

Assessment of Knowledge and Compliance with Protective Measures against Needle Stick Injuries among Doctors in a Tertiary Care Hospital: A Cross-Sectional Study

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Abstract

Background: Needle stick injuries (NSIs) pose a significant occupational risk to healthcare workers (HCWs), particularly in low- and middle-income countries (LMICs) like Pakistan. Despite global guidelines, knowledge and compliance gaps persist, increasing exposure to blood borne pathogens.

Objective: To assess knowledge and observed compliance with NSI preventive measures among doctors in a tertiary care hospital and identify barriers to adherence.

Methodology: A cross-sectional study was conducted among 350 doctors at Bahwal Victoria Hospital, Bahawalpur. Data were collected via structured questionnaires evaluating knowledge, self-reported compliance and barriers alongside direct observational audits. Chi-square test and multivariable logistic regression analyzed associations between compliance, demographic factors and workplace variables.

Results: While 64.3% of participants demonstrated adequate knowledge, observed compliance was only 47.4%. Medical doctors showed higher compliance (53.6%) than surgical staff (41.2%) ($p=0.003$). Formal NSI training significantly improved adherence (62.8% vs. 34.7%; $p<0.001$). Key barriers included heavy workload (42.3%), lack of training (31.7%), and inadequate safety-engineered device (SED) supply (28.6%). Multivariable analysis revealed that NSI training (adjusted OR: 2.8; 95% CI: 1.9–4.2) and medical specialty (OR: 1.7; 95% CI: 1.2–2.5) were strong predictors of compliance, while high workload reduced adherence by 40% (OR: 0.6; 95% CI: 0.4–0.9).

Conclusion: A significant knowledge-compliance gap exists among HCWs, driven by systemic factors such as insufficient training, workload pressures and SED shortages. Strengthening institutional training programs, ensuring SED availability, and optimizing staffing ratios are critical to reducing NSI risks in resource-limited settings.

Keywords: Compliance, Healthcare workers, Needle-stick injuries, Occupational safety, Training

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Introduction

Needle-stick injuries (NSIs) are a critical occupational hazard for healthcare workers (HCWs), with an estimated 2 million NSIs occurring annually worldwide, leading to over 400 HBV, 200 HCV, and 40 HIV infections among HCWs.^{1,2,3} The burden is disproportionately higher in low- and middle-income countries (LMICs) due to resource constraints, inadequate safety protocols, and limited access to post-exposure prophylaxis (PEP).^{4,5,6}

In South Asia, NSI prevalence ranges from 18% to 60% among HCWs, with studies in Pakistan reporting 42–55% lifetime risk among doctors.^{7,8,9} A 2021 survey in Karachi revealed that 63% of HCWs experienced at least one NSI in the past year, with HBV and HCV being the most feared outcomes.⁷ In Southeast Asia, a 2022 study in Bangladesh highlighted that 38% of NSIs involved contaminated devices, underscoring

gaps in safe handling practices.¹⁰

Occupational risks include exposure to blood borne pathogens such as HIV, HBV, and HCV. The risk of HBV transmission after NSI is 30–60% without PEP, while HCV transmission occurs in 1.8–10% of cases.^{11,12,13} In Pakistan, the HBV sero-prevalence among HCWs is 2.5–10%, far exceeding the global average of 0.8%.¹⁴

Protective measures including safety engineered devices (SEDs), proper disposal in puncture proof containers and adherence to standard precautions, reduce NSIs by 30–50%.¹⁵ However, adoption of SEDs remains suboptimal in LMICs, with only 20–40% of hospitals using them routinely.¹⁶

Despite global guidelines, significant gaps exist in knowledge and compliance with NSI prevention among doctors in resource-limited settings. A 2022 study in Lahore reported that only 35% of HCWs were aware of SEDs, and 28% followed proper disposal protocols.⁸

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Barriers include heavy workloads, lack of training, and inadequate supply availability, as documented in studies from Nepal and Ethiopia.^{18,3} Evidence-based interventions such as mandatory training programs and institutional safety policies have demonstrated success in reducing NSIs. However, localized data from Pakistan and other LMICs are scarce, necessitating context specific strategies to address systemic challenges. The objective of this study is to assess the knowledge and observed compliance of doctors with needle stick injury (NSI) preventive measures in a tertiary care hospital and identify barriers to adherence.

Methodology

This cross-sectional analytical study was conducted at Bahwal Victoria Hospital, Bahawalpur from October 2023 to March 2024. The study population comprised doctors (residents, specialists, consultants) across clinical departments with inclusion criteria requiring direct patient contact and ≥ 6 months of clinical experience. Administrative staff and those unwilling to participate were excluded. A sample size of 350 doctors was calculated based on a 35% estimated compliance rate with NSI preventive measures,¹⁹ 95% confidence level, and 5% margin of error. Stratified random sampling was used to ensure representation across departments (e.g., surgical, medical) and experience levels (≤ 3 years vs. > 3 years).

