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Occupational Exposure and Infection Prevention in Dental and Perioperative Healthcare: A Systematic Review

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ABSTRACT: Dental and perioperative healthcare workers are repeatedly exposed to blood and body fluids, yet evidence from these two high-risk settings has rarely been synthesized. Following PRISMA 2020, PubMed/MEDLINE, Scopus, and Web of Science were searched from 2009 to 15 January 2026 for English-language randomized, cohort, case-control, cross-sectional, and case-series studies reporting occupational exposure and safety practices. Risk of bias was appraised with Joanna Briggs Institute (JBI) tools. A random-effects meta-analysis of cumulative injury prevalence was performed where definitions were comparable, and certainty of evidence was graded with GRADE. Thirteen studies (seven dental, six perioperative; 2010–2025) were included. Cumulative injury prevalence in survey studies ranged from 30% to 89%. Exploratory pooled prevalence was 40% (95% CI 26–55%) in dental and 76% (95% CI 46–92%) in perioperative studies, with high heterogeneity (I^2 95–96%) and differing exposure windows. Surveillance data showed surgical injury rates rising while non-surgical rates fell, and exposure increased with blood loss, team size, and operative duration. Poor infection-control knowledge, absent hepatitis B vaccination, no infection-control unit, haste, understaffing, and training without practice were associated with injury. Underreporting was common and was driven by time burden and fear of reprisal. Risk-of-bias ratings were low to moderate for all studies; certainty was low to very low. Occupational exposure remains frequent in both settings, but its drivers differ: operator-dependent technique and training in dentistry, and team-level, procedural, and organizational factors in perioperative care. Combined vaccination, engineered devices, hands-free passing, safe staffing, and simplified reporting merit prospective evaluation.

1. INTRODUCTION

Healthcare workers are exposed daily to biological hazards that can be transmitted through needles, blades, and other sharp devices. Globally, percutaneous exposure has been estimated to account for a substantial share of hepatitis B, hepatitis C, and human immunodeficiency virus infections among healthcare personnel, and most of these infections are considered preventable (Prüss-Üstün et al., 2005). Pooled analyses across professions and regions confirm that blood and body fluid exposure remains a persistent threat to the health workforce (Mengistu et al., 2022). Beyond infection risk, each exposure triggers laboratory testing, possible prophylaxis, work disruption, and psychological strain, which magnifies its institutional cost.

Dental practice combines features that raise this risk. Clinicians work in a small, moist, and poorly visualized field, handle needles, burs, scalers, and endodontic files, and are routinely in contact with blood and saliva. Dental students, assistants, and nurses add further vulnerability because of limited experience and frequent instrument transfer. Dentistry has long been recognized as a setting in which hepatitis B virus transmission is a particular concern (Mahboobi et al., 2010). Even so, evidence on dental exposure is dominated by single-institution surveys and regional reports, and the one available synthesis addresses a single country (Pervaiz et al., 2018).

Perioperative care presents a different hazard profile. Surgical teams pass suture needles and scalpels within a crowded sterile field, often under time pressure and with considerable bleeding. Analyses of multi-hospital surveillance data indicate that injuries in surgical settings have not followed the downward trend observed elsewhere in hospitals after safety legislation (Jagger et al., 2010). Surgeons in training appear especially exposed, and many of their injuries are never reported (Makary et al., 2007).

Although dental and perioperative environments differ in devices, team structure, and workflow, they depend on a common safety architecture. This architecture includes hepatitis B vaccination, standard precautions, protective equipment, engineering controls, safe handling and passing of sharps, training, prompt reporting, and timely post-exposure management. The way these elements relate to actual exposure is scattered across studies that use inconsistent definitions, recall periods, and denominators, and underreporting further obscures the true burden.

Existing syntheses have been organized by country or by profession. A meta-analysis of Iranian hospitals pooled needlestick and sharps injuries across all hospital workers (Ghanei Gheshlagh et al., 2018), global reviews have combined many roles and settings (Mengistu et al., 2022), and the dental review mentioned above is geographically restricted (Pervaiz et al., 2018). None has juxtaposed dental and perioperative workers, and none has paired epidemiological estimates with the safety practices that plausibly explain them.

A comparative synthesis is warranted for practical reasons. If shared determinants emerge, such as training quality, staffing, vaccination coverage, and reporting culture, then interventions can be designed once and deployed across services. If determinants diverge, setting-specific controls are needed instead. Clarifying this distinction is relevant for infection-prevention programs and occupational health policy, particularly where hepatitis B endemicity and vaccination coverage vary.

This systematic review therefore aims to synthesize epidemiological evidence on occupational blood and body fluid exposure among dental and perioperative healthcare workers and to appraise the safety practices linked to it. The guiding question is: among dental and perioperative healthcare workers, how frequent is occupational exposure to blood and body fluids, and which safety practices and organizational factors are associated with lower exposure and better post-exposure management?

