

Review Article

Prevalence and risk factors of needlestick injuries among surgeons: a systematic review and meta-analysis

Fayo Haji^{1*}, Mohammad Ali Maksoud², Ahmed Mustafa El-Shiekh Idrees³

Full list of author information is available at the end of the article.

ABSTRACT

Background: Needlestick injuries (NSIs) and sharps injuries are a major occupational hazard for surgeons, exposing them to bloodborne pathogens and significant psychological and economic burdens. Despite extensive literature on healthcare workers, comprehensive global estimates specific to surgeons are scarce.

Methods: We conducted a systematic review and meta-analysis in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. PubMed, Scopus, and Web of Science were searched through September 2025 for studies reporting NSI prevalence in surgeons. Data extraction and risk of bias assessment were performed independently by two reviewers. Pooled prevalence estimates were calculated using random-effects models. Predictors of NSIs and reporting behaviors were also considered.

Results: Twelve cross-sectional studies comprising 9,997 surgeons and trainees were included. The pooled prevalence of NSIs was 46% [95% confidence interval (CI): 31–62], with substantial heterogeneity ($I^2 = 99.2\%$). Reporting rate to occupational authorities was 62% (95% CI: 50–73). Consistent predictors of injury included senior training level, extended working hours, and inadequate specialty-specific preparation. Post-exposure management was suboptimal, with low uptake of prophylaxis. Publication bias assessment employing Doi plots and Luis Furuya-Kanamori indices suggested asymmetry.

Conclusions: Nearly half of surgeons sustain NSIs during their careers, yet many incidents remain unreported and inadequately managed. High prevalence and variability underscore the need for standardized definitions, improved preventive training, and robust reporting systems. Adoption of safety-engineered devices, specialty-specific education, and streamlined post-exposure protocols are critical to reduce occupational risk. Global strategies tailored to surgical settings are essential to enhance compliance with international safety guidelines.

Keywords: Needlestick injuries, sharps injuries, occupational injury, surgeons, meta-analysis.

Introduction

Needlestick injuries (NSIs) and other sharps injuries pose a significant occupational hazard for healthcare workers, particularly surgeons. The World Health Organization estimates that over 2 million percutaneous exposures occur each year among the 35 million healthcare workers worldwide [1]. Surgical practice involves frequent handling of needles, scalpels, and other sharp tools in blood-rich operative fields, so surgeons face especially high exposure risk. These injuries can transmit bloodborne pathogens; for example, NSIs account for roughly 66,000 new hepatitis B, 16,000 hepatitis C, and 1,000 HIV infections annually among healthcare staff

globally [1]. Studies indicate that sharps exposures occur disproportionately in certain groups – nurses, surgeons, and emergency personnel have among the highest NSI rates [1]. Each NSI also carries substantial economic cost: estimates suggest direct and indirect medical

Correspondence to: Fayo Haji

*General Practitioner, Care Medical Alrawabi, Riyadh, Saudi Arabia.

Email: Fayoalhaji@gmail.com

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costs on the order of \$175–350 per injury [1,2]. Together, the health risks and costs underscore the heavy burden of sharps injuries in surgical settings. Empirical data confirm that sharps injuries are extremely common in surgery. In one U.S. survey of surgical trainees, 83% reported at least one NSI during residency, and by the end of training 99% had been injured [3].

Reported injury rates vary widely by setting and specialty. Large-scale analyses show geographic disparities: for example, a global meta-analysis of healthcare workers reported pooled NSI prevalence below 15% in high-income countries such as Singapore, New Zealand, and Australia, but above 70% in some South Asian settings [1]. Within surgical specialties, certain fields carry especially high risk. For instance, in one Canadian teaching hospital study surgical trainees were three times more likely than non-surgical trainees to incur a needlestick [incident rate ratio (IRR) = 3.0], and orthopedic surgery trainees had the highest risk (IRR = 12.4 relative to emergency medicine trainees) [4]. Contributing factors in the operating room include complex or urgent procedures, crowded or unfamiliar odds ratio (OR) environments, fatigue from long cases, and lapses in safe technique. Indeed, many NSIs are attributed to “unsafe practices and gross negligence” during instrument handling [5], emphasizing that improved training and strict adherence to safety protocols could prevent many injuries.

The implications of each sharps injury are serious. Even a single contaminated needle can carry significant infection risk (roughly 6%–30% for HBV, 2% for HCV, and 0.3% for HIV) [4,6]. Although modern prophylaxis and vaccine use greatly reduce disease transmission, NSIs still contribute substantially to occupational infections: worldwide, needlestick exposures account for an estimated 4.4% of healthcare-worker HIV seroconversions [7]. In addition to infection risk, injured surgeons face psychological stress and the burden of post-exposure management. Underreporting of NSIs is a chronic problem in surgery – one study found that fewer than 5% of trainee surgeons formally reported their injuries for evaluation [8]. This hinders timely prophylaxis and underestimates true incidence rates, complicating prevention efforts.

Despite numerous individual studies on NSIs in surgery, a comprehensive synthesis of the problem is lacking. Prior reviews have examined NSI prevalence in broad healthcare populations or in operating-room settings, but reviews focusing on surgical settings are scarce. In particular, the global prevalence and predictors of sharps injuries in surgeons remain unclear. To address this gap, we conducted a systematic review and meta-analysis of published studies of sharps and NSIs in surgeons. The aim of the present study is to estimate the pooled global prevalence of NSIs in surgeons and to identify key predictors of injury, providing an evidence base for targeted prevention strategies.

Methods

This systematic review and meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [9].

