

Clinical, economic and emotional burden of needlestick injuries and blood exposure on healthcare workers in the Middle East and Africa

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Introduction

Bloodborne pathogen exposure from needlestick injuries (NSIs) and blood exposure pose a significant occupational health risk and creates a significant burden to healthcare workers (HCWs), patients, hospitals and healthcare systems.

The World Health Organization (WHO) estimated that almost 3 million of 37 million HCWs experienced at least 1 NSI in the past year.¹

Over 25 pathogens can be transmitted via needles.¹

Blood exposure occurring from patients who tested positive for bloodborne viruses, such as HIV, HCV and HBV, can put HCWs at a higher risk of contracting the same bloodborne infections.

Use of safety-engineered devices (SEDs) can reduce the risk of NSIs and blood exposure among HCWs, reducing the cost burden on healthcare systems.^{5,12,19}

This literature review aims to aggregate and investigate the available evidence on NSI and blood exposure among HCWs as well as the impact of SEDs in the Middle East and Africa as no previous review has been conducted for this region.

Methods

A targeted literature review of studies published in English from 2009 to 2019 was conducted using PubMed, Cochrane Central Register of Controlled Trials (CENTRAL).

The review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist (Figure 1). The searches were developed using key terms and Medical Subject Heading (MeSH) terms.

Only high-quality studies that reported clinical, economic or emotional burden of NSI or blood exposure in HCWs were included. Studies were limited to human subjects. Eligibility criteria details are provided in Table 1.

Titles and abstracts identified by the search were screened by 1 reviewer and verified by another reviewer. The qualifying full texts of relevant studies were then screened for inclusion with strict eligibility criteria.

Table 1. Eligibility criteria

PICO	Inclusion criteria	Exclusion criteria
Population	HCWs experiencing NSIs or blood exposure (blood and body fluids, occupational blood exposure), percutaneous injury or mucocutaneous exposure	- No NSI or blood exposure experience - Non-HCWs (patients, police) - HCW experiencing NSI or blood exposure during surgery or in labs, EMT, paramedics
Intervention	N/A	- NSI and/or blood exposure from suture needles, diabetic sharps - Gloving practice
Comparator	N/A	N/A
Outcomes	- Clinical: NSI, blood exposure, infections (bloodborne) - Economic cost (disease related, blood cleaning), resources (time) - HCW-related PRO: quality of life loss, emotional distress (pain, stress), working efficiency - Institutional: hospitalization, penalty, reputation, patient admission rate - Other: knowledge, guidelines, practice change, legal implications, prevention, risk factors	Not NSI or BE relevant
Study designs	High-quality, well-structured methodology (systematic reviews and meta-analysis, randomized controlled trials, observational studies, large cohort studies)	Case studies, case series, commentaries, editorials, letters
Settings	Inpatient	Outpatient, home care, community service centers, surgical/operating rooms (if possible)

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Results

A total of 32 out of 1,330 studies were included. Study details are provided in Tables 2, 3 and 4.

A significant risk for occupational exposures such as NSI, blood exposure, mucocutaneous exposure and percutaneous injuries is found among HCWs within the Middle East and Africa. Occupational exposures are associated with certain healthcare professions, devices, lack of safety device use, training and improper safety practices. Economic and emotional burden are underreported in the Middle East and Africa.

Discussion

The targeted literature review highlights the clinical, economic and emotional burden of NSIs and blood exposure for HCWs in the Middle East and Africa.

Burden of NSI and mucocutaneous exposure is high among Middle Eastern and African countries, and nurses are impacted the most.

Severe underreporting of occupational exposure exists in the Middle East and Africa.^{3,10,12,18}

Majority of NSIs occurred during needle recapping. Knowledge of consequences, protocols and practices remains low among HCWs.^{3,6,8-10,12,14,18,20,21,23,25}

Although prevalence of bloodborne infections is low, it represents a significant burden among HCWs. SEDs and training programs can reduce the burden.^{5,9,12,19}

NSIs and blood exposures are associated with fear, anxiety and stigma among HCWs.

