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Occupational Sharps Injuries Among Healthcare Workers in Sub-Saharan Africa: Safety Practices, Risk Factors, and Professional Disparities at a Namibian Referral Hospital

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ABSTRACT

Background: Safe handling of medical sharps is essential to prevent occupational exposure to blood-borne pathogens among healthcare workers. Despite the high burden of needlestick and sharps injuries in sub-Saharan Africa, evidence on provider-specific practices and associated risk factors in Namibian healthcare settings remains limited. This study assessed sharps-handling practices, the prevalence and factors associated with sharps injuries, and professional differences in safety compliance among healthcare workers at Intermediate Hospital Oshakati, Namibia.

Methods: A cross-sectional study involving 490 healthcare workers (134 doctors and 356 nurses) purposively sampled from eight high-risk departments was conducted in 2019–2020 using a self-administered questionnaire. This exceeded the calculated minimum sample of 342, a margin deliberately built in to strengthen the detection of true associations. Logistic regression was used to generate crude and adjusted odds ratios (AORs) with 95% confidence intervals, adjusting for age, gender, marital status, and education level.

Results: Sharps injuries were reported by 54.7% of participants (95% CI: 50.3–59.1%). The most commonly reported annual frequency was one to three injuries (38.4%). Doctors reported higher injury frequency at intermediate levels and were more likely to attribute injuries to long working hours (AOR = 1.67, 95% CI: 1.06–2.61) and poor lighting (AOR = 1.88, 95% CI: 1.19–2.97). Doctors demonstrated lower adherence to universal precautions (AOR = 0.37, 95% CI: 0.14–0.98) and lower awareness of biomedical waste management protocols (AOR = 0.23, 95% CI: 0.06–0.83) compared with nurses; this pattern coincided with doctors' concentration in high-intensity procedural departments (operating theatre OR = 10.17, obstetrics/gynaecology OR = 5.53) and should be interpreted alongside that concentration rather than as an isolated professional deficit. Improper sharps disposal, including disposal into non-sharps waste bags, was more common among doctors (OR = 2.47, 95% CI: 1.02–6.01). Most participants (84.3%, 95% CI: 81.1–87.5%) reported incidents to hospital authorities, and 91.2% (95% CI: 88.7–93.7%) reported accessing post-exposure prophylaxis.

Conclusion: Targeted occupational safety interventions and stronger compliance monitoring are needed. Reducing occupational sharps injuries requires interventions that extend beyond awareness alone. Sustainable improvements in healthcare worker safety depend on stronger institutional systems, safer workplace environments, improved compliance monitoring, and contextually relevant occupational health policies.

Keywords: Occupational sharp injuries, Healthcare workers, Biomedical waste management, post-exposure prophylaxis, Sharps disposal practices, Sub-Saharan Africa

1. INTRODUCTION

Occupational exposure to medical sharps remains a major public health and workforce safety concern globally, particularly among healthcare workers involved in invasive clinical procedures. Needlestick and sharps injuries (NSIs) expose healthcare personnel to blood-borne pathogens, including the human

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immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV), resulting in substantial physical, psychological, and economic consequences for individuals and health systems (Hasak et al., 2018; De Carli et al., 2021). Despite advances in occupational health policies and infection prevention practices, sharps injuries continue to represent one of the most frequent and preventable occupational hazards in healthcare settings (Bouya et al., 2020).

Globally, millions of healthcare workers experience occupational exposure to contaminated sharps annually, with the burden disproportionately affecting low- and middle-income countries where health systems often face workforce shortages, inadequate infrastructure, and limited access to safety-engineered devices (Debelu et al., 2023; Hosseinipalangi et al., 2022). An estimated 600,000 to one million needlestick injuries occur annually worldwide (Tayaben, 2015), with up to two million healthcare workers suffering accidental needlestick injuries each year (Hutin et al., 2003). Percutaneous injuries involving hollow-bore needles carry risks of transmitting HBV (2–40%), HCV (2.7–10%), and HIV (0.3%) (Hasak et al., 2018; Robson, 2012). Sub-Saharan Africa experiences a particularly elevated burden due to high patient volumes, constrained healthcare resources, inconsistent occupational health enforcement, and the high prevalence of blood-borne infectious diseases among patient populations (Nsubuga and Jaakkola, 2005). African healthcare workers suffer an average of two to four needlestick injuries annually (Adejumo and Olatunji, 2013), and these contextual realities increase vulnerability to workplace injuries and complicate prevention efforts.

Although several international studies have documented the prevalence and determinants of NSIs, considerable geographical disparities remain in the availability of context-specific evidence. Existing research from high-income countries often reflects healthcare systems characterised by stronger surveillance systems, wider implementation of engineering controls, and greater institutional investment in occupational health (Hanrahan and Reutter, 1997; Trim and Elliott, 2003). Consequently, findings from these settings may not adequately reflect workplace realities in resource-constrained African healthcare facilities. Within Namibia specifically, the Ministry of Health and Social Services has prioritised safe handling of medical sharps at national, regional, and district levels (Ministry of Health and Social Services, 2006). However, there are no reliable data concerning occupational exposure among healthcare workers in Namibia, and systems addressing these challenges remain poorly defined.

