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Needle-stick injuries and splash exposures among health-care workers at a tertiary care hospital in north-western Tanzania

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Abstract
Background: Needle-stick injuries (NSIs) and splash exposures carry a risk of occupational acquisition of HIV and other blood borne pathogens to healthcare workers (HCWs) involved in clinical care. This study was carried out to determine the frequency and factors contributing to NSIs and splash exposures as well as post-exposure practices among HCWs in our centre.
Methods: This was a cross-sectional study among healthcare workers which was conducted at Bugando Medical Centre (BMC) over a one-year period between April 2013 and March 2014.
Results: Out of 436 HCWs who participated in this study, 212 (48.6%) reported incidents of NSIs and splash exposures within the previous 12 months. NSIs were reported by 65.1% (n= 138) and splash exposures by 27.4% (n = 58). Sixteen (7.5%) respondents had both NSIs and splash exposures. High rates of NSIs were observed among nurses (71.0%), during procedures (53.6%) and occurred commonly in the Accident and Emergency department (33.3%). Hollow bore needles were responsible for 63.8% of NSIs. Splash exposures occurred more commonly in operating theatre (41.4%). At the time of the exposure, 116 (54.7%) HCWs wore protective equipment. The most common action following exposure was washing the site with soap and water (55.6%). Only 68 (32.1%) reported the incident of exposure to the relevant authority. Healthcare workers aged ≤ 40 years; those with work experience of ≤ 5 years and those not trained on issues related to infection prevention and occupational risk reduction were more likely to be exposed to any type of occupational injuries studied. While male healthcare workers were less likely to be exposed to NSIs, female were more likely to encounter both NSIs and mucocutaneous splashes ($p < 0.001$). The majority of HCWs, 185 (87.3%) were not adequately immunized for hepatitis B virus and only 17 (8.0%) were fully vaccinated, having received three doses of the vaccine. Only 16.7% of exposed HCWs received post-exposure prophylaxis for HIV. Subsequent six-month follow-up for HIV showed zero seroconversion.
Conclusion: NSIs and splash exposures are common among HCWs at our centre and are under-reported. Post-exposure management is generally poor. All HCWs should be trained on issues related to infection prevention and occupational risk reduction. The hospital should establish surveillance system for registering, reporting and management of occupational injuries and exposures.

Keywords: Needle-stick injuries, splash exposures, healthcare workers, HIV, Hepatitis virus, Tanzania

Introduction

Needle-stick injuries and splash exposures to mucocutaneous membranes constitutes a significant risk of transmission of HIV and other blood borne pathogens to healthcare workers (Wilburn & Eijkemans, 2004; Lee, *et al*., 2005; Amira & Awobusuyi, 2014). Health care workers are at risk of various occupational hazards in the hospital, including exposure to blood borne infections such as HIV and hepatitis B and C virus from accidental needle-stick injuries and mucocutaneous exposure to blood and other body fluids (Pruss *et al*., 2005; Lee, *et al*., 2005; Amira & Awobusuyi, 2014). HIV transmission in particular is a major threat in the workplace due to the serious consequences it has

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on the affected worker. (Wilburn & Eijkemans, 2004; Ansa *et al*., 2004; Bi *et al,* 2006). Occupational risks associated with exposure affects the quality of care delivered as well as health-care workers safety and wellbeing (Sagoe-Moses *et al*., 2001; Ansa *et al*., 2004; Bi *et al,* 2006). As a result exposed workers experience significant fear, anxiety and emotional distress that can result in occupational and behavioural changes (Lee *et al*., 2005; Amira & Awobusuyi, 2014). The prevalence of needle-stick injuries and splash exposures varies greatly across different countries and within the same country. Globally, needle-stick injuries are the most common source of occupational exposures to blood which result in transmission of blood-borne infections (Sagoe-Moses *et al*., 2001; Amira & Awobusuyi, 2014). The World Health Organization estimates that 3 million percutaneous exposures occur annually among 35 million healthcare workers globally; over 90% occurring in resource constrained countries (Wilburn & Eijkemans, 2004; Pruss *et al*., 2005; Amira & Awobusuyi, 2014). Health-care workers in Africa suffer two to four needle-stick injuries per year on average (Nsubuga & Jaakola, 2005) with Nigeria, Tanzania and South Africa reporting 2.1 injuries per healthcare workers on average (Rabbits, 2003; Manyele *et al*., 2008; Efetie & Salami, 2009; Mbaisi *et al*., 2013). Worldwide, it is estimated that about 2.5% of HIV cases and 40% of HBV and HCV cases among healthcare workers occur as a result of these occupational exposures (Prüss-Üstün *et al*., 2003; Logez *et al*., 2005). Each year as a consequence of occupational exposure, an estimated 66,000 Hepatitis B, 16,000 Hepatitis C and up-to 1,000 HIV infections occur among healthcare workers (Prüss-Üstün *et al*., 2003). These infections are preventable through infection control measures which significantly reduce the risk of HIV and Hepatitis transmission among healthcare workers (Amita *et al*., 2008).

