledge regarding NSI risks and post-exposure prophylaxis in Sudan was adequate, with most respondents having sufficient knowledge of bloodborne pathogen transmission through needlesticks and the importance of reporting. Some knowledge gaps exist regarding PEP for hepatitis B and HIV, with close to 30% of respondents incorrectly stating or not knowing the PEP protocol for hepatitis B and 50% incorrectly stating or not knowing the protocol for HIV. Many factors influence the reporting of needlestick injuries among physicians and the behaviors that contribute to them. Multiple studies indicate a perceived lack of risk, lack of time to report, a complicated reporting process, and fear of blame and stigma as some of the most common reasons for non-reporting of NSIs[19–21]. In our study, the most common cause of under-reporting was not knowing how to report, and another pertinent factor was that physicians believed there was no need to report since they were already vaccinated. Notably, however, Sudanese physicians rejected many common psychosocial causes of non-reporting, such as embarrassment and fear of career impact. Although these perceptions indicated a positive mindset that should have reduced needless-stick reporting rates, infrastructural issues still affected reporting rates. Thus, it is important to improve occupational health and safety to better reflect under-reporting rates.

Another behavioral facet is the incorrect application of needles, which is a major cause of injuries, denoting the need for educational programs and workshops to alleviate this issue. Globally, needle recapping is the leading behavioral cause of NSIs (30.5% of all identified causes), although this differs from our study, which indicates that injuries occur during application/use. This can be explained by the issue of overcrowding in hospitals in Sudan and also falls under the umbrella of mental distractions as a

cause (17.96% of the causes)[22]. An audit in Sudan showed that training and education in safety practices using workshops and increasing the supply of safety equipment substantially increased adherence to needlestick injury safety procedures and the importance of safe disposal of sharps, thus directly contributing to a safer occupational environment[23].

Bivariate and multivariate analyses showed that the biggest drivers of reporting needlestick injuries are a known infectious-source patient and knowledge of the local reporting system for NSIs, indicating that providing a standardized, easy-to-access pathway for reporting needlestick injuries is a high priority. Another aspect of the analysis is that under-reporting rates are higher in junior roles (house officers and general practitioners). Studies in the US have shown that junior doctors are more vulnerable to under-reporting due to fear of poor evaluation and stigma from a perceived risk of "obstructing" or "disrupting" a surgical case[24, 25]. This shows that even with a strong understanding of the importance of reporting, stigma and fear prevail, creating a culture that may impede occupational safety, which is especially risky in surgical specialties.

The consequences of under-reporting are numerous. Under-reporting can delay or prevent adequate post-exposure prophylaxis, leading to an increase in the risk of becoming infected with serious bloodborne diseases and increasing the economic burden associated with it, which includes, but is not limited to, testing the injured worker and the patient if their status is unknown, provision of post-exposure prophylaxis, requiring the healthcare worker to be absent or replaced, and if infected, treatment of the worker and possible legal action and compensation demands[26]. Under-reporting also skews surveillance and epidemiological data for infectious diseases, health occupation-related infectious diseases, and workplace injury incidents, which can create issues for hospital- and state-wide statistical data that are used to drive safety programs and funding for occupational safety. Needlesticks also create a psychological burden, causing significant anxiety and stress in affected healthcare workers that can reach PTSD levels[27].

Our recommendations to improve reporting in Sudan are to establish a simplified, national, and confidential NSI reporting pathway, drawing on advice from physicians and other healthcare workers to facilitate reporting, alleviate fears of retaliation, and ensure that up-to-date statistics on needlestick incidents can be provided to the relevant authorities. These statistics can then be used to more efficiently target areas with a lack of reporting and to apply more specific interventions. The worker facet of needlestick incidents must also be addressed by providing mandatory NSI awareness and reporting training through annual workshops, while also ensuring that these workers are protected by adequate hepatitis B vaccination and by making post-exposure prophylaxis and personal protective equipment readily available. Through these methods, both the infrastructural and behavioral aspects of needlestick injuries can be sufficiently managed. These recommendations are relevant to similar situations globally, and we hope to benefit from our research findings.