Literature search and keywords

A comprehensive literature search was performed in PubMed, Scopus, and Web of Science for studies published up to September 2025. The search strategy used in the databases was: (“needlestick injury” OR “needlestick injuries” OR “needle-stick injury” OR “needle-stick injuries” OR “sharp injury” OR “sharp injuries” OR “sharps injury” OR “sharps injuries” OR “percutaneous injury” OR “percutaneous injuries”) AND (“surgeon” OR “surgeons” OR “surgical staff” OR “surgical staffs” OR “surgical resident” OR “surgical residents” OR “surgical trainee” OR “surgical trainees”.) Reference lists of included articles and relevant reviews were also screened to identify additional eligible publications.

Eligibility criteria

Studies were eligible if they met the following criteria:

1. Observational studies with a cross-sectional or any other observational design.
2. Surgeons (consultants, trainees, or residents) working in surgical specialties, regardless of subspecialty.
3. Studies that reported the prevalence of NSI or sharp injuries (any type) and/or related reporting behaviors or preventive measures.

Exclusion criteria were:

1. Non-original works (e.g., reviews, commentaries, editorials, protocols, theses, and conference abstracts).
2. Studies not specific to surgeons (e.g., mixed healthcare workers without separate data for surgeons).
3. Studies with insufficient or unclear data on prevalence of NSI/sharp injuries.

Study selection and data extraction

After removing duplicates, all records were imported into Rayyan software for blinded screening [10]. Two reviewers independently screened titles and abstracts according to the eligibility criteria, followed by full-text review of potentially relevant studies. Disagreements were resolved through discussion. Reference lists of included studies were also checked to capture additional eligible articles.

Data extraction was carried out independently by two authors using a standardized electronic form. Extracted information included:

- Study characteristics: first author, year of publication, study design, country, surgical specialty, sample size, and key findings.



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- Participant characteristics: age and gender (if available).
- Outcomes: prevalence of overall NSI/sharp injuries, reporting to occupational authorities or staff, adherence to post-exposure prophylaxis (PEP), and post-exposure actions.

Risk of bias assessment

The methodological quality of included studies was independently evaluated by two reviewers using the Newcastle–Ottawa Scale (NOS) adapted for cross-sectional studies [11]. The domains assessed included sample representativeness, adequacy of sample size, ascertainment of NSI/sharp injuries, and adjustment for potential confounders. Discrepancies were resolved by consensus.

Statistical analysis

All statistical analyses were conducted using RStudio with the “meta” package [12]. Pooled prevalence estimates were calculated using a random-effects model with corresponding 95% confidence intervals (CIs). Heterogeneity among studies was quantified using the I^2 statistic and Cochran’s Q test, with $I^2 \geq 50\%$ or $p < 0.10$ considered evidence of substantial heterogeneity [13].

Publication bias was assessed using the Luis Furuya-Kanamori (LFK) asymmetry index and the Doi plot [14]. A symmetrical Doi plot was interpreted as absence of bias, while asymmetry suggested possible bias. Based on the LFK index, values within ± 1 indicate no asymmetry, between ± 1 and ± 2 indicate minor asymmetry, and values greater than ± 2 suggest major asymmetry [14]. The Doi plots and LFK indices were generated using the MetaXL add-in for Microsoft Excel [15].

Sensitivity analysis

Sensitivity analyses were conducted using a leave-one-out method to determine the influence of individual studies on the overall pooled prevalence estimates and to explore potential sources of heterogeneity.

Results

Literature search

The electronic database search yielded 975 records. After removal of duplicates, 801 records were screened by title and abstract and 50 full-text articles were assessed for eligibility. Following detailed evaluation, 12 cross-sectional studies published between 2015 and 2025 were included in the systematic review and meta-analysis [4,16–26]. The study selection process is illustrated in the PRISMA flow diagram (Figure 1).

Study and population characteristics

The twelve included studies enrolled a total of 9,997 surgeons and surgical trainees from multiple regions (North America, Europe, Middle East, Africa, and Asia). Sample sizes ranged from 29 to 7,391 participants. Studies represented a variety of surgical specialties,

including otorhinolaryngology/ENT, orthopaedics, oral and maxillofacial surgery, ophthalmology (cataract), general surgery and mixed surgical specialty cohorts; several studies sampled trainees/residents while others included attending surgeons and perioperative staff. Sex was variably reported; male predominance was observed in several cohorts with the proportion of male participants where reported ranging from 46% to 89.7%. Full study and participant details are presented in Table 1.

Quality assessment

Methodological quality was appraised using the adapted NOS for cross-sectional studies. Total scores ranged from 6 to 9 out of 10, indicating moderate to high methodological quality overall. Five studies scored 9/10, four studies scored 7/10, and three studies scored 6/10. Common methodological strengths included adequate outcome assessment and appropriate statistical testing. Recurrent limitations were variable representativeness of the sampled populations and incomplete reporting on non-respondents. A summary of the quality assessment for each study is provided in Supplementary Table 1.

Meta-analysis

Prevalence of sharps/NSIs

The pooled prevalence of sharps/NSIs among surgeons across included studies was [46% (95% CI: 31–62)] (Figure 2A). Between-study heterogeneity was substantial ($I^2 = 99.2\%$, $p < 0.0001$). Leave-one-out sensitivity analysis indicated that exclusion of any single study did not materially alter the pooled estimate or resolve heterogeneity (Figure 2B). Publication bias assessment using DOI plot returned an LFK index of 2.63 indicating major asymmetry (Figure 3).