Healthcare workers in developing countries are particularly at increased risk of infections from blood-borne pathogens because of the high prevalence of such pathogens in their communities as well as the lack of basic personal protective equipment like gloves, gowns and goggles (Sagoe-Moses *et al*., 2001; Wilburn & Eijkemans, 2004). In a study from three health institutions from Southeast Nigeria, Ansa *et al.* (2002) observed that supplies of protective equipment were grossly inadequate and adherence to safety practices was poor, and all these could increase the risk of healthcare workers contracting blood-borne infections.

Despite following 'universal precautions', accidental needle-stick injuries and mucocutaneous blood exposure still occur while performing invasive procedures and handling high risk fluids (WHO, 2002). Studies have extensively reported suboptimal and non-uniform adherence to standard precautions by healthcare workers in developing countries as in developed ones (Bennet & Mansell, 2003; Zhang *et al*., 2009). It is evident the occurrence of needle-stick injuries and mucocutaneous blood exposure is inversely related to routine standard precaution compliance (Doebbeling *et al.,* 2003). Avoiding occupational blood exposures by adhering to universal precautions and post exposure management are integral components of a complete program to prevent HIV and other blood-borne infections following occupational exposure and are important elements of workplace safety (Mashoto *et al*., 2013; Amira & Awobusuyi, 2014).

Although 90% of the occupational exposures occur in the developing world, most of the reports of occupational infection come from the USA and Europe (Sagoe-Moses *et al*., 2001; Wilburn & Eijkemans, 2004). There are few published information on the status of needle-stick injuries and splash exposures among healthcare workers in Tanzania, particularly the study area. This study was carried out to determine the frequency, associated factors and circumstances surrounding the occurrence of needle-stick injuries and splash exposures as well as post-exposure practices among healthcare workers at Bugando Medical Centre, a tertiary care hospital in north-western Tanzania.

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Methods and Materials

Study design and setting

This was a cross-sectional study among healthcare workers which was conducted at Bugando Medical Centre (BMC) over a one-year period between April 2013 and March 2014. BMC is a tertiary care hospital located in Mwanza city in the north-western part of the United Republic of Tanzania offering a tertiary specialist care for a catchment population of about 13 million people from neighbouring regions. It is one of the four largest tertiary care hospitals in the country with a bed capacity of 1000 and has more than 800 healthcare workers. The hospital also serves as a teaching hospital for the Catholic University of Health and Allied Sciences-Bugando.

Study population

The study population consisted of health-care workers who came into contact with patients, or were potentially exposed to body fluids from patients while attending to or handling samples from patients. These healthcare workers included doctors, nurses, laboratory staff and auxiliary health workers. Only those who were present at the time of data collection were recruited. The workers whose jobs were not directly related to health care delivery services and handling of injections were excluded from this study. A minimum sample size was determined using modified Cochran formula (Cochran, 1977). Stratified sampling method was used to recruit healthcare workers into the study, based on the various categories of healthcare workers, who were allocated proportionally according to the size of each stratum.

Data was collected using a standard semi-structured questionnaire adopted from Centre for Disease Control and Prevention workbook for designing sharp prevention programme (CDC, 2008). The questionnaires were pre-tested by research assistants who were trained prior to data collection, and appropriate modifications made. Participants were asked to recall needle stick injuries and splash exposures in the preceding 12 months. Included in the questionnaire were age and sex of respondents, job category and duration, details of and needle-stick injuries and splash exposures in the past, kind of activity and procedure during which the needle-stick injuries and splash exposures occurred, if injury was reported, vaccination status of respondents and post-exposure treatment received and follow up of exposed HIV cases. Practice of managing occupational exposure was assessed by asking HCWs if they tested for HIV after occupational exposure, if they knew the patient's/source's HIV status, and if they reported the exposure to the focal person and was counselled. Accidental needle stick injury was defined as a prick with a needle or other sharp object during use of the object for patient care (Singru & Banerjee., 2008) whereas, splash exposures was defined as mucocutaneous exposure to blood and other body fluids. Prevalence of needle-stick injury / splash exposure was defined as the total number of cases of needle-stick injuries/splash exposure during the period of study divided by the total number of respondents and stated as a percentage.