2. MATERIALS AND METHODS

2.1 Protocol and reporting

This review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement (Page et al., 2021).

2.2 Review question and eligibility criteria

The question was structured with the PICO framework:

Population: healthcare workers in dental settings (dentists, dental students, dental assistants, dental nurses, hygienists) and perioperative settings (surgeons, surgical residents, anesthesia providers, scrub and circulating nurses, surgical technologists).

Exposure/intervention: occupational exposure to blood and body fluids (percutaneous injury, mucocutaneous splash) and associated safety or infection-prevention practices (vaccination, standard precautions, protective equipment, engineered devices, safe passing, training, reporting, post-exposure management).

Comparator: other occupational groups, experience levels, exposure intervals, or presence versus absence of a safety practice; descriptive studies without a comparator were retained for prevalence outcomes.

Outcomes: primary, prevalence or incidence of exposure; secondary, circumstances and devices involved, determinants, compliance with safety practices, reporting, testing, prophylaxis, and bloodborne infection.

Inclusion criteria: (i) randomized controlled trials, cohort, case-control, cross-sectional, or case-series designs; (ii) original data on occupational exposure among dental or perioperative personnel, with setting-specific results; (iii) published in English between January 2009 and 15 January 2026; (iv) peer-reviewed full report. Exclusion criteria: reviews, editorials, case reports, qualitative-only studies, conference abstracts, studies of mixed hospital workers without separable dental or perioperative data, non-occupational exposure, animal or laboratory studies, and duplicate reports of the same cohort.

2.3 Information sources and search strategy

PubMed/MEDLINE, Scopus, and Web of Science Core Collection were searched from 1 January 2009 to 15 January 2026. The PubMed strategy was: ("Occupational Exposure"[MeSH] OR "Needlestick Injuries"[MeSH] OR "sharps injur*" OR "blood and body fluid exposure*" OR "percutaneous injur*") AND (dentist* OR dental OR "oral surgery" OR "operating room*" OR perioperative OR surgical OR "scrub nurse*" OR "surgical technolog*") AND ("infection control" OR "standard precautions" OR "personal protective equipment" OR "safety-engineered" OR vaccination OR "post-exposure" OR reporting OR prevent*). Scopus used TITLE-ABS-KEY with identical terms, limited to PUBYEAR > 2008 AND PUBYEAR < 2027 AND LANGUAGE(english). Web of Science used TS= with identical terms, limited to PY=(2009–2026) AND LA=(English).

2.4 Study selection and data extraction

Two reviewers independently screened titles and abstracts, then full texts, resolving disagreements by consensus or a third reviewer. Data were extracted with a piloted form covering country, setting, design, population, sample size, definition and recall period of exposure, outcome estimates, determinants with effect sizes, reporting and post-exposure management, and authors' conclusions.

2.5 Risk of bias and certainty of evidence

Methodological quality was evaluated using JBI critical appraisal checklists matched to design: the 8-item checklist for analytical cross-sectional studies, the 11-item checklist for cohort studies, and the 10-item checklist for case series (Joanna Briggs Institute, 2020; Munn et al., 2014; Munn et al., 2020). Studies meeting at least 75% of items were rated low risk, 50–74% moderate, and below 50% high risk. Certainty of evidence for key outcomes was rated with the GRADE approach (Guyatt et al., 2008).

2.6 Synthesis methods

Studies were summarized narratively by setting. A random-effects meta-analysis (DerSimonian–Laird) of logit-transformed proportions was performed only for studies reporting a comparable outcome, namely cumulative (career or training-period) prevalence of needlestick or sharps injury. Study-level confidence intervals used the Wilson method. Heterogeneity was quantified with I^2 and τ^2, and prespecified subgroups were dental and perioperative settings. Outcomes with incompatible definitions (two-week frequency, annual incidence, per-procedure rates) were not pooled. Publication bias was not assessed formally because fewer than ten studies contributed to any pooled estimate.

3. RESULTS AND DISCUSSION

3.1 Study selection

The database search retrieved 1,336 records. After removal of duplicates, 947 records were independently screened by two reviewers, 91 reports were sought, and 91 were assessed in full text. Seventy-eight reports were excluded for the following reasons: ineligible study design (n = 32), wrong population/no separable setting-specific data (n = 21), no eligible exposure or safety outcome (n = 15), non-English (n = 6), and conference abstracts (n = 4). Thirteen studies met the eligibility criteria and were included (**Figure 1**).

