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Occupational Exposure to Blood and Body Fluids and Knowledge of HIV Post-Exposure Prophylaxis among Medical and Allied Health Students in Northern Nigeria

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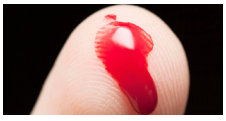

Abstract

Background: Clinical students are at increased risk of exposure to blood-borne pathogens. However, little has been documented about their exposure to blood and body fluids and their knowledge of post-exposure prophylaxis (PEP) in high-HIV burden settings, such as Nigeria.

Objective: To determine the prevalence and predictors of BBF exposure and knowledge about PEP among medical and allied health students in northern Nigeria.

Methods: In a cross-sectional study, 273 clinical students were asked to complete structured questionnaires. The prevalence of BBF exposure was determined. Binary logistic regression was used to determine the independent predictors of BBF exposure.

Results: The majority of the respondents (98.2%) had heard about PEP; 26.0% (n=71) had adequate knowledge about PEP. 76 (27.8%) of the 273 respondents reported accidental exposure to HIV. 230 (84.2%) respondents had positive attitude toward HIV PEP. Of those who had had accidental exposure to HIV (n=76), only 13% (n=10) received PEP. The level of knowledge about PEP was predicted by previous training (aOR 0.43, 95% CI 0.23 to 0.80 ["no" vs "yes"]), year of training (aOR 4.10, 95% CI 1.60 to 10.47 [6th *vs* 4th year]), course of study (aOR 4.69, 95% CI 2.06 to 10.68 ["allied health" *vs* "clinical medicine"]) and religion (aOR 5.39, 95% CI 1.40 to 20.71 ["non-Muslim" *vs* "Muslim"]). Similarly, accidental exposure was independently predicted by respondents' sex (aOR 2.55, 95% CI1.36 to 4.75 ["female" *vs* "male"]), age (aOR 2.54, 95% CI 1.06 to 6.15 ["25–29" *vs* "20–24" years]), ethnicity (aOR 2.15, 95% CI1.10 to 5.14 ["others" *vs* "Hausa/Fulani"]), course of study (aOR 0.06, 95% CI 0.01 to 0.38 ["allied health" *vs* "clinical medicine"]), and previous PEP training (aOR 0.39, 95% CI 0.20 to 0.78 ["no" *vs* "yes"]).

Conclusion: One in four clinical students reported exposure to BBF. Most students expressed a positive attitude toward PEP, but knowledge and uptake of PEP was sub-optimal. We recommend strengthening training curricula for infection control and prevention and enhancing protocols for timely post-exposure evaluation and follow up for all exposure incidents.

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Keywords: Knowledge; Occupational exposure; Blood-borne pathogens; Post-exposure prophylaxis; HIV; Nigeria

Introduction

Clinical students are at increased risk of accidental exposure to HIV, especially in sub-Saharan Africa, where a substantial proportion of infected people are unaware of their status.[1] An exposure incident is defined as a specific eye, mouth or other mucous membranes, non-intact skin, or parenteral contact with blood or other potentially infectious materials.[2] With 3 in 1000 of such exposures resulting in HIV transmission, exposure events are a serious cause of anxiety among clinical trainees and could result in a career-ending disease or even death.[3] Workplace exposures are more frequent in settings with inadequate supervision, staff shortages, low adherence to standard precautions, overcrowding, lack of basic safety equipment, low-risk perception, unnecessary injections, recapping, reuse of contaminated instruments, and poor medical waste management.[4]

The risk of transmission of HIV following exposure is increased with a deep wound, visible blood on the device, a hollow-bore blood-filled needle, use of the device to access an artery or vein, and high-viral-load status of the patient.[5-7] Evidence suggests that it could take 3 days from exposure for the virus to be detected in lymph nodes, and up to 5 days in blood.[8,9] This finding offers a short window of opportunity during which HIV transmission could be averted through post-exposure prophylaxis (PEP), which halts the irreversible establishment of HIV infection.[10] Effective PEP is thus an important secondary measure to maximize safety in health institutions. PEP involves emergency short-term treatment after a potential exposure,[8] and entails counseling, testing, and antiretroviral medication. The US Centers for Disease Control and Prevention (CDC) recommends that PEP be initiated as soon as possible, preferably within an hour of exposure, at most within 72 hours using a 3-drug regimen for 4 weeks.[11] Retrospective data from prevention of mother-to-child transmission (PMTCT) studies and occupational exposure support the efficacy of PEP among health care providers in Europe and the US.[12,13] When started soon after exposure, PEP is estimated to reduce seroconversion risk by 87%.[14]

