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Original Research Article

Timeliness and guideline concordance of post-exposure prophylaxis following occupational blood and body fluid exposures at Prince Sultan Military Medical City: a retrospective timestamp-based cohort study (2024-2025)

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ABSTRACT

Background: Healthcare workers (HCWs) are at increased risk of acquiring bloodborne infections through occupational exposure to blood and body fluids (BBFEs). Prompt post-exposure prophylaxis (PEP) is essential to reduce the risk of transmission yet delays and inconsistent adherence to institutional protocols remain significant concerns. To determine the median exposure-to-reporting delay, the proportion of HCWs reporting within the institutional target of ≤24 hours, assess adherence to PEP guidelines, and identify predictors of delayed reporting.
Methods: A retrospective cohort study was conducted at Prince Sultan Military Medical City (PSMMC), Riyadh, Saudi Arabia, from January 2024 to December 2025. All HCWs who reported occupational BBFEs with complete exposure and reporting timestamps were included. Data were extracted from occupational health and electronic health records. The primary outcome was exposure-to-reporting delay in hours. Logistic regression identified predictors of delayed reporting (>24 hours).
Results: Among 145 HCWs (mean age 32.6±7.1 years; 74.5% female), the median exposure-to-reporting delay was 504.30 hours (IQR: 1463.88), with only 39.3% reporting within ≤24 hours. Needlestick injuries comprised 88.3% of exposures. HIV PEP was indicated in 47 cases (32.4%), of which 26 (55.3%) were initiated. HBIG was administered in 4 cases (2.8%). Follow-up attendance declined from 37.9% in 6 weeks to 4.1% in 12 months. Delayed reporting was significantly associated with initiation of HIV PEP ($p=0.003$), HBIG administration ($p<0.001$), and infectious disease consultation ($p<0.001$). No demographic or occupational factors predicted delayed reporting.
Conclusions: Substantial gaps exist in the occupational exposure management pathway at PSMMC, with prolonged reporting delays, suboptimal PEP initiation, and poor follow-up adherence. Reporting delays appear systemic rather than attributable to individual HCW characteristics. Urgent improvements in reporting systems, documentation, and follow-up reminders are needed to protect HCWs from preventable infections.

Keywords: Occupational exposure, Needlestick injuries, Post-exposure prophylaxis, Healthcare workers, Guideline adherence, Saudi Arabia

INTRODUCTION

Healthcare workers (HCWs) are at increased risk of acquiring bloodborne infections through occupational exposure to BBFEs. Every year, millions of percutaneous injuries occur worldwide, exposing HCWs to serious infections including hepatitis B virus (HBV), hepatitis C virus (HCV), and Human Immunodeficiency Virus (HIV).[1,2] Prompt initiation of PEP may significantly decrease the risk of transmission. All international guidelines recommend initiating PEP as soon as possible after exposure, preferably within 72 hours.[2] The effectiveness of HIV PEP is highly time-dependent; modeling studies suggest that delays beyond 24-48 hours significantly reduce its preventive value and that early initiation is critical to reducing HIV risk.[3,5]

Clear policy mandates exist, yet significant delays persist throughout the PEP management pathway, including long periods between exposure and reporting, between reporting and risk assessment, and between risk assessment and the initiation of PEP.[5,6] Delays are caused by working outside normal hours, lack of knowledge, incomplete paperwork, failure to obtain source patient laboratory results in a timely manner, and delays in pharmacy dispensing.[5,6] Also, failure to adhere to the required serologic testing, follow-up visits, and proper administration of hepatitis B immunoglobulin (HBIG) greatly hinders the organization's prevention goals.[9]

Studies worldwide consistently show that most BBFE cases are caused by nurses, with needlestick and sharp injuries being the most common mechanisms, predominantly occurring in wards, emergency departments, and operating rooms.[10] The usual risk factors include being female, being younger, and working the night shift.[5,12] Migrants in Saudi Arabia are at a substantially increased risk.[13] There are important management gaps despite established protocols: a significant proportion of exposed HCWs do not promptly report exposures, and PEP initiation rates are suboptimal when indicated.[2,14] Additionally, follow-up attendance declines dramatically over time, from over 75% at initial intervals to less than 40% at three months, and baseline serological testing and HBIG administration are often discordant with policy guidelines.[10,11] Al-Zahrani et al reported that 8.40% of HCWs in Saudi Arabia had sharps and other injuries and that male gender and laboratory personnel were significant risk factors.[13] Sula et al also observed that migrant workers have a higher risk of occupational hazards, where injuries from cuts and sharp objects constitute a large proportion of work-related injuries.[14]

PSMMC has a standardized post-exposure management policy; however, there has been no systematic evaluation of its timeliness and policy concordance. While previous studies have reported the epidemiology of BBFEs and the risk factors associated with exposure, few have assessed the complete PEP management pathway, from exposure reporting to prophylaxis administration and adherence to follow-up, in the Saudi Arabian healthcare setting. Furthermore, local predictors of delayed reporting and factors associated with non-concordance with policy guidelines are poorly characterized. Understanding existing gaps in the PEP pathway is essential for quality improvement, given the critical importance of timely PEP administration and the risk of preventable infection. Therefore, the objective of this study is to assess the timeliness of reporting of occupational exposures, quantify the median time intervals (in hours) for exposure-to-reporting, assess adherence to the PSMMC post-exposure management policy, and identify the predictors of delayed reporting among HCWs with occupational blood and body fluid exposures at PSMMC from January 2024 to December 2025.