Limitations:

Several limitations of this study should be considered when interpreting its findings. The cross-sectional design, for instance, limits any conclusions regarding causality. While associations were observed between reporting behavior and factors like awareness of reporting systems or the source patient's status, these correlations do not imply a temporal or causal relationship. Longitudinal research designs are generally better suited for tracking behavioral shifts and establishing cause-and-effect linkages than cross-sectional approaches.

Second, employing a self-administered questionnaire may have introduced potential recall and reporting biases. Participants might have underreported needlestick injuries or inaccurately recalled events from the previous year. Considering the known prevalence of underreporting, with global estimates as high as 59.9%[3, 10] The true prevalence and reporting patterns in this context may differ from the findings reported here. Beyond this, responses regarding knowledge and attitudes may have been influenced by social desirability bias.

Third, the study relied on convenience sampling across several teaching hospitals. While the target sample size was attained, the resulting participant composition revealed important departures from the demographic profile of physicians across Sudan. Early career practitioners were substantially overrepresented; house officers and general practitioners accounted for 70.86% of respondents, whereas specialists and consultants accounted for fewer than 7%. This imbalance almost certainly exceeds their actual share in the national health workforce, where senior physicians typically hold greater influence over clinical decisions. An additional skew is evident in specialty representation, with 32.64% of participants drawn from surgical departments, a proportion that may not reflect their distribution among medical specialties overall. Such disparities are particularly relevant given that both professional seniority and specialty type showed significant associations with reporting behavior in the bivariate analysis. As a result, the overall reporting rate of 51% may reflect an underreporting among experienced clinicians and an overreporting of patterns common among junior staff. The sampling frame also excluded physicians practicing in non-teaching or rural facilities, as well as those displaced by conflict. Their omission may have excluded subgroups with differing exposure risks and reporting practices, especially within a health system experiencing substantial workforce disruption[3, 5].

Fourth, this study was limited to physicians, which means that other healthcare workers, including nurses and laboratory staff, who also face a considerable risk of needlestick injuries, were not represented. Consequently, the findings cannot be readily extended to the wider healthcare workforce.

Fifth, a number of the variables relied on subjective perceptions instead of objective measures. For instance, the evaluation of the reporting system's accessibility and barriers was based on participants' views rather than on institutional audits or systematic observations. Consequently, the data may not capture the actual structure or the operational efficiency of such systems.

Finally, although multivariate regression was used to account for confounding variables, the model exhibited moderate explanatory power, as indicated by a McFadden Pseudo R^2 of 0.144. This finding implies that additional unmeasured factors, such as the enforcement of institutional policies, the

availability of occupational health services, and workload intensity, may also affect healthcare workers' reporting behavior. Future research should incorporate these variables and consider employing mixed-method approaches to achieve a more comprehensive contextual understanding.

Finally, although multivariate regression was applied to control for potential confounders, the model demonstrated only moderate explanatory power, with a McFadden Pseudo R^2 of 0.144. This suggests that other unmeasured factors, such as the enforcement of institutional policies, the availability of occupational health services, and variations in workload intensity, could also influence reporting behaviors among healthcare workers. Subsequent studies would benefit from including these variables and adopting mixed-methods designs to develop a more thorough contextual understanding.

Conclusion

This multicenter cross-sectional study illuminates the prevalence, reporting practices, and factors associated with needlestick injuries among Sudanese doctors. The findings revealed a high incidence of needlestick injuries: 40.08% of participants experienced at least one in the past year, with a notable underreporting rate of 49%. These results align with existing research from developing regions, where needlestick injuries remain a major occupational risk and reporting practices are often inadequate[2, 3].