This targeted literature review can improve the awareness of HCWs in the Middle East and Africa on the burden associated with NSI and blood exposure.

Limitation of these results stem from limited evidence for economic and emotional burdens in the Middle East and Africa region.

Conclusion

NSI and blood exposure imposes significant clinical, economic and emotional burden on HCWs in the Middle East and Africa.

Training and SEDs may reduce such burden and are cost-effective within certain parameters.^{5,9,12,19}

Decision- and policy-makers at the hospital and national level should promote the use of SEDs and training programs to enhance HCWs' safety in healthcare institutions.

Figure 1. PRISMA chart of study inclusion

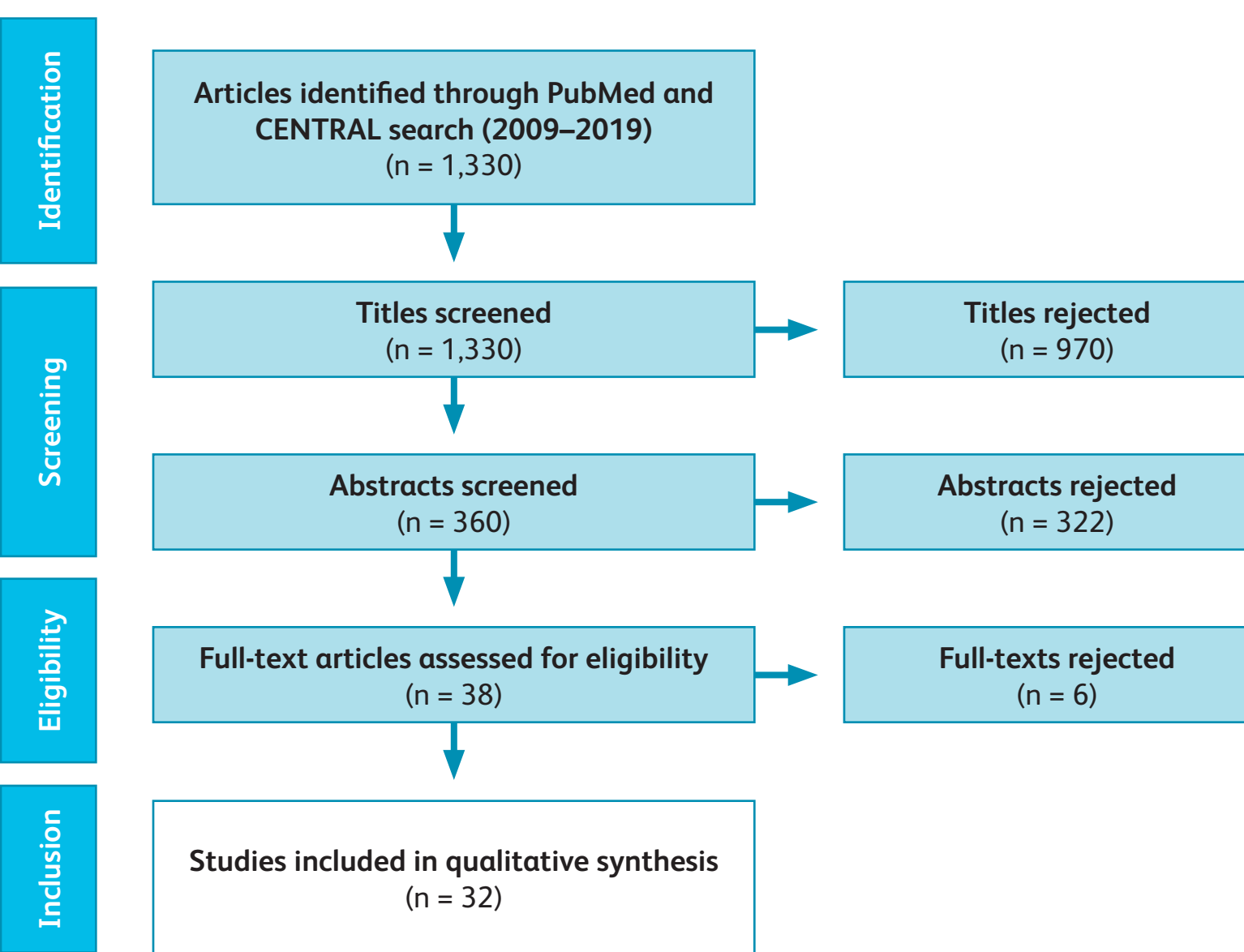


Table 2. Summary of studies reporting clinical burden for NSI and blood exposure

Study name	Study type	Outcomes studied and significance
Saudi Arabia (9 studies)		
Mahfouz et al. ² 2009	Prospective study	1 in 6 PHCC nurses had at least 1 NSI in the past 12 months, equaling 0.38 NSI/nurse/year - Only 35.5% of nurses recognized the possibility of injection-associated transmission of HIV, hepatitis B and C - Nurses administered an average of 25 injections per week (median 15); 40% of nurses were injured during recapping with both hands - Only 25.5% of nurses attended CME on infection control, 6.4% on infection safety
Balkhy et al. ⁶ 2011	Prospective study	- Mean PI rate was significantly lower at KAMC-R (12.3 per 100 daily occupied beds) than U.S.-EPINet teaching (33.6) and non-teaching hospitals (17.0) over a 5-year period - Nurses (KAMC-R: 52.8%, EPINet U.S.: 38.1%) reported more PIs than other HCWs - KAMC-R vs EPINet reported more PIs associated with placing an IV line (1.4% vs 0.3%, $p = 0.003$), winged steel needle IV set (2.5% vs 6%, $p = 0.006$) and IV catheter (0.8% vs 3.2%, $p = 0.013$) - KAMC-R vs EPINet source patient was identifiable in 85.1% vs 95% ($p < 0.001$)
Hashmi et al. ⁹ 2012	Retrospective study	32 NSIs reported within a 6-month period; nurses made up the majority of reported SIs (46.9%) 35.55% of disposable syringes, 9.7% of IV catheters and 6.7% of unattached hypodermic associated with NSIs 96.9% of devices associated with SI lacked a SED; 90.6% of SIs were associated with a contaminated device
El Beltagy et al. ⁶ 2012	Prospective study	- Nurses sustained PIs in pre- and post-intervention period (37.6 per 1,000 HCWs and 15.0 per 1,000 HCWs, respectively); intervention was an education program 56.04% and 52.80% of PIs were reported by nurses in pre- and post-intervention period, respectively - Pre- vs post-intervention PIs among all HCWs (all significant differences): needle on IV line (4.3% vs 1.4%), IV catheter (9.3% vs 0.8%)