Data analysis

Statistical data analysis was done using SPSS software version 17.0 (SPSS, Inc, Chicago, IL). Data was summarized in form of proportions and frequent tables for categorical variables. Continuous variables were summarized using ranges, median and inter-quartile ranges (IQR). A univariate analysis was used to determine measure of association (odds ratio) between occupational exposure and associated factors. Factors that were found to be significantly associated with the outcome were entered in multivariate logistic regression model (forward stepwise procedure). Statistical

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significance of the associations was determined by Chi-square, with a p-value of less than 0.05 considered significant.

Ethical considerations

Approval and clearance for this study was received from the Catholic University of Health and Allied Sciences/Bugando Medical Centre joint institutional ethic review committee before commencement of the study. Written Informed consent was sought and obtained from the participants before administration of the questionnaires. Participation was voluntary.

Results

Demographic characteristics

During the period of study, a total of 436 healthcare workers participated in the study including doctors 86 (19.7%), nurses 278 (63.8 %), laboratory staff 54 (6.2%) and auxiliary health workers 18 (4.1%). Among all participants 328 (75.2%) were females and 108(24.8%) were males. The age of respondents ranged from 18-54 years with a median of 26 years (+ IQR of 24 to 28 years). The modal age group was 21-30 years accounting for 205(47.0%) respondents.

Table 1: Characteristics of needle-stick injuries and splashes exposures among healthcare workers

Respondent's characteristics	Respondent's characteristics	NSI alone (N/%); (n= 138)	Splashes alone (N/%); (n = 58)	Both NSIs and splashes (N/%) (n= 16)
Age (years)	<20	5 (3.6)	2(3.4)	8(50.0)
	21-30	109(79.0)	44(75.9)	6(35.4)
	31-40	23(16.7)	10(17.2)	1(6.3)
	>40	1(0.7)	2(3.4)	1(6.3)
Sex	Male	34(24.6)	36 (62.1)	2(12.5)
	Female	104(75.4)	22(37.9)	14(87.5)
Job	Doctors	9(6.5)	4(6.9)	1(6.3)
	Nurses	98(71.0)	32 (55.2)	10(62.5)
	Laboratory personnel	16(11.6)	12 (20.7)	2(12.5)
	Auxiliary health workers	15(10.9)	10(17.2)	3(18.7)
Work experience (years)	≤5	136(98.6)	56(96.6)	12(75.0)
	>5	2(1.4)	2(3.4)	4(25.0)
Trained	Yes	12 (8.7)	10(17.2)	10(62.5)
	No	126 (93.3)	48 (82.8)	6(35.5)

Prevalence and characteristics of needle-stick injuries and splash exposures

Out of 436 respondents, 212 (48.6%) reported incidents of needle-stick injuries and splash exposures within the previous 12 months. Of these, 138 (65.1%) respondents reported incidents of needle-stick injuries alone, 58 (27.4%) reported previous history of splash exposures alone and the remaining 16 (7.5%) respondents reported having had both needle-stick injuries and splash exposures. The prevalence of needle-stick injuries was higher among females (75.4%), healthcare workers of age group 21-30 years (79.0%), among healthcare workers with work experience of ≤5 years (98.6%) and among those who were not trained on issues related to infection prevention and occupational risk reduction (93.3%). The nurses had the highest prevalence of needle-stick injuries accounting for 71.0%

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of respondents (Table 1). A & E Department and operating theatres were the most common places of injury or exposure (Table 2).

Table 2: Distribution of type of injuries/exposure according to the place of injury/exposure

Type of injuries /exposure	Place of injury /exposure	Number of participants	Percentages
NSIs (N= 138)	A & E department	46	33.3
	Operating theatre	22	15.9
	Obstetrics/gynaecology wards	18	13.0
	Medical wards	14	10.1
	Surgical wards	10	7.2
	Paediatric wards	8	5.8
	Labour wards	8	5.8
	ICU	5	3.6
	Laboratories	4	2.9
	Other place	2	1.4
Splash exposure	Operating theatre	24	41.4
	A & E department	16	27.6
	Obstetrics/gynaecology wards	9	15.5
	Labour wards	4	6.9
	Other places	2	3.4

Key: A & E = Accident and Emergency, ICU= Intensive care unit

Regarding the time of exposure, the majority of needle-stick injuries and splashes exposures (92.5% i.e. 196/212) occurred during the day, with 52.0% (i.e. 102/196) of cases occurring at morning hours and 48.0% (i.e. 94/196) occurring in the afternoon. However, 2.0% (i.e. 4/196) of the affected healthcare workers could not recall time the injury occurred.