The study identified two main independent factors influencing reporting behavior: knowledge of the reporting system and infectious status of the source patient. Physicians familiar with reporting procedures were twice as likely to report injuries, and those exposed to known infectious sources were more than five times as likely to report injuries. These results underscore the importance of institutional awareness and perceived risk in influencing reporting practices, aligning with previous research on underreporting factors[8, 19].

While knowledge of transmission risks is generally adequate, significant gaps persist in protocols for post-exposure prophylaxis, particularly concerning HIV and hepatitis C. The most frequently cited barrier was a lack of practical knowledge about reporting procedures, rather than psychosocial factors such as fear or stigma. This suggests that structural and educational deficiencies, rather than attitudinal resistance, are the primary drivers of underreporting.

These results underscore the necessity of interventions targeted at the institutional level. The establishment of clear, accessible, and efficient reporting systems is a critical priority. Training programs must focus on the practical mechanics of reporting and post-exposure management, with particular emphasis on early-career physicians who exhibit lower reporting rates. Reinforcing occupational health infrastructure and ensuring adequate vaccination coverage, especially for hepatitis B, are crucial steps in light of the existing gaps in Sudan[6, 12].

Improved reporting practices have direct clinical and public health consequences. Timely reporting facilitates appropriate post-exposure prophylaxis, lowers the risk of blood-borne infections, and enhances the accuracy of surveillance data that inform policies and resource allocation[26]. Therefore,

addressing both knowledge gaps and systemic barriers is essential to mitigating the impact of needlestick injuries and improving healthcare worker safety, particularly in resource-limited and conflict-affected environments.

Abbreviations

aOR(s)
Adjusted odds ratio(s)
CI(s)
Confidence interval(s)
HBV
Hepatitis B virus
HCV
Hepatitis C virus
HCW(s)
Healthcare worker(s)
HIV
Human immunodeficiency virus
LLR
Likelihood ratio test
NSI(s)
Needlestick injury/ies
PEP
Post-exposure prophylaxis
R^2
Pseudo R-squared
STROBE
Strengthening the Reporting of Observational Studies in Epidemiology
WHO
World Health Organization

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki and relevant guidelines and regulations. The Medical Research Ethics Committee of the University of Gadarif granted ethical approval under reference number GU/FM/REC/Q1.01.26.3 on 18/01/2026. Informed consent was obtained from all participants prior to enrollment.

Consent for publication

Not applicable.

Availability of data and materials

Data can be provided upon reasonable request to the corresponding author.

Competing Interests

The authors declare no competing interests.

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Author contributions

M.I.: Study design and conceptualization, methodology development, data collection, manuscript review and journal draft editing (Prepublication). A.S.: Study design, Manuscript editing, manuscript review, data collection and journal draft editing (Prepublication). A.M.T.: Data analysis, methodology development, original manuscript draft, writing, proofreading, and journal draft editing (Prepublication). A.M.: Study design, manuscript review, journal draft editing, and data visualization. S.A.: Data collection, manuscript editing, and manuscript review. A.H.: Data collection, manuscript editing, and manuscript review.

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Trial Registration Unique Number

The research was registered on the Pan African Clinical Trial Registry database (pactr.samrc.ac.za); unique identification number: PACTR202606518764702.

AI Usage

No AI was used in research or manuscript development.

References

1. Hosseinipalangi Z. others. Global, regional and national incidence and causes of needlestick injuries: a systematic review and meta-analysis. East Mediterr Health J. 2022;28(3):233–41. 10.26719/emhj.22.031.