Mazi et al. ⁷ 2015	Retrospective study	5.9 OE-BBFEs/10,000 patient-days incidence; majority among nurses (82%); 20% during obtaining blood sample, 16.9% during establishing IV or arterial access, 16.9% during injection through skin or mucous membrane 13 reported incidents of exposure to HCV and 4 to HBV with no documented seroconversions; no reported occupational exposure to HIV
Ismail et al. ¹⁰ 2014	Retrospective study	14.8% of PHCC nurses had an NSI in the past year - Only 30% of 10 urban centers and 17% of 23 rural centers had a health and safety person responsible for managing NSI
Memish et al. ⁸ 2013	Retrospective study	77.2% incidence of NSSIs reported in 2011, but highest in 2009 (13.84%); 64.6% of nurses reported NSSIs 64.1% of NSSIs were associated with disposable needles, 6.6% with IV catheter stylet 19.6% nurses did not wear gloves during incident
Memish et al. ⁸ 2015	Prospective study	- Mean NSIs was significantly lower at Saudi MOH hospitals (3.2 per 100 daily occupied beds) than EPINet U.S. teaching (20.7) or non-teaching hospitals (16.5) - Nurses (SA MOH: 59.4%, EPINet U.S.: 41.9%) reported more PIs than other HCWs - SA MOH vs EPINet reported more PIs associated with disposable syringes (47.2% vs 37.4%, $p = 0.2$) and IV catheter (5.6% vs 3.9%, $p = 0.5$) - Rate of PIs in Saudi HCWs while using no safety device (86.8%) was significantly ($p = 0.03$) higher than that reported in U.S. hospital workers (55.7%) 36.5% of PIs occurred during use of a syringe/sharp, 13.9% after use and before disposal, and 5.6% during needle-recapping
Al Jarallah et al. ²¹ 2016	Prospective study	- Overall incidence of NSI among nurses was 9.42% (ED 15.62%, medical-surgical ward 13.79%); intervention was education, training program and orientation of nurses - Knowledge of NSI was inadequate (45.6%) - Pre- vs post-intervention: Significant reduction from 9.42% to 3.93% in NSI, 54.45% to 91.57% increase in knowledge of NSI preventions, reporting increased from 66.67% to 100%, and 55.56% to 100% increase in NSI/SI protocol-based management
Egypt (6 studies)		
Abdelwahab et al. ²⁶ 2012	Prospective study	- Average of 0.6 ± 1.2 NSI/HCW/year (includes all HCWs) - Prevalence of anti-HCV, hepatitis B surface antigen (HBsAg) and co-infection was 16.6%, 1.5% and 0.2%, respectively; but infections more likely to be community acquired - HCV RNA were present in 72.1% of anti-HCV-positive HCWs, and all but one subject were infected with HCV genotype 4 77.6% did not report a history of NSI in the year preceding enrollment