The majority of the devices responsible for the needle-stick injuries were hollow-bore needles 88(63.8%) followed by solid needles 34(24.6%). The other types of needles accounted for 16 (11.6%). Most of needle-stick injuries occurred during procedures in 74 (53.6%) cases, including blood collection (n= 28, 37.8%), surgical procedures (n=20, 27.0%), intravenous line insertion (n=18, 24.3%) and laboratory procedures (n=8, 10.8%). Improper disposal of the sharps and recapping devices occurred in 44 (31.9%) and 20 (14.5%) cases, respectively. Out of 138 healthcare workers who sustained needle-stick injuries, 72 (52.2) sustained needle-stick injuries after use but before disposal of the needles, 36 (26.1%) sustained needle-stick injuries before use of the needles, 20 (14.5%) sustained needle-stick injuries during use of the needles. The remaining 10 (7.2%) healthcare workers sustained needle-stick injuries from needles concealed in bed linen.

Splash exposure occurred during procedures such as insertion/manipulation/withdrawal of needles (n= 32, 55.2%), during disposal (n= 18, 31.0%), handling uncooperative patient (n= 4, 6.9%), rapid gush of fluid during spontaneous rupture of amniotic membrane (n= 3, 5.2%) and accidental splash by a colleague (n=1, 1.7%). Ninety-two (66.7%) of the needle-stick injuries were superficial (scratch with little or no bleeding) while 38 (27.5%) were moderate (penetrated through the skin, wound bled). Eight (5.8%) injuries involved deep penetration (intramuscular penetration). The finger was the most commonly injured site (85.5% i.e. 118/138), while the eye mucosa was the most frequently exposed to splashes (79.3% i.e. 46/58).

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Use of protective equipment and actions taken after exposure

At the time of the exposure, 116 (54.7%) healthcare workers wore protective equipment. Double gloves were worn by 98(46.2%) healthcare workers. No eye or facial protection (goggles) was worn during execution of procedures at the time splash exposures occurred. Masks were worn by only 12 (5.7%) healthcare workers. Immediately after needle-stick injuries, the majority of healthcare workers took action 126(91.3%, N= 138), while 8(3.8%, N= 138) did not take any action. The action taken included washing the site with soap and water 70 (55.6%, N =126), cleaning the site with appropriate antiseptic agents (n= 48, 38.1%) and squeeze the injured site 8(6.3%, N= 126). For splash exposures, 54 (93.1%, N= 58) healthcare workers cleaned the site with running water while four did not take any action.

Table 3: The reasons for not reporting the incident of needle-stick injuries and splashes exposures among healthcare workers at Bugando Medical Centre (N= 144)

Reasons for not reporting	Frequency	Percentages
Lack of knowledge of appropriate procedures after injury	54	37.7
Source thought not to be infectious	32	22.2
Incidence was not important	22	15.3
Worried about future consequences	18	12.5
Did not know who to repot	10	6.9
No reason given	8	5.6

Rate of reporting incidence of needle-stick injuries/ splashes exposures and vaccination against Hepatitis B virus

Out of 212 healthcare workers who had needle-stick injuries and splash exposures, only 68 (32.1%) reported the incident to the relevant authority. The reasons for not reporting are shown in Table 3. Of the 212 healthcare workers who sustained needle-stick injuries and those who had splashes exposures, 185 (87.3%) were not adequately immunized for hepatitis B virus and only 17 (8.0%) were fully vaccinated, having received three doses of the vaccine. The remaining 10 (4.7%) healthcare workers were not immunized for hepatitis B. Doctors were more likely to be immunized for Hepatitis B than all other categories of healthcare workers (p = 0.002). Reasons cited by healthcare workers for not having been vaccinated included vaccine not always available (n= 7, 70.0%), high cost of the vaccine (n=6, 60.0%), low risk perception (n= 4, 40.0%), not aware of the need to be vaccinated (n=3, 30.0%) and fear of the side effects if the vaccine (n= 3. 30.0%).

Practice of Universal Precautions

Most needle-stick injuries and splash exposures occurred when universal precautions or standard procedures were not followed (n = 186, 87.7%), while a much smaller proportion (n = 26, 12.3%) had needle-stick injuries and splash exposures despite following adequate universal precautions.