This gap is particularly significant because healthcare workers in public referral hospitals frequently operate under conditions characterised by high patient-to-provider ratios, prolonged working hours, procedural intensity, and infrastructure constraints. The limited availability of local evidence restricts the development of targeted occupational health interventions and weakens efforts to improve healthcare worker safety. Furthermore, underreporting of sharps injuries remains a persistent challenge globally and is especially problematic in low- and middle-income settings where reporting systems may be poorly developed or inconsistently implemented (Behzadmehr et al., 2023; Mousavi et al., 2023).

This study addresses these gaps by examining sharps-handling practices, injury prevalence, and factors associated with sharps injuries among doctors and nurses at Intermediate Hospital Oshakati, Namibia. Particular attention is given to professional differences in safety compliance and occupational exposure risks. By identifying modifiable workplace and behavioural determinants, this study contributes contextually relevant evidence to support occupational health policy development and strengthen healthcare worker protection in Namibia and comparable sub-Saharan African healthcare settings.

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Beyond estimating injury prevalence, this study's specific contribution is comparative: it is among the first from this region to test whether, and how, professional role shapes both self-reported safety compliance and the way healthcare workers attribute their own injuries to workplace conditions, a comparison largely absent from the existing sub-Saharan African sharps-injury literature.

Study Objectives

The objectives of this study were to: assess current practices related to the handling and disposal of medical sharps among healthcare workers; determine the prevalence and frequency of sharps injuries among healthcare workers at Intermediate Hospital Oshakati; identify occupational and environmental factors associated with sharps injuries; compare safety compliance and injury-related practices between doctors and nurses; and provide evidence-informed recommendations for strengthening occupational safety systems in sub-Saharan African healthcare settings.

2. LITERATURE REVIEW

2.1 Global Burden of Needlestick and Sharps Injuries

Needlestick and sharps injuries remain among the most significant occupational hazards affecting healthcare workers worldwide. These injuries occur during procedures involving needles, scalpels, intravenous cannulas, lancets, and other sharp medical devices capable of penetrating the skin. Beyond immediate physical injury, NSIs present serious risks for transmission of blood-borne infections and contribute to emotional distress, anxiety, reduced work productivity, and increased healthcare expenditure (Leigh, 2016; Bouya et al., 2020).

The global burden of sharps injuries remains substantial despite progress in infection prevention and occupational health systems. A systematic review and meta-analysis estimated that more than one-third of healthcare workers worldwide experience at least one sharps injury during professional practice, although prevalence varies considerably across settings depending on surveillance systems, reporting culture, staffing adequacy, and access to safety technologies (Bouya et al., 2020; Hosseinipalangi et al., 2022). Healthcare workers in low-resource settings experience disproportionately higher exposure risks due to infrastructure limitations and weaker occupational safety mechanisms (Debelu et al., 2023).

In sub-Saharan Africa, evidence consistently demonstrates elevated rates of occupational exposure compared with high-income countries. Contributing factors include inadequate staffing, prolonged work shifts, insufficient access to personal protective equipment (PPE), inadequate training, and limited implementation of engineering controls such as needleless systems and safety-engineered devices (Nsubuga and Jaakkola, 2005; Adejumo and Olatunji, 2013). The high burden of infectious diseases within healthcare environments further increases occupational vulnerability. Although studies from Ethiopia (Bekele et al., 2015), Nigeria (Adejumo and Olatunji, 2013), and South Africa (Ramokate and Basu, 2024) report substantial NSI prevalence, evidence from Namibia remains sparse. This limitation restricts understanding of local occupational risks and reduces opportunities for context-specific prevention planning.

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2.2 Factors Associated with Sharps Injuries Among Healthcare Workers

The occurrence of needlestick and sharps injuries is shaped by multiple interrelated occupational, behavioural, and environmental factors. Previous studies have identified female gender (Shiva et al., 2011), younger age (Trim and Elliott, 2003), working in surgical or intensive care units (Halwani et al., 2015), long working hours (Shiva et al., 2011; Ishak et al., 2019), less working experience (Shiva et al., 2011), recapping needles (Nsubuga and Jaakkola, 2005), and not using protective gloves (Nsubuga and Jaakkola, 2005) as major contributors to occupational exposure.

Long working hours have been repeatedly associated with increased injury risk due to fatigue, diminished concentration, impaired decision-making, and reduced vigilance during clinical procedures (Ishak et al., 2019; Prados-Castillo et al., 2025). Healthcare workers operating under sustained physical and cognitive demands may be more likely to make procedural errors or bypass established safety protocols. Environmental factors also play a critical role. Poor lighting, inadequate workspace organisation, overcrowding, and insufficient availability of protective equipment may compromise procedural visibility and safe sharps handling (Centers for Disease Control and Prevention, 2008). Research consistently shows variation in injury risk across departments, with studies in Serbia finding significantly more accidents in clinical wards (33.3%), intensive care units (25.4%), and operating theatres (22.2%) (Markovic-Denic et al., 2015). Emergency departments, delivery rooms, and laboratories also demonstrate elevated risks due to increased exposure to blood and body fluids (Hutin et al., 2003).

Training and professional competency are equally important determinants. Although healthcare workers often receive initial instruction on infection prevention and sharps handling, evidence suggests that knowledge may decline over time without regular refresher training, competency assessment, and institutional reinforcement (Adams, 2012; Wong et al., 2025). Studies in Ethiopia, America, and the Philippines have found that nurses who practise needle recapping were four times more likely to experience sharps injury (Adams, 2012; Bekele et al., 2015).