Unfortunately, interventions to avert HIV transmission are rarely adhered to in high-burden, low-income countries, even among health care professionals.[15] The situation could be worse among clinical students due to inexperience, poor supervision, shortage or lack of personal protective equipment, inadequate knowledge of standard precautions, and limited access to PEP.[16] Furthermore, student-centered policies and procedures for post-exposure response may not be available. Where such policies exist, students may be reluctant to report injuries and avoid PEP procedures out of concerns about antiretroviral side-effects and stigma, as reported elsewhere.[17]

A recent survey in Nigeria found an HIV prevalence of 1.5%, with a third of the 1.9 million infected people unaware of their status.[18] With increasing numbers of students and limited training resources, students could be at increased risk of accidental exposures when performing potentially hazardous procedures like setting intravenous lines, sample collection, assisted delivery, and assisting with surgery. Without adequate orientation, policies, and procedures for first aid, and prompt reporting, the exposed trainees may not seek timely PEP. Although many studies have explored knowledge and PEP practices for HIV among health care workers in Nigeria,[19-22]

and elsewhere,[23,24] rarely have they focused on clinical and allied health students, especially in northern Nigeria. In addition, with the establishment of more medical schools, it is unclear if these institutions have policies and programs for protecting students undergoing experiential training, as part of the key strategies for the promotion of occupational and patient safety, thereby protecting the country's future human resource for health.

This study was conducted to determine the prevalence of workplace exposure to blood and body fluids as well as knowledge and predictors of PEP use among clinical and allied health students in a university hospital in Kano, northern Nigeria.

Materials and Methods

Setting

The study was conducted in three of the four faculties constituting the College of Health Sciences, Bayero University Kano, and its affiliate teaching hospital, the Aminu Kano Teaching Hospital. The participating faculties included clinical sciences, dentistry, and allied health.[25] The faculty of basic medical sciences was excluded, as their students have no clinical contact with patients. The majority of students are from Kano and neighboring states, but a sizeable proportion come from other parts of Nigeria and West Africa.[25] The study population consisted of clinical and allied health undergraduate students in the 4th through 6th years. We excluded students on postings outside Kano, students on sick leave, and those who withheld consent.

Design

This was a cross-sectional study. Using Fisher's formula for estimating the minimum sample size for single proportions,[26] and assuming a standard normal deviate at 95% confidence level, the proportion of medical students with adequate knowledge of antiretroviral PEP for HIV reported in a previous study (25.4%),[27] and a tolerable margin of error of 5%, we came to a minimum sample size of 292. To account for non-response, 10% was added to the initial sample size, making a total sample size of 325.

Sampling

We used a multistage sampling technique to select participants. In the first stage, after stratification by faculty, samples were allocated proportionate to the student population. This step was followed by a proportionate allocation by year of study in each faculty. Systematic sampling method was then used to identify potential participants from each level.

Measures

Data were collected using a structured self-administered questionnaire adapted from previous studies.[23,24] The first section had 12 items that elicited participants' socio-demographic characteristics, including age, marital status, religion, ethnicity, course of study, level of study, and place of residence. The second section assessed their knowledge about PEP using 25 items.

TAKE-HOME MESSAGE

- Accidental exposure to blood and body fluids among medical and allied health students in northern Nigeria is common.
- Whereas most students expressed a positive attitude toward PEP, their knowledge and uptake of PEP were suboptimal.
- Knowledge of PEP was predicted by previous training, year of training, course of study, and religion.
- Exposure to blood or body fluids was predicted by students' sex, age, ethnicity, course of study, and previous PEP training.

This included questions on whether participants had ever heard about PEP; the sources of knowledge; if they had ever received training on PEP; and what to do in case of exposure, indications, and regimens for PEP for HIV. To determine the prevalence of accidental exposure and the response, a third section inquired about ever occurrence of accidental exposure to blood and other body fluids. For participants who responded affirmatively, its occurrence in the preceding year, frequency, circumstances of exposure, and action following the most recent exposure were ascertained. Furthermore, it was clarified if the source patient and the respondent were screened for HIV, if they received PEP, and the interval between the exposure and commencement of PEP. The final section had six items on a 5-point Likert scale that assessed the respondent's attitude toward PEP.

