



Epidemiology of percutaneous exposure to needlestick and sharp object injuries in the Botswana public health sector: A health facility cross sectional study

Styn M Jamu^{*1}, Lesego Gabaitiri², Kelly K Mudongo³, Nelson K Mwaniki⁴

ABSTRACT

Objective

To evaluate the extent and distribution of needlestick and sharp object injuries in the Botswana public health sector.

Methods

This was a cross-section study carried out in eight hospitals and 72 clinics and health posts.

Results

The study comprised of 885 randomly selected healthcare workers. The sample included medical doctors, nurses, laboratory staff, and dental staff and housekeeping staff. The reference group was a sample of housekeeping staff. The lifelong prevalence of needle-stick injuries was 48.9% (95% CI: 45.6, 52.2). Life-long prevalence was significantly higher in nurses (Adjusted Odds ratio [Adj. OR] = 4.1, 95% CI: 3.0, 5.7), medical doctors (Adj. OR = 4.2, 95% CI: 2.1, 8.4) compared with the reference. The prevalence of needlestick and sharp object injuries in six-month duration was 11.8% (95% CI: 9.6%, 14.0%). Nurses (Adj. OR = 3.5, 95% CI: 2.0, 6.1) were three times likely to sustain injuries in a six-month period compared with the reference group. Most injuries occurred at patient's bedside and in the emergency departments. Disposable syringes caused most of the injuries, often during and immediately after a medical procedure.

Conclusions: Healthcare workers in Botswana remain at risk of percutaneous exposure to needlestick and sharp object injuries. They are at an increased risk of bloodborne infections including HIV.

Keywords: Percutaneous Exposure, Human Immunodeficiency Virus (HIV), Needlestick, Sharp Object Injury

INTRODUCTION

The first report of a healthcare worker infected with the human immunodeficiency virus (HIV) by a needlestick injury in 1984,¹ raised a global concern about occupational transmission of HIV. Evidence suggests that exposure to contaminated needlestick and sharp

objects are the typical route for HIV transmission among healthcare workers.² Transmission of HIV can occur during patient care, dental and laboratory work, and autopsy.³⁻⁶

The World Health Organization (WHO) estimates suggest of the 35 million health workers in the world,

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¹Research Technical Advisor, Stepping Stones International

²Senior Lecturer, Faculty of Social Sciences, Department of Statistics, University of Botswana

³Matron, University of Botswana Health Sciences

⁴Public Health Specialist, Department of Public Health, Environment and Occupational Health, Botswana Ministry of Health

*Corresponding Author:

Styn M Jamu
Research Technical Advisor, Stepping Stones International and Former Country Director at JSI Research & Training Institute (JSI R&T) in Botswana

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three million sustain occupational injuries each year. More than 500 healthcare workers contract HIV because of occupational exposure to contaminated medical devices every year.³ Most of the HIV transmission among healthcare workers occur in developing countries. Preventing needlestick and sharp object injuries are therefore an important public health step for ensuring healthcare workers safety in the workplace.²⁻³

Statement of Problem

Botswana has one of the highest prevalence of HIV infection in the world. Current estimates suggest 17.6% people aged 18 months and above have HIV. The annual incidence rate is 2.9%.⁷ HIV/AIDS and opportunistic infections make up the main reason for most hospital admissions. HIV/AIDS and opportunistic infections are the leading cause of 50% hospital bed occupancy.^{8, 9}

High prevalence of needlestick and sharp object injuries among health workers poses a significant risk of HIV transmission in the healthcare settings. Studies suggest high HIV prevalence in the patient population increases the risk of HIV transmission among healthcare workers percutaneous injuries.¹⁰

No studies have investigated the epidemiological pattern of needlestick and sharp object injuries. Thus, data are scarce about the population at risk for percutaneous injuries in healthcare settings; how injuries occur, where these injuries occur, and what causes most these injuries. Earlier studies on occupational injuries in healthcare setting had either small sample size or excluded other healthcare worker population such as doctors, laboratory, dental, and housekeeping staff. Besides, the previous studies had poor response rates.^{8, 9} Further, these studies neither characterized the circumstances under which injuries occurred nor showed the distribution of injuries.

There was a need for an epidemiological study to examine the extent and distribution of needlestick and sharp object injuries in healthcare settings. The epidemiological information was critical for developing evidence-based injury prevention strategies.