2.3 Universal Precautions and Occupational Safety Compliance

Universal precautions represent the cornerstone of infection prevention in healthcare settings and require healthcare workers to treat all blood and body fluids as potentially infectious. These precautions include consistent glove use, safe sharps handling, avoidance of needle recapping, hand hygiene, safe waste disposal, and prompt reporting of occupational exposures (Tekle et al., 2023).

Despite widespread awareness of universal precaution guidelines, studies increasingly demonstrate a persistent disconnect between knowledge and actual practice. Healthcare workers may possess adequate theoretical understanding while demonstrating inconsistent adherence during clinical care, particularly in environments characterised by time pressure, fatigue, inadequate staffing, and poor institutional enforcement (Duerink et al., 2013; Elbur et al., 2024). Emerging evidence suggests that occupational safety behaviour reflects a complex interaction between individual, organisational, and systems-level factors rather than knowledge alone (Bekele et al., 2015; Feleke, 2013).

2.4 Professional Differences in Exposure Risk

Occupational exposure to sharps may differ across professional groups because of variations in clinical responsibilities, procedural intensity, duration of patient contact, and workplace roles. Doctors frequently

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perform invasive diagnostic and surgical procedures that increase direct exposure to contaminated sharps, whereas nurses often experience repeated daily exposure through medication administration, blood collection, injections, and patient monitoring (Hasak et al., 2018; Dosh et al., 2024).

Emerging evidence suggests that professional education level alone does not guarantee stronger safety compliance. Several studies have documented inconsistent adherence to universal precautions among highly trained professionals, suggesting that workplace culture, perceived risk, workload pressures, and organisational enforcement significantly influence occupational behaviour (Bekele et al., 2015; Duerink et al., 2013). These findings challenge traditional assumptions that knowledge automatically translates into safe clinical practice.

2.5 Sharps Disposal Practices and Biomedical Waste Management

Safe sharps disposal constitutes a fundamental component of occupational health and infection prevention. International guidelines recommend immediate disposal of used sharps into puncture-resistant sharps containers positioned close to points of care. The Centers for Disease Control and Prevention recommends that needles should not be recapped but placed immediately in puncture-resistant containers (CDC, 2008). Unsafe disposal practices, including needle recapping, disposal into inappropriate waste streams, or carrying used sharps in clothing pockets, substantially increase occupational injury risks (Lakbala et al., 2012; Ramokate and Basu, 2024).

Despite clear recommendations, unsafe disposal practices continue to be reported globally. Needle recapping remains a persistent concern despite strong evidence linking the practice to increased injury risk (Adams, 2012; Nsubuga and Jaakkola, 2005). Improper waste segregation creates additional hazards for downstream workers, including cleaners, waste handlers, and support personnel, thereby extending occupational risks beyond frontline healthcare professionals (Lakbala et al., 2012; Vaz et al., 2010).

2.6 Incident Reporting and Post-Exposure Management

Incident reporting plays a critical role in occupational safety surveillance and prevention. Prompt reporting of sharps injuries facilitates access to post-exposure prophylaxis (PEP), medical assessment, counselling, and follow-up care while enabling healthcare institutions to identify risk patterns and strengthen prevention systems (Lee et al., 2024; Behzadmehr et al., 2023).

However, underreporting remains a major global challenge. A systematic review and meta-analysis by Behzadmehr et al. (2023) found that the overall proportion of unreported NSIs was approximately 60%. Healthcare workers may fail to report injuries due to fear of blame, perceptions that injuries are minor, lack of confidence in reporting systems, time constraints, or uncertainty regarding reporting procedures (Mousavi et al., 2023; Vaz et al., 2010). Institutions that establish accessible, confidential, and non-punitive reporting systems tend to demonstrate stronger occupational health outcomes and improved safety culture.

2.7 Conceptual Framework: Hierarchy of Control Theory

This study is guided by the Hierarchy of Control Theory, an evidence-based occupational health framework used to prioritise hazard prevention strategies according to effectiveness (Levy and Wegman, 2000). The framework categorises interventions into engineering controls, administrative controls, work-practice controls, and personal protective equipment (PPE).

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Engineering controls represent the most effective level and include interventions such as safety-engineered devices, needleless systems, improved lighting, and accessible sharps disposal infrastructure. Administrative controls include institutional policies, staff training, workload management, and reporting systems. Work-practice controls focus on behavioural compliance with safe procedures, including proper sharps handling and avoidance of needle recapping. PPE, including gloves and eye protection, provides an additional protective layer but is generally considered the least effective when used in isolation. The Hierarchy of Control Theory provides a useful framework for understanding gaps in occupational safety and for identifying strategic intervention priorities within healthcare settings.

3. METHODS

3.1 Study Design and Setting

A cross-sectional study was conducted in 2019–2020 at Intermediate Hospital Oshakati, an 884-bed referral hospital located in northern Namibia. The hospital serves a broad catchment population across the Oshana region and neighbouring areas and functions as a major referral centre within the public healthcare system. Like many healthcare institutions in sub-Saharan Africa, the facility operates within resource constraints while managing high patient volumes and diverse clinical demands.

3.2 Study Population and Sampling

The study population comprised doctors and nurses directly involved in clinical procedures requiring sharps handling, drawn from a total pool of 950 doctors and nurses employed at the hospital at the time of the study (per the staff register). Participants were purposively selected from departments considered at high risk for occupational sharps exposure, including the operating theatre, intensive care unit, outpatient department, emergency department, surgical wards, medical wards, paediatric ward, and obstetrics and gynaecology department. A precise count of staff approached versus enrolled, and therefore a formal response rate, was not recorded in the underlying project records; this is noted as a methodological limitation in Section 6. Purposive sampling was considered appropriate because it ensured adequate representation of healthcare workers with frequent exposure to sharps-related procedures and elevated occupational risk; the implications of this sampling approach for generalizability are discussed in Section 6.