Hanafi et al. ¹⁰ 2011	Retrospective study	67.9% of HCWs (438/645) had at least 1 NSI in the previous 12 months; highest prevalence in nurses (62.3%) (of total 645 HCWs, 371 were nurses) 38.4% of NSIs were associated with disposable needles, 13.5% winged butterfly, 7.8% IVC stylet; 36.5% of NSIs occurred in inpatient ward and 15.8% in ICU - High-risk patients (those with a history of infection with HIV, HBV or HCV or injection drug use) were involved in 8.2% of injuries - Significant factors that increased a HCW's chance of suffering a high-risk injury were exposure to a source patient who had evidence of bloodborne infection; when the procedure involved inserting a needle directly in a patient's vein or artery; deep injury; and not wearing personal protective equipment 74.7% did not report NSI to employee health service; 70.3% of nurses did not report - Factors that decreased the frequency of NSIs were: access to devices with safety features; adherence to infection control guidelines; having had training in injection safety and appropriate work practices; a comfortable room temperature; and available written protocol for prompt reporting
Abdelwahab et al. ¹¹ 2013	Prospective study	21 NSIs reported in 18 months among 651 HCWs (36.3% of 651 HCWs were nurses) 4.8% vs 0.3% incidence of HCV-seroconversion was observed among nurses who reported NSIs vs nurses with no NSIs
Zawilla et al. ⁹ 2013	Retrospective study	40% reported at least one SI in the year before intervention, of which more than 70% experienced >1 injury (69.5% of participants were nurses, others were physicians and housekeepers) 39% of nurses reported at least 1 SI in the preceding year, which constituted 68% (283/416) of the total SIs - Among nurses, more than 90% (262/283, 92.6%) did not report their injury; lab investigations after SI were not made (78.1%), and hepatitis B vaccination after SI were lacking or doses were not completed (81.6%) - Sharp item was contaminated with visible blood (58.2%) and main use of the sharp item was for withdrawal of blood from patients (157/416, 37.7%) 36.9/100-person SI rate pre-intervention vs 12.4/100-person post-intervention ($p < 0.001$) - Significant improvement in SI reporting and adequate post-exposure management among ICU-HCWs was observed after safety training and IV catheter with safety-engineered feature interventions 50% in 2011 vs 13.5% in 2010 ($p = 0.002$)
Ahmed et al. ²² 2018	Retrospective study	Study showed several gaps and lack of alignment in HCW occupational exposure management policies and practices as compared to the national (MOHP) and global guidelines (CDC)
Nawafleh et al. ¹³ 2019 (Egypt, Saudi Arabia)	Retrospective study	59% and 8% of nursing students from Egypt and SA, respectively, experienced NSIs - Of 310 NSIs, number of NSI in Egypt: once (182), twice (78), 3 times (26), 4 times (10), 5 or more (15); only 56 HCWs got blood test after NSI - Of 45 NSIs, number of NSI in SA: once (19), twice (10), 3 times (5), 4 times (3), 5 or more (7)
Turkey (5 studies)		