METHODS AND PROCEDURES

Study Design and Study Population

The study was a cross-sectional of randomly selected healthcare workers. The healthcare population included doctors, nurses, dental staff, laboratory, and housekeeping staff. The housekeeping staff included nurse auxiliaries, laundry staff, mortuary staff, cleaners, and incinerator operators. This study population is, directly or indirectly, involved in using and handling medical devices in the course of their work. The study excluded pharmaceutical, administrative, and catering staff.

Sampling Method

The study applied a three-stage multi-sampling technique based on simple random sampling. In the first stage, the study randomly selected six out of 29 health districts. Botswana has one district hospital in each health district. District hospitals have larger health workforce representation than primary hospitals, clinics, and health posts.

In the second stage, the study automatically included one hospital in each randomly selected health district to ensure enough representation of doctors, nurses, dental staff, laboratory, and housekeeping staff. Besides, the study randomly selected lower level facilities (clinics and health posts). The sample included 80 health institutions comprised of eight district hospitals and 72 clinics and health posts.

The third stage involved selection of healthcare workers in selected health facilities. Eligible healthcare workers were sampled randomly proportionate to the size. The study included healthcare workers who had worked for six or more months in the selected health institutions. They had to be on a 48-hour duty roster during data collection. Each data collection team had a pre-determined number of eligible healthcare workers by job category from each selected facility. On arrival in each selected facility, the data collection supervisor asked a list of eligible healthcare workers on the 48-hour duty roster from the officer-in-charge. Names of eligible healthcare workers were recorded on pieces of paper and mixed in a box. The study selected eligible healthcare workers by picking one



name from the box. The process continued for each job category until the expected sample size of that facility was selected. The research team then found the selected participants in their duty stations and asked for consent.

Sample Size Determination

Sample size determination was based on a multi-stage sampling aimed at obtaining a representative sample of healthcare workers in Botswana. The study assumed that within a six month recall period, 13% of healthcare workers would sustain an injury during their work. This assumption was based on a previous study which had found an annual needle-stick injury

rate of 26% among nurses.⁸ The sample accounted for design effect due to cluster variability of districts, health facilities, and respondents. The sample determination took into account for a 12% refusal rate and 10% for missing data.

The estimated sample for the study was 1,000. One hundred and five healthcare workers were not at their duty stations during data collection, and ten healthcare workers declined to take part in the study. Eight hundred and eighty-five healthcare workers gave consent and took part in the study (Figure 1).