Predictors of needle-stick injuries and splash exposure

Healthcare workers aged ≤ 40 years; those with work experience of ≤ 5 years and those not trained on issues related to infection prevention and occupational risk reduction were more likely to be exposed to any type of occupational injuries studied. While male healthcare workers were less likely to be exposed to NSIs, female were more likely to encounter both NSIs mucocutaneous splashes in multivariate logistic regression analysis (Tables 4, 5 and 6).

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Table 4: Predictors of needle stick injuries according to univariate and multivariate analysis

Independent variable	Response	Needle-stick injuries		Univariate analysis			Multivariate analysis		
		Yes (N/%)	No (N/%)	OR	95%CI	P-value	OR	95%CI	P-value
Age (years)	≤40	137(71.0)	56(29.0)						
	>40	1(33.3)	2(66.7)	3.65	1.12-6.64	0.012	2.65	1.65-7.22	0.002
Sex	Male	34(48.6)	36(51.4)						
	Female	104(82.5)	22(17.5)	0.42	0.23-0.95	0.015	3.94	2.54- 6.83	0.011
Job category	Doctors	9(69.2)	4(30.8)						
	Nurses	98(75.4)	32 (24.6)	1.34	0.39-2.98	0.883			
	Lab personnel	16(57.1)	12 (42.9)	3.76	0.99- 5.84	0.331			
	Auxiliary HCWs	15(60.0)	10(40.0)	1.72	0.44-3.41	0.098			
Work experience (years)	≤5	136(70.8)	56(29.2)						
	>5	2(50.0)	2(50.0)	5.89	2.45-8.98	0.023	3.43	2.74-8.56	0.000
Trained	Yes	12 (54.5)	10(45.5)						
	No	126 (72.4)	48 (27.6)	2.86	1.12-4.65	0.021	4.84	2.99-8.72	0.001
Works place	A & E Dep't	46 (74.2)	16(25.8)						
	Operating theatre	22(47.8)	24(52.2)	1.34	0.43-2.55	0.987			
	Obs/Gyn wards	18(66.7)	9(33.3)	0.33	0.18-4.31	0.453			
	Labour ward	8(66.7)	4(33.3)	3.22	0.98-3.88	0.067			
	Laboratories	4(57.1)	3(42.9)	0.88	0.45-1.65	0.816			
	Other places	40(95.2)	2(4.8)	1.45	0.99-2.33	0.059			

Keys: A&E = Accident and Emergency; Obs/gyn = Obstetrics and Gynaecology

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Table 5: Predictors of splash exposures to mucocutaneous membranes according to univariate and multivariate analysis

Independent variable	Response	Splashes exposures		Univariate analysis			Multivariate analysis		
		Exposed (N/%)	Not exposed (N/%)	OR	95%CI	P-value	OR	95%CI	p-value
Age(years)	≤40	56(35.0)	134(65.0)						
	>40	2(33.3)	4(66.7)	2.21	1.89-6.33	0.042			
Sex	Male	38(54.3)	32(45.7)						
	Female	20(15.9)	106(84.1)	2.32	1.11-5.89	0.025			
Job category	Doctors	2(13.4)	11(84.6)						
	Nurses	30 (23.1)	100(76.9)	3.09	0.99-4.33	0.987			
	Lab personnel	12 (42.9)	16(57.1)	1.55	0.55-1.99	0.453			
	Auxiliary HCWs	4(28.6)	11(78.6)	0.88	0.22-3.66	0.443			
Work experience (years)	≤5	56(32.7)	115 (67.3)						
	>5	2(8.0)	23 (92.0)	2.86	1.89-7.98	0.021	2.44	1.33-8.99	0.001
Trained	Yes	4(18.2)	18 (81.8)						
	No	54 (31.0)	120 (69.0)	2.86	1.12-6.45	0.013	3.19	1.54-8.26	0.016
Work place	A & E Department	16(25.8)	46 (74.2)						
	Operating theatre	24(52.2)	22(47.8)	2.98	1.34-3,87	0.045			
	Obs/gyn wards	9 (33.3)	18(66.7)	1.21	0.98-3.54	0.980			
	Labour ward	2(16.7)	10(83.3)	5.87	3.45-5.98	0.041			
	Laboratories	3 (42.9)	4(57.1)	1.32	0.67-2.43	0.876			
	Other places	4 (9.5)	38(90.5)	0.54	0.13-2.76	0.985			