3.3 Sample Size and Participants

A minimum sample size of 342 participants was calculated using EPINFO STATCAL version 7.2, based on a 95% confidence level, 5% margin of error, an assumed prevalence of 50%, and a 25% contingency for non-response, loss to follow-up, and data loss in multivariate analysis. A total of 490 participants were deliberately included in the final study, exceeding this minimum, to strengthen the ability to detect statistically significant associations where they existed. The larger achieved sample enhanced statistical precision and strengthened the reliability of findings.

3.4 Data Collection Procedures

Data were collected between 2019 and 2020 using a pre-tested, self-administered structured questionnaire developed with reference to World Health Organization guidelines, Centers for Disease Control and Prevention recommendations, and relevant occupational health literature.

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The questionnaire captured information on demographic characteristics, occupational factors (job location and work duration), sharps injury history (occurrence and frequency), contributing factors to injury occurrence, exposure-related procedures, use of protective equipment, post-exposure management practices, knowledge and awareness of safety protocols (including universal precautions and biomedical waste management), incident-reporting behaviour, and sharps disposal practices.

3.4.1 Questionnaire Development and Validity

The instrument was developed with reference to WHO and CDC guidance and existing sharps-injury questionnaires from the literature. The questionnaire was piloted among 10 healthcare workers who handled medical sharps at a district hospital approximately 30 minutes from the study site, chosen to avoid influencing potential study participants. Participants who consented completed the same questionnaire again after five days for test-retest purposes, and Cronbach's alpha was used to assess the consistency of responses between administrations; a specific alpha coefficient was not recorded in the underlying project records, and this is noted transparently as a limitation in Section 6 rather than presented as a stable figure. Based on pilot feedback, one combined attitude question was separated into two items, the sharps-frequency question was restructured, and questionnaire numbering and coding were corrected before the main data-collection round. Research assistants were trained to administer the questionnaire consistently, and were available during administration to clarify queries.

3.5 Data Analysis

Data were analysed using Epi Info version 7.2 and IBM SPSS version 25. Descriptive statistics, including frequencies and percentages, were used to summarise participant characteristics and key study variables. Ninety-five percent confidence intervals for key prevalence estimates were calculated using the Wald normal approximation method.

Crude odds ratios (OR) were calculated using Epi Info 7.2, and adjusted odds ratios (AOR), with 95% confidence intervals, were estimated using multivariable logistic regression in SPSS to compare occupational practices and injury-related outcomes between doctors and nurses. Doctors were treated as the exposure group and nurses as the reference group; this reflects the paper’s core aim of characterising professional disparities in safety compliance against the larger, more procedurally homogeneous nursing workforce, and mirrors the convention used in the companion analysis of knowledge and attitudes conducted on the same dataset. Multivariable models adjusted for demographic factors including age, gender, marital status, and education level to minimise confounding effects. Formal collinearity diagnostics (for example, variance inflation factors) and goodness-of-fit testing (for example, the Hosmer-Lemeshow test) were not part of the original analysis; this is noted here as a limitation of the statistical reporting rather than retrofitted. Statistical significance was set at $p < 0.05$.

Occupational variables potentially relevant to injury risk, including department of work, years of professional experience, workload, shift duration, and frequency of invasive procedures, were not captured with sufficient granularity to enter the multivariable models. Because department assignment is itself strongly correlated with profession (Section 4.1), the doctor-nurse comparisons reported here should be interpreted as reflecting the combined effect of professional role and procedural exposure rather than professional role in isolation; this is discussed further in Section 6.

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3.6 Ethical Considerations

Ethical approval for the study was obtained from the University of Johannesburg Faculty of Health Sciences Research Ethics Committee (REC-494-2020) and the Namibian Ministry of Health and Social Services. Written informed consent was obtained from all participants before data collection. Participants were informed about the study objectives, voluntary participation, confidentiality protections, and their right to withdraw at any stage without consequence. No identifying information was retained, and the study adhered to internationally recognised ethical principles governing occupational health research.

4. RESULTS

4.1 Participant Characteristics and Occupational Distribution

A total of 490 healthcare workers participated in the study, comprising 134 doctors (27.3%) and 356 nurses (72.7%). Participants were recruited from departments considered to be at elevated risk for occupational sharps exposure. The distribution of participants across job locations is presented in Table 1.

Table 1. Distribution of participants by job location and professional category

Job Location	Total n (%)	Doctors n (%)	Nurses n (%)
Medical Ward	127 (25.9)	23 (18.1)	104 (81.9)
Surgical Ward	69 (14.1)	23 (33.3)	46 (66.7)
Emergency Department	52 (10.6)	12 (23.1)	40 (76.9)
Intensive Care Unit	6 (1.2)	2 (33.3)	4 (66.7)
Operating Theatre	13 (2.7)	9 (69.2)	4 (30.8)
Obstetrics/Gynaecology	94 (19.2)	21 (22.3)	73 (77.7)
Paediatric Ward	25 (5.1)	9 (36.0)	16 (64.0)
Outpatient Department	104 (21.2)	35 (33.7)	69 (66.3)

In crude analysis, doctors were significantly more likely to work in high-risk procedural departments than nurses, particularly in surgical wards (OR = 2.26, 95% CI: 1.15–4.44), operating theatres (OR = 10.17, 95% CI: 2.88–35.92), and obstetrics and gynaecology departments (OR = 5.53, 95% CI: 1.49–20.52). This occupational concentration reflects differences in professional responsibilities and procedural intensity between healthcare worker categories, and is an important interpretive context for the professional-comparison findings reported in Sections 4.5 and 4.6. The majority of participants (52.9%) had worked at the facility for one to three years, while 15.9% had worked for ten or more years.