Objectives

Primary objective

To determine the timeliness of occupational exposure reporting by calculating the median exposure-to-reporting delay (in hours) among HCWs with occupational blood and body fluid exposures at PSMMC, and to determine the proportion of HCWs who report the exposure to the Occupational Health Section within the institutional target of ≤24 hours.

Secondary objectives

Secondary objectives were to quantify the median time intervals (in hours) for exposure-to-reporting, to assess adherence to the PSMMC post-exposure management policy and to identify demographic, occupational, and exposure-related factors associated with delayed reporting (>24 hours) to the occupational health section.

METHODS

Study design

This was a retrospective cohort study conducted at PSMMC, Riyadh, Saudi Arabia. The study included all HCWs who reported an occupational blood or body fluid exposure (BBFE) and were managed under the PSMMC PEP pathway between January 1, 2024, and December 31, 2025.

Population

The study included all healthcare workers who reported a needlestick injury, sharp injury, splash to mucous membranes, or other body fluid exposure as defined by PSMMC occupational exposure definitions, had a documented occupational exposure requiring risk assessment and management under the PSMMC PEP pathway, and had complete exposure and reporting timestamps documented in the occupational health records. Exposures that were non-occupational in nature, records with missing exposure time or date that prevented accurate calculation of reporting delays, and cases that were not managed under the PSMMC PEP pathway were excluded from the study.

Sample size

All eligible healthcare workers who met the inclusion criteria during the study period were included in the analysis. No minimum sample size was calculated a priori, as this was a retrospective study of all available records. The final analytic cohort comprised all valid cases with complete exposure and reporting timestamps, yielding a total of 145 healthcare workers

Data collection tool

A structured data collection form was developed to extract all variables relevant to the study objectives. The form was divided into seven sections (A through G) and was designed to capture comprehensive information from occupational health records, electronic health records, and paper-based incident files.

Section A: Incident recognition and timestamps

This section captured incident identification details and all available timestamp variables, including the dates and times of exposure and reporting to the Occupational Health Section (OHS). These variables were used to calculate the main outcome measure, the delay between the exposure and reporting.

Section B: Demographic and occupational data of health workers

This section recorded the demographic and occupational characteristics of the exposed healthcare worker such as: age (years), sex (male/female), nationality (Saudi/Non-Saudi), occupation (physician, nurse, allied health, housekeeping, student, or other), department (emergency room, operating room, intensive care unit, ward, outpatient department, laboratory, or other), shift at time of exposure (day: 07:00-19:00 or night: 19:01-06:59), and whether the exposure occurred on a weekend (yes/no).

Section C: Exposure information

Specific exposure characteristics were recorded in this section including: type of exposure (needle stick, sharp injury, splash to mucous membrane, exposure to non-intact skin or human bite), type of instrument (if applicable), depth of injury (superficial or deep), personal protective equipment (PPE) use at time of exposure (yes/no), injured or exposed body part, and first aid performed (yes/no).

Section D: Patient status (index) source

This section gathered information on the source patient, including whether the source patient was identified (yes/no) and the source patient’s HIV, HBV, and HCV serostatus (positive, negative, or unknown).

Section E: Baseline laboratory testing for healthcare workers

Baseline laboratory tests performed on the exposed health care worker were documented in this section and included HIV test (positive, negative, or unknown), HBsAg (positive, negative, or unknown), anti-HCV (positive, negative, or unknown), and HBsAb titer (IU/L).

Section F: PEP therapy

This section collected data on PEP administration: if HIV PEP was indicated per policy (yes/no), if HIV PEP was started (yes/no), if HBIG was indicated (yes/no), if HBIG was given (yes/no), if the hepatitis B vaccine was given if indicated (yes/no), and if an infectious disease consultation was done (yes/no).

Section G: Compliance follow-up

This section describes compliance with the PSMMC follow-up schedule, including attendance at 6-week, 4-month, 6-month, and 12-month follow-up visits (yes/no for each).

Data analysis

All statistical analyses were performed using statistical package for social sciences (SPSS) for Windows, version [26] (IBM Corp., Armonk, NY, USA). Continuous variables were first assessed for normality using Shapiro-Wilk test. Normally distributed continuous data were expressed as mean±standard deviation (SD), while non-normally distributed continuous data, including exposure-to-reporting time intervals and baseline HBsAb titers, were reported as median (IQR). Categorical variables were summarized as frequencies and percentages.

For univariate analysis comparing healthcare workers (HCWs) who reported their exposure within institutional target of ≤24 hours versus those who reported after >24 hours, Mann-Whitney U test was used for non-normally distributed continuous variables (e.g., age, baseline HBsAb titer). Chi-square test (or Fisher's exact test) was used to compare categorical variables, including sex, nationality, occupation, department, shift type, weekend exposure, type of exposure, depth of injury, PPE use, source patient identification, and all post-exposure management variables (HIV PEP indication and initiation, HBIG indication and administration, hepatitis B vaccination, infectious disease consultation, and follow-up attendance).