Prevalence of reporting to staff/occupational authority

The pooled prevalence of reporting needlestick exposures to occupational health services or designated staff was [62% (95% CI: 50–73)] (Figure 4A). Considerable heterogeneity was present ($I^2 = 96.9\%$, $p < 0.0001$). Sensitivity analyses showed that the exclusion of any single study did not affect the pooled estimate or resolve heterogeneity (Figure 4B). The DOI plot yielded an LFK index of -1.82, consistent with minor asymmetry (Figure 5).

Predictors of sharp/needlestick events

In multivariable analyses, several consistent predictors of sharps/needlestick events emerged across large surgical trainee cohorts. In the national orthopaedic residency survey, Gordon et al. [24] found that greater postgraduate year was strongly associated with more sharps injuries: each additional year of training was associated with a more than twofold increase in the odds of sustaining ≥ 5 sharps injuries (adjusted OR: 2.04, 95% CI: 1.64–2.52). In the same model, inadequate specialty-specific preparation for orthopaedic surgery also independently increased risk (adjusted OR: 2.32,



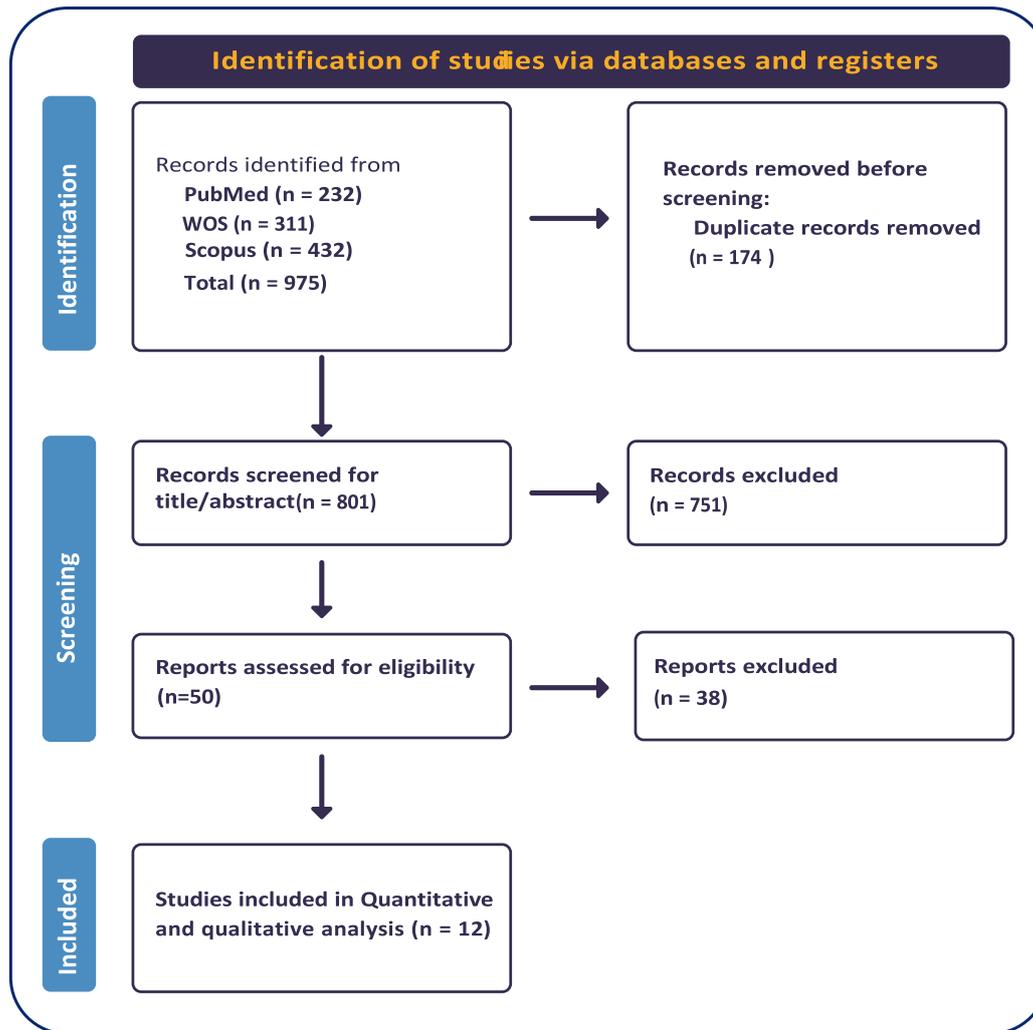


Figure 1. PRISMA flowchart of study selection.

95% CI: 1.20-4.46), whereas female sex showed a non-statistically significant trend toward higher risk (adjusted OR: 1.91, 95% CI: 0.95-3.83).

Similarly, in a national cohort of US general surgery residents, Yang et al. [18] reported that senior training level and workload factors predicted recent needlesticks: PGY-5 residents had higher odds than PGY-1 residents (adjusted OR: 1.66, 95% CI: 1.41-1.96), female residents were more likely than males to report an event (adjusted OR: 1.31, 95% CI: 1.18-1.46), and working >80 hours in a week was independently associated with increased odds (adjusted OR: 1.42, 95% CI: 1.20-1.68). These hierarchical multivariable models also identified operating-room exposure (most events) and use of solid needles as important contextual contributors.

In keeping with these findings, McCabe et al.'s [26] ordinal logistic regression of Irish surgical trainees identified year of training as the sole independent predictor of greater reported needlestick burden (OR:

1.31 per year, 95% CI: 1.04-1.67), while other candidate factors (gender, categorized weekly hours) did not remain significant in the adjusted model. McCabe's cohort additionally highlighted perceived contributors (time pressure, mental fatigue) in descriptive analysis, but these did not emerge as independent predictors in the multivariable model.