2. Sagoe-Moses C, Pearson RD, Perry J, Jagger J. Risks to Health Care Workers in Developing Countries. N Engl J Med. 2001;345(7):538–41. 10.1056/NEJM200108163450711.
3. Behzadmehr R, Balouchi A, Hesaraki M, Alazmani Noodeh F, Rafiemanesh H, Nashwan J. Prevalence and causes of unreported needle stick injuries among health care workers: a systematic review and meta-analysis. Rev Environ Health. 2023;38(1):111–23. 10.1515/reveh-2021-0148 . PubMed PMID: 34913621.
4. NIOSH alert: preventing needlestick injuries in health care settings. [Internet]. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health; 1999 Nov [cited 2026 Jun 22]. Available from: https://www.cdc.gov/niosh/docs/2000-108/ 10.26616/NIOSHPUB2000108
5. Hosseinipalangi Z, Golmohammadi Z, Ghashghaee A, Ahmadi N, Hosseinifard H, Mejareh ZN, et al. Global, regional and national incidence and causes of needlestick injuries: a systematic review and meta-analysis. East Mediterr Health J. 2022;28(3):233–41. 10.26719/emhj.22.031.
6. Mohamed Awad M, Altalib S, Shaaban KM. Hepatitis B vaccination status, knowledge and associated factors among healthcare professionals in Dongola, Sudan, 2024: a cross-sectional study. BMC Infect Dis. 2025;25(1):1279. 10.1186/s12879-025-11703-x.
7. Taha AE. The state of health and health services in Sudan as a result of the war. Afr J Prim Health Care Fam Med. 2023;15(1):4260. 10.4102/phcfm.v15i1.4260 . PubMed PMID: 37916714; PubMed Central PMCID: PMC10546216.
8. El-Saed A, Othman F, Al-Fayez S, Alotaibi AT, Alharthi NW, Alamry RF, et al. Magnitude and determinants of underreporting needlestick injuries among healthcare workers in a tertiary care hospital. Infect Dis Health. 2026;31(1):100386. 10.1016/j.idh.2025.08.003.
9. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol. 2008;61(4):344–9. PubMed PMID: 18313558.
10. Behzadmehr R. others. Prevalence and causes of unreported needle stick injuries among health care workers: a systematic review and meta-analysis. Rev Environ Health. 2021;38(1):111–23. 10.1515/reveh-2021-0148 PubMed PMID: 34913621.
11. Khogali A, Homeida A. Impact of the 2023 armed conflict on Sudan’s healthcare system. Public Health Chall. 2023;2(4):e134. 10.1002/puh2.134.
12. Abdelrahim RA, Otitolaiye VO, Omer F, Abdelbasit Z. Scoping Review of the Occupational Health and Safety Governance in Sudan: The Story So Far. Saf Health Work. 2023;14(2):174–84. 10.1016/j.shaw.2023.03.007.
13. Mengistu DA, Tolera ST. Prevalence of occupational exposure to needle-stick injury and associated factors among healthcare workers of developing countries: systematic review. J Occup Health. 2020;62(1):e12179. 10.1002/1348-9585.12179 . PubMed PMID: 32065738.
14. Kaweti G, Feleke T. Prevalence and associated factors of needlestick and sharp object injuries among healthcare workers in Ethiopia: a systematic review and meta-analysis. Front Epidemiol.

2024;4:1385417. 10.3389/fepid.2024.1385417.