To identify independent predictors of delayed reporting (>24 hours), a binary logistic regression model was constructed. The dependent variable was delayed reporting (coded as 1 for >24 hours, 0 for ≤24 hours). Independent variables entered the multivariable model included shift at time of exposure (day vs. night), occupation category (physician, nurse, allied health, other), age (in years, continuous), and PPE use at the time of exposure (yes/no). Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were calculated for all predictors. Model fit was evaluated using Omnibus test of model coefficients and the Nagelkerke R-squared value. The overall model was assessed for goodness of fit using Hosmer-Lemeshow test, and classification accuracy was reported. A two-sided $p<0.05$ considered statistically significant for all analyses.

Ethical considerations

Ethical approval for this study was obtained from the Institutional Review Board (IRB) of PSMMC. A waiver of informed consent was granted by the IRB due to the retrospective nature of the study and the use of de-identified data. All data were anonymized prior to analysis to ensure patient and HCW confidentiality. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki.

RESULTS

Baseline characteristics of the study cohort

A total of 145 HCWs who reported occupational BBFEs at PSMMC between January 2024 and December 2025 were included in final analysis. The demographic characteristics of the study population are summarized in Table 1. The mean age of HCWs was 32.61±7.08 years (median: 32 years, IQR: 9), with a predominance of females (74.5%, n=108). Most HCWs were Saudi nationals (58.6%, n=85), while non-Saudi HCWs constituted 41.4% (n=60). Nurses comprised the largest occupational group (54.5%, n=79), followed by physicians (16.6%, n=24), allied health professionals (11.7%, n=17), dentists (9.7%, n=14), students (4.8%, n=7), and housekeeping staff (2.8%, n=4). Most exposures occurred during day shifts (81.4%, n=118) and on weekdays (93.1%, n=135). The most common departments involved were wards (29.7%, n=43) and outpatient departments (24.1%, n=35).

Exposure and source patient characteristics

The exposure characteristics are presented in Table 2. Needlestick injuries were the predominant exposure type, accounting for 88.3% (n=128) of all cases, followed by splashes to mucous membranes (9.7%, n=14) and sharp injuries (2.1%, n=3). Among 131 cases with documented instrument types, needles were the most frequently involved (85.5%, n=112). Most injuries were superficial (90.9%, n=120), with deep injuries comprising only 9.1% (n=12). Personal protective equipment (PPE) was used in 90.3% (n=131) of exposures, and first aid was performed in all cases (100%, n=145). The finger was the most frequently injured body part (71.7%, n=104), followed by the hand (15.2%, n=22) and face/eye (9.7%, n=14).

The source patient was identified in 84.8% (n=123) of cases. Source HIV, HBV, and HCV serostatus were negative in 66.9% (n=97), 62.1% (n=90), and 66.9% (n=97) of cases, respectively. Source serostatus was unknown in 32.4% (n=47) of cases across all three bloodborne pathogens. Positive source serostatus was rare, with only 1 case of HIV-positive (0.7%), 8 cases of HBV-positive (5.5%), and 1 case of HCV-positive (0.7%) source patients identified.

Baseline laboratory testing

Baseline laboratory testing for exposed HCWs is shown in Table 3. All 145 HCWs (100%) tested negative for baseline HIV, HBsAg, and anti-HCV. The mean baseline HBsAb titer was 588.50±416.05 IU/L (median: 666 IU/L, IQR: 877), indicating that most HCWs had protective immunity against hepatitis B.

PEP characteristics and follow-up adherence

Table 4 summarizes the PEP characteristics and follow-up adherence. HIV PEP was indicated per policy in 32.4% (n=47) of cases; however, only 26 HCWs (17.9% of all cases/55.3% of those indicated) started HIV PEP. Among the 47 indicated cases, 20 (42.6%) did not start PEP. HBIG was indicated per policy in only 3 cases (2.1%). However, HBIG was documented as administered to 4 HCWs (2.8%). Review of the fourth case revealed that it was administered following infectious disease consultation for an initially unknown source HBsAg status, which was subsequently confirmed negative. The hepatitis B vaccine was given in 16 cases (11.0%), with 2 cases (1.4%) documented as not receiving it despite indication. Infectious disease consultation was performed in 30 cases (20.7%), while 56 (38.6%) did not receive a consultation and 59 (40.7%) had no indication documented. Follow-up attendance declined substantially over time. Attendance at the 6-week follow-up was 37.9% (n=55), decreasing to 19.3% (n=28) in 4 months, 11.0% (n=16) in 6 months, and only 4.1% (n=6) in 12 months.

Reporting timeliness

The median exposure-to-reporting delay among all HCWs was 504.30 hours (approximately 21 days; IQR: 1463.88), with a mean of 710.39±798.32 hours (range: 0.03-4920.25 hours). Only 57 HCWs (39.3%) reported their exposure within the institutional target of ≤24 hours, while 88 HCWs (60.7%) reported after 24 hours.