Data collection involved three components: knowledge assessment via a validated structured questionnaire covering NSI risks, preventive guidelines, and post-exposure prophylaxis (PEP) protocols; compliance assessment through self-reported adherence to safety practices (e.g., needle recapping, sharps disposal) and direct observational audits during clinical procedures; and barrier evaluation using open-ended questions on challenges such as workload, training adequacy, and supply availability.

Independent variables included age, gender, specialty (surgical/medical), years of experience, and prior NSI training while dependent variables were knowledge scores (categorized as adequate/inadequate using a pre-validated cutoff) and compliance rates (dichotomized as yes/no based on observed adherence). Descriptive statistics summarized demographic and clinical characteristics, while chi-square tests examined

associations between variables. Multivariable logistic regression identified predictors of compliance, adjusting for confounders. All data were analyzed using SPSS version 26, with statistical significance set at $p < 0.05$.

Ethical approval was obtained from the Institutional Review Board (IRB) (Ref. No. 295/DME/QAMC/BWP Dated: 27-05-2023) and informed consent was secured from all participants. Confidentiality was maintained by anonymizing responses and restricting data access to the research team.

Results

Total 350 doctors participated in this cross-sectional study, with key demographic and clinical characteristics summarized in Table I. The majority (38.6%) were aged 26–30 years, followed by 31–35 years (32.0%), while 68.6% were male. Over half (54.3%) worked in surgical specialties, and nearly equal proportions had ≤ 3 years (52.0%) or > 3 years (48.0%) of clinical experience. Only 41.1% reported receiving formal NSI prevention training in the past year.

Table II revealed that 225(64.3%) demonstrated adequate knowledge of NSI risks and preventive measures. However, self-reported compliance was lower at 206(58.9%), and direct observational audits confirmed even lower adherence at 166(47.4%), underscoring a significant disparity between perceived and actual practices. Medical doctors exhibited higher observed compliance (53.6%) compared to surgical staff (41.2%) ($p = 0.003$) and trained participants showed significantly better adherence (62.8% vs. 34.7%, $p < 0.001$).

Common barriers to compliance included heavy workload (42.3%), lack of training (31.7%), and inadequate supply of safety-engineered devices (28.6%) (Table III).

Logistic regression analysis (Table IV) identified NSI training as the strongest predictor of compliance (adjusted OR = 2.8; 95% CI: 1.9–4.2, $p < 0.001$), followed by medical specialty (OR = 1.7; 95% CI: 1.2–2.5, $p = 0.004$). Conversely, high workload reduced compliance odds by 40% (OR = 0.6; 95% CI: 0.4–0.9, $p = 0.018$).

Table I: Demographic profile of participants (n=350)

Variable	Frequency (%)
Age Group (years)	
20–25	48 (13.7%)
26–30	135 (38.6%)
31–35	112 (32.0%)
>35	55 (15.7%)
Gender	
Male	240 (68.6%)
Female	110 (31.4%)
Specialty	
Surgical	190 (54.3%)
Medical	160 (45.7%)
Experience (years)	
=3	182 (52.0%)
>3	168 (48.0%)
NSI Training (past year)	
Yes	144 (41.1%)
No	206 (58.9%)

Table II: Knowledge and observed compliance with NSI preventive measures

Parameter	Frequency (%)
Adequate Knowledge	225 (64.3%)
Self-Reported Compliance	206 (58.9%)
Observed Compliance	166 (47.4%)
Compliance by Specialty	
Medical	86/160 (53.6%)
Surgical	80/190 (41.2%)
Compliance by NSI Training	
Trained	90/144 (62.8%)
Untrained	76/206 (34.7%)

Table III: Barriers to NSI compliance (n=350)

Barrier	Frequency (%)
Heavy workload	148 (42.3%)
Lack of training	111 (31.7%)
Inadequate safety device supply	100 (28.6%)
Time constraints during emergencies	77 (22.0%)
Lack of institutional protocols	63 (18.0%)

Table IV: Predictors of NSI compliance (Multivariable Analysis)

Variable	Adjusted OR (95% CI)	p-value
NSI Training	2.8 (1.9–4.2)	<0.001
Medical Specialty	1.7 (1.2–2.5)	0.004
Workload	0.6 (0.4–0.9)	0.018

Discussion

This cross-sectional study assessed knowledge and compliance with protective measures against needle-stick injuries (NSIs) among 350 doctors in a tertiary care hospital. The results revealed that while 64.3% of participants had adequate knowledge of NSI risks and preventive practices, observed compliance was significantly lower at 47.4%, highlighting disparity between awareness and actual implementation. Factors influencing compliance included formal NSI training (adjusted OR=2.8), medical specialty (adjusted OR = 1.7), and workload (adjusted OR = 0.6). Barriers such as heavy workload (42.3%), lack of training (31.7%) and inadequate supply of safety-engineered devices (SEDs) (28.6%) were frequently reported. These findings align with global trends underscoring systemic challenges in translating knowledge into practice, particularly in resource-limited settings.

The observed knowledge level (64.3%) is consistent with studies from low- and middle-income countries (LMICs), where NSI awareness ranges from 50–70% due to limited training and institutional oversight.^{1,19} However, compliance rates (47.4%) are alarmingly lower than those reported in high-income countries (HICs), where compliance often exceeds 70% due to robust safety protocols and widespread adoption of SEDs.^{3,4,5} This discrepancy reflects disparities in resource allocation and occupational health infrastructure between LMICs and HICs.