15. Issac A, Nayak SG, Srivastava SP, George RR. Exploring the Causes, Immediate Responses and Preventive Measures of Needle Stick Injuries Among Healthcare Workers: A Qualitative Evidence Synthesis. J Clin Nurs. 2026;35(2):889–906. 10.1111/jocn.70136.
16. Isse SA, Omar MA, Doğan A, Çelik AK, Ali TA, Pir S, et al. Prevalence and Associated Factors of Needlestick and Sharp Injuries Among Healthcare Workers in a Tertiary Care Hospital, Mogadishu, Somalia: A Prospective Single-Center Study. Health Sci Rep. 2025;8(10):e71298. 10.1002/hsr2.71298 PubMed PMID: 41017865; PubMed Central PMCID: PMC12464720.
17. Assen S, Wubshet M, Kifle M, Wubayehu T, Aregawi BG. Magnitude and associated factors of needle stick and sharps injuries among health care workers in Dessie City Hospitals, north east Ethiopia. BMC Nurs. 2020;19(1):31. 10.1186/s12912-020-00422-0.
18. Bekele T, Gebremariam A, Kaso M, Ahmed K. Attitude, reporting behavour and management practice of occupational needle stick and sharps injuries among hospital healthcare workers in Bale zone, Southeast Ethiopia: a cross-sectional study. J Occup Med Toxicol. 2015;10:42. 10.1186/s12995-015-0085-2 . PubMed PMID: 26640508; PubMed Central PMCID: PMC4669598.
19. El-Saed A, Othman F, Al-Fayez S, Alotaibi AT, Alharthi NW, Alamry RF, et al. Magnitude and determinants of underreporting needlestick injuries among healthcare workers in a tertiary care hospital. Infect Dis Health. 2026;31(1):100386. 10.1016/j.idh.2025.08.003.
20. prevalence and underreporting of needlestick injuries among. hospital workers: a cross-sectional study | International Journal for Quality in Health Care | Oxford Academic [Internet]. [cited 2026 Apr 19]. Available from: https://academic.oup.com/intqhc/article-abstract/33/1/mzab009/6101296?redirectedFrom=fulltext
21. Bernard JA, Dattilo JR, Laporte DM. The incidence and reporting of sharps exposure among medical students, orthopedic residents, and faculty at one institution. J Surg Educ. 2013;70(5):660–8. 10.1016/j.jsurg.2013.04.010 . PubMed PMID: 24016379.
22. emhj, Global. regional and national incidence and causes of needlestick injuries: a systematic review and meta-analysi [Internet]. [cited 2026 Apr 19]. Available from: https://www.emro.who.int/emhj-volume-28-2022/volume-28-issue-3/global-regional-and-national-incidence-and-causes-of-needlestick-injuries-a-systematic-review-and-meta-analysi.html
23. Abdelbagi AY, Widaa Mohamed AA, Yousif ASA, Ahmed Osman Mohamed A, Abdalla M, Saeed Abdelrahim Saeed S et al. Awareness and Perspectives of Doctors on Needle Stick Injuries at Port Sudan Teaching Hospital: A Quality Improvement Project. Cureus. 2025 Oct 28. 10.7759/cureus.95617
24. Yang AD, Quinn CM, Hewitt DB, Chung JW, Zembower TR, Jones A, et al. National Evaluation of Needlestick Events and Reporting Among Surgical Residents. J Am Coll Surg. 2019;229(6):609–20. 10.1016/j.jamcollsurg.2019.09.001 . PubMed PMID: 31541698; PubMed Central PMCID: PMC6900867.

25. Sharma GK, Gilson MM, Nathan H, Makary MA. Needlestick injuries among medical students: incidence and implications. Acad Med J Assoc Am Med Coll. 2009;84(12):1815–21. 10.1097/ACM.0b013e3181bf9. e5f PubMed PMID: 19940594.
26. Cooke CE, Stephens JM. Clinical, economic, and humanistic burden of needlestick injuries in healthcare workers. Med Devices Auckl NZ. 2017;10:225–35. doi:10.2147/MDER.S140846 PubMed PMID: 29033615; PubMed Central PMCID: PMC5628664.
27. Wicker S, Stirn AV, Rabenau HF, von Gierke L, Wutzler S, Stephan C. Needlestick injuries: causes, preventability and psychological impact. Infection. 2014;42(3):549–52. 10.1007/s15010-014-0598-0.