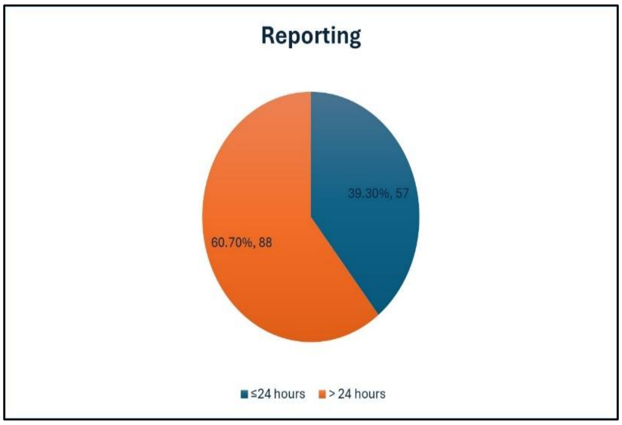

Figure 1: Distribution of exposure-to-reporting time intervals (hours) among healthcare workers with occupational blood and body fluid exposures, (n=145).

Significant association between post-exposure management and reporting timeliness

When comparing HCWs who reported within ≤24 hours versus those who reported after >24 hours (Table 5), several striking and significant differences emerged:

First, HCWs who did not receive an infectious disease consultation were significantly more likely to have delayed reporting. Among the 56 HCWs who did not receive an ID consultation, 42 (75.0%) reported within ≤24 hours, whereas among the 30 HCWs who did receive a consultation, only 7 (23.3%) reported within ≤24 hours ($p<0.001$). This suggests that ID consultations were performed preferentially in cases where reporting was already delayed, likely because delayed cases required more intensive management.

Second, HCWs who received HIV PEP were significantly more likely to have delayed reporting. Among the 26 HCWs who started HIV PEP, only 4 (15.4%) reported within ≤24 hours, while 22 (84.6%) reported after 24 hours ($p=0.003$). Similarly, among the 20 HCWs for whom PEP was indicated but not started, 13 (65.0%) reported within ≤24 hours, while only 7 (35.0%) delayed reporting.

Third, all 4 HCWs who received HBIG reported after >24 hours (100%, $p<0.001$), and all 3 HCWs for whom HBIG was indicated reported after >24 hours, although this did not reach statistical significance ($p=0.279$) due to small numbers.

Fourth, although not statistically significant, HCWs who received the hepatitis B vaccine had a higher proportion of timely reporting: 10 out of 16 vaccine recipients (62.5%) reported within ≤24 hours, compared to only 1 out of 2 (50.0%) who did not receive the vaccine, and 46 out of 127 (36.2%) for whom vaccination was not applicable ($p=0.075$).

Importantly, none of the pre-exposure demographic or exposure-related factors showed significant associations with reporting timeliness. Age ($p=0.126$), gender ($p=0.547$), nationality ($p=0.840$), occupation ($p=0.554$), department ($p=0.340$), shift ($p=0.545$), weekend exposure ($p=0.515$), type of exposure ($p=1.000$), depth of injury ($p=0.763$), PPE use ($p=0.387$), source patient identification ($p=0.265$), and baseline HBsAb titer ($p=0.245$) were all non-significant. However, there was a notable trend for HCWs working in the Emergency Room, where 5 out of 7 (71.4%) reported within ≤24 hours, compared to the lowest timely reporting rate observed in the Outpatient Department (25.7%, 9 out of 35)-though this did not reach statistical significance ($p=0.340$).

Predictors of delayed reporting: multivariable logistic regression

Table 6 presents the univariate and multivariable logistic regression analysis for predictors of delayed reporting (>24 hours). After adjusting for shift, occupation, age, and PPE use, the overall model was not statistically significant ($\chi^2=6.196$, df=6, $p=0.402$), explaining only 5.7% of the variance in reporting timeliness (Nagelkerke $R^2=0.057$). The model correctly classified 61.4% of cases.

None of the evaluated pre-exposure predictors reached statistical significance in either univariate or multivariable analysis. Night shift workers had an adjusted odds ratio (AOR) of 1.46 (95% CI: 0.60-3.55, $p = 0.410$) for delayed reporting compared to day shift workers. Compared to physicians, nurses had an AOR of 0.66 (95% CI: 0.26-1.72, $p=0.398$), allied health workers had an AOR of 1.28 (95% CI: 0.38-4.36, $p=0.692$), and other occupations had an AOR of 0.95 (95% CI: 0.26-3.55, $p=0.944$). Age was not significantly associated with delayed reporting (AOR 1.04 per year; 95% CI 0.99-1.10; $p=0.111$).

Although PPE use was associated with a lower odd of delayed reporting (AOR 0.56, 95% CI: 0.16-1.97), this association did not reach statistical significance ($p=0.368$).

Post-exposure management variables (HIV PEP, HBIG, ID consultation, and hepatitis B vaccine) were excluded a priori from the multivariable logistic regression model, as they represent downstream consequences of the reporting process rather than baseline predictors of delayed reporting. However, their associations with delayed reporting were examined descriptively in Table 5 and demonstrate a consistent pattern: delayed reporting was strongly associated with the need for and receipt of PEP, HBIG, and infectious disease consultation, reflecting the clinical reality that HCWs who report late require more intensive management.

Table 1: Demographic and occupational characteristics of healthcare workers with occupational blood and body fluid exposures (n=145).