To enhance clarity and cultural sensitivity, the questionnaire was pre-tested on 35 students at Maitama Sule University Kano. The content validity of the questionnaire was assessed by infectious disease specialists and community physicians at Bayero University. The reliability estimates based on Cronbach's α values were 0.87, 0.82, and 0.83, respectively, for the sections on knowledge of PEP, accidental injury, and attitude toward PEP.

The main outcomes of the study were (1) ever-occurrence of workplace exposure to blood or body fluids, (2) knowledge of PEP, (3) uptake of PEP, and (4) attitude toward PEP. The prevalence of accidental exposure was defined as the proportion of respondents who ever had a specific eye, mouth or other mucous membranes, non-intact skin, or parenteral contact with blood or other potentially infectious materials during clinical placement.[2] For knowledge questions, the options were "Yes," "No," and "Don't know." Correct responses were scored '1' and incorrect or "don't know" responses scored '0.' The total knowledge scores were categorized as either "inadequate" (score 0–12), or "adequate" (score 13–25). Attitudes were assessed on a 5-point Likert-type scale (total of 6 items). Negative statements were scored in the reverse direction. The total and mean scores were obtained. Respondents with scores greater than the mean were considered to have positive attitudes; those who scored less than the mean were categorized as having negative attitudes. For multivariate models, the explanatory variables for the two main outcomes (ever occurrence of accidental exposure and knowledge of PEP) included socio-demographic variables (sex, ethnicity, religion, and residence), course, year of study, and PEP training.

Procedures

Students were informed of the study through the student union and class representatives. Trained research assistants provided self-completed questionnaires to sampled students during lunch breaks, and retrieved them immediately after completion. All questionnaires were checked for completeness. Data were double-entered independently by clerks into a password-protected database at the Department of Community Medicine, Bayero University.

Ethics

The study protocol was approved by the College of Health Sciences Ethics Review Committee. Detailed information about the study was provided to prospective participants prior to obtaining informed written consent. They were also informed that participation was voluntary and that there were no consequences if they declined. Students who required counseling or health services were referred to university health services or the teaching hospital. Questionnaires were anonymous but retained unique serial numbers.

Table 1: Socio-demographic characteristics of the studied students (n=273)

Characteristic	n (%)
Sex	
Male	125 (45.8)
Female	148 (54.2)
Age group	
20–24	199 (72.9)
25–29	61 (22.3)
≥30	13 (4.8)
Ethnicity	
Hausa/Fulani	236 (86.5)
Others*	37 (13.6)
Religion	
Islam	261 (95.6)
Christianity	12 (4.4)
Marital status	
Single	257 (94.1)
Ever-married	16 (5.9)
Course of study	
Clinical sciences	194 (71.1)
Dentistry	24 (8.8)
Allied health	55 (20.2)
Year of study	
4th	106 (38.8)
5th	103 (37.7)
6th	64 (23.4)
Place of residence	
On-campus	148 (54.2)
Off-campus	125 (45.8)
Previous training on PEP	
Yes	77 (28.2)
No	196 (71.8)

*Igbo, Yoruba, Tiv, Egbira, Kanuri, Nupe

Statistical Analysis

Data were coded, sorted, and processed using SPSS® for Windows® ver 22 (IBM Corp, Armonk, NY, USA). After data cleaning, continuous variables were summarized using means and SD or median and range. Categorical data were presented as frequencies and percentages. At the bivariate level, Pearson's χ^2 was used for comparison of frequencies; Fisher's exact test was used when >20% of the cells had expected frequencies of <5.[28] Variables with a p value <0.10 at the bivariate level were entered into multivariate logistic regression models for the two outcomes.[29] Adjusted odds ratios (aOR) and 95% CI were computed using the stepwise approach. Hosmer-Lemeshow statistic and Omnibus tests were conducted to determine the model fitness, with a Hosmer-Lemeshow χ^2 yielding a p value >0.05 indicating a good fit.[30]

Results

Of the 325 clinical students studied, 273 (84.0%) completed the questionnaires. There were 194, 24, and 55 respondents from the faculties of clinical sciences, dentistry, and allied health, respectively. The mean age of respondents was 23.5 (SD 2.8) years. The majority of the respondents were female (54.2%), of Hausa/Fulani ethnicity (86.5%), Muslim (95.6%) and single (94.1%). Overall, 77 (28.2%) of students had previous PEP training (Table 1).