Tables

Participant demographics

Table 1: Participant demographics (N = 484)

Variable	Category	N	%
Gender	Female	246	50.83
	Male	236	48.76
	Prefer not to say	2	0.41
Role	House Officer	191	39.46
	General Practitioner	152	31.40
	Registrar	108	22.31
	Specialist	24	4.96
	Consultant	9	1.86
Primary Department/Specialty	Surgery	158	32.64
	Internal Medicine	89	18.39
	Pediatrics	85	17.56
	Obstetrics and Gynecology	61	12.60
	Orthopedics	22	4.55
	Emergency Medicine	22	4.55
	Anesthesia	11	2.27
	Other	36	7.44
Hospital	Kassala Teaching Hospital	110	22.73
	Wad Madani Teaching Hospital	94	19.42
	Sinjah Teaching Hospital	85	17.56
	Port Sudan Teaching Hospital	75	15.50
	Al Manaqil Teaching Hospital	55	11.36
	Al Qadarif Teaching Hospital	49	10.12
	Sinnar Teaching Hospital	16	3.31

Prevalence, characteristics, and institutional management of NSIs

Table 2: Prevalence, characteristics, and institutional management of needlestick injuries (N = 484)

Variable	Category	N	%
Needlestick injury reporting status	Reported	100	20.66
	Not Reported	96	19.83
	No recent needlestick injury	288	59.50
NSI incident in the past 12 months	Yes	196	40.08
	No	288	59.92
Hepatitis B vaccination status	Complete (3 doses)	255	52.69
	Incomplete	115	23.76
	Not vaccinated	90	18.60
	Don't know / Do not remember	24	4.96
Awareness of NSI reporting system/process	No	288	59.50
	Yes	116	23.97
	Don't know	80	16.53
Accessibility of NSI reporting system/process (n = 176)*	Neutral	64	36.36
	Easy	37	21.02
	Difficult	49	27.84
	Very easy	6	3.41
	Very difficult	20	11.36
Mode of injury (most recent NSI) (n = 196)*	Syringe	86	43.88
	Suture	75	38.27
	Intravenous cannula	21	10.71
	Scalpel	10	5.10
	Other	4	2.04
Stage of procedure when NSI occurred (n = 196)**	During usage/application	111	56.63
	During recapping	31	15.82
	During passing tools	26	13.27
	During disposal	23	11.73
	Other	5	2.55

Infectious status of source patient (n = 196)**	Negative	104	53.06
	Unknown	50	25.51
	Hepatitis B positive	26	13.27
	Hepatitis C positive	9	4.59
	HIV positive	7	3.57
Post-exposure action taken (n = 196)**	No action was taken	96	32.88
	Source patient tested	42	16.54
	Own blood tests (HBV/HCV/HIV)	34	13.39
	Doctor evaluation	33	12.99
	Post-exposure prophylaxis (PEP)	31	12.20
	Follow-up appointments	18	7.09

** Accessibility was only assessed among the 176 participants who responded to this item (those aware of or uncertain about the reporting system). Percentages for this variable are of n = 176, not 484.*

*** Only participants who had a needlestick injury*

Perceived barriers to NSI reporting

Table 3a: Perceptions of barriers to reporting needlestick injuries — Likert scale responses (N = 484)

Barrier	1 – Strongly Disagree		2		3 – Neutral		4 – Agree		5 – Strongly Agree	
	N	%	N	%	N	%	N	%	N	%
Already vaccinated, no need to report	135	27.89	79	16.32	108	22.31	79	16.32	83	17.15
Didn't know how to report	73	15.08	64	13.22	103	21.28	99	20.45	145	29.96
Didn't know I must report	132	27.27	86	17.77	121	25.00	70	14.46	75	15.50
Embarrassed	201	41.53	104	21.49	114	23.55	43	8.88	22	4.55
Feared job/career impact	134	27.69	93	19.21	148	30.58	52	10.74	57	11.78
Process too complicated	89	18.39	133	27.48	146	30.17	64	13.22	52	10.74
Reporting staff/office unavailable	67	13.84	124	25.62	123	25.41	69	14.26	101	20.87
Thought it was not important	228	47.11	83	17.15	94	19.42	42	8.68	37	7.64
Thought nothing would happen	196	40.50	100	20.66	93	19.21	51	10.54	44	9.09
Thought risk was too low	207	42.77	84	17.36	94	19.42	62	12.81	37	7.64
Too busy	245	50.62	55	11.36	91	18.80	39	8.06	54	11.16

Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree. All rows sum to N = 484.