Characteristics	Category	Value, N (%)
Age (in years)	Mean±SD	32.61±7.08
	Median (IQR)	32 (9)
	Min-max	21-58
Gender	Male	37 (25.5)
	Female	108 (74.5)
Nationality	Saudi	85 (58.6)
	Non-Saudi	60 (41.4)

Continued.

Characteristics	Category	Value, N (%)
Occupation	Nurse	79 (54.5)
	Physician	24 (16.6)
	Allied Health	17 (11.7)
	Dentist	14 (9.7)
	Student	7 (4.8)
	Housekeeping	4 (2.8)
Department	Ward	43 (29.7)
	Outpatient department	35 (24.1)
	Operating room	20 (13.8)
	Intensive care unit	18 (12.4)
	Emergency room	7 (4.8)
	Laboratory	6 (4.1)
	Other	16 (11)
Shift at exposure	Day (07:00-19:00)	118 (81.4)
	Night (19:01-06:59)	27 (18.6)
Weekend exposure	Yes (Weekend)	10 (6.9)
	No (Weekday)	135 (93.1)

Table 2: Exposure characteristics and source patient serostatus among healthcare workers with occupational blood and body fluid exposures (n=145).

Characteristics	Category	N (%)
Type of exposure	Needlestick	128 (88.3)
	Splash to mucous membrane	14 (9.7)
	Sharp injury	3 (2.1)
Instrument type (if applicable), (n=131)	Needle	112 (85.5)
	Lancet	10 (7.6)
	Cannula	6 (4.6)
	Surgical blade	3 (2.3)
Depth of injury, (n=132)	Superficial	120 (90.9)
	Deep	12 (9.1)
PPE used	Yes	131 (90.3)
	No	14 (9.7)
Body part injured/exposed	Finger	104 (71.7)
	Hand	22 (15.2)
	Face and eye	14 (9.7)
	Arm	2 (1.4)
	Leg	2 (1.4)
	Thigh	1 (0.7)
First aid performed	Yes	145 (100)
	No	0 (0)
Source patient identified	Yes	123 (84.8)
	No	22 (15.2)
Source HIV status	Positive	1 (0.7)
	Negative	97 (66.9)
	Unknown	47 (32.4)
Source HBV status	Positive	8 (5.5)
	Negative	90 (62.1)
	Unknown	47 (32.4)
Source HCV status	Positive	1 (0.7)
	Negative	97 (66.9)
	Unknown	47 (32.4)

Table 3: Baseline laboratory testing results for exposed healthcare workers (n=145).

Variables	Category	Value
Baseline HBsAb titer (IU/L)	Mean±SD	588.50±416.05
	Median (IQR)	666 (877)
	Min- Max	2-1000

*All 145 HCWs tested negative for baseline HIV, HBsAg, and anti-HCV.

Table 4: PEP characteristics and follow-up adherence among healthcare workers with occupational exposures (n=145).

Variables	Category	N (%)
HIV PEP indicated	Yes	47 (32.4)
	No	98 (67.6)
HIV PEP started	Yes	26 (17.9)
	No	20 (13.8)
	N/A	99 (68.3)
HBIG indicated	Yes	3 (2.1)
	No	142 (97.9)
HBIG given	Yes	4 (2.8)
	No	113 (77.9)
	N/A	28 (19.3)
Hepatitis B vaccine given	Yes	16 (11)
	No	2 (1.4)
	N/A	127 (87.6)
Infectious disease consultation	Yes	30 (20.7)
	No	56 (38.6)
	N/A	59 (40.7)
6-week follow-up	Yes	55 (37.9)
	No	90 (62.1)
4-month follow-up	Yes	28 (19.3)
	No	117 (80.7)
6-month follow-up	Yes	16 (11)
	No	129 (89)
12-month follow-up	Yes	6 (4.1)
	No	139 (95.9)

Table 5: Comparison of demographic, exposure, and management characteristics by reporting timeliness (≤24 hours vs. >24 hours) among healthcare workers, (n=145).

Characteristics	Category	Reporting ≤24 h (n=57), N (%)	Reporting >24 h (n=88), N (%)	P value
Age (in years)	Median (IQR)	30 (8)	32.5 (10)	0.126†
Gender	Male	13 (35.1)	24 (64.9)	0.547
	Female	44 (40.7)	64 (59.3)	
Nationality	Saudi	34 (40.0)	51 (60.0)	0.840
	Non-Saudi	23 (38.3)	37 (61.7)	
Occupation	Nurse	35 (44.3)	44 (55.7)	0.554
	Physician	7 (29.2)	17 (70.8)	
	Allied Health	6 (35.3)	11 (64.7)	
	Others	9 (36.0)	16 (64.0)	
Department	Ward	20 (46.5)	23 (53.5)	0.340‡
	Outpatient department	9 (25.7)	26 (74.3)	
	Operating room	8 (40.0)	12 (60.0)	
	Intensive care unit	7 (38.9)	11 (61.1)	
	Emergency room	5 (71.4)	2 (28.6)	
	Laboratory	2 (33.3)	4 (66.7)	
	Other	6 (37.5)	10 (62.5)	
Shift at exposure	Day (07:00-19:00)	45 (38.1)	73 (61.9)	0.545
	Night (19:01-06:59)	12 (44.4)	15 (55.6)	
Weekend exposure	Yes (Weekend)	5 (50.0)	5 (50.0)	0.515‡
	No (Weekday)	52 (38.5)	83 (61.5)	
Type of exposure	Needle stick	51 (39.8)	77 (60.2)	1.000‡
	Splash to mucous membrane	5 (35.7)	9 (64.3)	
	Sharp injury	1 (33.3)	2 (66.7)	

Continued.

