

## Human Immunodeficiency Virus and Hepatitis B Virus Infection Prevention Following Occupational Exposure among Staff at a Regional Referral Hospital in Western Kenya

### Abstract

**Background:** Postexposure prophylaxis (PEP) with antiretroviral therapy (ART) and vaccination against hepatitis B virus (HBV) aides in preventing human immunodeficiency virus (HIV) infection and HBV, respectively, from accidental or occupational exposure. We assessed compliance to guidelines for HIV and HBV prevention after occupational exposure among hospital staff at a referral Kenyan hospital. **Methods:** We reviewed PEP registers for hospital staff reporting an occupational injury at a referral hospital in Western Kenya between January 2011 and December 2012. Proportions were used to summarize number of participants receiving the recommended services, Kaplan–Meier curves were used to describe time to ART initiation, and Chi-square statistics was used to describe the association between participant characteristics and PEP completion rates.  $P < 0.05$  was considered statistically significant. **Results:** Majority of documented hospital staff ( $n = 52$ ) were health workers (63%) and students (27%) and had high HIV risk exposures (97%). All had timely PEP initiation with 50% completing PEP. Completion rates did not vary by gender ( $P = 0.78$ ), exposure type ( $P = 1.0$ ), or department of exposure ( $P = 0.75$ ). Retesting for HIV and negativity rates at months 1.5, 3, and 6 were 96%, 25%, and 17% and 100%, 100%, and 100%, respectively. At the time of exposure, 17% (9) of staff were HBV vaccinated and HBV status of sources was unknown; no intervention was provided for HBV prevention. **Conclusions:** Low rates of completion and follow-up negate intended benefits of PEP. Efforts should be directed to enforce universal precaution practices and completion of PEP. Low rates of HBV testing and vaccination illustrate the need for support for the implementation of HBV prevention guidelines.

**Keywords:** Hepatitis B, human immunodeficiency virus/AIDS, workplace injuries

### Introduction

#### Risk of occupational exposure to biological hazards (infections) among health workers

In 2013, there were 0.18–4.0 needlestick injuries (NSI) per health worker per annum<sup>[1,2]</sup> that contributed to 37% of hepatitis B virus (HBV) infections and <10% of human immunodeficiency virus (HIV) infections globally.<sup>[3]</sup> In Kenya, the incidence of NSI ranged from 0.1<sup>[4]</sup> to 0.97<sup>[5]</sup> in a private and government hospital, respectively. Majority (95%) of HBV infections from occupational exposure are preventable by pre- and postexposure immunization.<sup>[6,7]</sup> In Kenya, among health workers in a district, provincial, and private hospital, 12%, 47%, and 50% have been vaccinated against HBV; vaccination completion rates were all

suboptimal (<50%).<sup>[4,5,8]</sup> Likewise, 95% of HIV infections from occupational exposure are preventable by simple low-cost measures.<sup>[3]</sup>

#### Risk of human immunodeficiency virus and hepatitis B virus infection following occupational exposure among health workers

This depends on the prevalence of these infections in the general population.<sup>[3]</sup> According to the Kenya AIDS Indicator Survey (KAIS) of 2012, the HIV prevalence in Kenya is 5.6% and 15.1% in Kisumu County.<sup>[9]</sup> In sub-Saharan Africa, HBV carrier rates range from 9% to 20%.<sup>[10]</sup> From KAIS 2007, the prevalence of HBV infections in the HIV-negative general population was 31.5%.<sup>[11]</sup>

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### Occupational Health Recommendations for human immunodeficiency virus postexposure prophylaxis

Hospital staff who are exposed to blood and body fluids should immediately report to the postexposure prophylaxis (PEP) clinic for HIV testing and risk assessment. If found to be at risk of HIV infection, a 28-day dose of antiretroviral therapy (ART) for PEP is initiated within 72 h of injury. HIV retesting is then done at months 1.5, 3, and 6 following exposure. Other supportive management is also instituted.<sup>[12]</sup>

