

Determinants of occupational exposure to blood and body fluids, healthcare workers' risk perceptions and standard precautionary practices: A hospital-based study in Addis Ababa, Ethiopia

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Abstract

Background: The risk of occupational exposure to blood-borne infections is on the rise in hospital settings. The situation is worse in developing countries for a variety of reasons, such as poor working condition, excessive injection use, and poor adherence towards universal precautions. This study was undertaken to assess the determining factors of occupational exposures to blood-borne infections, as well as to describe healthcare workers' risk perceptions and standard precautionary practices in selected hospitals in Addis Ababa, Ethiopia.

Methods: A cross-sectional study was conducted from December 2016 to January 2017. A total of 323 healthcare workers from four public hospitals were selected for the study using a simple random-sampling technique. Structured questions administered by an interviewer were used to collect data. Multivariable binary logistic regression was used to identify the determining factors.

Results: Healthcare workers' lifetime and one-year prevalence of needlestick injuries were 39.0% (95% CI: 33.6-44.8) and 19.9% (95% CI: 15.2-24.5), respectively. The lifetime and one-year prevalence of blood and body fluid exposures were 42.6% (95% CI: 36.8-48.4) and 29.2% (95% CI: 23.8-34.7), respectively. Almost three out of five healthcare workers, 62.8% (95% CI: 57.0-68.9) had adequate risk perception, and 41.2% (95% CI: 35.4-46.9) adopted good standards of precautionary practice. Service year (AOR: 2.40; 95% CI: 1.00-5.77) and having poor standards of precautionary practice (AOR: 2.30; 95% CI: 1.18-4.46) were the determinants of needlestick injuries.

Conclusions: The high prevalence of occupational exposure and healthcare workers' sub-optimal practice of taking standard precautions seemed to be common. Long-term and in-service, focused, short-term training were found to be helpful in increasing awareness of the risks and reducing exposure to them. [*Ethiop. J. Health Dev.* 2019;33(1):4-11]

Key words: Blood and body fluid exposure; needlestick injuries; risk perception; standard precautions; Ethiopia

Background

Healthcare workers (HCWs) are at risk of occupationally-acquired infections as they perform their clinical activities in hospitals, including exposure to blood-borne viral infections such as human immunodeficiency virus (HIV) and hepatitis B and C virus (HBV and HCV) from sharps injuries and contact with body fluids (1,2). The most likely means of transmission of these viruses to HCWs is by direct percutaneous inoculation of infected blood by a sharps injury or via blood splashing onto broken skin or mucous membranes (3-5). The risk of transmission from an infected patient after such an injury has been shown to be one in three when a source patient is infected with HBV and is e-antigen positive, one in 30 when the patient is infected with HCV, and one in 300 when the patient is infected with HIV (3). According to World Health Organization (WHO) estimates, about 3 million HCWs face occupational exposure to blood-borne viruses each year (2 million to HBV, 900,000 to HCV, and 300,000 to HIV), and 90% of the infections that result from these exposures are in low-income countries (6,7).

Developing countries, which account for the highest prevalence of HIV-infected patients in the world, also record the highest rate of occupational infections, including from needlestick injuries (8). In Sub-Saharan

Africa, high incidences of occupational exposures have been reported in recent years; moreover, HCV and HBV infections are generally considered endemic in the region (9). Applying standard precautions (SPs) is an effective means of preventing both occupational exposure incidents and associated infections, as they are designed for the care of all patients, regardless of whether or not they are infected, and apply to blood and all other body fluids, secretions and excretions (except sweat) (5,8). However, studies extensively report non-uniform adherence to SPs among HCWs in many developing countries (6,10-13).