4.2 Prevalence and Frequency of Sharps Injuries

More than half of participants (54.7%, n = 268, 95% CI: 50.3–59.1%) reported having experienced at least one sharps injury during clinical practice, highlighting a substantial occupational health burden within the study setting. Among all participants, 38.4% reported sustaining between one and three injuries annually, 11.2% reported four to six injuries, 2.7% reported seven to nine injuries, and 0.4% reported ten or more injuries annually, indicating recurrent occupational exposure rather than isolated incidents. The prevalence and frequency distributions are presented in Table 2.

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Table 2. Prevalence and frequency of sharps injuries by professional category

Characteristic	Total n (%)	Doctors n (%)	Nurses n (%)
Ever suffered sharps injury – Yes	268 (54.7)	66 (28.9)	162 (71.1)
Ever suffered sharps injury – No	262 (45.3)	68 (26.0)	194 (74.0)
1–3 times/year	188 (38.4)	46 (24.5)	142 (75.5)
4–6 times/year	55 (11.2)	21 (38.2)	34 (61.8)
7–9 times/year	13 (2.7)	9 (69.2)	4 (30.8)
10+ times/year	2 (0.4)	0 (0.0)	2 (100.0)
Not applicable	232 (47.3)	58 (25.0)	174 (75.0)

Professional differences in injury frequency were observed. In crude analysis, doctors demonstrated significantly higher odds of reporting intermediate injury frequencies, including four to six injuries annually (OR = 1.91) and seven to nine injuries annually (OR = 6.95), compared with nurses. However, after adjustment for demographic factors, doctors were less likely to report ten or more injuries annually (AOR = 0.20, 95% CI: 0.06–0.73) (Table 3). These findings suggest that exposure patterns differ by professional role and may be influenced by department-specific procedural demands.

Table 3. Adjusted odds ratios for occupational factors and sharps injury frequency (doctors vs. nurses)

Frequency of injury per year	Adjusted Odds Ratio	95% CI
1–3 times	Reference	–
4–6 times	1.19	0.74–1.91
7–9 times	0.53	0.26–1.08
10+ times	0.20	0.06–0.73

Adjusted for age, marital status, gender, and education level.

4.3 Factors Associated with Sharps Injuries

Several occupational and environmental factors were identified as contributors to sharps injuries. The distribution of self-reported reasons for injury across professional categories is presented in Table 4.

Table 4. Self-reported reasons for sharps injuries by professional category

Reason	Total Yes n (%)	Doctors n (%)	Nurses n (%)
Long working hours (>10 hrs)	292 (59.6)	93 (31.8)	199 (68.2)
Inappropriate environment	320 (65.3)	89 (27.8)	231 (72.2)
Stress	319 (65.1)	89 (27.9)	230 (72.1)
Inadequate training	348 (71.0)	102 (29.3)	246 (70.7)
Poor lighting	305 (62.2)	95 (31.1)	210 (68.9)
Poor restraint	303 (61.8)	85 (28.1)	218 (71.9)
Lack of safety measures	374 (76.3)	95 (25.4)	279 (74.6)
Hasty work	337 (68.8)	88 (26.1)	249 (73.9)

After adjustment for demographic factors, doctors were significantly more likely than nurses to identify long working hours as a contributing factor (AOR = 1.67, 95% CI: 1.06–2.61). Similarly, poor lighting was significantly associated with injuries among doctors (AOR = 1.88, 95% CI: 1.19–2.97), suggesting that environmental conditions may compromise procedural visibility and increase exposure risk (Table 5). Across professional groups, lack of safety measures (76.3%), inadequate training (71.0%), hasty work

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(68.8%), stress (65.1%), and inappropriate environment (65.3%) were among the most commonly cited contributors to sharps injuries.

Table 5. Adjusted odds ratios for reasons for sharps injury (doctors vs. nurses)

Reason	Adjusted Odds Ratio	95% CI
Long working hours (Yes vs. No)	1.67	1.06–2.61
Poor lighting (Yes vs. No)	1.88	1.19–2.97
Other reasons (Yes vs. No)	0.37	0.24–0.57

Adjusted for age, marital status, gender, and education level.

4.4 Procedures Associated with Exposure

Participants identified multiple clinical procedures associated with sharps exposure. The most frequently cited procedures were suturing (88.4%), handling uncooperative patients (88.2%), injecting (83.9%), recapping (82.7%), collecting blood samples (82.7%), and handling garbage (70.6%). Additionally, manipulating a needle in a patient (72.7%), taking a cap off a needle (62.7%), and withdrawing drugs (55.1%) were commonly identified. Most participants (88.4%) reported using gloves during phlebotomy.

4.5 Adherence to Universal Precautions and Biomedical Waste Management

Although most healthcare workers reported adherence to universal precaution guidelines, important professional differences emerged. Overall, 87.3% of participants (95% CI: 84.3–90.3%) reported practising universal precautions, while 8.8% did not and 3.9% were uncertain. Regarding biomedical waste management, 77.3% of participants (95% CI: 73.6–81.0%) indicated awareness, 14.1% reported no awareness, and 8.6% were uncertain.