Characteristics	Category	Reporting ≤24 h (n=57), N (%)	Reporting >24 h (n=88), N (%)	P value
Depth of injury	Superficial	48 (40.0)	72 (60.0)	0.763‡
	Deep	4 (33.3)	8 (66.7)	
PPE used	Yes	53 (40.5)	78 (59.5)	0.387
	No	4 (28.6)	10 (71.4)	
Source patient identified	Yes	46 (37.4)	77 (62.6)	0.265
	No	11 (50.0)	11 (50.0)	
Source HIV status	Positive	1 (100.0)	0 (0.0)	0.565‡
	Negative	38 (39.2)	59 (60.8)	
	Unknown	18 (38.3)	29 (61.7)	
Source HBV status	Positive	4 (50.0)	4 (50.0)	0.843‡
	Negative	35 (38.9)	55 (61.1)	
	Unknown	18 (38.3)	29 (61.7)	
Source HCV status	Positive	1 (100.0)	0 (0.0)	0.566‡
	Negative	38 (39.2)	59 (60.8)	
	Unknown	18 (38.3)	29 (61.7)	
Baseline HBsAb titer (IU/L)	Median (IQR)	1000 (879)	536 (878)	0.245†
HIV PEP indicated	Yes	18 (38.3)	29 (61.7)	0.863
	No	39 (39.8)	59 (60.2)	
HIV PEP started	Yes	4 (15.4)	22 (84.6)	0.003
	No	13 (65.0)	7 (35.0)	
	NA	40 (40.4)	59 (59.6)	
HBIG indicated	Yes	0 (0.0)	3 (100.0)	0.279‡
	No	57 (40.1)	85 (59.9)	
HBIG given	Yes	0 (0.0)	4 (100.0)	<0.001‡
	No	29 (25.7)	84 (74.3)	
	NA	28 (100.0)	0 (0.0)	
Hepatitis B vaccine given	Yes	10 (62.5)	6 (37.5)	0.075‡
	No	1 (50.0)	1 (50.0)	
	NA	46 (36.2)	81 (63.8)	
Infectious disease consultation	Yes	7 (23.3)	23 (76.7)	<0.001
	No	42 (75.0)	14 (25.0)	
	NA	8 (13.6)	51 (86.4)	
6-week follow-up	Yes	26 (47.3)	29 (52.7)	0.125
	No	31 (34.4)	59 (65.6)	
4-month follow-up	Yes	10 (35.7)	18 (64.3)	0.665
	No	47 (40.2)	70 (59.8)	
6-month follow-up	Yes	7 (43.8)	9 (56.3)	0.700
	No	50 (38.8)	79 (61.2)	
12-month follow-up	Yes	4 (66.7)	2 (33.3)	0.212‡
	No	53 (38.1)	86 (61.9)	

*Chi- square test, ‡Fisher's exact test, †Mann-Whittney test

Table 6: Univariate and multivariable logistic regression analysis of factors associated with delayed reporting (>24 Hours) among healthcare workers with occupational exposures, (n=145).

Predictors	Crude OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Shift (Ref. Day)	1.30 (0.56-3.02)	0.546	1.46 (0.60-3.55)	0.410
Occupation (Ref. physicians)				
Nurses	0.71 (0.28-1.79)	0.465	0.66 (0.26-1.72)	0.398
Allied health	1.37 (0.41-4.54)	0.611	1.28 (0.38-4.36)	0.692
Other	1.03 (0.29-3.74)	0.963	0.95 (0.26-3.55)	0.944
Age (per year)	1.04 (0.99-1.10)	0.113	1.04 (0.99-1.10)	0.111
PPE used (Ref. No)	0.59 (0.18-1.98)	0.391	0.56 (0.16-1.97)	0.368

DISCUSSION

This study aimed to assess the timeliness of reporting of occupational exposures, quantify the median time from exposure to reporting, evaluate adherence to the PSMMC PEP Policy, and identify predictors of delayed reporting among healthcare workers with occupational exposures to BBFEs at PSMMC from January 2024 to December 2025. Our results showed a significant delay in reporting, with a median exposure-to-reporting interval of 504.30 hours (approximately 21 days), and only 39.3% of HCWs reported within the ≤24 hours institutional target. Baseline laboratory testing demonstrated excellent adherence (100% completion), but significant gaps were identified in HIV PEP initiation (55.3% of indicated cases), HBIG administration, infectious disease consultation, and follow-up attendance, with attendance declining dramatically from 37.9% at 6 weeks to 4.1% at 12 months. Notably, pre-exposure demographic and occupational factors did not predict delayed reporting in multivariable analysis, suggesting that reporting delays are a systemic issue rather than tied to individual HCW characteristics.