Keys: A & E = Accident and Emergency, Obs/gyn = Obstetrics and gynaecology

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Table 6: Predictors of both needle-stick injuries and splash exposures among healthcare workers at Bugando Medical Centre according to univariate and multivariate analysis

Independent variable	Response	Having both NSI & Splashes exposures		Univariate analysis			Multivariate analysis		
		Exposed (N/%)	Not exposed (N/%)	OR	95%CI	P-value	OR	95%CI	P-value
Age (years)	≤40	10(71.4)	4(28.6)						
	>40	1 (50.0)	1(50.0)	2.67	1.32-6.30	0.002	1.43	1.11-4.87	0.000
Sex	Male	1(50.0)	1(50.0)						
	Female	8(57.1)	6(42.9)	2.88	2.11-5.91	0.015	4.11	2.56-7.88	0.013
Job category	Doctors	0(0)	1(100.0)						
	Nurses	4 (40.0)	6(60.0)	3.09	0.34-5.98				
	Lab personnel	1 (50.0)	1(50.0)	1.51	0.65-1.94				
	Auxiliary HCWs	2(66.7)	1(33.3)	0.81	0.22-3.63				
Work experience (years)	≤5	10(83.3)	4(16.7)						
	>5	1(25.0)	3 (75.0)	2.33	1.43-7.91	0.011	1.44	1.02-2.92	0.023
Trained	Yes	3(30.0)	7 (70.0)						
	No	5 (83.3)	1(16.7)	2.12	1.98-6.95	0.020	3.10	2.58-6.26	0.031
Work place	A & E Dep't	2(66.7)	1 (33.3)						
	Operating theatre	2(66.7)	1(33.3)	1.09	1.54-3,89	0.041			
	Obs/gyn wards	1(50.0)	1(50.0)	5.98	0.98-3.51	0.450			
	Labour ward	1(50.0)	1(50.0)	1.87	0.45-5.28	0.079			
	Laboratories	1(50.0)	1(50.0)	1.45	0.67-2.43	0.226			
	Other places	1(50.0)	1(50.0)	0.14	0.10-3.79	0.123			

Keys: NSI= needle-stick injuries; A&E = Accident and Emergency' Obs/gyn = Obstetrics and Gynaecology

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Management of needle-stick injuries and splashes exposures

Out of 212 healthcare workers who had needle-stick injuries and splash exposures, only 38 (17.9%) tested for HIV infection and all were HIV negative. The HIV serostatus was not known in 174 (82.1%) respondents (healthcare workers). Source patient was identified in 175 (82.5%) cases. Of these, 26 (14.9%) were HIV positive, 134 (83%) were negative while the serostatus of 15 (8.6%) respondents was unknown. Source patients were not investigated for hepatitis B or hepatitis C infection.

Out of 38 healthcare workers who had their baseline HIV testing done, twelve (31.6%) acknowledged to have been exposed to HIV positive source. Of these, only 2 (16.7%) healthcare workers received post-exposure prophylaxis (PEP) for HIV. The reasons for not taking PEP among healthcare workers who were exposed to HIV positive source include: perceived stigma and fear of side effects of antiretroviral drugs, the lack of a formal reporting system, inexperience and poor awareness of the risk of disease transmission. Of the 38 healthcare workers who tested negative for HIV, only 5 (13.2%) reported for followed-up at 1, 3 and 6 months and all showed zero seroconversion at 6 months.

Discussion

In this study, 48.6% of health care workers reported incidents of needle-stick injuries and splash exposures within the previous 12 months. This figure is higher than that reported by Mbaisi *et al* (2013) in Kenya. In the present study, needle-stick injuries were more common than splash exposures to mucocutaneous membranes. Similar trend was also reported by others (Mbaisi *et al*., 2013; Amira & Awobusuyi, 2014). Our figure for the needle-stick injuries was higher than that reported by other authors (Lee, *et al*., 2005; Reda *et al*., 2010; Jacob *et al*., 2010; Mbaisi *et al*., 2013; Amira & Awobusuyi, 2014). This figure is however much lower than the rates reported from other studies (Odeyemi *et al*., 2005; Chen *et al*., 2009; Muralidhar *et al*., 2010). These differences in the rates of needle-stick injuries reflects differences in the infection control policies instituted by all the studied centres as well as differences in the adherence to universal precautions.