In Ethiopia, infection prevention and patient safety in healthcare settings is a nationwide initiative that involves the regular implementation of recommended SP practices in every aspect of patient care (5). However, the progress of attaining safe practice in hospitals is inadequate, and the lack of compliance with SPs is of great concern (10,11). HCWs are exposed to the major risk of transmission of infections such as HIV and hepatitis viruses (14-19). Previously conducted studies indicate that the prevalence of HCWs' exposure to blood or body fluids ranges from 20.2% (12) to 60.2% (16), and needlestick injuries from 17.5% (12) to 42.8% (20). An earlier study conducted by Feleke in Addis Ababa hospitals reports

a high prevalence of sharps injuries among HCWs, where the lifetime proportion was 66.6%, although the study was restricted to sharps injuries and did not assess the prevalence or determining factors of blood and body fluid exposure among HCWs (21). HCWs' risk perception of occupational exposure is scarcely addressed in previously conducted studies, despite the significant increase in HCWs' exposure to blood-borne pathogens (11,12,16-21). Accordingly, there is a paucity of information regarding the determining factors of occupational exposure, HCWs' risk perceptions and SP practices, particularly in relation to the situation in Ethiopia. The current study seeks to redress this paucity of information.

Methods

Study design, setting and population: A cross-sectional study was employed from 15 December 2016 to 13 January 2017 to assess the determining factors of HCWs' occupational exposure in four randomly selected government hospitals in Addis Ababa, Ethiopia: St. Paul's Hospital Millennium Medical College, Yekatit 12 Hospital Medical College, Menelik II Referral Hospital, and Ras Desta Damtew Memorial General Hospital. At the time of the study, there were 1,431 full-time HCWs in the selected hospitals.

Sample size and sampling procedure: The sample size was determined using Epi Info version 7.1.1.14 (software designed by the Centers for Disease Control and Prevention in Atlanta, Georgia, USA) using a single population proportion formula with the assumptions of 95% confidence level and 5% precision. The sample size was calculated considering prevalence of one-year blood and body fluid splash (60.2%; $n = 368$) (16). Furthermore, to identify predictors of the outcome variable, similar software for two-population proportion formula for the comparative cross-sectional design was used. Then, the largest sample size ($n = 368$) calculated, using a single population proportion formula, was used to address all objectives.

Since the source population was less than 10,000, it needed a finite population correction and the final sample size (n_f) of the study was $n_f = 323$, including a 10% non-response rate. The sample size was allocated to each hospital, proportional to the number of HCWs they employed, and from a sampling frame obtained from each hospital human resources department that contained a list of HCWs, participants were selected using a simple random-sampling technique. HCWs on annual and maternity leave were excluded.

Data collection procedures: Three trained nurses collected data by conducting face-to-face interviews with participants and asking them questions from a pre-tested and structured questionnaire. The data collection tool was adopted from previously used materials (14,16). First, the tool was prepared in English, translated into Amharic (local language), then back-translated into English to ensure consistency. To enhance the validity of data collection, the tool was

pre-tested on 10% of the actual sample size in a different hospital. Training was given to data collectors and supervisors. On-the-spot supervision was carried out during the data collection. In addition, double data entry was carried out using Epi-Data 3.1 software.

Measurements: The standard precautions (SPs) survey questionnaire contained seven item domains: hand hygiene, use of personal protective equipment (PPE), instrument decontamination practice, safe injection practice, cough etiquette, and proper healthcare waste management practice. A three-point Likert scale was used to assess SP practice. A score of 3 was assigned for 'always', and a score of 1 and 0 for 'sometimes' and 'never' responses, respectively. Hence, the total score for the SP practice ranged from 0 to 21. Subsequently, a composite score was computed and a mean was calculated. HCWs who scored equal or above the mean value were considered to have good SP practice and those who scored less than the mean were judged to have poor SP practice. HCWs' risk perception (perceived susceptibility) of occupational exposure was measured by 10 items and presented in a five-point Likert scale ranging from 'not sure = 1' to 'very high risk = 5'. The total score for each participant ranged from 10 to 50. HCWs who scored equal or above the mean value were considered to have adequate risk perception toward occupational exposure; those who scored below the mean had inadequate risk perception (22).

Operational definitions: Occupational exposure: exposure of HCWs to needlestick injuries and blood and other body fluids in the course of their work (12).

Standard precautions: basic levels of standards or guidelines designed to create a barrier between micro-organisms and a person to prevent the spread of infection and applied for the care of all patients regardless of whether or not they are infected (16).