Most of the respondents (n=206, 75.5%) felt they were at risk of acquiring HIV during clinical training; 76 (27.8%) reported at least one accidental exposure since the onset of their clinical training. The common exposure modes included needlestick injury (50%, n=38) and blood or bodily fluid splashes on mucosal surfaces (50%, n=38). Of the 56 students exposed in the preceding 12 months, 43 (77%),

7 (13%), and 6 (11%) were exposed once, twice, and at least three times, respectively. The most frequent circumstances of exposure were while setting up intravenous lines (59%, n=45), surgical procedures (21%, n=16) and assisted delivery (20%, n=15). Of the 76 participants who were exposed, only 19 (25%) got tested for HIV post-exposure (Table 2). Amongst those who were not tested (n=57), 21 (37%) were not aware of the need, 10 (18%) were unfamiliar with the PEP procedures, and 26 (46%) assumed the source patient was HIV-negative. Only 13% (n=10) of the students who reported accidental exposure to HIV in the past (n=76) received PEP, most of whom (n=8) received it within 24 hours of exposure; all of them completed the 28-day treatment course.

The majority of the respondents (98.2%) had heard about PEP; 187 (68.5%) correctly defined the term. The students heard about PEP mostly from lectures (81.0%, n=221), ward rounds (25.3%, n=69), and from textbooks (19.4%, n=53). Based on knowledge scores, 26.0% of the respondents (n=71) had adequate knowledge of PEP. Specifically, 2.9% of students correctly cited the proportion of needle-stick injuries that could result in HIV transmission. A substantial majority of respondents (100%, and 86.1%, respectively) correctly identified blood and breast milk as high-risk media for HIV transmission. Most respondents correctly identified needle-stick injury (93.0%, n=254) and rape (93.8%, n=256) as indications for PEP; lower proportions reported HIV-exposed infants (81.7%, n=223) and blood or bodily fluid splash on mucosal surfaces (76.2%, n=208) as indications. Less than half (43.2%, n=118) of the participants correctly stated that PEP should be commenced within an hour of the exposure. Regarding PEP drug regimen, 114 (41.8%) participants mentioned the expanded 3-drug regimen. Overall, respondents accurately

Table 2: Knowledge of post-exposure prophylaxis and response to accidental exposure to blood or body fluids among the studied students (n=273, unless stated otherwise)

Parameter	n (%)
Knowledge of PEP	
Had heard of PEP	268 (98.2)
PEP is prophylactic antiretroviral medication for exposed seronegative individuals	187 (68.5)
Adequate knowledge	71 (26.0)
Inadequate knowledge	202 (74.0)
Sources of information*	
Lectures	221 (81.0)
Ward rounds	69 (25.3)
Textbooks	53 (19.4)
Internet	36 (13.2)
Friends and colleagues	34 (12.5)
Media	28 (10.3)
Seminar/workshop	18 (6.6)
High risk body fluids for transmission	
Blood†	273 (100.0)
Breast milk†	235 (86.1)
Urine	40 (14.7)
Saliva	77 (28.2)
Peritoneal fluid†	132 (48.4)
Synovial fluid†	101 (37.0)
Cerebrospinal fluid†	125 (45.8)
Stool	29 (10.6)
Indications for initiation of PEP	
Rape	256 (93.8)
Needle-stick injury	254 (93.0)
HIV-exposed infants	223 (81.7)
Blood/body fluid splash on mucosal surface	208 (76.2)
The source patient is at high risk for HIV	187 (68.5)

Continued

Table 2: Knowledge of post-exposure prophylaxis and response to accidental exposure to blood or body fluids among the studied students (n=273, unless stated otherwise)