After adjustment for demographic confounders, doctors were significantly less likely to practise universal precautions than nurses (AOR = 0.37, 95% CI: 0.14–0.98 for “No” responses). Similarly, doctors demonstrated significantly lower awareness of biomedical waste management protocols (AOR = 0.06, 95% CI: 0.02–0.19 for “Don't know” responses) (Table 6). As noted in Section 4.1, doctors in this sample were significantly more concentrated in high-intensity procedural departments (operating theatre, obstetrics/gynaecology, surgical wards) than nurses, and this concentration should be considered alongside professional role when interpreting these adherence differences; the pattern likely reflects an interaction between role, procedural intensity, and workplace systems rather than a uniform professional deficit.

Regarding knowledge of needleless safety devices, 78.4% of participants reported awareness, while 13.5% reported no knowledge, and 8.2% were uncertain. Also, 8.4% do not take PEP if pricked accidentally.

Table 6. Adjusted odds ratios for safety practices (doctors vs. nurses)

Characteristic	Adjusted Odds Ratio	95% CI
Universal Precaution – Yes	Reference	–
Universal Precaution – No	0.37	0.14–0.98
Universal Precaution – Don't know	0.23	0.06–0.83
Biomedical Waste Mgmt Awareness – Yes	Reference	–
Biomedical Waste Mgmt Awareness – No	0.29	0.10–0.81
Biomedical Waste Mgmt Awareness – Don't know	0.06	0.02–0.19

Adjusted for age, marital status, gender, and education level. AOR < 1 indicates that the comparison group (doctors) had lower odds of the “Yes” (reference) category relative to nurses.

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4.6 Sharps Disposal Practices

Most participants (95.5%, 95% CI: 93.7–97.3%) reported disposing of sharps in designated sharps containers, reflecting broad awareness of recommended disposal practices. However, unsafe disposal behaviours persisted. Approximately 22.0% of participants (95% CI: 18.3–25.7%) reported recapping needles despite recommendations discouraging this practice. In addition, 8.8% (95% CI: 6.3–11.3%) reported disposing of sharps into blue bags, an inappropriate disposal method that increases occupational risks for healthcare workers and waste handlers. Professional disparities in disposal behaviour were also observed (Table 7).

Table 7. Sharps disposal practices by professional category

Practice	Total n (%)	Doctors n (%)	Nurses n (%)	Crude OR	95% CI
Recapping – Yes	108 (22.0)	30 (28.6)	78 (71.4)	Reference	–
Recapping – No	382 (78.0)	82 (21.5)	300 (78.5)	0.71	0.44–1.16
Sharps container – Yes	468 (95.5)	134 (28.6)	334 (71.4)	Reference	–
Sharps container – No	22 (4.5)	0 (0.0)	22 (100.0)	0.25	0.06–1.08
Blue bag – Yes	43 (8.8)	6 (14.0)	37 (86.0)	Reference	–
Blue bag – No	447 (91.2)	128 (28.6)	319 (71.4)	2.47	1.02–6.01
Coat pocket – Yes	44 (9.0)	9 (20.5)	35 (79.5)	Reference	–
Coat pocket – No	446 (91.0)	125 (28.0)	321 (72.0)	1.51	0.71–3.24

Doctors were significantly more likely than nurses to dispose of sharps in blue bags (OR = 2.47, 95% CI: 1.02–6.01), indicating concentrated unsafe disposal behaviour among a subset of physicians. Furthermore, 9.0% (n = 44, 95% CI: 6.5–11.5%) of all participants reported placing sharps in ward or laboratory coat pockets, representing an additional high-risk practice.

4.7 Incident Reporting and Post-Exposure Prophylaxis Utilisation

Most participants (84.3%, n = 413, 95% CI: 81.1–87.5%) reported sharps injuries to hospital authorities, compared with 11.4% (n = 56) who did not report incidents and 4.3% (n = 21) who were uncertain about reporting procedures. The high reporting rate suggests the presence of institutional systems and workplace norms supportive of transparency in occupational health reporting.

Post-exposure prophylaxis uptake following sharps injuries was also high. Most participants (91.2%, n = 447, 95% CI: 88.7–93.7%) reported accessing PEP after occupational exposure, whereas 8.4% (n = 41) reported not seeking post-exposure management. This finding suggests reasonable institutional access to occupational health services and post-exposure care, although the minority failing to utilise PEP highlights opportunities for strengthening post-exposure compliance and follow-up systems.

5. DISCUSSION

This study examined sharps-handling practices, the prevalence of sharps injuries, and professional differences in occupational safety compliance among healthcare workers at Intermediate Hospital Oshakati, Namibia. All associations reported below derive from a cross-sectional design and describe patterns observed at a single point in time; they should not be read as establishing causal or temporal relationships. The findings reveal a substantial occupational health burden, important professional disparities in exposure patterns, and persistent gaps between safety awareness and actual clinical practice.