Risk perception: HCWs' perceived risk or opinion about acquiring occupational injury (such as needlestick or sharps injury) or exposure to blood/body fluids while on duty.

Data analysis: The collected data were cleaned, coded and entered into Epi-Data 3.1 software and analysis was done using SPSS version 20.0 statistical software. Descriptive statistics were computed. Bivariate logistic regression analysis was employed to determine the crude association between outcomes and independent variables. To avoid an excessive number of variables and unstable estimates, variables with a p -value ≤ 0.25 at bivariate model were further considered in the multivariable logistic regression model. Lastly, the multivariable binary logistic regression was used to identify the determinants of occupational exposure, using the adjusted association between occupational exposure and the exposure variables. Adjusted odds ratios (AORs) with a corresponding 95% confidence interval (CI) were estimated to assess the strength of association, and a p -value ≤ 0.05 was considered for all statistically significant tests as a cut-off point.

Ethical considerations: The study was reviewed by Addis Ababa city government health bureau Institutional Review Board (IRB) and ethical clearance also obtained from the IRB of St. Paul's Hospital Millennium Medical College. Permission was obtained from directors at each of the hospitals. Written consent was obtained from each HCW in a form provided with the questionnaire, after they were informed about the study. Confidentiality of the information was assured.

Results

Socio-demographic characteristics of healthcare workers: A total of 277 HCWs participated in the study, with a response rate of 85.7%. The mean (standard deviation (SD)) age and number of service years of HCWs were 31(SD= 6.9) and 4.09 (SD= 3.29), respectively (Table 1).

Table 1: **Socio-demographic characteristics of healthcare workers who participated in the survey in hospitals of Addis Ababa, Ethiopia, December 2016 to January 2017 (n = 277)**

Variables	Number of HCWs	%
Sex		
Female	164	59.2
Male	113	40.8
Age group (years)		
<25	53	19.1
25-30	117	42.2
31-35	51	18.4
36-40	21	7.6
≥ 40	35	12.6
Profession		
Nurses and midwives	200	72.2
Physicians	45	16.2
Health officers, laboratory technicians and others*	32	11.6
Department/ward		
Internal medicine, surgical and pediatrics	105	37.9
OPD, E-OPD and triage	61	22.0
OT, minor-OT, gynecology and obstetrics	54	19.5
Laboratory and other**	57	20.6
Level of education		
Diploma	54	19.5
First degree and above	223	80.5
Year of service in the current hospital		
≤ 5	184	66.4
>5	93	33.6
Marital status		
Single	169	61.0
Married	108	39.0
Ever had infection prevention training?		
Yes	147	53.1
No	130	46.9
Hospital type		
Teaching	181	65.3
Referral	53	19.1
General	43	15.5

OPD = Outpatient department, E-OPD = Emergency outpatient department, OT = Operating theater, MCH= Maternal and child health, ART= Antiretroviral treatment, TB= tuberculosis

* Anesthesiologist, dentist and dermatologist

** Dressing and injection room, dental clinic, MCH clinic, ART clinic, TB clinic

Risk perception: A total composite score of HCWs' risk perceptions showed that 174 (62.8%) (95% CI: 57.0-68.9) of HCWs had adequate risk perception of occupational exposures, whereas 103 (37.2%) (95% CI: 31.1-43.0) of HCWs had inadequate risk perception.

Self-reported standard precaution practice: HCWs were asked about certain aspects of standard precautions and their compliance with these procedures. In total, 114 (41.2%) (95% CI: 35.4-46.9) had good SP practice, while 163 (58.8%) (95% CI: 53.1-64.6) had poor practice.

Prevalence and circumstances of occupational exposure status: The self-reported lifetime prevalence of at least one needlestick injury and blood and body fluid splash on mouth or eyes among HCWs was 39.0% (95% CI: 33.6-44.8) and 42.6% (95% CI: 36.8-48.4), respectively. The previous one-year prevalence of needlestick injury and blood and body fluid exposure were 19.9% (95% CI: 15.2-24.5) and 29.2% (95% CI: 23.8-34.7), respectively. In addition, 22.0% (95% CI: 17.0-27.1) of the HCWs reported that they were experienced glove breakage/perforation in the past six months while performing an invasive procedure.