Parameter	n (%)
Indications for initiation of PEP	
The source patient is known to be HIV-positive	164 (60.1)
The HIV status of the source patient is unknown	147 (53.9)
Even when source patient recently tested negative to HIV	132 (48.4)
All needle-stick injuries in the workplace	91 (33.3)
Commencement of PEP	
PEP should be commenced within 1 hour	118 (43.2)
Three antiretroviral drugs are used for PEP	114 (41.8)
The duration of antiretroviral drugs for PEP is 4 weeks	100 (36.6)
Accidental exposure	
Ever had accidental exposure	76 (27.8)
Exposed during last 12 months	56 (20.5)
Number of exposures in the last 12 months (n=56)	
Once	43 (76.8)
Twice	7 (12.5)
Thrice	6 (10.7)
Type of Exposure (n=76)	
Needle-stick injury	38 (50.0)
Blood/body fluid splash	38 (50.0)
Circumstances of exposure (n=76)	
Setting up intravenous line	45 (59.2)
During surgery	16 (21.1)
Assisted delivery	15 (19.7)
Post-exposure HIV screening and prophylaxis (n=76)	
Post-exposure HIV screening	19 (25.0)
Received PEP	10 (13.2)

*Multiple responses
†High-risk body fluids for HIV transmission

identified zidovudine (82.8%), lamivudine (54.6%), nevirapine (53.9%), and tenofovir (23.4%) as examples of drugs used in PEP. However, only 100 (36.6%) students reported the correct 4-week duration of PEP.

Regarding attitude toward PEP, overall, 230 (84.2%) respondents had positive attitude toward HIV PEP. Most respondents strongly agreed (n=169, 61.9%) or agreed (n=61, 22.3%) that HIV PEP is important, while 209 (76.6%) strongly agreed or agreed that PEP training should be enhanced in the curriculum (Fig 1). Regarding access to PEP in clinical areas, most respondents strongly agreed (n=142, 52%) or agreed (n=69, 25.3%) that all students should have access to PEP. The majority of participants strongly agreed (n=182, 66.7%) or agreed (n=59, 21.6%) to seek PEP immediately after the exposure. One-hundred and eighty-six (68.1%) respondents strongly agreed or agreed that they would recommend PEP to their colleagues. Furthermore, 179 (65.6%) of participants strongly agreed or agreed that PEP reduces the likelihood of HIV infection post-exposure (Fig 1).

Bivariate analysis revealed that accidental exposure to blood or body fluids was associated with the respondent's sex, ethnicity, course of study, year of study, and previous PEP training (Table 3). Similarly, knowledge about PEP was associated with previous training, course of study, religion, and residence, but not year of study.

After adjusting for confounders, it was found that accidental exposure to blood or body fluids was predicted by respondents' sex, age, ethnicity, course of study, and previous PEP training. Female students were more than twice as likely to have had accidental exposure (aOR 2.55, 95% CI 1.36 to 4.75). Similarly, students in the 25–29 age bracket had two-fold odds of accidental exposure relative to their younger colleagues (aOR 2.54, 95% CI 1.06 to 6.15). Further,