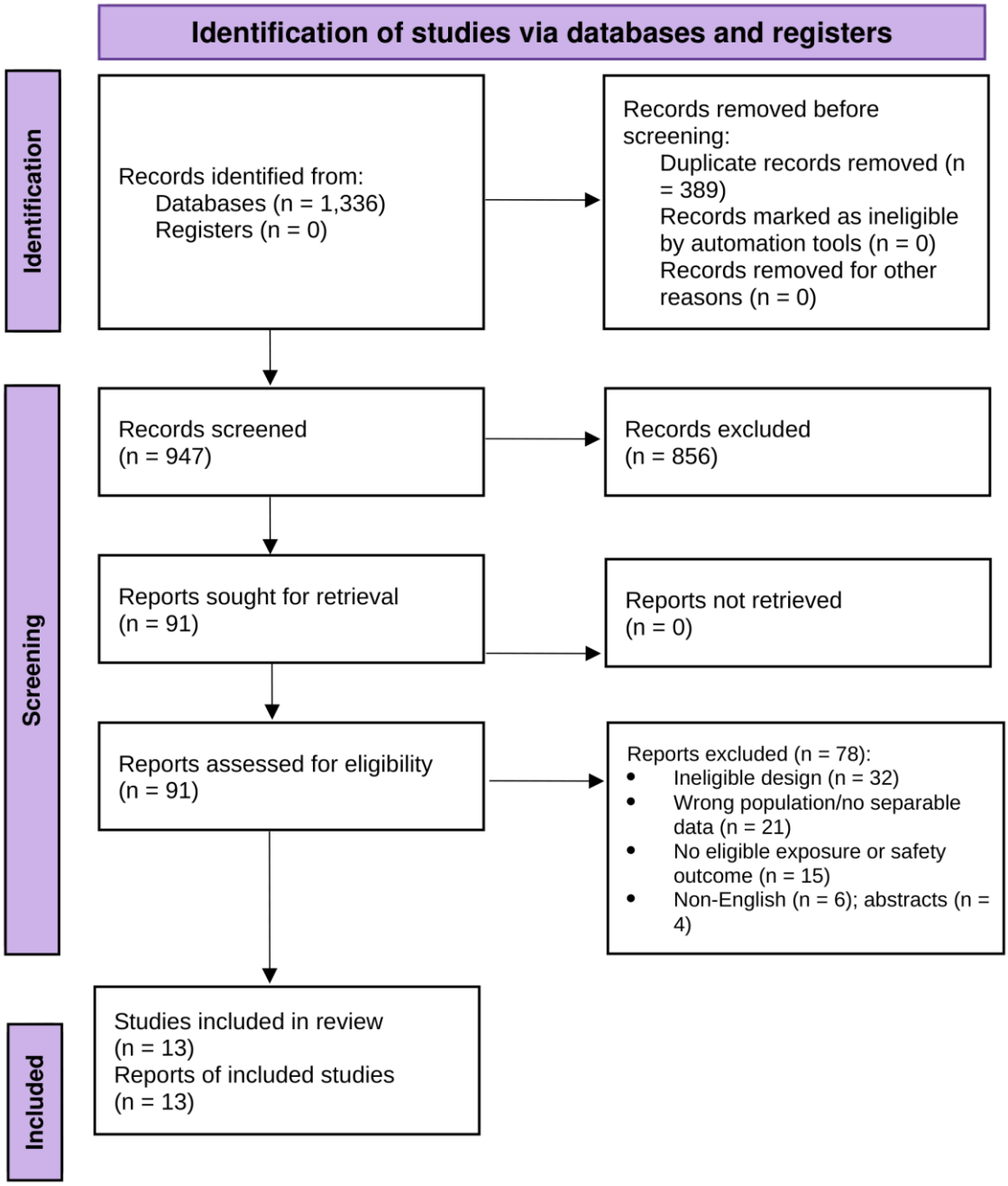


Figure 1. PRISMA 2020 flow diagram of study identification via databases and registers. Database records comprised PubMed/MEDLINE (n = 428), Scopus (n = 517), and Web of Science (n = 391). Adapted from Page et al. (2021), CC BY 4.0.

3.2 Characteristics of included studies

The 13 studies were published between 2010 and 2025 and came from Taiwan (two), China (two), Germany (one), Saudi Arabia (two), Iran (one), Thailand (one), and the United States (four) (Table 1). Nine were cross-sectional surveys, two were retrospective cohort or surveillance analyses, and two were retrospective case series. No randomized trial or case-control study was eligible. Seven studies addressed dental personnel and six addressed operating room or surgical personnel. Outcome definitions ranged from exposures per week to career-long history and per-procedure incidence, constraining quantitative pooling.

Table 1. Characteristics of the included studies.