Exposure characteristics

Needlestick injuries were the most common among our cohort (88.3%), consistent with the report by Feng et al in which sharp injuries accounted for 84.6% of occupational exposures in a Chinese tertiary hospital, and Changraksa et al reported that needlestick injuries were the most common mechanism (54%) at Siriraj Hospital.[1,11] Likewise, Deva et al found 94% of exposures in their Indian cohort were needlestick injuries.[15] Our study found a high proportion of nurses affected (54.5%), which is consistent with the global literature, including Feng et al (47.2% nurses), Romero-Mora et al (35.6% nurses), and Changraksa et al (28.8% nurses).[1,10,11] This trend highlights the higher occupational risk for nursing staff performing most bedside procedures involving sharps.

In our study, the most common sites of exposure were wards (29.7%) and outpatient departments (24.1%), while in some international studies, operating rooms or emergency departments were the most common sites of exposure.[11,15] Yet, Al-Zahrani et al in their Saudi Arabian cohort, reported the highest injury rate (29.2%) among laboratory personnel, indicating differences in exposure risk across departments within healthcare settings.[13]

Reporting timeliness

The median delay between exposure and reporting in our study was 504.30 hours (approximately 21 days), which is alarmingly prolonged and far exceeds institutional targets. Fewer than 40% of HCWs reported within 24 hours, compared to 78% reported by Lahuerta et al.[16] In Tanzanian healthcare facilities, the average time to report was within 2 hours. This stark difference may reflect differences in institutional reporting culture, awareness of PEP protocols, and availability of occupational health services.

The high proportion of needlestick injuries among nurses in our cohort aligns with a recent cross-sectional study conducted at King Fahad Medical City in Riyadh, which identified nurses as the highest at-risk group, accounting for 49.9% of reported needlestick and sharps injuries.[17] Similarly, Alshammari et al reported that only 30.5% of healthcare workers in Saudi Arabia reported their needlestick injuries, with needle recapping identified as the leading cause.[18] These findings suggest that systemic barriers, rather than individual factors, are primarily responsible for the prolonged delays observed in our cohort.

The time-critical nature of HIV PEP makes the long reporting delays observed in our cohort particularly worrisome. Modeling studies by Zhang et al demonstrated that delays in initiating PEP beyond 24-48 hours significantly diminish the preventive benefit of PEP and that early initiation is crucial to decrease the risk of HIV transmission.[5] Delays in reporting jeopardize the effectiveness of PEP and increase the risk of preventable infections among HCWs.

The delays are likely to be due to several factors, including working outside normal hours, a lack of knowledge of reporting procedures, incomplete documentation, and work-related barriers, as previously identified by Liu et al and Shulakova et al.[6,7] Likewise, Takougang et al revealed that lack of knowledge (79%) and patient agitation (49%) were the most common reasons for exposure.[8] Most workers (62%) did not report any exposures. The results highlight the need for more targeted educational interventions and streamlined reporting systems.

PEP administration

The low rate of only 55.3% of indicated cases starting HIV PEP is a major concern. This rate was higher than 28.7% reported by Changraksa et al among HCWs at risk for HIV acquisition at Siriraj Hospital but lower than 50.8% reported by Takougang et al in Cameroon.[8,11] Low initiation rate in our cohort might be due to HCW reluctance to take PEP due to concerns about side effects, as reported by Changraksa et al where gastrointestinal intolerance was observed in nearly half of those receiving an LPV/r-based regimen and switched to second-line regimens.[11] The suboptimal PEP initiation rate in our cohort (55.3% of indicated cases) aligns with a recent systematic review which concluded that the use of PEP among healthcare workers in highly endemic regions remains suboptimal, with barriers operating at both the individual HCW and health facility levels.[19]

Hepatitis B vaccination and seroprotection

At baseline, HBsAb testing yielded a median titer of 666 IU/l, and most HCWs had protective immunity. Romero-

Mora et al however, reported that only 40.5% of exposed HCWs had protective titers and that there was poor concordance between self-reported vaccination and actual serology (kappa=0.02).[10,13] Our findings indicate relatively better vaccination coverage at PSMMC. However, the administration of the hepatitis B vaccine in 11% of indicated cases indicates gaps in vaccination protocols.

Follow-up adherence

A significant weakness in the PEP management pathway is the steep decline in follow-up attendance, from 37.9% at 6 weeks to 4.1% at 12 months. Similar findings were reported by Changraksa et al with follow-up serology at 1 and 3 months of 77.6% and 38.8%, respectively.[11] Our 12-month follow-up rate of 4.1% is much lower than the 6-month re-evaluation rates reported by Liu et al who found that nursing staff had higher 6-month re-evaluation rates than non-nursing staff.[6] The progressive loss to follow-up compromises the ability to detect seroconversion and complete post-exposure management.

Infectious disease consultation

Infectious disease consultation was performed in only 20.7% of cases, which is concerning given the complexity of PEP decision-making and the need for individual-level risk assessment. The high correlation between delayed reporting and ID consultation ($p<0.001$) suggests that ID consultations were preferentially made in cases with delayed reporting, perhaps because these cases required more intensive management and source patient evaluation.