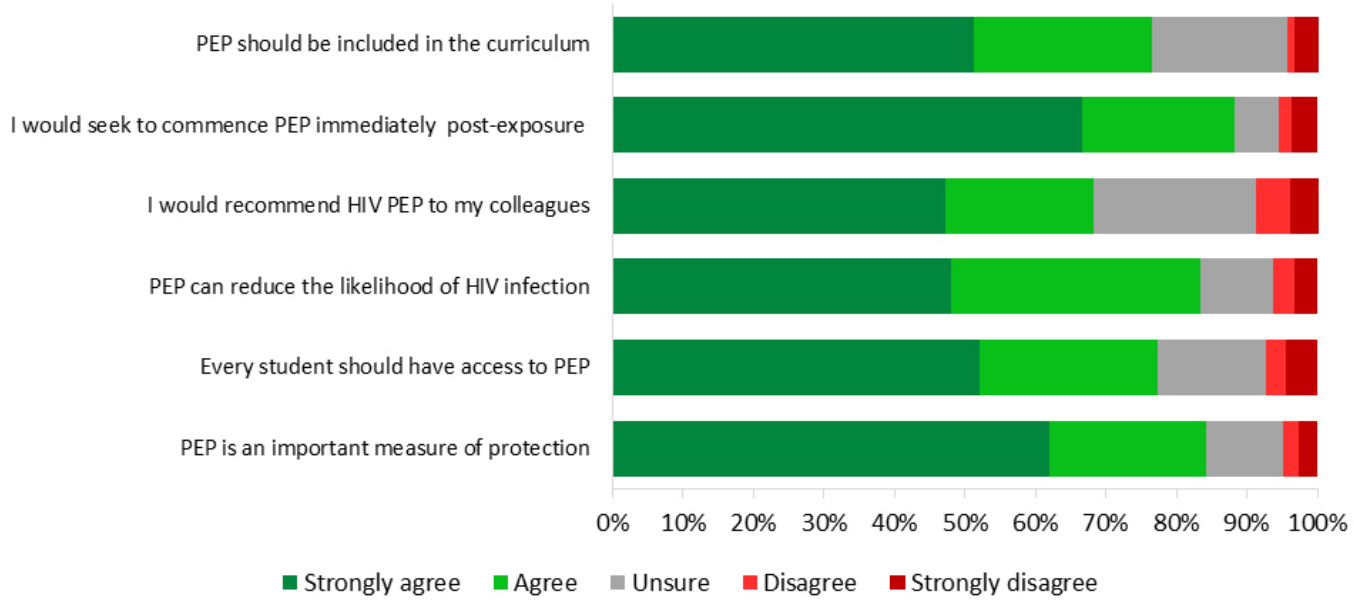

Figure 1: Attitudes toward post-exposure prophylaxis, Kano, Nigeria (n=273)

non-Hausa/Fulani students were more than twice as likely as their Hausa/Fulani peers to have had accidental exposure (aOR 2.15, 95% CI 1.10 to 5.14). Dental and allied health students had 94% lower odds of accidental exposure compared to medical students. Finally, respondents without prior PEP training were 61% less likely to have been exposed to blood or body fluids (aOR 0.39, 95% CI 0.20 to 0.78).

Regarding knowledge of PEP, previous training, year of study, course of study, and religion remained independent predictors. Specifically, students without prior PEP training were 57% less likely to have adequate knowledge of PEP relative to those who received training (aOR 0.43, 95% CI 0.23 to 0.80). In contrast, students in their 6th year of study had greater than four-fold odds of having adequate knowledge compared to 4th-year students (aOR 4.10, 95% CI 1.60 to 10.47), as was also the case with allied health students *vs* clinical medical students (aOR 4.69, 95% CI 2.06 to 10.68). Finally, non-Muslim students were more than five times as likely to know about PEP compared to their Muslim peers (aOR 5.39, 95% CI 1.40 to 20.71, Table 4).

Discussion

Students on clinical placement are at increased risk of accidental exposure to blood and body fluids and therefore to acquisition of blood-borne pathogens, especially in low-resource settings. Therefore, there is a need to determine the predictors of accidental exposure to blood and body fluids and knowledge, as well as attitude toward PEP. In this study, one in four of our participants were accidentally exposed to blood or body fluids, but three in four students had inadequate knowledge of PEP. The latter was predicted by previous training, years of study, and religion. Although most of our students had a positive attitude toward PEP, uptake was low.

Students' awareness of PEP (98.2%) was similar to the figures from some Nigerian institutions (96%–97.7%),[31,32] but higher than others (25.4%).[33] Our figure was also higher than those reported from

Table 3: Accidental HIV-exposure and knowledge of PEP by respondent characteristics (n=273)

Characteristics	n	Accidental exposure to HIV	p value	Adequate knowledge of PEP	p value
Sex					
Male	125	24 (19.2)	0.003	29 (23.2)	0.33
Female	148	52 (35.1)		42 (28.4)	
Age group					
20–24	199	54 (27.1)	0.41	51 (21.6)	0.92
25–29	61	20 (32.8)		16 (26.2)	
≥30	13	2 (15.4)		4 (30.8)	
Ethnicity					
Hausa/Fulani	236	59 (25.0)	0.008	61 (25.9)	0.88
Others	37	17 (46.0)		10 (27.0)	
Religion					
Islam	261	70 (26.8)	0.08	64 (24.5)	0.009
Christianity/Other	12	6 (50.0)		7 (58.3)	
Marital status					
Ever-married	16	3 (18.8)	0.40	4 (25.0)	0.93
Single	257	73 (28.4)		67 (26.1)	
Course of study					
Clinical sciences	194	66 (34.0)	<0.001	40 (20.6)	0.006
Dentistry	24	8 (33.3)		9 (37.5)	
Allied health	55	2 (3.6)		22 (40.0)	
Year of study					
4th	106	18 (17.0)	0.002	20 (18.9)	0.068
5th	103	40 (38.8)		29 (28.2)	
6th	64	18 (28.1)		22 (34.4)	
Residence					
On-campus	148	43 (21.9)	0.63	46 (31.1)	0.038
Off-campus	125	33 (26.4)		25 (20.0)	
Previous training on PEP					
Yes	77	31 (40.3)	0.004	33 (42.9)	<0.001
No	196	45 (23.0)		38 (19.4)	
Knowledge of PEP					
Adequate	71	16 (22.5)	0.25	—	—
Inadequate	202	60 (29.7)		—	
All respondents	273	76 (27.8)		71 (26.0)	