Talas et al. ¹⁴ 2009	Retrospective study	49% of 473 nursing students (2nd–4th year) experienced NSI and only 43.9% reported the NSI 63.5% had ≥2 NSIs - Frequent site of injury was on the hand (98.7%); majority of students (65.2%) were not wearing gloves at the time of injury - Most common devices: medication ampoules and serum bottles (43%) of all injuries, normal hollow-bore needles (syringe/plebotomy needles, IV catheter stylet; 42%) and other items (15%) 70% of students reported reason for their injury was due to underdeveloped manual skills and 27% due to needle recapping 67.7% of the nursing students that experienced NSIs had completed the hepatitis B immunization series
Toraman et al. ¹⁵ 2011	Prospective study	14 NSIs were reported, 36% of NSIs were reported by nurses
Unver et al. ¹⁴ 2012	Retrospective study	52.5% (74 of 141) of military nursing students experienced NSSIs, BBFEs among mucosal membranes (27%) - Main cause of NSSI: injection needles (47.3%); only 13.5% of students reported injuries
Ture et al. ²³ 2016	Retrospective study	166 (~50%) of 331 HCWs experienced occupational exposure (NSSI or mucosal exposure) in ~2 year study period - Incidence: 2.18 exposure/person-year; major injury NSI (80%) and 7.9% mucosal injury; common site: hand (84%) - Mucosal exposure: 15 exposures in 13 HCWs; 60% (9/15) to blood, and 13.3% (2/15) to saliva - Source patient known in 65% cases (108). Of 108, 19 HCWs had a risky contact with patients who had HBsAg positivity, 20 HCWs with anti-HCV positivity patients and 4 with anti-HIV positivity patients; at the end, no HCWs were infected - Heavy workload, long working hours lead to carelessness during risky practices, such as recapping needles
Leblebicioglu et al. ²² 2016	Retrospective study	51 healthcare-related exposures to Crimean-Congo hemorrhagic fever (CCHF) with 4 deaths - Healthcare-related transmission of CCHF virus is dangerous, with an estimated total of 90–95 exposures of staff in 9,069 admissions (~1%) in 12 years - Main routes of exposure: 62.7% NSI (32/52), 23.5% (12/51) BBFE to mucous membranes (splash) - After NSIs, 8/32 (25%) had laboratory-confirmed infection, 3/8 (37.5%) of whom also had clinical disease. After splash exposure, 10/12 (83.3%) had laboratory-confirmed infection, 8/10 (80%) of whom also had clinical disease - Of 44 identified exposure, 19 got Ribavirin PEP and 25 did not (of which 3 died)
Kuwait (1 study)		
Omar et al. ¹⁷ 2015	Retrospective study	0.7% (249) of 33,364 HCWs reported exposure to blood and other potentially infectious materials - NSI (75.9%), mucous membrane exposure (splashes to eye; 5.2%) and contact with nonintact skin (0.8%) - Major NSIs were from hollow-bore needles (93.7%); major blood exposure occurred when drawing blood and inserting or removing needles from patients (35.4%) - Exposed HCP: nurse (66.7%), doctor (14.1%), technician (10.4%), housekeeping staff (8.8%) - Only 52.2% of exposed HCWs were fully vaccinated with the HBV vaccine