### Occupational health recommendations for prevention of hepatitis B virus infection

All health personnel who are at risk of coming into contact with blood and body fluids should receive 3 doses of Hepatitis B vaccine, be retested after 1–2 months of the 3<sup>rd</sup> dose, and if found to be immune, no further vaccination would be required. If they are found to be nonimmune to HBV, a repeat of the “3 doses of the vaccine” should be administered. This is because up to 70% of those who are nonimmune will respond after repeat vaccination.<sup>[13]</sup> If they are still found to be nonimmune, the individual should be considered a nonresponder who is susceptible to infection.<sup>[14]</sup>

In the event of an exposure, an unvaccinated health-care personnel should receive Hepatitis B vaccine and complete the vaccination series; a partially vaccinated individual should complete his vaccination irrespective of “infectivity of source of exposure.” A completely vaccinated individual who was not retested should receive a single booster dose in the event of exposure to an infectious source. An individual who had completed his vaccination and was retested should receive no further treatment irrespective of “infectivity of source of exposure.” All persons exposed to “infected sources” should receive additional hepatitis immune globulin.<sup>[14]</sup>

### Objective statement

We ascertained adherence to guidelines for the medical management of HIV PEP and recommendations for prevention of HBV infection following occupational exposure<sup>[12,14]</sup> for staff at a regional referral hospital in Western Kenya.

## Methods

### Study design and setting

A retrospective review of PEP registers was conducted for staff at the Jaramogi Oginga Odinga Teaching and Referral hospital (JOOTRH) in Kisumu County, Western Kenya, who reported an injury between January 2011 and December 2012. The hospital has 687 health workers of whom 347 are clinical staff, 101 support staff, and 238 of other cadres (Olilo P, Senior Clinical Officer, JOOTRH, Personal communication May 25, 2016).

### Study population

All documented hospital staff who reported occupational injuries during the study period were eligible for inclusion.

### Data collection

Data on date of exposure, age, gender, cadre, date and time of exposure, date and time of presentation at the PEP clinic, where the injury occurred, nature and severity of the injury, device causing the injury, procedure that was being conducted at the time of the injury, HIV and Hepatitis B status of the source, date and time of PEP initiation and completion rates of PEP, reasons for noncompletion of PEP, and the Hepatitis B vaccination status or Hepatitis B surface antigen testing status of the exposed, and HIV status of the exposed health worker at baseline, at months 1.3, 3, and 6 were collected.

### Data analysis

Guidelines for medical management following occupational exposure to HBV and HIV were used in this analysis.<sup>[12,14]</sup> The health workers was referred to as the “exposed” whereas the patients from whom the exposure was obtained was referred to as the “source.” An occurrence of one occupational exposure was referred to as an “incident.” A high-risk HIV exposure was defined as an exposure from a HIV-positive source and an injury by needle, cut, or splash on mucosal membrane. The risk of Hepatitis B infection is increased when source is HBV positive and the exposed is not HBV vaccinated.<sup>[12]</sup>

Proportions were used to summarize participant characteristics and rates of adherence to PEP guidelines. Kaplan–Meier curves were used to describe time to ART initiation among the exposed. Chi-square statistics was used to describe association between participant characteristics and injury type and PEP completion rates.  $P < 0.05$  was considered statistically significant.<sup>[15]</sup>

### Ethical approval

This was granted by the Kenya Medical Research Institute (SSC 1525).

## Results

### Characteristics of hospital staff

Fifty-two hospital staff reported occupational injuries; majority were aged 20–24 years (41%), female (52%), from inpatient departments (71%) and were clinical staff (63%) and students (27%). The overall prevalence for 2011 was 3.5% (24/687), and for 2012, it was 4.1% (28/687) [Table 1].