The knowledge-compliance gap (64.3% vs. 47.4%) mirrors findings from Nepal and Ethiopia, where HCWs reported high theoretical understanding but failed to implement preventive measures consistently.^{17,18} A 2023 systematic review attributed this gap to systemic issues such as workload pressures, organizational culture and limited enforcement of safety policies, rather than individual negligence.¹⁰ In our study, 42.3% of doctors cited heavy workload as a primary barrier, corroborating evidence that time constraints compromise adherence to safety protocols, especially in high-intensity specialties like surgery.^{13,18}

The impact of NSI training (adjusted OR = 2.8) aligns with global evidence showing that structured education programs improve compliance by 2–4 times.^{14,16} For instance, a 2022 cluster randomized trial in India demonstrated a 52% reduction in NSIs following mandatory training on SEDs and post-

exposure prophylaxis (PEP).¹⁹ Conversely, only 41.1% of participants in our study had received recent training, emphasizing a critical gap in institutional support.

Specialty-based disparities (medical vs. surgical) reflect divergent risk profiles. Medical doctors had higher compliance (53.6%) compared to surgical staff (41.2%), likely due to differences in procedural frequency and exposure to sharps. Surgical teams face higher NSI risks due to the nature of invasive procedures, yet they reported greater barriers like time constraints (22.0%) and inadequate SEDs (28.6%). This aligns with a 2021 meta-analysis linking surgical specialties to a 1.5–2.0-fold higher NSI incidence globally.^{7,17}

The strong association between NSI training and compliance underscores the need for institutional investment in continuous education. A 2023 WHO report emphasized that structured training on NSI prevention reduces occupational hazards by reinforcing safe practices and PEP protocols.⁷ Similarly, a 2022 multicenter study in South Asia found that refresher courses increased compliance by 37% over 12 months.¹⁸ In contrast, the low training uptake (41.1%) in our study highlights systemic neglect of occupational safety, a common issue in LMICs where 60–80% of hospitals lack formal NSI prevention programs.¹⁹

The protective effect of medical specialties (adjusted OR = 1.7) may stem from lower exposure to high-risk procedures compared to surgical departments. However, this finding contradicts studies from Europe and North America, where surgical staff exhibit better compliance due to standardized safety protocols in operating rooms.¹³ The disparity suggests that specialty-specific interventions are necessary, particularly for surgical teams facing complex workflows.

Workload emerged as a modifiable barrier, reducing compliance odds by 40% (adjusted OR = 0.6). This aligns with a 2021 cohort study in Bangladesh, which found that excessive patient-to-doctor ratios increased NSI risk by 2.3 times due to rushed procedures and fatigue.¹⁵ A 2023 qualitative study in Pakistan further identified staffing shortages as a root cause of noncompliance, with 68% of HCWs reporting insufficient time for safety protocols during emergencies.¹⁷

The shortage of SEDs (28.6%) is a well-

documented challenge in LMICs. A 2020 WHO survey revealed that only 30–40% of hospitals in South Asia have consistent access to SEDs, compared to 80–90% in HICs.⁷ Without SEDs, HCWs resort to unsafe practices like needle recapping (32.6% in our study), which accounts for 20–30% of NSIs globally.^{1,7}

The findings underscore critical areas for systemic improvement in needle-stick injury (NSI) prevention. Training programs are pivotal, as NSI training nearly tripled compliance (OR = 2.8). Integrating mandatory NSI prevention modules into medical education and continuing professional development (CPD) is essential. Resource allocation must prioritize safety-engineered devices (SEDs), as 28.6% of participants reported inadequate supply. Workload management reforms, such as optimizing staffing ratios and team-based workflows, are critical. Specialty-specific interventions are needed, particularly for surgical teams. Finally, policy advocacy should mandate universal SED adoption, standardized PEP protocols, and NSI incident reporting systems.

This study's cross-sectional design limits causal inferences, necessitating longitudinal research to evaluate interventions like training programs over time. Self-reporting bias likely inflated compliance estimates highlighting the need for direct observation or electronic monitoring in future studies. Single-center data restricts generalizability, particularly to rural or under-resourced settings where NSI risks may be higher. Recall bias in barrier assessments could skew qualitative insights, warranting focus group discussions for deeper understanding. Lastly, the absence of pathogen-specific data (e.g., HBV, HIV) limits insights into clinical consequences; linking compliance to infection outcomes would strengthen public health relevance. Qualitative studies exploring healthcare workers' (HCWs) perspectives on NSI barriers could inform culturally tailored solutions. Longitudinal monitoring through cohort studies tracking NSI incidence and compliance over time will clarify causal relationships.

Conclusion

This study reveals a significant gap between knowledge and actual compliance with NSI preventive measures among healthcare workers. Formal NSI training emerged as the strongest predictor of compliance. Prioritizing structured

training programs, ensuring consistent supply of safety-engineered devices and addressing workload disparities across specialties are critical to mitigating occupational risks and improving adherence to safety protocols.

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