Table 3b: Perceived primary factor contributing to under-reporting of needlestick injuries (N = 464*)

Perceived primary factor leading to under-reporting	N	%
Didn't know how to report	106	22.84
Already vaccinated, no need to report	69	14.87
Reporting staff/office unavailable	66	14.22
Didn't know I must report	60	12.93
Too busy	52	11.21
Feared job/career impact	29	6.25
Embarrassed	19	4.09
Process too complicated	18	3.88
Thought nothing would happen	18	3.88
Thought it was not important	16	3.45
Thought risk was too low	7	1.51
Other (unavailable office, wrong technique, destiny)	3	0.66

** Respondents could select one primary factor; 20 participants selected 'Other' write-in responses (consolidated above). Total may differ from 484 due to non-response.*

Knowledge regarding NSI risks and post-exposure protocols

Table 4: Knowledge assessment regarding NSI risks and post-exposure prophylaxis protocols (N = 484)

Question	Response	N	%
Needlestick injuries can transmit bloodborne pathogens	True	458	94.63
	False	16	3.31
	Don't Know	10	2.07
There is an effective vaccine available to prevent Hepatitis C	False (correct)	188	38.84
	Don't Know	149	30.79
	True (incorrect)	147	30.37
A needlestick injury must be reported	True	415	85.74
	Don't Know	38	7.85
	False	31	6.40
Standard PEP protocol for HIV exposure	Combination of three antiretrovirals (correct)	250	51.65
	Don't Know	162	33.47
	One antiretroviral drug (incorrect)	72	14.88
Standard PEP for HBV exposure in unvaccinated individual	Vaccine + immunoglobulin (correct)	332	68.60
	Don't Know	56	11.57
	Immunoglobulin only	53	10.95
	Vaccine only	43	8.88

Factors associated with NSI reporting behaviour

Table 5: Factors associated with the reporting of needlestick injuries among healthcare workers with an NSI in the past 12 months (N = 196)

Variable	Category	Not Reported N (%) 96 (48.98)		Reported N (%) 100 (51.02)		P-value	Cramer's V
		N	%	N	%		
Age (years) M(SD)	27.5 (3) vs 28.0 (4)	—	—	—	—	0.492 M	—
Gender N (%)	Female	47	50.00	47	50.00	0.498 L	0.071
	Male	49	48.51	52	51.49		
	Prefer not to say	0	0.00	1	100.00		
Professional level N (%)	House Officer	36	55.38	29	44.62	**0.015 L***	0.228
	General Practitioner	33	52.38	30	47.62		
	Registrar	25	48.08	27	51.92		
	Specialist	2	16.67	10	83.33		
	Consultant	0	0.00	4	100.00		
Years of experience M(SD)	2.0 (2) vs 2.0 (3)	—	—	—	—	0.202 M	—
Specialty N (%)	Anesthesia	2	33.33	4	66.67	0.250 L	0.212
	Emergency Medicine	4	44.44	5	55.56		
	Internal Medicine	16	51.61	15	48.39		
	Obstetrics & Gynecology	14	58.33	10	41.67		
	Orthopedics	7	77.78	2	22.22		
	Pediatrics	15	57.69	11	42.31		
	Surgery	30	38.96	47	61.04		
	Other	8	57.14	6	42.86		
Hospital N (%)	Al Manaqil Teaching Hospital	13	35.14	24	64.86	0.265 L	0.196
	Al Qadarif Teaching	5	33.33	10	66.67		