Taken together, these multivariable analyses indicate a consistent pattern: increased seniority (greater cumulative exposure during training) is associated with higher reported counts of NSI/sharps injuries, and this effect coexists with modifiable risk factors in some cohorts – notably inadequate specialty-specific preparation in orthopaedics and excessive weekly work hours in general surgery – while associations with sex vary by study.

Post-exposure actions

In the study by Ouyang et al. [4], surgeons reported a variety of post-exposure actions following NSIs, with



Table 1. Summary of the included study characteristics.

Study (Author, Year)	Country	Department/surgery specialty	Design	Sample size	Age (years), mean (SD) / range n (%)	Sex (male), n (%)	Key findings
Ahadzadeh et al (2020) [23]	USA	Otorhinolaryngology (ENT)	Cross-sectional	310	NA	NA	Healthcare professionals face a high risk of occupational exposure, with surgical trainees being particularly vulnerable. Most otolaryngology residents experience NSIs during their early training years, yet many of these incidents go unreported, often due to perceptions that the reporting process is overly burdensome and time-consuming
Choi et al (2016) [20]	USA	Surgical specialties including (general surgery, otolaryngology, plastic surgery, orthopedic surgery, and neurosurgery), general surgery attendings, surgical technicians	Cross-sectional	195	NA	NA	The two leading reasons for not reporting NSIs are the burdensome nature of the time-consuming reporting process and concerns about embarrassment or potential punitive consequences of admitting an injury. Further research is warranted to address and reduce these barriers.
Gordon et al (2022) [24]	USA	Orthopaedics	Cross-sectional	518	NA	430 (83%)	Sharps injuries represent a frequent and concerning issue among orthopedic surgical trainees. Despite their high prevalence, only 42% of residents consistently reported such incidents. Factors contributing to the increased risk include insufficient specialty-specific training and progression through successive years of postgraduate training
Hasak et al (2017) [22]	USA	Surgical specialties including (cardiothoracic, acute and critical care, colon and rectal, endocrine and oncologic, hepatobiliary pancreatic and gastrointestinal, minimally invasive, transplant, vascular, pediatric, plastic and reconstructive, and urologic)	Cross-sectional	150	NA	51 (34%)	NSIs and occupational exposure to bloodborne pathogens remain major hazards for both surgeons and nurses. Although awareness of these risks is evolving, the actual risk of seroconversion continues to be underestimated
Khatony et al (2015) [21]	Iran	Various surgical specialties	Cross-sectional	29	49.96 (7.45)	26 (89.7%)	Given the relatively high prevalence of NSIs among surgeons and the frequent lack of reporting, strict adherence to safety guidelines in the operating room is strongly recommended. In addition, the adoption of safer, lower-risk surgical instruments should be encouraged
McCabe et al (2025) [26]	Ireland	Various surgical specialties	Cross-sectional	73	25-29: 19 (26%) 30-34: 40 (55%) 35-39: 12 (16%) 40-44: 2 (3%)	48 (66%)	Although surgical trainees face a high risk of NSIs and their complications, most do not report all incidents. Simplifying the reporting process could help increase the number of reports.
Osodin et al (2022) [25]	Nigeria	Oral and maxillofacial	Cross-sectional	117	NA	NA	Risk of sharps injury was relatively high due to the high incidence of glove perforation



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Study (Author, Year)	Country	Department/surgery specialty	Design	Sample size	Age (years), mean (SD) / range n (%)	Sex (male), n (%)	Key findings
Ouyang et al (2017) [4]	Canada	Various surgical specialties	Cross-sectional	350	NA	159 (46%)	NSIs represented a frequent, yet underreported hazard for medical trainees. Further studies are needed to explore approaches that both minimize these injuries and encourage better reporting among trainees who are at high risk but reluctant to disclose incidents.
Papadopoli et al (2019) [17]	Italy	Various surgical specialties	Cross-sectional	62	NA	NA	The study revealed significant underreporting of NSIs, along with insufficient preparedness among students regarding both preventive measures and appropriate post-exposure responses. These findings highlight the need to strengthen healthcare students' education to promote safe handling of needles and sharps, emphasize the importance of injury reporting, and ensure compliance with PEP protocols
Rewri et al (2019) [19]	India	Ophthalmology (Cataract surgery)	Cross-sectional	479	40 (26-69)*	NA	The survey identified a high prevalence of occupational sharp injuries among ophthalmologists. While most were familiar with universal precautions, adherence to PEP protocols remained insufficient.
Vijndren et al (2016) [16]	UK	Otorhinolaryngology (ENT)	Cross-sectional	323	NA	NA	The study demonstrated limited evidence on sharps injuries among ENT surgeons, with reporting rates remaining low and consistent with findings from other UK studies. These results underscore the necessity for further research and greater awareness of sharps injury regulations within the specialty.
Yang et al (2019) [18]	USA	General Surgery (Residents, multiple subspecialties)	Cross-sectional	7391	NA	4,528 (61.3%)	This nationwide survey of surgical residents revealed that NSIs were common, yet frequently went unreported due to multiple barriers. These insights highlight opportunities to reduce the incidence of such injuries and to promote better reporting practices among trainees.

NA, Not available.

*Median (range).