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Table 2. Summary of studies reporting clinical burden for NSI and blood exposure (continued)

Study name	Study type	Outcomes studied and significance
UAE (1 study)		
Jacob et al. ²⁸ 2010	Retrospective study	19% (190/994) of HCWs reported SIs in 2006 calendar year of whom 15 had >5 such injuries - Only 18% reported (via an incident reporting form); 49% of respondents with a SI were unaware of reporting procedures and 22% felt it was useless to report an incident - Among those who sustained an SI, 53% (n = 101) were from blood-contaminated sharps - Successful hepatitis B vaccination was accomplished for 65% in the group with SI compared to 52% in the group without a SI ($P < 0.01$) - Risk of suffering a SI almost doubled in the group of HCWs who were noncompliant with standard precautions (19 vs 31%, respectively, $P < 0.05$)
Uganda (3 studies)		
Ziraba et al. ²⁹ 2010	Retrospective study	67.8% of HCWs were exposed to HBV via NSIs and 41% via the mucosal membrane - NSI potential was high among physicians (72%) and nurses (71.4%) 8.1% seroprevalence of hepatitis B was observed among 370 HCWs 48.1% of lifetime exposure to hepatitis B virus infection 6.2% of HCWs were vaccinated for hepatitis B, only 3% were immune from the vaccination
Kumakech et al. ²⁴ 2011	Retrospective study	224 HCWs experienced occupational BBFE via NSSI or mucosal exposures over 1 year 8.93% (20) of HCWs were exposed to HIV through NSSIs and 10.27% (23) were exposed through mucocutaneous contamination 47.1% of HCWs did not report BBFE because they believed the risk of HIV was low 26.9% did not report because they believed that washing the exposed area with plenty of water and soap would prevent HIV seroconversion 28.1% (63) of HCWs received no training on prevention of occupational exposure nor PEP, nor universal precautions
Odongkara et al. ³⁰ 2012	Retrospective study	46% of 235 HCWs experienced occupational HIV exposure (NSI or mucosal exposure) in 5 years 27.7% of HCWs experienced an NSI-related BBFE to HIV; 19.1% experienced a mucosal exposure to HIV 23.2% of HIV exposures were not reported
Kenya (2 studies)		
Mbaisi et al. ³¹ 2013	Retrospective study	19% of 305 HCWs reported a PI and 7.2% were exposed via splash to mucosal membrane 25% of 305 HCWs were exposed to BBFEs in the past year 48% of HCWs reported the incidents and 20% of those who reported took PEPs against HIV
Ongete et al. ³² 2018	Retrospective study	18.75% (36) of 192 HCWs were splashed with body fluid and 46.2% (192) experienced SSNIs 46.9% (90) of 192 HCWs used antiretroviral medications after a BBF exposure
Ghana (1 study)		
Akagbo et al. ²⁵ 2017	Retrospective study	33% of HCWs reported an HIV-related NSI and only 50% of HCWs protected themselves against BBFE to HIV 44% of HCWs did not have time to comply with standard precautions
South Africa (1 study)		
Nkoko et al. ¹⁸ 2014	Retrospective study	14.9% of HCWs (11/74) were exposed to NSIs or BBF, of which 90% who had NSI or BBFE were either nurses or physicians (this was a rural facility) 81.8% of HCWs exposed to NSI/BBF lacked knowledge in needle recapping protocol

Abbreviations: BBFE, blood and body fluid exposure; EPINet, Exposure Prevention Information Network, United States; HCP, healthcare personnel; KAMC-R, King Abdulaziz Medical City, Riyadh; MOH, ministry of health; NSI, needlestick and sharp injuries; OE, occupational exposure; PHCC, primary health care centers; PI, percutaneous injury; SI, sharps injuries; SSNI, sharps and needlestick injuries.