Determining factors associated with healthcare workers' needlestick injuries and occupational exposure to blood and body fluids: Multivariable logistic regression analysis was conducted to assess the independent determining factors of occupational exposure. In the final model, the results showed that HCWs who had less five years work experience were 2.4 times more likely to get a needlestick injury compared to those who had equal and more than service year (AOR: 2.40; 95% CI: 1.00-4.46). In

addition, HCWs who had poor SP practice were almost two times more likely to get a needlestick injury compared to those who had good practice (AOR: 2.30; 95% CI: 1.13-4.46) (Table 2). Regarding HCWs' blood and body fluid splash, only marital status showed a significant association (AOR: 1.94; 95% CI: 1.18-3.41) (Table 3). An association was also observed between HCWs' needle-recapping practice and previous one-year needlestick injury (Fisher Exact test, p-value \leq 0.05).

Table 2: Association between healthcare workers' needlestick injuries and determinant variables in hospitals of Addis Ababa, Ethiopia, December 2016 to January 2017 (n = 277)

Characteristics	Needlestick injury in past one year		Crude OR (95%CI)	Adjusted OR (95%CI)
	Yes = 55 (%)	No = 222 (%)		
Sex				
Male	24 (43.6)	89 (40.1)	1.15 (0.63-2.10)	
Female	31 (56.4)	133 (59.9)	1	
Age				
<30	41 (74.5)	129 (58.1)	2.11 (1.08-4.09)*	
\geq 30	14 (25.5)	93 (41.9)	1	
Year of service in the current hospital				
<5	48 (87.3)	160 (72.1)	2.65 (1.14-6.18)*	2.40(1.00-4.46)**
\geq 5	7 (12.7)	62 (27.9)	1	1
Profession				
Physicians	8 (14.5)	37 (16.7)	1.16 (0.34-3.96)	
Nurses and midwives	42 (76.4)	158 (71.2)	1.43 (0.52-3.95)	
Health officers, laboratory technicians and others	5 (9.1)	27 (12.2)	1	
Educational level				
Diploma	14 (25.5)	40 (18.0)	1.55 (0.77-3.11)	
First degree and above	41 (74.5)	182 (82.0)	1	
Hospital				
Teaching	34 (61.8)	147 (66.2)	0.59 (0.27-1.28)	
Referral	9 (16.4)	44 (19.8)	0.52 (0.19-1.40)	
General	12 (21.8)	31 (14.0)	1	
Department/ward				
Medical, surgical and pediatrics	9 (16.4)	52 (23.4)	0.58 (0.22-1.50)	
OPD, E-OPD and triage	23 (41.8)	82 (36.9)	0.94 (0.43-2.05)	
OT, minor-OT, gynecology and obstetrics	10 (18.2)	44 (19.8)	0.76 (0.30-1.93)	
Laboratory and other	13 (23.6)	44 (19.8)	1	
Ever had training on infection prevention?				
Yes	21 (38.2)	126 (56.8)	1	1
No	34 (61.8)	96 (43.2)	2.12 (1.16-3.89)*	1.83 (0.97-3.44)
Risk perception				
Adequate	34 (61.8)	140 (63.1)	1	
Inadequate	21 (38.2)	82 (36.9)	1.05 (0.57-1.93)	
Standard precaution practice				
Good	15 (27.3)	99 (44.6)	1	1
Poor	40 (72.7)	123 (55.4)	2.14 (1.12-4.11)*	2.30 (1.18-4.46)**

OR = odds ratio, * (p<0.05) crude, ** (p<0.05) adjusted

Table 3: Association between healthcare workers' occurrence of blood and body fluid splash in past one year and determinant variables in hospitals of Addis Ababa, Ethiopia, December 2016 to January 2017 (n = 277)