#	Study	Country / setting	Design	Population (n)	Outcomes assessed	Recall / period
1	Cheng et al. (2012)	Taiwan; 60 hospitals and 340 clinics (nationwide)	Cross-sectional survey	Dentists; 434 of 580 responded (74.8%)	NSI frequency; age, experience, compliance, knowledge, worry	Past 2 weeks (>1 NSI/week)
2	Lee et al. (2014)	Taiwan; dental department, university hospital	Retrospective case series (incident reports)	All dental workers; 56 NSI events	NSI incidence, instruments, procedures	Annual
3	AlDakhil et al. (2019)	Saudi Arabia; 40 private clinics, Jeddah	Cross-sectional	Dental assistants; 450 of 500 invited	NSI prevalence, determinants, reporting, testing, PEP	Career (lifetime)
4	Huang et al. (2022)	China; Peking University School and Hospital of Stomatology	Cross-sectional	Dental students (2011–2015 classes); 268 (90.0%)	NSI epidemiology, circumstances, reporting	Clinical training
5	Zhang et al. (2025)	China; tertiary dental hospital, Wenzhou	Retrospective case series	Dentists, nurses, technicians, support staff; 170 injuries (2020–2024)	Incidence density, risk groups, pathogen profile	Annual (2020–2024)
6	Jagger et al. (2010)	USA; 87 hospitals (EPINet surveillance)	Retrospective surveillance cohort	Hospital personnel; 31,324 injuries (7,186 surgical), 1993–2006	Injury rates before/after legislation; devices, circumstances	Surveillance 1993–2006
7	Lakbala et al. (2014)	Iran; 14 hospitals, Hormozgan Province	Cross-sectional	Operating room personnel; 215 participants in the analyzed dataset	NSSI prevalence, injection practices, post-injury actions	Career
8	Myers et al. (2016)	USA; large academic teaching hospital	Retrospective cohort	333,073 surgical procedures; 2,113 BBF exposures (2001–2010)	BBF exposure rate per 1,000 procedures and surgical hours	10 years
9	Kasatpibal et al. (2016)	Thailand; 247 hospitals	Cross-sectional	Operating room nurses; 2,031 of 2,500 (81.2%)	NSI, SI, and BBFE prevalence; risk factors	Career

#	Study	Country / setting	Design	Population (n)	Outcomes assessed	Recall / period
10	Choi et al. (2017)	USA; single academic institution	Cross-sectional	Students, surgical residents, attendings, technicians, OR nurses; 195 of 528 (37%)	SNI history, reporting rate, reasons for not reporting	Workplace history
11	Manoli et al. (2018)	USA; academic teaching hospital	Cross-sectional	Orthopedic residents; 54 of 62 (87%)	Intraoperative sharps exposure, reporting	Residency
12	Wicker and Rabenau (2010)	Germany; clinical setting	Cross-sectional survey	Dental professionals and students; 265	NSI prevalence, frequency and reporting	Professional lifetime; annual frequency also reported
13	Al-Zoughool and Al-Shehri (2018)	Saudi Arabia; three dental clinic types, Riyadh	Cross-sectional survey	Dentists; 515	Previous injury and infection; infection-control practices and determinants	Previous injury and infection history

NSI, needlestick injury; SI, sharps injury; NSSI, needlestick and sharps injury; SNI, sharps and needlestick injury; BBF, blood and body fluid; BBFE, blood and body fluid exposure; PEP, post-exposure prophylaxis. (x) denotes the study number used throughout.

3.3 Exposure burden and circumstances

Among dental survey respondents, cumulative prevalence ranged from 29.8% to 54.3% (AlDakhil et al., 2019; Huang et al., 2022; Wicker and Rabenau, 2010). Al-Zoughool and Al-Shehri (2018) examined correlates of previous injury and infection. Incident-based data gave annual incidence of several cases per 100 workers (Lee et al., 2014; Zhang et al., 2025). In perioperative settings, cumulative prevalence was substantially higher and more variable (Choi et al., 2017; Lakbala et al., 2014; Manoli et al., 2018), and large-scale data placed the per-procedure exposure rate at several per thousand operations (Myers et al., 2016). Surveillance across United States hospitals showed that surgical injury rates increased after national legislation even as non-surgical rates declined (Jagger et al., 2010) (Table 2).

Needles were the dominant sharp in both settings, but circumstances differed. Dental injuries clustered around anesthetic needle handling and removal, recapping, scaling, and instrument cleanup, and they occurred more often when the clinician worked unassisted (Huang et al., 2022; Lee et al., 2014). Perioperative injuries were concentrated in suture needles and scalpel blades during use and passing (Jagger et al., 2010), and exposure rose with blood loss, team size, and operative duration (Myers et al., 2016). Nurses and technicians were frequently injured by instruments originally used by others, whereas surgeons and residents were the original users of the devices involved.

Table 2. Key findings, determinants, and conclusions of the included studies.