Table 3. Summary of studies reporting economic burden for NSI and blood exposure

Study name	Study type	Outcomes studied and significance
South Africa (1 study)		
De Jager et al. ¹⁹ 2018	Cost-utility analysis	HIV seroconversion rate: Current practice: 0.66% vs training 0.66%; SEDs: 0.53%; training and SEDs: 0.41% 45-year prevention: Current practice: NSI incidence vs training: may prevent 2,209 NSIs/1,000 HCWs; SEDs: 3,314 NSIs/1,000 HCWs; training and SEDs: 4,349 NSIs/1,000 HCWs Average annual discount: Current practice: \$1,163.29 USD/HCW vs training: \$1,247.64 USD/HCW; SEDs: \$3,247.64 USD/HCW; training and SEDs: \$1,247.64 USD/HCW ICER: training and SED: dominant cost-effective strategy with \$377.08 USD/QALY gained; training: cost effective with \$32.90 USD/QALY gained; SED: Cost effective with \$432.32 USD/QALY gained Discounted QALYs and costs: Training increases both: discounted QALYs by 2.56, discounted costs by \$84.34 USD; SED: 4.90 QALYs, \$1,987.87 USD; training and SED: 6.51 QALYs, \$2,455.74 USD WTP threshold: Training and SED: strategy of choice with a WTP threshold of \$6,483.9/QALY gained. Cost effective 95.4% of the time under specific parameters
Saudi Arabia (1 study)		
Al Johani et al. ³³ 2016	Review	- Sharp damage can bring about various immediate and direct costs for the healthcare services, including: - Loss of representative time - Cost of tying up staff to research the harm - Expense of lab testing - Cost of treatment for contaminated staff - Cost of substituting affected staff

Table 4. Summary of studies reporting emotional burden for NSI and blood exposure

Study name	Study type	Outcomes studied and significance
South Africa (1 study)		
Delabelle et al. ³⁴ 2009	Retrospective study	58.6% of HCWs feared occupational exposure to HIV while caring for HIV- and AIDS-infected patients, but only 17.2% of HCWs agreed that you need to worry about potentially placing relatives and friends at risk of exposure - Knowledge: 9 in 10 agreed with "risk of occupational HIV/AIDS infection among healthcare workers is high" (90%; n = 126) - Attitude: Nursing staff demonstrated a high level of knowledge and negative stigma from the community and workplace - Practices: 7 in 10 nursing staff reported attempts to access PEP following occupational NSIs, and 34.2% reported PEP not being available at their workplace. Furthermore, frequent unsafe injection practices
Uganda (1 study)		
Kumakech et al. ²⁴ 2011	Retrospective study	2.9% of HCWs did not report BBFE because of fear of the long and tiresome process of reporting exposure 14.3% of HCWs that did not initiate PEP. The HCWs reported that they were afraid of the ART adverse effects
Egypt (2 studies)		
Hanafi et al. ¹⁰ 2011	Retrospective study	77.4% of HCWs reported feeling emotional distress after experiencing an NSI
Nawafleh et al. ¹³ 2019 (Egypt, Jordan, Saudi Arabia)	Retrospective study	12%, 11% and 1% of nursing students from Egypt, Jordan and Saudi Arabia did not report NSIs out of fear of getting in trouble 10, 2% and 4% of nursing students from Egypt and Jordan did not report out of fear that the injury would affect their grade 52% and 48% from Egypt and Jordan did not report because they were busy and did not want to be seen as having poor clinical skills
Kenya (1 study)		
Ongete et al. ³² 2018	Retrospective study	50% of 192 SSNI-exposed HCWs were despaired about the future 52% of HCWs felt depressed, suffered anxiety and worrying

Abbreviations: ART, antiretroviral therapy; PEP, post-exposure prophylaxis.