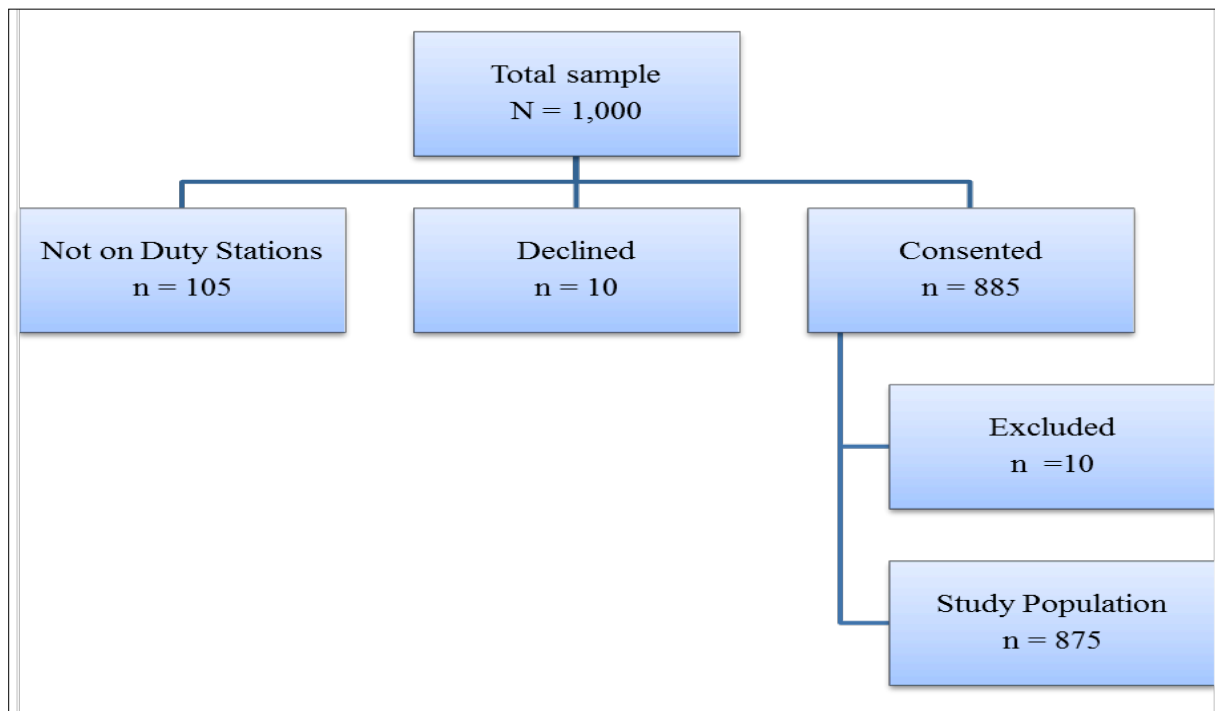


Fig 1 The Flowchart of Healthcare Worker Sample in the Study

Statistical Analysis

The study was a descriptive epidemiological study. The primary outcomes of interest were self-reported needlestick injuries over a course of work and within a six-month period. The secondary outcomes included injuries from other medical instruments, the source of the injuries and circumstances under which the reported injuries occurred. The primary and secondary outcomes are presented in percentages and odds ratios. Data were analyzed using Statistical

Analysis System (SAS Institute, Cary, North Carolina) version 8.0 for Windows. The determinant threshold for making the statistical decision was set at $p < 0.05$ and 95% confidence interval for the odds ratios.

Ethical Review

The Centers for Disease Control and Prevention (CDC, Atlanta, GA, USA) and the Botswana Health Research and Development Committee (HRDC) Institutional Review Boards reviewed and approved the study.



RESULTS

Profile of the Sample

One thousand healthcare workers were sampled, of whom 88.5% consented and took part in the study. Hospital staff made up 75.6% of the sample population while lower level facilities contributed 24.4% respondents. Nurses comprised of more than half of the study population (52%) which mirrored the distribution of nurses within the Botswana health workforce (Table 1).

Eight of every ten healthcare workers were females. Half of the workforce mostly registered nurses had diploma qualifications (a three-year university education). About 39.3% had high school education or lower, and 10.4% had bachelors or graduate degrees. The overall mean length of time working in the healthcare profession of the study population was 10.1 (\pm 9.1).

Table 1 Demographic Characteristics of Health Worker Sample Population (N=875)

	N ¹	95% CI ²
Sample Population Characteristics		
Sex		
Male	190 (21.7)	(19.1, 24.6)
Female	685 (78.3)	(75.4, 80.9)
Job Category		
Medical Doctor	49 (5.6)	(4.3, 7.3)
Registered Nurse	452 (51.7)	(48.3, 55.0)
Laboratory Staff	32 (3.7)	(2.6, 5.1)
Dental Staff	8 (0.9)	(0.5, 1.8)
Lay Counselor	20 (2.3)	(1.5, 3.5)
Housekeeping Staff	314 (35.9)	(32.8, 39.1)
Formal Education		
Never attended	63 (7.2)	(5.7, 9.1)
Primary Education	106 (12.1)	(10.1, 14.4)
Secondary Education	176 (20.1)	(17.6, 22.9)
University Diploma	438 (50.1)	(46.8, 53.4)
University Degree	92 (10.5)	(8.7, 12.7)
Type of Health Facilities		
Lower Level Facilities	209 (23.9)	(21.2, 26.9)
Hospitals	666 (76.1)	(73.2, 78.8)
Length of Service (Mean in Years)		
	Mean (\pm SD)	
Medical Doctor	10.8 (10.3)	(7.8, 13.7)
Registered Nurse	11.5 (9.5)	(10.6, 12.4)
Laboratory Staff	10.7 (9.5)	(7.3, 14.1)
Dental Staff	8.2 (7.7)	(1.7, 14.6)
Lay Counselor	2.2 (1.1)	1.6, 2.7)
Housekeeping Staff	8.5 (7.9)	(7.6, 8.0)
Overall mean	10.1 (9.1)	(9.5, 10.7)

¹ Unless otherwise stated

²95% CI for the percentages were calculated based on the Wilson Score Method (Newcombe RG, Altman DG. Proportions and their difference. In Altman DG et al. (eds). Statistics with confidence (2nd ed). London: BMJ Books: 46-48.



Who is at risk of needlestick and sharp object injuries?