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The prevalence of sharps injuries observed in this study (54.7%, 95% CI: 50.3–59.1%) is considerably high and reflects an ongoing occupational safety challenge within the healthcare setting. This prevalence exceeds rates reported in some developing countries, such as 37.1% in Ethiopia (Bekele et al., 2015) and 35% in Romania (Dentinger et al., 2004), but is lower than rates reported in other contexts, such as 86% in Nigeria (Adejumo and Olatunji, 2013). The finding also significantly exceeds rates reported in developed countries, which typically range from 1.8% to 5.8% (Hanrahan and Reutter, 1997; Nsubuga and Jaakkola, 2005). This elevated prevalence underscores the heightened vulnerability of healthcare workers in resource-constrained settings. It reinforces growing concerns that they continue to face disproportionate occupational risks despite increasing global emphasis on infection prevention (Debelu et al., 2023).

Professional differences in exposure patterns were particularly notable. Doctors demonstrated higher frequencies of sharps injuries than nurses at intermediate exposure levels and were significantly more concentrated in high-risk procedural departments, including operating theatres, surgical wards, and obstetrics and gynaecology units. These findings likely reflect the procedural demands of medical practice, where doctors routinely undertake invasive interventions requiring sustained sharps handling. Similar associations have been documented internationally, particularly in emergency, surgical, and theatre environments where procedural complexity and time-sensitive decision-making increase occupational risk (Markovic-Denic et al., 2015; Hasak et al., 2018). The finding that doctors were less likely to report ten or more injuries annually after adjustment may reflect the nature of their procedural exposure, which, although intense, may be more episodic than the continuous daily sharps contact experienced by nurses during medication administration and routine patient care.

Importantly, doctors were more likely to identify long working hours and poor lighting as contributors to sharps injuries. These findings emphasise the influence of workplace systems and environmental conditions on occupational safety. Fatigue associated with prolonged working hours has consistently been linked to reduced vigilance, impaired concentration, and procedural errors (Ishak et al., 2019; Prados-Castillo et al., 2025), while inadequate lighting may compromise visual accuracy during clinical interventions. The fact that 59.6% of participants reported working shifts exceeding ten hours daily underscores the systemic nature of this risk factor. These findings suggest that occupational injuries should not be understood solely as behavioural failures but rather as outcomes shaped by broader organisational and infrastructural conditions (Centers for Disease Control and Prevention, 2008).

One of the most important findings was the discrepancy between safety knowledge and practice. Although most participants reported awareness of universal precautions (87.3%) and biomedical waste management principles (77.3%), unsafe practices persisted. Doctors, in particular, reported lower adherence to universal precautions and lower awareness of biomedical waste management protocols than nurses. This interpretation should be read alongside the finding, reported in Section 4.1, that doctors in this sample were disproportionately concentrated in high-intensity procedural departments (operating theatre OR = 10.17, obstetrics/gynaecology OR = 5.53, surgical wards OR = 2.26); the observed professional gap in adherence therefore likely reflects an interaction between occupational role, procedural intensity, and workplace systems rather than a uniform deficit specific to doctors as a group. With that caveat, the finding still challenges the expectation that higher education levels would correlate with better safety practices (Bekele et al., 2015), and supports emerging evidence suggesting that organisational culture, workload pressure, perceived risk, and institutional accountability substantially influence safety

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compliance (Duerink et al., 2013; Elbur et al., 2024). Possible explanations include overconfidence, time pressure, or inadequate training emphasis on practical safety protocols in medical curricula.

Unsafe sharps disposal practices remain a matter of concern despite generally high levels of awareness. Although most healthcare workers (95.5%) used designated sharps containers, needle recapping (22.0%) and inappropriate disposal into blue waste bags (8.8%) continued to occur. Particularly concerning was the higher likelihood among doctors to engage in inappropriate disposal practices (OR = 2.47). These findings align with studies from other developing countries where unsafe disposal practices persist despite available guidelines (Lakbala et al., 2012; Ramokate and Basu, 2024). Unsafe disposal behaviours expose not only frontline clinicians but also cleaners, waste handlers, and support personnel to preventable occupational hazards (Vaz et al., 2010). The finding that 9.0% of participants reported placing sharps in ward or laboratory coat pockets represents an additional high-risk practice that warrants specific attention in training interventions.

Encouragingly, the high incident-reporting rate observed in this study (84.3%) suggests the presence of a relatively supportive institutional safety culture. Reporting occupational injuries is essential for strengthening surveillance systems, facilitating post-exposure care, and identifying patterns requiring intervention (Behzadmehr et al., 2023). Similarly, high uptake of post-exposure prophylaxis (91.2%) indicates reasonable access to occupational health support systems within the institution. Nevertheless, the persistence of non-reporting among 11.4% of healthcare workers suggests opportunities to strengthen awareness, simplify reporting pathways, and reinforce reporting expectations (Mousavi et al., 2023).

Applying the Hierarchy of Control Theory (Levy and Wegman, 2000), the findings indicate weaknesses across multiple levels of control, each with a corresponding policy implication. At the engineering control level, findings point to a need for mandatory procurement standards for safety-engineered sharps devices and structured lighting audits in procedural areas. At the administrative control level, inadequate training, excessive workload, and limited policy enforcement were identified, pointing toward staffing ratios and shift-length limits aligned with the Ministry of Health and Social Services' National Occupational Health and Safety Strategic Plan 2023–2028. At the work-practice control level, poor adherence to universal precautions and unsafe disposal practices were prevalent, indicating a need for routine, unannounced departmental compliance audits with defined institutional accountability. Regarding PPE, inconsistent use was noted despite general availability. Collectively, these findings demonstrate that education alone is unlikely to achieve sustained improvements in workplace safety. Rather, comprehensive interventions addressing environmental conditions, organisational systems, workload pressures, behavioural compliance, and engineering controls are likely to produce more meaningful reductions in occupational exposure.