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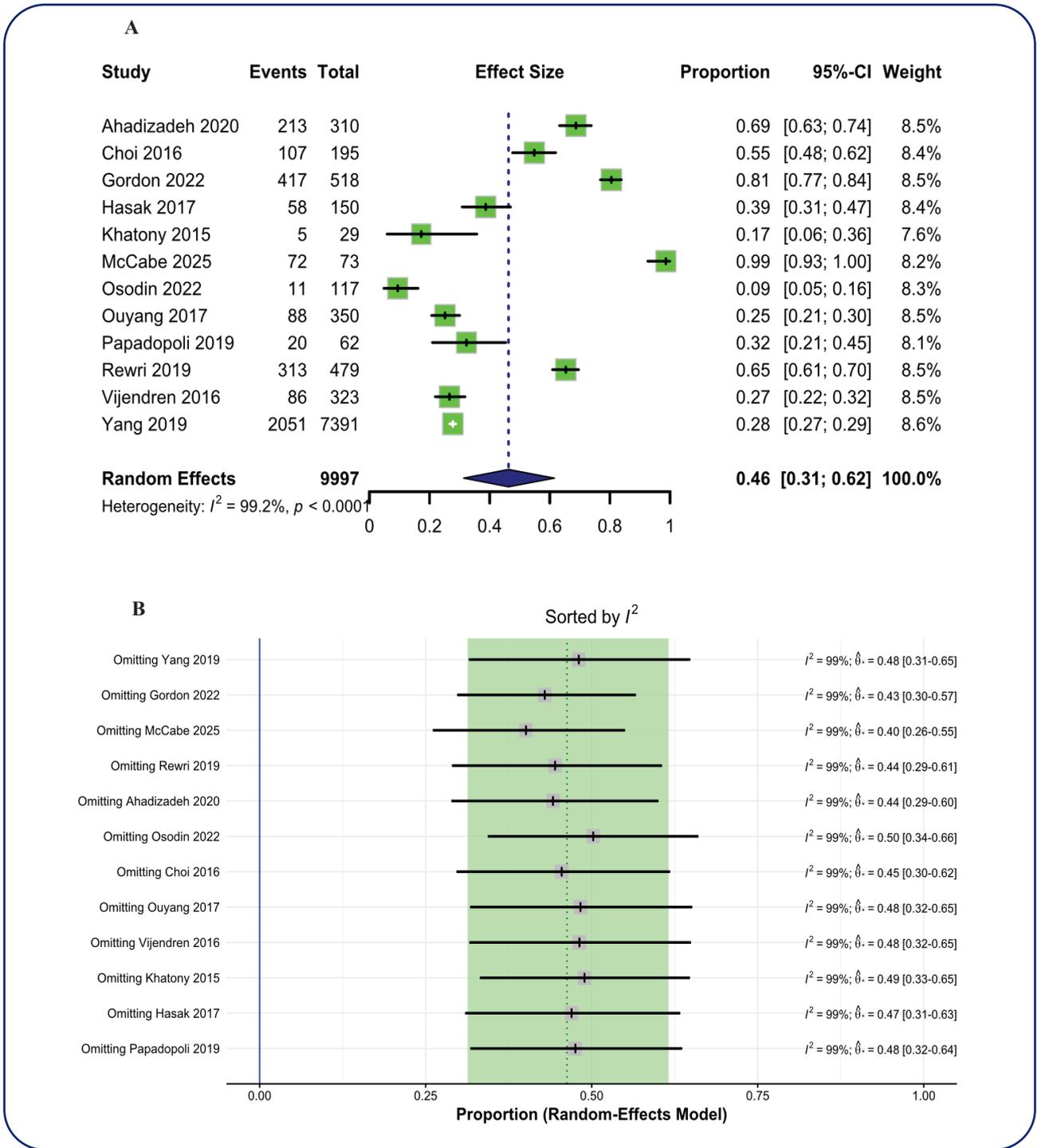


Figure 2. (A) Prevalence of sharp/needlestick injuries among surgeons, (B) Leave-one-out analysis.

multiple responses permitted. The most frequently adopted measures included washing the wound (58%), reporting the incident to staff (58%), and continuing to work despite the injury (41%). Other actions comprised consenting the patient to have blood drawn (32%), arranging for the patient’s blood to be tested (31%), having their own blood tested (30%), and encouraging

witnesses to seek help (26%). Reporting pathways involved colleagues (45%), occupational health services (32%), and the emergency department (26%). HIV/ hepatitis C prophylaxis was rarely undertaken, with only 10% receiving prophylaxis. Similarly, Khatony et al. [21] found that post-exposure responses among surgeons included changing the gloves (100%), applying