Of the 885 consenting respondents, ten could not recall whether they ever sustained an injury in the course of their work. Of the 875 individuals who responded, 49% incurred one or more needle-stick or sharp object injuries in the course of their work. The mean number of injuries was 2.83 (SD 3.34). Medical doctors, nurses, laboratory staff and dental staff are at high risk of needle-stick and sharp object injuries in the Botswana public health sector. Doctors (adjusted OR 4.22, 95% CI 2.1, 8.4, p<0.001) and nurses (adjusted OR = 4.1, 95% CI: 2.99, 5.7, p<0.001) were

four times at risk of sustaining a needle-stick or sharp object injury over the course of their work than the reference group.

The study also found that laboratory staff were more than two times more likely to sustain an injury in the course of their work than the reference group, adjusted OR = 2.8, 95% CI: 1.30, 6.7, p<0.01. In addition, dental staff were about six times at risk of needlestick and sharp object injuries in the course of their work more than the reference group, adjusted OR = 5.99, 95% CI: 1.3, 26.9, p = 0.05 (Table 2).

Table 2 Reported Extent of Percutaneous Exposure to Needle-stick and Sharp Object Injuries in the Course of Respondent's Work (N=875)

Job category	Experienced an injury?		Crude odds ratios(COR)		Adjusted odds ratios (AOR)	
	Yes (%)	95% CI	COR	95% CI	AOR	95%CI
Medical Doctor	61.2	(47.2, 73.6)	4.12	(2.20, 7.70)***	4.22	(2.13, 8.38)***
Registered Nurse	63.1	(58.2, 67.4)	4.45	(3.26, 6.09)***	4.13	(2.99, 5.69)***
Laboratory Staff	53.1	(36.4, 69.1)	2.96	(1.42, 6.18)**	2.81	(1.30, 6.07)**
Dental Staff	62.5	(30.6, 86.3)	4.35	(1.02,18.59)*	5.99	(1.33, 26.92)*
Lay Counselor	20.0	(8.1, 41.6)	0.65	(0.21,2.01)	0.96	(0.31, 3.02)
Housekeeping Staff+	27.8	(23.0, 32.9)	1.00	-	1.00	-
+ Reference Group	48.9	(45.6, 52.2)				

*0.05, **<0.01, ***<0.001
 The odds ratios were adjusted for sex, education, health districts, type of facility, and length of service

The study evaluated the risk needlestick and sharp object injuries over a six-month period among the respondent population. Descriptive analysis based on Chi-Square measures of association found significant associations between reported needlestick and sharp object injuries and job categories, formal education, and health districts (Table 3).

Results suggest that 11.8% (95% C.I.: 9.6%, 14.0%) of the healthcare workers reported sustaining one or more injuries overall six month period. The mean

number of injuries was 1.6 (SD =1.5) with a range of 0-8 injuries. Multivariate logistic regression modeling suggest the odds of sustaining one or more injuries over a six months period was significantly high among nurses (OR = 3.49, 95% CI: 2.01:6.08, p<0.001) and dental staff (OR =19.8, 95% CI: 3.89,101.8, p<0.001) compared with the reference group. However, the risk of injury among dental staff had a wide the 95% confidence interval potentially because of a small sample in this category.



Table 3 Reported Extent of Percutaneous Exposure to Needlestick and Sharp Object Injuries in the Last Six Months

Job category	Ever experienced an injury? (N = 875)		Crude odds ratios (COR)		Adjusted odds ratios (AOR)	
	Yes (%)	95% CI	COR	95% CI	AOR	95%CI
Medical Doctor	8.2	(3.2,19.2)	1.55	(0.50, 4.82)	2.09	(0.63, 3.61)
Registered Nurse	16.4	(13.2, 20.1)	3.42	(1.98, 5.92)***	3.49	(2.01, 6.08)***
Laboratory Staff	9.4	(3.2, 24.2)	1.81	(0.50, 6.53)	1.99	(0.54, 7.37)
Dental Staff	37.5	(13.7, 69.4)	5.82	(1.09,31.04)*	19.74	(3.83, 101.80)***
Lay Counselor	10.0	(2.8, 30.1)	1.94	(0.42,9.06)	2.14	(0.44, 10.36)
Housekeeping Staff+	5.4	(3.4, 8.5)	1.00	-	1.00	-
	11.8	(9.8, 14.1)				

+ Reference Group
*0.05, **<0.01, ***<0.001
The odds ratios were adjusted for sex, education, health districts, type of facility, and length of service

Type of Needle/Sharp which caused the Latest Injury

Data show disposable needles were the main culprit for causing accidental needlestick and sharp injuries among healthcare workers in the Botswana public health sector followed by suturing needles and surgical instruments. Results suggest that 75.7% of the injuries in the last six months occurred during and

immediately after performing a medical procedure. Injuries included during drawing blood, when a patient fidgeted, and during surgery. Most of the injuries occurred during recapping, disassembling used device or because of poor device disposal behaviors. Occasionally, doctors left a used device on linen, floor, table or other inappropriate places.