Study	Key quantitative findings	Safety practices and determinants	Authors' conclusions
Cheng et al. (2012)	23.0% (100/434) reported >1 NSI per week. Higher odds with older age (OR 3.18; 95% CI 1.62–6.25), longer practice (OR 2.57; 1.41–4.69), and clinic work (OR 1.73; 1.08–2.77).	Lower compliance with infection control (OR 1.82; 1.04–3.18), insufficient BBP knowledge (OR 1.67; 1.04–2.67), and greater worry about infection (OR 1.82; 1.05–3.13).	High NSI rates and low compliance threaten occupational safety; prevention strategies are needed.
Lee et al. (2014)	56 NSI events (31 during surgical treatment, 25 during cleanup). Annual incidence 8.19% among all dental workers.	Dental injection needle was the commonest instrument (19 cases); 9 of 19 occurred during needle removal.	Needle-related injuries predominate; a standard procedure for needle removal is necessary.
AlDakhil et al. (2019)	29.8% (134/450; 95% CI 25.6–34.2) had ≥1 NSI. Needles caused 53% (recapping 23%). About 63% unreported; 35% tested; 19% received PEP.	Poor knowledge (aOR 1.87; 1.18–2.97), no HBV vaccination (aOR 1.89; 1.05–3.41), ≤12 patients/day (aOR 1.63; 1.03–2.56), and no infection-control unit (aOR 2.28; 1.45–3.57).	Training in infection-control protocols is warranted; clinics should establish infection-control units.
Huang et al. (2022)	36.2% had ≥1 NSI (97/268 injured people; 112 injury events). Local anesthesia and scaling each 15.2%; 26.8% of incidents under-reported.	Lapse of concentration (67.9%) and fatigue (22.3%) were main causes; 66.1% occurred when working alone vs 10.7% when assisted.	Dental students are prone to NSI; quality of infection-control education is critical.
Zhang et al. (2025)	170 injuries; incidence density 3.09–5.15 per 100 person-years. HBV (9.2%) and syphilis (3.1%) most identified; 63.85% had unknown pathogen status.	Dentists had higher HBV exposure than nurses (13.9% vs 5.4%; P = 0.04). Incomplete source-patient documentation.	The authors emphasized standardized training, safer device handling and more complete reporting.
Jagger et al. (2010)	After 2000 legislation, non-surgical injury rates fell 31.6% but surgical rates rose 6.5%. Suture needles 43.4%, scalpel blades 17%, syringes 12%.	About three-quarters occurred during use or passing. Surgeons/residents were usually original users; nurses/technicians were injured by devices others used.	Surgical injuries kept rising despite legislation and technology; surgeons, administrators, educators, and policy makers share roles.
Lakbala et al. (2014)	192 of 215 (89.3%) had a career NSSI. Nurses and OR technicians sustained 74.9% (161) vs 10.7% (23) for surgeons/physicians/residents.	Anesthesia technicians (27.4%) and OR technicians (25.6%) had the most injuries in the past year; awareness of local protocols was worst among residents.	Safety devices reduce NSSIs and the risk of bloodborne infection.

Study	Key quantitative findings	Safety practices and determinants	Authors' conclusions
Myers et al. (2016)	6.3 exposures per 1,000 procedures (2.9 per 1,000 hours). Rate 17.7 (501–1,000 mL) and 26.4 (>1,000 mL) per 1,000 with blood loss; 34.4 with ≥15 personnel; 14.3 (4–<6 h) and 27.1 (≥6 h).	Associations stronger for suture-needle exposures. Blood loss, team size, and duration were independent drivers.	Results support prior work; suture-needle risk factors differ from other devices and need study.
Kasatpibal et al. (2016)	Prevalence: NSI 23.7%, SI 9.8%, BBFE 40.0%.	NSI: haste (OR 4.81; 3.41–6.79), training without practice (1.67; 1.29–2.17), understaffing (1.60; 1.21–2.11), outdated guidelines (1.69; 1.04–2.74). BBFE: long hours (2.07; 1.06–4.04), haste (1.66; 1.30–2.13).	Preventable risk factors identified; guidelines, staffing, training, and awareness may reduce occurrences.
Choi et al. (2017)	55% (107/195) had a workplace SNI; 64% reported after first injury. Surgical staff vs attendings: IRR 1.33 (P = 0.085) for reporting.	Fear of not reporting: medical students (IRR 2.86; P = 0.008) and residents (IRR 2.21; P = 0.04) vs attendings.	Time-consuming reporting and fear of embarrassment or punishment are main barriers.
Manoli et al. (2018)	76% (41/54) had ≥1 exposure; 55% of incidents never reported.	Low perceived risk was the commonest reason for nonreporting; witnessed exposures were reported more often (57% vs 23%; P = 0.043).	Unreported exposures form a "silent majority"; interventions should raise reporting.
Wicker and Rabenau (2010)	54.3% (144/265) reported at least one NSI during professional life. Students reported 0.74 NSIs per year versus 0.42–0.49 among dentists.	Only 28.5% of injured respondents reported every NSI. Low perceived risk was a reason for underreporting.	The authors emphasized early training and complete reporting.
Al-Zoughool and Al-Shehri (2018)	Among 515 dentists, the odds of prior injury were lower with 10–20 years of experience (unadjusted OR 0.48, 95% CI 0.27–0.87) or more than 20 years (OR 0.38, 95% CI 0.16–0.89).	Greater infection-control compliance was associated with fewer reports of previous infection (OR 0.31, 95% CI 0.12–0.84). General safety training was not associated with lower injury or infection rates.	The authors advocated targeted infection-control and occupational safety training.