Interestingly, we observed that delayed cases were more likely to receive infectious disease consultation and PEP. This creates a paradoxical situation where HCWs who report early may receive less thorough risk assessment.[17] To ensure equitable care, protocols must guarantee that every exposed HCW regardless of reporting time undergoes standardized evaluation and management. This paradox warrants further investigation through qualitative studies exploring HCWs' perceptions of the reporting process and the factors that influence consultation decisions.

Predictors of delayed reporting

However, none of the demographic or occupational pre-exposure factors assessed were significant predictors of delayed reporting in the multivariable analysis, contrary to our hypothesis. Night shift workers had an adjusted odds ratio of 1.46 (95% CI: 0.60-3.55, $p=0.410$) for delayed reporting, which was non-significant. This is contrary to the findings of Avnisha et al who reported younger age and female gender as risk factors for needlestick injuries, and of Al-Zahrani et al who reported male gender and laboratory personnel as significant predictors of sharp-object injuries.[13,20] However, it is essential to note that these studies focused on risk factors for exposure rather than for reporting delays.

The absence of significant predictors in our cohort indicates that reporting delays are systemic and not attributable to specific HCW characteristics. Factors such as organizational culture, accessibility of OHS, awareness of reporting protocols, and fear of consequences may be more influential than individual demographic or occupational characteristics. Similarly, Oh et al found that organizational factors, such as infection surveillance and control programs, significantly affected compliance with infection prevention protocols.[9]

Strengths and limitations

There are several important strengths to this study. First, it provides the first systematic evaluation of timeliness and guideline concordance in the PEP management pathway at PSMMC and provides an in-depth baseline for quality improvement initiatives. Second, the inclusion of all eligible cases over a 24-month period (n=145) ensures adequate representation of the affected HCW population. Third, the timestamped data enabled accurate computation of exposure-to-reporting delays and, thus, an accurate assessment of timeliness. Fourth, the data collection instrument was comprehensive, including different elements of the PEP pathway, including demographic characteristics, exposure details, source patient status, baseline laboratory testing, PEP administration and adherence to follow-up, providing a complete picture of the management process.

But there are some limitations worth mentioning. First, the retrospective design relies on the accuracy and completeness of existing medical records, which are subject to documentation errors and missing data. Second, the study was conducted at a single tertiary-care military hospital, which may limit the generalizability of the findings to other healthcare settings in Saudi Arabia or globally. Third, the 72-hour PEP timeliness measure was not calculable because timestamps for risk assessment and PEP initiation were missing, a critical data gap that underscores the need for improved electronic documentation systems.

Fourth, the low number of cases for some variables (e.g., indication for HBIG, source of HIV positivity) limited the statistical power for subgroup analyses and may have resulted in non-significant findings due to type II errors. Fifth, reasons for delayed reporting or non-adherence were not evaluated in this study and would need qualitative or survey-based methodologies. Sixth, the follow-up rates at later time points (4, 6 and 12 months) were very low, limiting the ability to draw definitive conclusions about long-term outcomes and seroconversion rates.

Lastly, the multivariable logistic regression model had limited explanatory power (Nagelkerke $R2=0.057$, 61.4% classification accuracy), suggesting that unmeasured factors such as organizational culture, awareness of PEP protocols, perceived risk, fear of consequence, and accessibility of OHS may be more important determinants of reporting timeliness than the demographic and occupational variables that we included in our model.

CONCLUSION

This study highlights considerable gaps in the occupational exposure management pathway at PSMMC, including late reporting, low PEP initiation rates, and low follow-up adherence. The median delay from exposure to reporting was 504.3 hours (21 days), and only 39.3% of HCWs reported within 24 hours, highlighting the inadequacy of current systems in ensuring timely PEP administration. The high rate of baseline laboratory testing completion (100%) contrasts starkly with poor follow-up attendance (4.1% in 12 months), indicating that initial management is good, but continuity of care is exceedingly poor.

This study provides novel evidence that reporting delays in our setting are systemic rather than individual. The absence of demographic predictors implies that improving timeliness requires system-level solutions simplifying reporting forms, offering 24/7 access to occupational health, and fostering a non-punitive reporting culture. Without such changes, the effectiveness of PEP will remain compromised, and HCWs will continue to face preventable risks of bloodborne infections.

Additionally, delayed reporting was associated with HIV PEP initiation ($p=0.003$), HBIG administration ($p<0.001$), and ID consultation ($p<0.001$). These strong associations suggest that delayed cases are treated more intensively, consistent with the clinical reality that late reporters may be higher-risk exposures and require more comprehensive intervention. Importantly, the lack of significant demographic or occupational predictors of delayed reporting suggests that reporting delays are more systemic than related to specific HCW characteristics and that interventions should be targeted at organizational and cultural factors rather than specific HCW subgroups.

Urgent improvements are needed in the timeliness and quality of occupational exposure management by enhancing electronic documentation systems, educational interventions, simplified reporting mechanisms, and strong reminder systems for follow-up attendance. Bridging these gaps is essential to protect HCWs from preventable infections and to meet organizational goals for infection prevention.

Future research using mixed-methods approaches is urgently needed to explore HCWs' perceptions of barriers to reporting and follow-up, and to co-design interventions that address the specific cultural and organizational context of military healthcare in Saudi Arabia. Implementing electronic reporting systems and automated reminder systems, as recommended in recent literature, could address many of the systemic barriers identified in our study.

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