Table 4: Logistic regression model for predictors of accidental exposure to blood or body fluids and knowledge of HIV PEP among the studied students (n=273)

Variable	Exposure to blood or body fluids, aOR* (95% CI)	Knowledge of HIV PEP, aOR† (95% CI)
Sex		
Male	1	1
Female	2.55 (1.36 to 4.75)	1.29 (0.66 to 2.55)
Age group (yrs)		
20–24	1	1
25–29	2.54 (1.06 to 6.15)	0.83 (0.36 to 1.91)
≥30	0.93 (0.16 to 5.52)	0.92 (0.21 to 4.08)
Ethnicity		
Hausa/Fulani	1	—
Others	2.15 (1.10 to 5.14)	—
Religion		
Islam	1	1
Christianity/Other	1.77 (0.38 to 8.23)	5.39 (1.40 to 20.71)
Course of study		
Clinical sciences	1	1
Dentistry	0.06 (0.012 to 0.26)	1.19 (0.43 to 3.30)
Allied health	0.06 (0.009 to 0.38)	4.69 (2.06 to 10.68)
Year of study		
4th	1	1
5th	0.69 (0.27 to 1.75)	2.17 (1.17 to 4.88)
6th	0.48 (0.22 to 1.03)	4.10 (1.60 to 10.47)
Place of residence		
On-campus	—	1
Off-campus	—	0.66 (0.36 to 1.21)
Previous PEP training		
Yes	1	1
No	0.39 (0.20 to 0.78)	0.43 (0.23 to 0.80)

*Logistic model including the following variables: sex, age group, ethnicity, religion, course, year of study, and previous PEP training
†Logistic model including the following variables: sex, age group, religion, course of study, year of study, residence and previous PEP training

parts of Africa (67.1%–89.0%),[16,23,24,34] and Asia (18.5%–87%).[35-38] Further, the proportion of participants with adequate knowledge (26.0%) was low, as in other Nigerian institutions (13.4%–35.9%).[31] In Africa, it was similar to the figures from Ethiopia (30%),[9] higher than those from Cameroon and Ghana (5.8%–20.0%),[23,34] but lower than the value from Botswana (70.7%).[39] Specifically, the proportion of respondents aware of high-risk body fluids (blood, breast milk, peritoneal, cerebrospinal, and synovial fluids) was lower than in other Nigeria studies,[21] but greater than figures from Cameroon and Ghana.[23,34] In contrast, the proportion of respondents who incorrectly identified saliva (28.2%) as high-risk fluid was higher than the numbers reported from Cameroon (14.3%) and Jordan (22.7%).[23,40] Further, the proportion of respondents with knowledge of indications for PEP (needle-stick injury, blood or body fluid splash on mucosal surfaces, rape, and HIV-exposed infants) was similar to those reported from Ghana,[34] but higher than reports from the Cameroon.[23] Apart from variations in study populations and methods, these differences could be due to disparities in training opportunities, curricula content, and intensity of HIV programming. These factors are important, as students' knowledge could influence risk perception and adoption of protective measures.

The proportion of respondents in this study who were aware of the recommended interval for initiating PEP (43.2%), the 3-drug regimen (41.8%), and duration of PEP (36.6%) were similar to reports from other centers in Nigeria,[31,32] sub-Saharan Africa[23,34] and Asia.[35] In contrast, most nursing students in a study in India were unfamiliar with time of initiation (94.6%) and duration of PEP (86.1%).[36] The proportion of students in the study with prior PEP training (28.2%) was higher than the figures from Cameroon (6.5%–12.5%)[23] and India (15.5%).[35] This could reflect variation in training opportunities among students. Similarly, lectures and clinical teaching as sources of knowledge concur with reports from Cameroon,[23] but not Ghana, India, and Nepal, where workshops/seminars, textbooks and independent study were the main sources, respectively.[34,35,41] This finding could be due to differences in curricula content, pedagogy, and internet access. The increased penetration of the Internet in low-resource settings is an opportunity for faculty to provide online resources to students.