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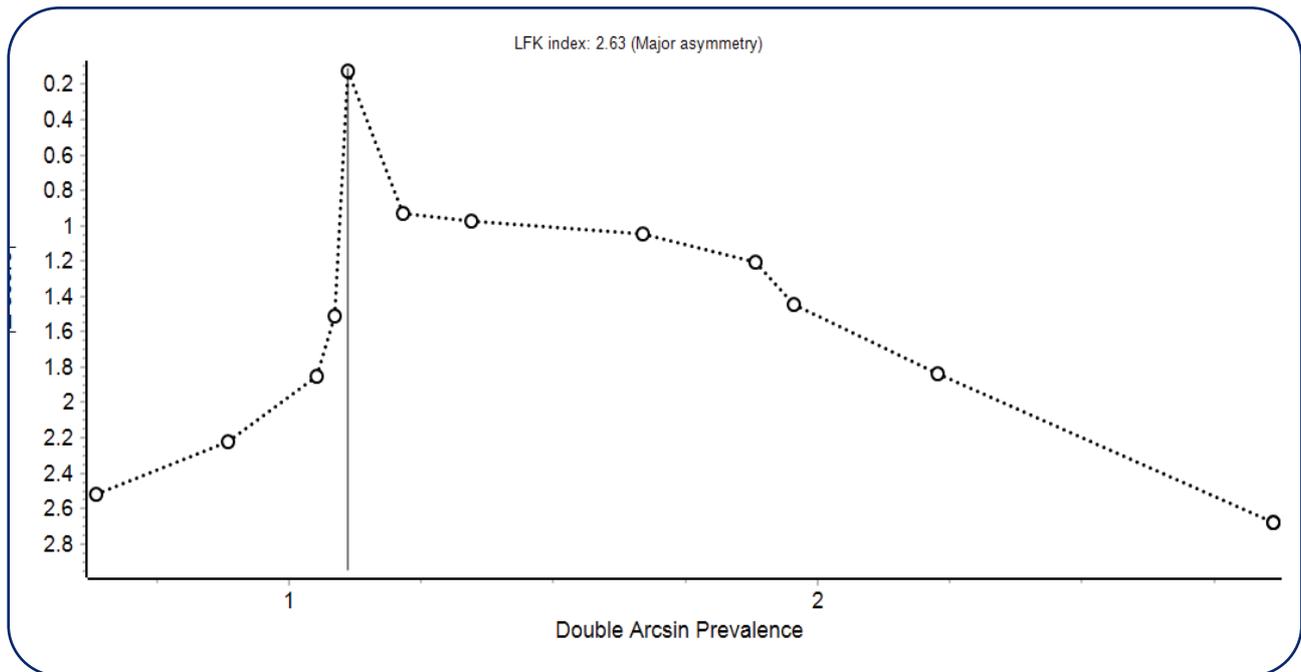


Figure 3. Doi plot and LFK index for prevalence of sharp/needlestick injuries among surgeons.

pressure to the injured region (80%), disinfecting with alcohol or Betadine (60%), washing with soap and water (40%), informing the scrubs nurse (40%), sending blood sample to laboratory (20%), and, in some cases, ignoring the injury and continuing to work (20%). These findings underscore considerable variability in post-exposure practices across settings, highlighting suboptimal adherence to recommended infection-control protocols.

Discussion

Our meta-analysis of NSIs among surgeons revealed an overall pooled prevalence of 46%. Heterogeneity was extremely high ($I^2 = 99.2\%$) and could not be resolved by leave-one-out sensitivity analyses. Key risk factors identified included greater seniority (higher training level), longer weekly work hours, and insufficient specialty-specific preparation. Only about 62% of surgeons reported their NSI events to occupational health, again with very high heterogeneity ($I^2 = 96.9\%$). Post-exposure care was suboptimal in many cases, with prophylactic measures (e.g. HIV PEP, hepatitis B immunoglobulin) infrequently undertaken contrary to guidelines.

These findings are broadly consistent with what has been reported for other healthcare worker groups, though prevalence estimates vary by specialty. For example, a recent systematic review found that nurses worldwide experienced NSIs in about 41% of cases [27]. Similarly, a meta-analysis of emergency medical personnel found a pooled NSI prevalence of 24.2%,

again with very high I^2 (>99%) [28]. Among dental trainees, pooled NSI prevalence was 44% [29], with common risk tasks including local anesthesia injections, scalars and sharps disposal. In anesthesiology, while no pooled meta-analysis is available, retrospective reports indicate similarly high risk among trainees: for instance, an analysis at one US anesthesia department found an overall NSI rate of 5.3% [30]. Underreporting of NSIs is also ubiquitous: for example, a large survey of Chinese healthcare workers (doctors and nurses) found that 28.5% of NSI events went unreported [31]. Qualitative reasons include low perceived risk, lack of time or awareness of reporting procedures, fear of stigma or administrative burden, and belief that “nothing will happen” [31,32]. Our finding that 38% of surgeons’ injuries were not reported fits this pattern of chronic underreporting noted in many settings.

Taken together, surgeons appear to sustain NSIs at rates comparable to or higher than other practitioners. Those senior surgeons and trainees both show risk suggests a U-shaped curve: novices may avoid sharps more, mid-level trainees take most procedural risks, then fully trained surgeons see fewer because of experience or special precaution practices. The very high I^2 in our analysis reflects massive variability in prevalence estimates across studies and countries. Similar heterogeneity has been seen in other HCW NSI meta-analyses [28]. Such differences likely stem from reporting culture, safety training and protocols, and resource availability. For instance, Abdelmalik et al. [27] found in nurses that NSI prevalence was much higher in low-resource regions (e.g. Southeast Asia) than in high-