Health-care workers of the age-group 21 to 30 years in our study had the highest rate of injuries which is consistent with other reports (Sagoe-Moses *et al*., 2001; Hosoglu *et al*., 2009; Mbaisi *et al.*, 2013). In agreement with other studies (Hosoglu *et al*., 2009; Mbaisi et al, 2013), age below 40 years was significantly associated with needle-stick injuries. The high rate of needle-stick injuries among healthcare workers aged below 40 years in the present study is possibly due to limited professional experience and the fact that young healthcare workers tend to be enthusiastic and aggressive in their work and are more likely to ignore the universal precautions or are not aware of guidelines. Our results have shown that females predominated among healthcare workers with needle-stick injuries and splash exposures. Similar gender difference was also reported by Mbaisi *et al.* (2013) and El-Hazmi & Al-Majid (2008) in Kenya and Saud Arabia, respectively. The female predominance in our study can be explained by the fact that the vast majority of nursing staff in the hospital are female in gender. In accordance with findings from other studies (Gessessew & Kahsu., 2006; Tadesse & Tadesse., 2010; Muralidhar *et al*., 2010; Mbaisi *et al*, 2013), nurses were found to be the major occupational group. Some studies have reported higher prevalence among doctors (Lee *et al*., 2005; Bi *et al*., 2006; Wicker *et al*., 2008; Zafar *et al*., 2009). The high rate of needle-stick injuries and splash exposures among nurses can be explained by the fact that nurses are responsible for most of blood sampling and other intravenous procedures in the hospital and that nurses are more likely to handle sharp devices and have more contact with patients. In addition to that, they are more diligent in their reporting behaviours.

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In the present study, the rate of needle-stick injuries as well as splash exposure to mucocutaneous membranes was high among those with experience less than five years which is in agreement with other studies (Clarke *et al.,* 2002; Mbaisi *et al*, 2013). Clarke *et al* (2002) in their study found that the probability of ever having a needle-stick injury or splash exposure to mucocutaneous membranes was inversely related to years of experience. This may be attributed to inadequate skills and knowledge regarding injection safety. Similar to findings of this study, previous training of healthcare workers on issues related to infection prevention and occupational risk reduction has been identified as a predicting factor in the occurrence of needle-stick injuries and splash exposures (Nsubuga *et al* 2005; Mbaisi *et al*, 2013). Those healthcare workers who had not attended any training on prevention and management of needle stick injuries and splash exposures in their workplace were at a significantly greater risk of sustaining such injury and exposure compared with those who had attended some kind of training. Training enhances awareness and improves skills among health-care workers.

Most of the needle-stick injuries in our study occurred in the Accident and Emergency department similar to observations by Hosoglu *et al.* (2009) in Turkey. The high rate of needle-stick injuries in the Accident and Emergency department in our series is related most probable to rush during patient care and lack of optimum caution during handling sharp devices, especially during patient resuscitation. In our study, splash exposure occurred more commonly in operating theatre which is at variance with a report of Mbaisi *et al.* (2013) in Kenya which identified working in the Accident and Emergency department as a risk factor for sustaining splash exposure to mucocutaneous membrane. As reported elsewhere (Macias *et al.,* 1996; Mbaisi *et al.,* 2013), the majority of exposures in our study occurred during the day, especially during morning shift. This may be attributed to busy schedule at the time and the pressure among staff to complete tasks.

The majority of the devices responsible for the needle-stick injuries were hollow-bore needles, an observation which is consistent with findings by other authors (Russi *et al*., 2000; Ng *et al*., 2002; Mbaisi *et al*., 2013; Amira & Awobusuyi, 2014). Hollow-bore needles have been identified as a risk factor that enhances transmission of pathogens, due to its nature of containing residual blood and other fluids and hence the most hazardous instruments among medical sharp devices (Lee *et al*., 2005; Bi *et al*., 2006; Salelkar *et al*., 2010; Mbaisi *et al*., 2013). Most of needle-stick injuries in our study occurred during procedures such as blood collection, surgical procedures, intravenous line insertion and laboratory procedures. This is in contrast to reports from other studies in which most of needle-stick injuries occurred during recapping of needles (Sadoh *et al*., 2006; Reda *et al*., 2010; Akeem *et al.*, 2011). In general, recapping of needles by healthcare workers though prohibited is still common in many developing countries and remains an important cause of needle-stick injuries. In the present study, recapping devices was rarely performed and was reported in only a few cases. Healthcare workers should be educated about occupational risks associated with these harmful practices as well as on effective measures that can prevent such occupational exposures to blood-borne pathogens.