	Hospital						
	Kassala Teaching Hospital	17	47.22	19	52.78		
	Port Sudan Teaching Hospital	18	56.25	14	43.75		
	Sinjah Teaching Hospital	17	56.67	13	43.33		
	Sinnar Teaching Hospital	5	71.43	2	28.57		
	Wad Madani Teaching Hospital	21	53.85	18	46.15		
Number of NSIs in past 12 months M(SD)	2.0 (2) vs 2.0 (2)	—	—	—	—	0.772 M	—
Infectious status of source patient N (%)	Negative	56	53.85	48	46.15	**< 0.001 L***	0.352
	Positive	7	16.67	35	83.33		
	Unknown	33	66.00	17	34.00		
Staff level (dichotomised) N (%)	Senior staff	2	12.50	14	87.50	**0.005 L***	0.199
	Supervised staff	94	52.22	86	47.78		
Vaccination status N (%)	Complete	49	45.79	58	54.21	0.618 L	0.070
	Incomplete	22	52.38	20	47.62		
	Not vaccinated / Unknown	25	53.19	22	46.81		
Awareness of NSI reporting system N (%)	No	65	58.56	46	41.44	**0.003 L***	0.209
	Yes	31	36.47	54	63.53		
Knowledge score M(SD)	2.0 (0.88) vs 2.0 (1.02)	—	—	—	—	0.748 M	—
NSI system accessibility M(SD)	2.0 (0.74) vs 2.0 (0.66)	—	—	—	—	0.394 M	—

*L = Likelihood Ratio test; M = Mann-Whitney U test; * p < 0.05; ** p < 0.01; *** p < 0.001. For continuous variables (Age, Years of experience, Number of NSIs, Knowledge score, Accessibility), values in the Category column represent the median (SD) for the Not Reported vs. Reported groups, respectively.*

Logistic regression analysis

Table 6: Bivariate and multivariate logistic regression analysis of factors associated with NSI reporting (N = 196)

Variable	Category (ref)	Bivariate regression			Multivariate regression		
		Coeff.	P	OR [95% CI]	Coeff.	P	aOR [95% CI]
Gender	Male [ref: Female]	0.038	0.893	1.04 [0.59–1.82]	0.127	0.703	0.88 [0.46–1.69]
Age	Per year increase	0.052	0.063	1.05 [1.00–1.11]	0.012	0.776	1.01 [0.93–1.10]
Staff level	Supervised [ref: Senior]	-2.035	0.008	0.13 [0.03–0.59]	1.647	0.095	0.19 [0.03–1.33]
Awareness of NSI reporting system	Yes [ref: No]	0.901	**0.002**	2.46 [1.38–4.40]	0.722	**0.025***	2.06 [1.10–3.86]
Infectious status	Positive [ref: Negative]	1.764	**< 0.001**	5.83 [2.38–14.33]	1.688	**< 0.001***	5.41 [2.15–13.57]
	Unknown [ref: Negative]	-0.509	0.154	0.60 [0.30–1.21]	0.335	0.367	0.72 [0.35–1.48]
Specialty	Surgical [ref: Non-surgical]	0.196	0.504	1.22 [0.69–2.16]	—	—	Not entered
Vaccination status	Incomplete [ref: Complete]	-0.264	0.469	0.77 [0.38–1.57]	—	—	Not entered
	Not vaccinated/Unknown	-0.296	0.398	0.74 [0.37–1.48]	—	—	Not entered
Number of NSIs	Per additional injury	0.042	0.520	1.04 [0.92–1.18]	—	—	Not entered
Accessibility (recoded)	Per unit increase	0.202	0.389	1.23 [0.77–1.94]	—	—	Not entered
Knowledge score	Per unit increase	0.079	0.700	1.08 [0.72–1.62]	—	—	Not entered

*Reference categories are indicated in the Category column. Variables not entered into the multivariate model did not meet the p < 0.20 screening threshold. * p < 0.05; ** p < 0.01; *** p < 0.001. Coeff. = regression coefficient; OR = unadjusted odds ratio; aOR = adjusted odds ratio; CI = confidence interval.*

Supplementary Files

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