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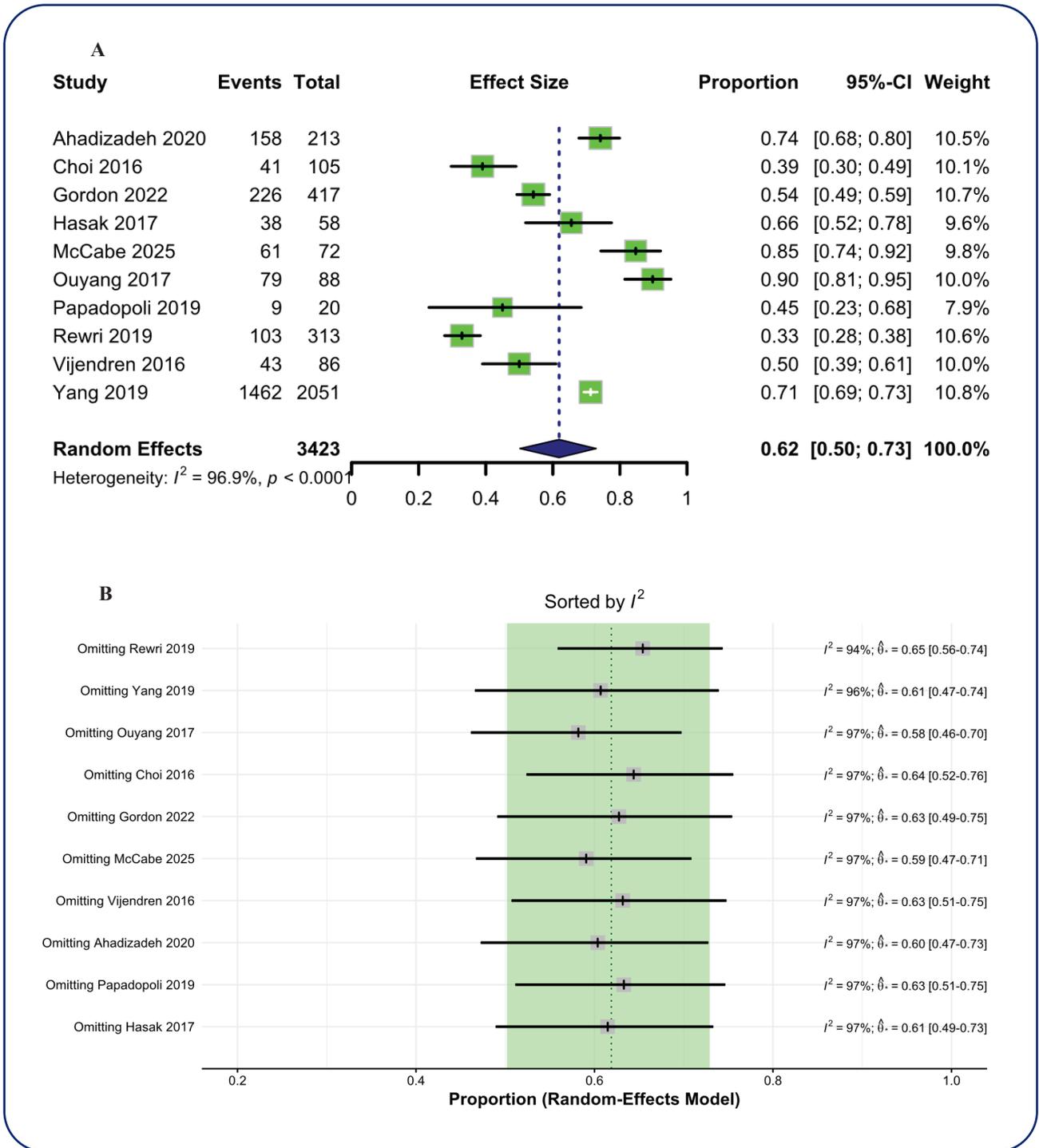


Figure 4. (A) Prevalence of reporting to staff/occupational authority, (B) Leave-one-out analysis.

income countries. Our own data likely span disparate health systems and definitions (some studies defined NSI broadly, others narrowly), which inflates I^2 . Reporting culture varies greatly: in some hospitals, injuries are routinely logged, whereas in others non-reporting is normalized. Lack of standardized definitions and recall bias in cross-sectional surveys add further inconsistency.

Moreover, specialty-specific factors matter: surgeons work in crowded operating rooms with many sharp instruments and time pressure, whereas emergency staff or dentists have different workflows. The operating theatre environment, use of surgical instruments, and emergency case load likely contributed to the extreme heterogeneity in our estimates. Training differences