Characteristics	Blood and body fluid splash in past one year		Crude OR (95%CI)	Adjusted OR (95%CI)
	Yes = 81 (%)	No = 196 (%)		
Sex				
Male	34 (42.0)	79 (40.3)	1.07 (0.63-1.81)	
Female	47 (58.0)	117 (59.7)	1	
Age				
<30	53 (65.4)	117 (59.7)	1.27 (0.74-2.19)	
≥30	28 (34.6)	79 (40.3)	1	
Marital status				
Single	58 (71.6)	111 (56.6)	1.93 (1.10-3.37)*	1.94 (1.10-3.41)**
Married	23 (28.4)	85 (43.4)	1	1
Service year				
<5	65 (80.2)	143 (73.0)	1.50 (0.80-2.83)	
≥5	16 (19.8)	53 (27.0)	1	
Profession				
Physician	13 (16.0)	32 (16.3)	1.21 (0.43-3.40)	
Nurses and midwives	60 (74.1)	140 (71.4)	1.28 (0.54-3.02)	
Health officers, laboratory technicians and others	8 (9.9)	24 (12.2)	1	
Department/ward				
OPD, E-OPD and triage	18 (22.2)	43 (21.9)	0.90 (0.41-1.98)	
Medical, surgical and pediatrics	32 (39.5)	73 (37.2)	0.95 (0.47-1.90)	
OT, minor-OT, gynecology and obstetrics	13 (16.0)	41 (20.9)	0.68 (0.29-1.58)	
Laboratory and other	18 (22.2)	39 (19.9)	1	
Educational level				
Diploma	21 (25.9)	33 (16.8)	1.72 (0.92-3.22)	1.74(0.93-3.28)
First degree and above	60 (74.1)	163 (83.2)	1	1
Hospital				
Teaching	54 (66.7)	127 (64.8)	1.60 (0.72-3.57)	
Referral	18 (22.2)	35 (17.9)	1.94 (0.76-4.91)	
General	9 (11.1)	34 (17.3)	1	
Ever had infection prevention training?				
Yes	38 (46.9)	109 (55.6)	1	
No	43 (53.1)	87 (44.4)	1.41 (0.84-2.38)	
Risk perception				
Adequate	57 (70.4)	117 (59.7)	1	
Inadequate	24 (29.6)	79 (40.3)	1.60 (0.92-2.79)	
Standard precaution practice				
Good	32 (39.5)	82 (41.8)	1	
Poor	49 (60.5)	114 (58.2)	0.91 (0.53-1.54)	

OR = odds ratio, * (p<0.05) crude, ** (p<0.05) adjusted

Discussion

Needlestick injuries and blood and body fluid exposures are serious occupational risks for HCWs. The present study detected a high level of self-reported needlestick injuries and blood and body fluid exposures among HCWs. The lifetime and one-year prevalence of needlestick injuries were 39.0% and 19.9%, respectively. The lifetime and one-year prevalence of blood and body fluid exposures were 42.6% and 29.2%, respectively. In the present study, factors associated with higher odds of acquiring needlestick injuries are year of service and having poor SP practices.

SPs are designed for the care of all patients regardless of whether they are infected. Their implementation is aimed at reducing the risk of transmitting micro-organisms from known or unknown sources of infection within the healthcare system (12,13). Despite the simplicity and clarity of these precautions, the

practice among HCWs in a clinical setting is poor, especially in resource-limited settings (11,23,24). Equally, non-compliance with specific standards on the use of equipment, wearing PPE, and disposing of sharp objects can play a pivotal role in increasing the possible risk of needlestick injuries (25,26). This study also detected sub-optimal SP practice among HCWs: only two fifths (41.2%) of HCWs had good SP practice. Hence, the majority of the HCWs in the hospitals studied had poor adherence to SPs. The current finding also in line with many related studies in north Ethiopia 42.9% (16), West Arsi, 36.3% (11) and Addis Ababa (23). The level of SP practice in the current study is also similar to levels identified in studies conducted in Nigeria (27), China (28) and Iran (29). On the other hand, the proportion of good SP practice (41.2%) among HCWs in the current study is lower than a study report in facilities in east Ethiopia (80.8%) (12). This discrepancy may be due to the

difference in study setting and sample size, since the latter study included 10 hospitals and 20 health centers.