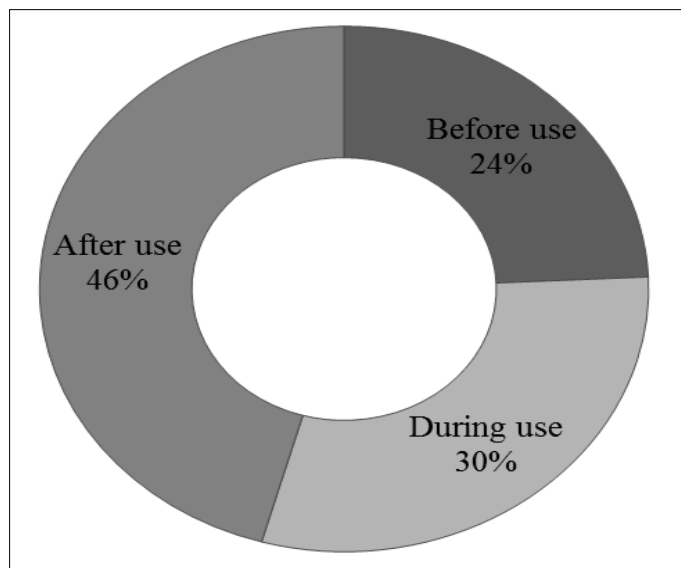


Fig 2 Circumstances under which percutaneous injuries occurred in six month period in selected primary healthcare settings in Botswana



Medical Areas where Injuries Occur

Most needlestick and sharp object injuries reported in a six-month period took place at the patient bedside (36%) and in the outpatient departments (31%). Results also suggest injuries occurred in the delivery rooms (13%) and theaters (7%) The rest of injuries (13%) took place among housekeeping staff while cleaning and transporting medical waste from medical floors.

DISCUSSION

Healthcare workers in the Botswana public health sectors are exposed to contaminated needlestick and sharp objects. Thus, they are at risk of contracting HIV and other bloodborne infections in the healthcare settings. Needle-stick and sharp object injuries are a health and safety and a human rights concern in the advent of HIV.¹¹ The study identified valuable information for developing infection prevention and control strategies to address safety gaps in the Botswana primary healthcare settings. The findings are consistent with findings from others studies. The rate of needlestick and sharp object injuries are predominate in health settings where infection prevention and control approaches are either lacking or weak.¹² Needle-stick and sharp object injuries serve as a “vector” for spreading bloodborne infections.¹³The importance of designing injury prevention strategies should be part of the quality of care and HIV combination prevention initiative.

Occupational health experts suggest an integrated injury prevention model combining engineered injection devices, continuous education, work control, and administrative procedures are critical in creating safe working environments in healthcare settings. Studies suggest that without technologically engineered devices, the other components of the model are unlikely to offer healthcare workers full protection because most of the sharps can still puncture the skin.^{14, 15.}

However, use of technologically engineered devices in resources constrained countries need supporting evidence of their effectiveness. Further, there is a

need to examine the effectiveness of the integrated injury prevention model that includes technologically engineered devices such as retractable syringes. This study provides a benchmark for monitoring the effectiveness of integrated injury prevention in Botswana.

CONCLUSION

In healthcare settings, needlestick, and sharp objects injuries link patients and healthcare workers. Evidence suggests that the concern over needlestick injuries also embody HIV stigma, discrimination, and fear. The study highlights the epidemiological pattern of needlestick and sharp object injuries in the Botswana public health settings. It also underscores the extent of the problem, the type of needle and sharp objects which cause injuries, medical locations where injuries occur, and circumstances under which injuries occur. The findings provide the Botswana Ministry of Health with valuable information for developing effective injury prevention strategies within the infection prevention intervention. Effective injury prevention strategies will ensure healthcare workers' and patients' safety from occupational injuries including HIV transmission. Preventing needlestick injuries is not only an HIV prevention strategy but a health management as well as a human rights issue.

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