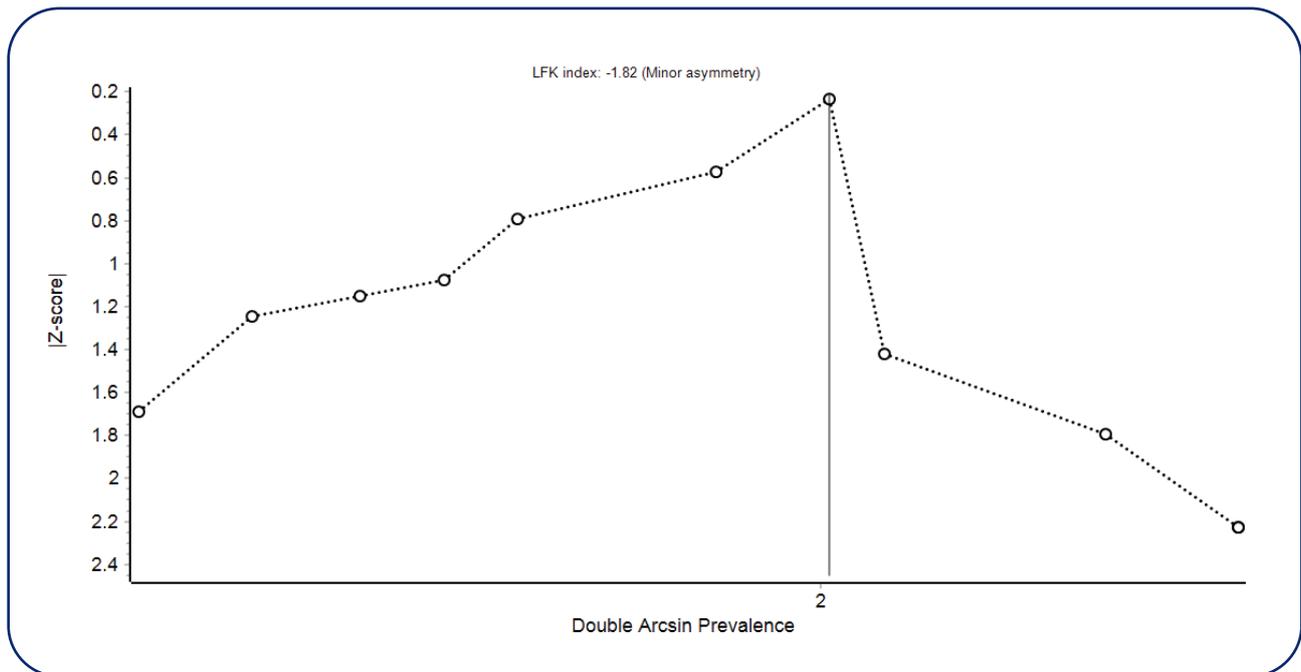


Figure 5. Doi plot and LFK index for prevalence of reporting to staff/occupational authority.

also play a role: institutions with strong sharps safety programs (e.g. one-handed recapping bans, mandatory sharps containers) will report fewer NSIs than those without.

International guidelines underscore the importance of preventive measures. The WHO and CDC recommend using safety-engineered devices (e.g. retractable needles, blunt suture needles) and ensuring immediate disposal of sharps into puncture-proof containers [33–35]. CDC’s Infection Control Guidance notes that healthcare facilities should “never reuse a needle or syringe” and should discard both immediately after use [33,35]. WHO estimates that sharps injuries among healthcare workers worldwide result in tens of thousands of new HBV, HCV, and HIV infections each year. For instance, one WHO report suggested sharps injuries account for 66,000 HBV and 16,000 HCV infections in health workers each year [1,36]. Both WHO and CDC stress prompt post-exposure management: this includes immediate washing of the wound, reporting the incident, evaluation of the patient’s blood, and if indicated, PEP for HIV and hepatitis B. In practice, however, we observed that guideline-recommended PEP was underused. This gap between guidelines and practice is noted in many studies, where clinicians often do not receive HIV PEP or immunoglobulin after NSIs despite exposures. The failure to follow protocols (e.g. skipping PEP or not testing source patients) amplifies the risk of seroconversion. These lapses highlight the need for better compliance with protocols.

Strengths of our meta-analysis include its broad scope and systematic quality appraisal of included studies. We included only studies with objective injury data, minimizing bias, and we performed sensitivity to investigate heterogeneity. We used NOS to assess the quality of studies. Moreover, we conducted publication bias employing Doi plot and LFK index. Nevertheless, there were some limitations. The included studies were cross-sectional surveys, relying on self-reported histories; this design is subject to recall and social desirability bias. Definitions of “needle-stick injury” varied between studies, and some did not clearly distinguish sharp versus blunt injuries. High heterogeneity means our pooled prevalence should be interpreted with caution; underlying prevalence likely differs by setting. Finally, our predictor analysis is limited by the data available in the source studies.

To address these issues, future research should involve longitudinal and interventional studies. Cohort studies of surgical trainees and staff would yield incidence rates and time-to-event analyses, helping to overcome recall bias. Controlled trials or before–after studies of safety interventions (e.g. introducing blunt suture needles, one-handed recapping training, or gamified reporting systems) could quantify the impact on NSI rates. We also recommend developing specialty-specific safety protocols: for example, surgical curricula should include sharps injury prevention training at each level (junior, mid, senior) and teams should rehearse emergency sharps handling. Hospitals should standardize reporting systems and ensure no blame is assigned for NSIs, to



encourage full reporting. Policymakers should enforce vaccination against HBV for all surgical staff and ensure timely access to HIV PEP after exposure, as per CDC/WHO guidelines.

Conclusion

This systematic review and meta-analysis demonstrates that needlestick and sharps injuries remain highly prevalent among surgeons, with nearly half affected and substantial underreporting persisting worldwide. Seniority, workload, and insufficient preparation emerged as consistent predictors, highlighting both cumulative exposure and modifiable risk factors. Post-exposure practices often fell short of recommended protocols, with limited uptake of prophylaxis despite established guidelines. These findings underscore an urgent need for strengthened preventive strategies, including safety-engineered devices, structured training, and simplified reporting systems that encourage transparency without stigma. Policymakers, institutions, and surgical educators must prioritize occupational safety by integrating sharps injury prevention into training curricula and ensuring universal access to timely post-exposure management.

List of Abbreviations

CI	Confidence interval
HCWs	Healthcare workers
LFK	Luis Furuya-Kanamori index
NA	Not available
NOS	Newcastle-Ottawa Scale
NSI	Needlestick injury
OR	Odds ratio
PEP	Post-exposure prophylaxis
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
SD	Standard deviation

Conflict of interest

The authors declare that they have no competing interests.

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Consent to participate

Not applicable.

Ethical approval

Not applicable.

Consent for publication

Not applicable.

Human ethics and consent to participate statement

Our manuscript was not applied to human beings and thus requires no ethical approval.

Data availability material

All data generated or analyzed during this study are included in this published article [and its supplementary material file].

Authors' contributions

The authors meet the criteria for authorship as recommended by the International Committee of Medical Journal Editors (ICMJE).

Author details

Fayo Haji¹, Mohammad Ali Maksoud², Ahmed Mustafa El-Shiekh Idrees³

1. General Practitioner, Care Medical Hospital, Riyadh, Saudi arabia
2. Medical Student, Alfaisal University, Riyadh, Saudi arabia
3. Emergency Department as ER Resident, Care Medical Hospital, Riyadh, Saudi arabia

Supplementary content (if any) is available online.

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