OR, odds ratio; aOR, adjusted odds ratio; CI, confidence interval; IRR, incidence rate ratio; HBV, hepatitis B virus; BBP, bloodborne pathogen. Figures are those reported by the original studies.

3.4 Pooled cumulative prevalence

Six studies contributed to exploratory pooling (Table 3, **Figure 2**). Al-Zoughool and Al-Shehri (2018) was synthesized narratively because a comparable injury numerator and recall window could not be verified. Statistical heterogeneity was high in both subgroups. Career history, workplace history, clinical training and residency reflect different periods at risk. The subgroup and overall estimates are descriptive and do not establish differences in exposure risk per procedure.

Table 3. Random-effects pooled cumulative prevalence of needlestick or sharps injury.

Subgroup	Studies (k)	Participants	Pooled prevalence, % (95% CI)	I^2	τ^2 (logit)
Dental settings (AlDakhil, 2019; Huang, 2022; Wicker, 2010)	3	983	39.7 (26.3–54.7)	95.2%	0.276
Perioperative settings (Lakbala, 2014; Choi, 2017; Manoli, 2018)	3	464	75.9 (46.5–92.0)	96.3%	1.241
Overall	6	1,447	58.5 (40.4–74.6)	97.4%	0.803

DerSimonian–Laird random-effects model on logit-transformed proportions.

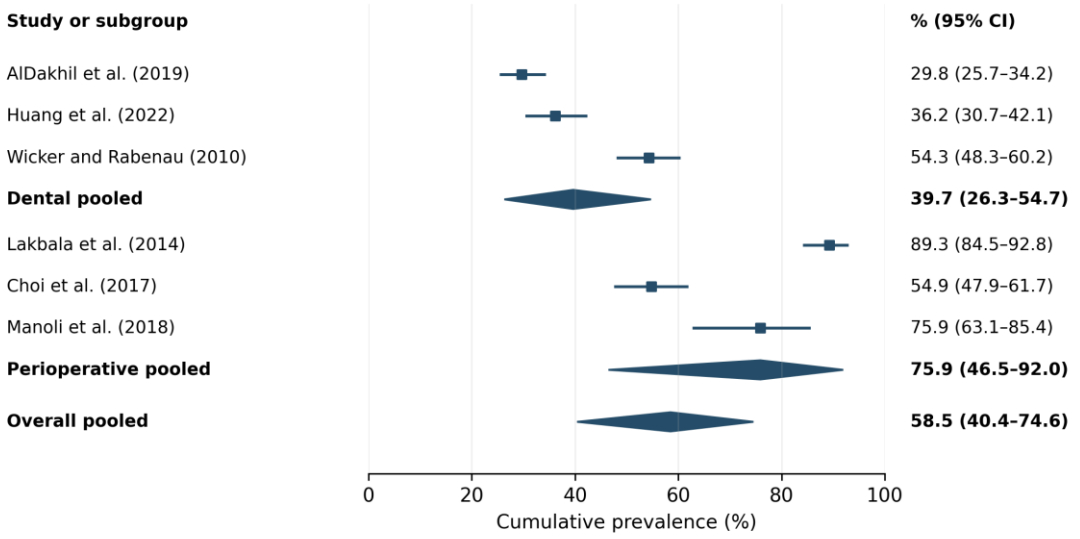


Figure 2. Forest plot of cumulative prevalence of needlestick or sharps injury in dental and perioperative studies (random-effects model; Wilson 95% CIs for individual studies). RE, random effects.

3.5 Safety practices, reporting, and post-exposure care

Across dental studies, injury was associated with insufficient infection-control knowledge, lower compliance with protocols, absent hepatitis B vaccination, and the lack of an infection-control unit (AlDakhil et al., 2019; Cheng et al., 2012). Among operating room nurses, haste, understaffing, outdated guidelines, long working hours, and training without practice were the main modifiable correlates (Kasatpibal et al., 2016). Underreporting was widespread in both settings and was explained by time burden, low perceived risk, and fear of embarrassment or punishment (AlDakhil et al., 2019; Choi et al., 2017; Huang et al., 2022; Manoli et al., 2018). Post-exposure care was incomplete where measured: only a minority of injured dental assistants were tested or received prophylaxis (AlDakhil et al., 2019).

3.6 Risk of bias and certainty of evidence

Independent appraisal was completed for all 13 studies; six were rated low risk and seven moderate (Table 4). Common concerns included self-reported outcomes, single-site sampling, low or unreported response rates, and passive reporting systems. Certainty for pooled dental prevalence was low, with inconsistency across studies. Certainty for pooled perioperative

prevalence and the overall pooled prevalence estimate was very low because of serious inconsistency and differing exposure windows. Certainty for the overall associations was also very low.

Table 4. Risk-of-bias assessment of included studies (JBI critical appraisal tools).