### Nature and details of exposure

Majority of the exposures were caused by needle pricks (92%); others were from cuts (6%) and mucosal

**Table 1: Characteristics of hospital staff reporting occupational injuries at a regional referral hospital in Western Kenya, 2011-2012**

Characteristics	Total (52), n (%)	Completed PREP 26 (50%)	v	P
Age group*				
20-24 years	21 (41)	10 (20)	11 (80)	0.7
25-29 years	17 (33)	8 (16)	9 (84)	
30+years	13 (26)	8 (16)	5 (84)	
Missing	1 (0)	0	1 (100)	
Gender				
Male	25 (48)	12 (48)	13 (52)	0.8
Female	27 (52)	14 (52)	13 (48)	
Cadre**				
Students	14 (27)	7 (50)	7 (50)	0.3
Clinical officers	10 (19)	6 (60)	4 (40)	
Doctors	10 (19)	4 (40)	6 (60)	
Nurses	9 (17)	7 (78)	2 (22)	
Laboratory staff	3 (6)	0	3 (100)	
Missing	2 (2)	1 (50)	1 (50)	
Others	4 (4)	1 (25)	3 (75)	
Medical engineer	1 (1)	0 (0)	1 (100)	
Records staff	1 (1)	1 (100)	0	
VCT counselor	1 (1)	0	1 (100)	
Waste handler	1 (1)	0	1 (100)	
Department				
Inpatient	37 (71)	19 (51)	18 (49)	0.8
Outpatient	15 (29)	7 (47)	8 (53)	
Year of reporting injury				
2011	24 (41)	15 (63)	9 (37)	0.1
2012	28 (59)	11 (39)	17 (61)	
Severity of injury				
Superficial	39 (75)	17 (44)	22 (56)	0.1
Deep	13 (25)	9 (69)	4 (31)	
Nature of injury				
Needlestick	48 (90)	23 (48)	25 (52)	0.7
Cuts	3 (6)	2 (67)	1 (33)	
Mucosal	1 (1)	1 (100)	0	

\*Missing age for one participant. \*\*Cadres for two participants missing. VCT=Voluntary counseling and testing, PREP=Preexposure prophylaxis

splashes (2%). Fifteen injuries had detailed information regarding actual injury; 14 were NSI and 1 was a cut.

The 14 NSI occurred during blood collection (5), cannulation (4), injection (3), suturing (1), and procedure details for 1 NSI were not documented. Four of five NSI that happened during blood collection were caused by a needle on a syringe during blood draw (2), disassembling (1), and disposal (1); the fifth NSI was caused by a phlebotomy needle during blood collection. Injuries that occurred during cannulation ( $n = 4$ ) happened during the procedure (3) and when the device was left on the table (1). NSI that occurred during injection ( $n = 3$ ) happened during disposal (2) and during the procedure (1). The NSI that was caused by a suture needle occurred during suturing and the NSI whose procedure details were missing was from disassembling an unused needle. In summary, 8 of 15 NSI occurred after the procedure either

during disassembly (3) or disposal (5). The cut was from a surgical bladed that occurred when disassembling the device in surgery.

Two of the support staff with details of injury documented experienced NSI caused during disassembling an unused needle and disposal of a used needle.

### Risk of human immunodeficiency virus infection

Majority ( $n = 36$ ; 69%) of the incidents had only documentation of the HIV status of the source; the ART regimen and HIV viral loads were not documented. Majority were HIV positive ( $n = 35$ ; 97%). Of hospital staff with documentation of HIV status (92%), all (100%) were HIV negative. In summary, 34 of 35 (97%) of the incidents were high-risk HIV exposures; one exposure to a HIV-positive source was missing nature of exposure.

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### Antiretroviral therapy initiation rates following occupational exposure

All staff initiated ART within 3 days of exposure; among those with complete documentation of date and timing of both exposure and ART initiation (50%), ART was initiated within 2 h of exposure.

### Hospital staff completing postexposure prophylaxis

Hospital staff completing PEP ( $n = 26$ ; 50%) were nurses (78%), clinical officers (60%), students (50%), doctors (40%), other cadres (25%), and undocumented (50%). Reasons for noncompletion were side effects (2), referral (1), and unknown (23). Completion rates did not vary by participant characteristics ( $P > 0.05$ ) [Table 1].

### Follow-up after postexposure prophylaxis completion

Retesting rates for HIV at months 1.5, 3, and 6 following PEP initiation were 96%, 25%, and 17% and HIV negativity rates were 100%, 100%, and 75%, respectively.