6. STRENGTHS AND LIMITATIONS

This study possesses several important strengths. The sample size (n = 490), deliberately set above the calculated minimum of 342 to strengthen the detection of true associations, enhanced statistical power and improved the reliability of findings. The inclusion of both doctors and nurses from multiple high-risk departments enabled meaningful comparison across professional groups, contributing novel insights into provider-specific occupational risks and safety behaviours. Furthermore, the study generated context-

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specific evidence from Namibia, a setting where empirical occupational health research remains limited, thereby strengthening understanding of healthcare worker safety in sub-Saharan Africa.

Several limitations should be acknowledged. The cross-sectional design limits causal inference, as associations between occupational factors and sharps injuries cannot establish temporal relationships. Data were self-reported and may therefore be subject to recall bias or social desirability bias, particularly regarding safety compliance and injury reporting practices. The study was conducted at a single referral hospital, which may limit generalisability to other healthcare settings in Namibia or beyond. Purposive sampling from high-risk departments, while appropriate for capturing the population of interest, introduces potential selection bias and limits generalizability to lower-risk departments and to the hospital workforce as a whole; it may also overstate injury prevalence relative to the general healthcare workforce. A precise participant response rate could not be reported, as the number of eligible staff approached was not recorded in the underlying project records; future studies at this site should record this prospectively. Occupational variables that could independently influence injury risk, including years of professional experience, workload, shift duration, and frequency of invasive procedures, were not captured with sufficient granularity for multivariable adjustment; because department is strongly correlated with profession in this sample, the doctor-nurse comparisons reported here should be interpreted as reflecting the combined effect of professional role and procedural exposure, and residual confounding by these unmeasured occupational factors cannot be excluded. Formal multicollinearity diagnostics (variance inflation factors) and goodness-of-fit testing were not part of the original analysis and are recommended for future analyses of this dataset. The pilot test-retest exercise used Cronbach's alpha to assess response consistency, but a specific coefficient was not recorded in the underlying project records; this is noted as a measurement-reporting limitation. Nevertheless, the inclusion of high-risk departments strengthens the relevance of findings to occupationally exposed healthcare workers.

7. RECOMMENDATIONS

The findings of this study indicate the need for a multidimensional occupational safety strategy to reduce sharps injuries among healthcare workers. First, healthcare institutions should improve working conditions by addressing long working hours through adequate staffing and structured shift scheduling, and by ensuring proper lighting in all procedural areas. Second, mandatory competency-based training programmes should be developed with a focus on universal precautions, safe sharps disposal practices, and biomedical waste management, with particular emphasis on doctors, who demonstrated lower compliance in this study once concentration in high-intensity procedural departments is accounted for. Training should move beyond theoretical awareness and incorporate behavioural reinforcement, practical simulations, and periodic competency assessments. Third, healthcare facilities should invest in safety-engineered sharps devices, including retractable needles and needleless systems, where feasible, to strengthen engineering controls. Fourth, stronger supervisory mechanisms should be established to ensure consistent adherence to infection prevention protocols through routine audits, departmental compliance monitoring, and clear accountability measures. Fifth, healthcare institutions should maintain transparent, confidential, and non-punitive reporting systems to encourage timely reporting of sharps injuries and ensure timely access to post-exposure prophylaxis. Finally, comprehensive sharps injury prevention policies with clear accountability mechanisms should be developed and enforced at the institutional, regional, and national levels.

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8. CONCLUSION

Needlestick and sharps injuries remain a significant occupational health concern among healthcare workers in resource-constrained healthcare settings. This study identified a high prevalence of sharps injuries (54.7%) among healthcare workers at Intermediate Hospital Oshakati and demonstrated important professional differences in occupational exposure and safety compliance.

Although healthcare workers reported high levels of awareness regarding universal precautions and biomedical waste management, inconsistencies in safety behaviour persisted, particularly among doctors, whose lower reported adherence coincided with their concentration in high-intensity procedural departments. Long working hours, poor lighting, procedural intensity, and unsafe disposal practices emerged as important contributors to occupational risk, highlighting the interaction between behavioural and systems-level factors.

The findings demonstrate that reducing occupational sharps injuries requires interventions that extend beyond awareness alone. Sustainable improvements in healthcare worker safety are likely to depend on stronger institutional systems, safer workplace environments, improved compliance monitoring, and contextually relevant occupational health policies. By generating evidence from an underrepresented setting, this study contributes valuable insights for healthcare institutions and policymakers seeking to strengthen occupational safety in Namibia and comparable sub-Saharan African contexts. Protecting healthcare workers from preventable occupational hazards is essential not only for workforce wellbeing but also for sustaining resilient healthcare systems and ensuring safe patient care.

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DECLARATIONS

Ethics Approval and Consent to Participate

Ethical approval was obtained from the University of Johannesburg Faculty of Health Sciences Research Ethics Committee (Reference: REC-494-2020) and the Namibian Ministry of Health and Social Services. Written informed consent was obtained from all participants before data collection. Participation was voluntary, and participants were informed of their right to withdraw at any stage without consequence.

Consent for Publication

Not applicable. No individual participant data are presented in a form that would allow identification.

Availability of Data and Materials

The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.

Competing Interests

The authors declare that there are no competing interests.

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Authors' Contributions

OLI conceptualised the study, designed the research methodology, conducted data collection, performed the data analysis, and drafted the manuscript. MC supervised the work and approved the final version.

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