The present study detected a high level of occupational exposure among HCWs. The prevalence of one-year needlestick injuries among HCWs was 19.9%, which is in line with studies conducted in northwest Ethiopia (19.5%) (30), east Ethiopia (17.5%) (12) and north Ethiopia (22.2%) (16). In addition, the present finding is similar to a study report from the United Arab Emirates (19%) (31), and lower than that of study reports from southern Ethiopia (30.9%) (32), north Ethiopia (31.5%) (33), northwest Ethiopia (39.3%) (19), Bahir Dar (42.8%) (20) and University of Alexandria hospitals in Egypt (67.9%) (34). The discrepancies might be due to differences in study design, sample size, and the socio-demographic characteristics of HCWs. Variations in SP practice and dissimilar healthcare facilities may be other reasons for discrepancies.

The prevalence of blood and body fluid exposures in the past 12 months before the study was 29.2%, implying that HCWs in the study hospitals were at risk of contracting blood-borne diseases due to blood and body fluid exposures. The past 12-month prevalence in this study was much lower than for HCWs in public health facilities in Mekelle special zone (Ethiopia) – 60.2% (16); six hospitals in Tigray Region (Ethiopia) – 56.3% (17); and four health facilities Amhara Region (Ethiopia) – 35.10% (33). The possible reason for this variation might be due to different study settings. For example, the study in Mekelle assessed five public health centers (16). Different SP practices among HCWs might be another possible reason for the different findings.

In contrast, the prevalence of blood and body fluid exposures in the current study is high compared to a study report from Gondar (Ethiopia) – 22.9% (35) and a report from east Ethiopia – 20.2% (12). The discrepancy may be due to dissimilarities in HCWs' SP practice, as well as study design differences.

In the present study, it was noted that recapping needles after use was positively associated with HCWs' needlestick injuries. This finding is reported in other research (36).

As shown in bivariate logistic regression analysis, HCWs who received no infection prevention training were more likely to have needlestick injuries compared with those who received the training. Other studies report similar findings (12,33,37). However, in multivariable logistic regression analysis this association is disappeared. Additionally, HCWs with poor SP practice were two times more likely to acquire needlestick injuries compared to those with good SP practice. In this regard, compliance with SPs is one of the key strategies to safeguard HCWs from the potential risk of needlestick and sharps injuries (33,38,39).

Regarding HCWs' risk perception, almost three out of five (62.8%) had adequate risk perception of occupational exposures. This finding is in line with other related studies (21,40). Having adequate risk perception was not found to be statistically significant in the multivariable analysis in this study. However, the odds ratio (OR) in bivariate logistic regression analysis suggests that inadequate risk perception was associated with higher odds of having needlestick injuries and blood and body fluid splash exposure. If the sample size had been larger, this could have been statistically significant. Hence, paying attention to enhance HCWs' risk perception is decisive to attain a significant decline in occupational exposure among HCWs.

Conclusions:

The prevalence of needlestick injuries and blood and body fluid exposures among HCWs were high. Sub-optimal SP practices among HCWs seemed to be common. Moreover, there was inadequate risk perception among a considerable number of HCWs. Seniority less than five years and having poor SP practices were determinants of needlestick injuries. The findings highlight the need to improve occupational health and safety measures in all of the hospitals. Long-term and in-service, focused, short-term training, such as on-the-job training for HCWs, was found to be helpful to reduce occupational exposure and to increase awareness of SPs. In addition, enhancing HCWs' risk perception is equally important.

Limitations of the study

The present study has several limitations, mainly the use of 'mean' as a cut-off point for dependent variables, which might have under- or over-estimated the results. The sample size used might not have been sufficient to detect the occurrence of independent variables in the final model, which were found to be not statistically significant. Hence, readers should exercise caution when interpreting the findings. In future, researchers are advised to plan better study design and hence reduce bias.

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