As far as use of personal protection was concerned only about half of the healthcare workers were wearing protective equipment at the time of the injury. This finding concurs with what was reported by others (Wicker *et al*., 2008; Rahul *et al.,* 2010; Mbaisi *et al*., 2013; Amira & Awobusuyi, 2014). Skin and mucous membrane contacts can be prevented with the use of barrier precautions such as gloves, masks, gowns, and goggles. However since the greatest risk of blood-borne pathogen transmission come from percutaneous (needle-stick) injuries, changes in techniques or use of safety devices is required. Tokars *et al.* (1992) noted that half of the needle-stick injuries during suturing occurred when fingers instead of instruments were used. Use of personal protective equipment is critical in prevention of exposures. The most common action taken post-injury was for the affected healthcare workers to wash the site with soap and water. The recommended action to

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be taken following needle-stick injuries or other potential exposure to a blood-borne pathogen is to immediately wash the site with soap and water; mucous membranes should be flushed with water (Wilburn & Eijkemans, 2004). Salelkar *et al* (2010) reported that half of their workers washed the injury site with soap and water and the less that three quarters applied an antiseptic solution.

There was a low rate of reporting of needle-stick injuries and splash exposure in this study, which is consistent with previous reports (Wilburn & Eijkemans, 2004; Bi *et al*., 2006; Tadesse & Tadesse., 2010; Mbaisi *et al*., 2013). Unreported needle-stick injuries and splash exposures are a serious problem and prevent injured healthcare workers from receiving PEP against HIV. According to some studies, 40%-75% of all needle-stick injuries and splash exposures are unreported (Wilburn & Eijkemans, 2004; Wilburn, 2004). The low rate of reporting in this study is attributed to lack of knowledge of appropriate procedures after injury and perceived low risk of transmission. It is important that our hospital should develop occupational and safety departments and standard process for reporting of needle-stick injuries and splash exposures as well as continuous surveillance. On the other hand, Hepatitis B vaccination (HBV) coverage among healthcare workers was lower than figures reported from developed countries (Lee *et al*., 2005; Wicker *et al*., 2008). The major reason given by most of healthcare workers was unavailability of the vaccine and only provided by the hospital but not regularly. This trend is not good for clinical practice given the high rate of HBV infection in developing countries (Sagoe-Moses *et al*., 2001; Wilburn & Eijkemans, 2004). There is need for a more proactive approach and change in policy in that all staff must be immunized against HBV infection, which is largely preventable by vaccination.

Universal precautions have been reported to reduce the risk of HIV transmission and other blood-borne pathogens among health care workers. However, some studies have indicated poor compliance to universal precautions particularly in developing countries where the prevalence of these pathogens is reported to be high (Sagoe-Moses *et al*., 2001; Wilburn & Eijkemans, 2004; Amira & Awobusuyi, 2014). Thus, the risk of exposure to HIV infection other blood-borne pathogens among health care workers in our setting is high. Poor compliance to universal precautions is reflected in our study in which most of needle-stick injuries and splash exposures occurred when universal precautions or standard procedures were not followed.

In the present study, less than one-fifth of exposed healthcare workers received post-exposure prophylaxis (PEP) for HIV/AIDS even though PEP drugs were available. This figure is lower than that reported by Mbaisi *et al*. (2013) in Kenya. However, our figure is high as compared to that reported in a study conducted in India (Rahul *et al.,* 2010). As most healthcare workers did not report the exposures, they were not evaluated for indication of PEP, therefore it is important to note that the number required to take PEP may not be exact. The major reasons for the poor compliance with PEP among healthcare workers who were exposed to HIV positive source included perceived stigma and fear of side effects of antiretroviral drugs.

The potential limitation of this study is the fact that as information was self-reported, misclassification of healthcare workers as exposed or not exposed is possible. Information on exposure was sought for the preceding 12 months; this might have introduced recall bias among the healthcare workers.

In conclusion, needle-stick injuries and splash exposure are common among healthcare workers at our centre and are under-reported. Hepatitis B vaccination (HBV) coverage among healthcare workers is very low and post-exposure management is poorly adhered to. All HCWs should be trained on issues related to infection prevention and occupational risk reduction. The hospital should establish surveillance system for registering, reporting and management of occupational injuries and exposures. Also, training and implementation of standard (universal) precautions, immunization against HBV to all healthcare workers, provision of personal protective

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equipment, proper sharps disposal and action to be taken in case of injury needs to be given to all categories of health care workers in order to increase occupational safety for healthcare workers in our setting.

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