The proportion of respondents who felt that they were at risk of HIV infection (75.5%) was lower than the figures from other Nigerian institutions (91.3%),[22] sub-Saharan Africa (85%–96.1%),[23,24] and Asia (89%).[35] The relatively lower prevalence of HIV in northwestern Nigeria where our institution is located could explain this finding.[18] The prevalence of accidental exposure (27.8%) was similar to other Nigerian institutions (30.9%)[21,31] and Ethiopia (29.2%),[42] but lower than in Cameroon (52.6%–67.5%)[23,24] and Botswana (53.7%).[39] The main circumstances of the exposure (intravenous line set-up, blood sample collection, surgical procedures, obstetric delivery) and type of exposure (percutaneous or mucocutaneous) were similar to those in other Nigerian and African health institutions.[23,24] Similarities in clinical training programs, patient characteristics, and resource constraints could explain these findings.

The proportion of respondents who received PEP (13.2%) was also low in other Nigerian institutions (1.5%–5.6%),[27] but higher in others (21.6%–43.7%).[21,31] In sub-Saharan Africa, our figure was similar to numbers reported from Cameroon (4.9%),[24] but lower than figures from Ethiopia (48.6%–59.3%)[9,16] and Asia (45.7%).[35] Reasons adduced for not taking PEP (lack of awareness, ignorance of hospital pro-

cedures, and belief that source patient is HIV-negative) together with concerns about stigma, fear of side-effects of ARV) have been cited in other studies from Nigeria[44] and elsewhere.[17] Most of the reasons stated by our respondents could be linked to limited knowledge and access to institutional policy and procedures prior to clinical placement.

The recognition of the importance of PEP by a majority (84.2%) of our respondents, and the belief that it could reduce the risk of transmission (83.5%) concurs with peer perceptions in Africa[23] and Asia.[35] Similarly, the positive predisposition of students toward PEP, support for enriching PEP content in the curriculum, and the quest for increased access have also been suggested elsewhere.[9,19] These findings indicate students' readiness to fill knowledge gaps and initiate PEP when exposed. Class members and co-workers could be trained to encourage and facilitate the referral of exposed colleagues to PEP focal points.

The effect of training on PEP knowledge was also reported from other facilities in Nigeria and the Cameroon.[23] Similarly, improvement in knowledge with years of clinical study was reported from other institutions in Nigeria, parts of Africa,[23,24] and Asia.[35] Greater likelihood of exposure to short-term intensive workshops and learning opportunities during clinical rounds could explain these predictive effects of PEP training and year of study. The influence of religion on knowledge is difficult to explain and warrants further in-depth qualitative investigation. Unlike other studies,[23,35] we found that age, sex, and history of exposure affected the knowledge of PEP.

The sex disparity in accidental exposure has also been reported in Ethiopia[45] and elsewhere.[46] This finding could be related to differences in representation by sex in some specialties and in compensation.[45] For instance, the dominance of females in the nursing and midwifery courses could increase their exposure to blood and body fluids during assisted delivery and other obstetric procedures. The predictive role of age could reflect maturity and experience, as senior students are expected to be more vigilant to adhering to protective measures.

There are limitations to this study. First, the study was conducted in one institution. Although the curriculum of health training institutions in Nigeria is similar, caution is required when extrapolating our findings. Second, exposure incidents were based on student recall, rather than a surveillance database. Although such incidents are unlikely to be forgotten, recall bias cannot be excluded. Finally, reports of uptake of PEP could be prone to social desirability bias, as respondents might be prone to providing answers they perceive would be favorably viewed. Our findings, nevertheless, provide a basis for advocacy to health training institutions to implement policies and guidelines to protect future health care professionals.

In summary, one in four medical and allied health students reported accidental exposure to blood or body fluids. Knowledge of PEP was predicted by previous training, years of study, and religion. Although most students had a positive attitude towards PEP, uptake was low. The positive predisposition of students, support for curricula enrichment, and access to online resources imply students' readiness to improve their knowledge and post-exposure response. Training in infection control policies should be required before clinical placements, in addition to the provision of adequate personal protective equipment and the strengthening of protocols for reporting exposure events and accessing timely treatment.

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