Study	JBI checklist	Items met	Principal methodological concerns	Overall risk
Cheng et al. (2012)	Cross-sectional (8 items)	6/8 (75%)	Stratified national sample with multivariable adjustment; unusual 2-week outcome window; self-report.	Low
Lee et al. (2014)	Case series (10 items)	6/10 (60%)	Single department; retrospective incident reports prone to underreporting; denominator limited.	Moderate
AlDakhil et al. (2019)	Cross-sectional (8 items)	7/8 (88%)	Random clinic sampling, good response, adjusted analysis; self-reported lifetime outcome (recall bias).	Low
Huang et al. (2022)	Cross-sectional (8 items)	5/8 (63%)	Single institution; retrospective recall across several class years; confounders not fully controlled.	Moderate
Zhang et al. (2025)	Case series (10 items)	7/10 (70%)	Single hospital; passive reporting; majority had unknown pathogen status.	Moderate
Jagger et al. (2010)	Cohort (11 items)	8/11 (73%)	Voluntary hospital network; changing participation over time; denominators by bed-days rather than procedures.	Moderate
Lakbala et al. (2014)	Cross-sectional (8 items)	5/8 (63%)	Sample-size reporting inconsistent; content-reviewed and pretested questionnaire (Cronbach's alpha 0.86); no multivariable adjustment.	Moderate
Myers et al. (2016)	Cohort (11 items)	9/11 (82%)	Very large linked administrative dataset with procedure-level denominators; counts only reported exposures.	Low
Kasatpibal et al. (2016)	Cross-sectional (8 items)	7/8 (88%)	Large multicenter sample, high response, adjusted odds ratios; self-report.	Low
Choi et al. (2017)	Cross-sectional (8 items)	4/8 (50%)	Low response rate (37%); single institution; mixed roles; nonresponse bias likely.	Moderate
Manoli et al. (2018)	Cross-sectional (8 items)	4/8 (50%)	Small single-center sample of one specialty; descriptive analysis; recall of career exposures.	Moderate
Wicker and Rabenau (2010)	Cross-sectional (8 items)	6/8 (75%)	Self-reported career history; mixed professional and student sample.	Low
Al-Zoughool and Al-Shehri (2018)	Cross-sectional (8 items)	7/8 (88%)	Self-reported prior injuries; highlighted experience estimates were unadjusted.	Low

Low risk: ≥75% of items met; moderate: 50–74%; high: <50%.

3.7 Interpretation and implications

Occupational exposure to blood and body fluids is a long-standing but still unresolved problem in dental and perioperative care. Taken together, the evidence indicates that exposure is common in both settings, that reported cumulative prevalence is higher in the sampled perioperative groups, with differing exposure windows limiting comparisons, and that the factors behind these injuries differ in kind. The pooled estimates should nevertheless be read as descriptive rather than definitive, because the underlying studies differ in recall period, sampling, and the professional groups surveyed, and these differences are reflected in the high between-study heterogeneity.

The contrast between settings is consistent with the way work is organized. In dentistry, a single operator typically controls the entire procedure, so injury reflects individual technique, concentration, and fatigue, together with the confined and poorly visualized oral field. Needle recapping, local anesthesia delivery, scaling, and instrument cleanup were the recurring circumstances, and injuries occurred more often when clinicians worked alone than when assisted. The German survey documented frequent needlestick injuries among dental professionals and students (Wicker and Rabenau, 2010), consistent with the observation that dental assistants, who handle contaminated instruments after use, are a vulnerable group. The finding that students were affected so often is also plausible, because psychomotor skills and risk perception are still developing during clinical training.

The role of experience is less straightforward. In the dental studies, injury was linked to inadequate infection-control knowledge and to poor compliance with protocols, which supports a behavioral mechanism. At the same time, one national survey found that longer practice and older age increased the likelihood of frequent injury, whereas work in Riyadh dental clinics suggested that greater experience was associated with fewer prior injuries and better compliance was associated with fewer prior infections (Al-Zoughool and Al-Shehri, 2018). These discrepancies likely arise from differences in how exposure was defined, from survivor effects in senior staff, and from the tendency of experienced clinicians to take on more complex surgical procedures. Experience therefore appears to lower risk only when it is accompanied by reinforced safe habits.

Vaccination and organizational infrastructure also deserve emphasis. Dental assistants who were not vaccinated against hepatitis B and who worked in clinics without an infection-control unit were more likely to be injured. A causal reading is cautious, but the association is biologically coherent: vaccination does not prevent injury, yet it is a marker of a facility culture that invests in training, supervision, and post-exposure pathways. Because hepatitis B remains the most transmissible bloodborne virus after percutaneous exposure in dentistry (Mahboobi et al., 2010), the combination of unvaccinated staff and weak oversight represents a compounding hazard rather than two independent ones.

In perioperative care, exposure is driven less by the individual and more by the surgical environment. Injury rates climbed with greater blood loss, longer operations, and larger teams in the operative field, which is mechanistically intuitive. Bleeding obscures anatomy and makes instruments slippery, long procedures produce fatigue and glove wear, and crowding increases the number of hand-to-hand transfers of suture needles and scalpels. Suture needles and scalpel blades accounted for most injuries, and the highest-risk moments were use and passing of devices. Importantly, those most often injured were frequently not those who had used the device, since scrub nurses and technicians were commonly injured by instruments originally handled by surgeons. Such asymmetry explains why safety decisions made by one team member shape the risk borne by others, and why the downward trend in non-surgical injuries after safety legislation was not mirrored in the operating room. Evidence that blunt-tip suture needles reduce percutaneous exposure incidents among surgical staff (Parantainen et al., 2011) supports prioritizing engineering and workflow controls such as hands-free passing over exhortation alone.

Evidence on staffing, haste, and training supports the same systems-level interpretation. Among operating room nurses, hurried work, inadequate staffing, long hours, outdated guidelines, and training without practice were each associated with injury, indicating that latent organizational conditions shape the immediate behaviors that lead to harm. A study of hospital workers in China likewise found more injuries among nurses than physicians and among staff with infrequent training (Cui et al., 2018), and meta-analytic evidence from Iranian hospitals documents a high background burden among hospital personnel (Ghanei Gheshlagh et al., 2018), which is in line with operating room staff occupying the upper end of the risk spectrum. By contrast, nurses and technicians accounted for most reported injuries in the Iranian operating room survey, whereas surgeons and

residents predominated in the United States data, a divergence that probably reflects local task allocation, since in some systems nurses and technicians perform most instrument handling.

Underreporting emerged as a unifying theme that cuts across both settings and professional hierarchies. Trainees and senior surgeons were the least likely to report, citing time burden, perceived low risk, and fear of embarrassment or punitive response, whereas injuries witnessed by colleagues were more likely to be reported. These findings echo earlier work showing that nearly every surgical trainee sustains at least one injury and that a large share goes unreported (Makary et al., 2007), as well as systematic evidence of underreporting among dental healthcare workers (Pervaiz et al., 2018). The consequence is twofold: surveillance data understate true incidence, and affected workers lose the window for timely testing and prophylaxis. In the dental studies, only a minority of injured assistants were tested or received prophylaxis, which suggests that failures of post-exposure management compound failures of prevention.

These findings carry several implications. First, prevention should be matched to the dominant mechanism: technique, supervision, and vaccination verification in dentistry, and device engineering, procedural protocols, safe staffing, and team-level accountability in perioperative care. Second, reporting systems need to be short, non-punitive, and integrated with immediate post-exposure care, because even well-designed prevention cannot succeed without accurate feedback. Third, future studies should adopt harmonized definitions, report denominators such as procedures or person-time, and test multi-component interventions prospectively, preferably with controlled designs, since none of the included studies was a randomized trial.

The findings support setting-specific prevention. Dental services can focus on safe needle handling, practical training, chairside assistance, and formal infection-control units. Perioperative services can address staffing and sharps transfer through measures such as hands-free passing. In both settings, accessible, non-punitive reporting can support accurate surveillance and timely assessment for post-exposure prophylaxis.

3.8 Strengths and limitations

This review has strengths: a prespecified protocol, a comparative focus across two high-risk settings, appraisal with design-specific JBI tools, and cautious restriction of meta-analysis to studies with a comparable outcome definition. Several limitations apply. Only a small number of studies met the criteria, and most were cross-sectional and relied on self-report, which introduces recall and nonresponse bias. Heterogeneity in recall period, injury definition, and professional mix limited pooling, and the pooled perioperative estimate is imprecise. Searches were restricted to three databases and English-language reports, so relevant studies may have been missed, and formal assessment of publication bias was not possible with so few studies. Finally, most data are from Asia and the United States, which limits generalizability to other health systems.

4. CONCLUSION

Occupational exposure to blood and body fluids remains frequent among dental and perioperative healthcare workers, with different reported circumstances and exposure windows across settings. Dental exposure is shaped by operator technique, training, vaccination, and infection-control infrastructure, whereas perioperative exposure is shaped by procedural intensity, crowding, staffing, and device-handling workflow. Persistent underreporting and incomplete post-exposure care weaken surveillance and protection in both settings. Setting-specific controls, supported by simplified reporting and harmonized measurement, should be evaluated in prospective, controlled studies.

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AUTHOR CONTRIBUTIONS

All authors equally contributed to this work (Conceptualization, Methodology, Data Curation, Formal Analysis, Writing – Original Draft, Writing – Review & Editing, and Supervision).

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICS STATEMENT

This study is a systematic review of previously published, de-identified data and did not involve new human or animal subjects; formal ethics approval was therefore not required.

DATA AVAILABILITY STATEMENT

The data extraction tables supporting this review are available from the corresponding author upon reasonable request. All included studies are publicly available in the cited peer-reviewed sources.

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