### Risk of hepatitis B virus infection and hepatitis B virus infection prevention following occupational exposure

Majority ( $n = 49$ ; 94%) of the sources of exposure were of unknown HBV status. Only ( $n = 9$ ) 17% of the exposed had been vaccinated against HBV; these were students ( $n = 6$ ; 42%) and clinical staff ( $n = 3$ ; 33%) and detailed vaccination status was not documented. The risk of HBV infection therefore could not be computed. There was no documented intervention regarding exposure to HBV.

## Discussion

We found a prevalence of 3.5% and 4.1% of occupational injuries over a 2-year period; this is likely to be underestimated because its computation relied on only the number of health workers who reported injuries and were documented in the register. The prevalence of sharp injuries among nurses in Ghana in 2016 was 28.9%,<sup>[16]</sup> and 21% among medical students in Pretoria<sup>[17]</sup> over a 1-year period; and 35.6% within a 3-month period in health workers in Egypt.<sup>[18]</sup>

The high proportion of sharp injuries among clinical staff we found could be attributed to the nature of their duties,<sup>[19]</sup> among nonclinical staff to handling biomedical waste, and<sup>[20]</sup> among students to their limited clinical experience.<sup>[21]</sup> This is because the majority of injuries were reported by health workers and occurred after the procedure due to poor handling of the device or incorrect disposal techniques, respectively.<sup>[17]</sup>

The scaleup of HIV testing services in an attempt to promote universal access to knowledge of HIV status through the availability of free HIV testing services could partly explain why all injuries were assessed for “risk of HIV infection.”<sup>[12]</sup> Although a high risk of HIV infection

was found, the absence of information regarding the HIV viral load of HIV-infected patients or the ART regimen of limited further characterization of HIV risk.<sup>[22]</sup> This risk may also be overestimated since hospital staff may only report exposures when they knew that the “source” of the exposure was HIV infected or was able to determine the HIV status of the source.<sup>[23]</sup> The current guidelines do not recommend testing samples from devices that may have caused injury and such health workers may opt not to report the injuries.<sup>[12]</sup> Poor HIV risk perception following occupational exposure also limits the number of exposures reported.<sup>[24,25]</sup> HIV-positive hospital staff may not wish to report occupational injuries and risk inadvertently discloses their HIV status; those unaware of their HIV status at the time of injury may not wish to be tested for HIV as part of the requirements for PEP administration.<sup>[24,25]</sup>

HIV testing for the “exposed” health worker before PEP initiation aides identifying whether the exposure resulted in HIV infection<sup>[12]</sup> and is eligible for compensation for occupationally acquired HIV as currently occurs in South Africa.<sup>[26]</sup> The Workman’s Compensation Act Kenya, 2007, directs that employers shall compensate workmen for occupational injuries resulting in incapacitation of a permanent nature that would reduce their earning capacity in any employment which they were able to undertake at the time of the injury.<sup>[27]</sup> Despite HIV infection meeting the criteria for this compensation, no such provisions exist in the event of HIV infection beyond that which is provided for general populations by HIV programs in Kenya.<sup>[12]</sup> This may also discourage health workers from reporting occupational injuries.

Only the initial PEP guidelines were followed; 100% initiated PEP within 2 h of exposure compared to only 50% initiating PEP within 24 h in Cameroon.<sup>[22]</sup> However, PEP completion rates were suboptimal (57%); lower than among medical students in Pretoria where close to three-quarters completed PEP.<sup>[17]</sup> With such a high HIV prevalence among hospital patients and suboptimal PEP completion rates, health workers in this region are at an increased risk of HIV infection.<sup>[3,28]</sup>

No HBV preventive services were offered after exposure. There was no attempt to test the “sources;” the costs of testing may have had to be borne by either the patient or the hospital staff. HBV vaccination status of the hospital staff was only documented from self-report of whom <one-fifth were vaccinated and majority were health workers; similar rates have been observed in Egypt,<sup>[18]</sup> and Zambia where also health workers bear the cost of vaccination.<sup>[29]</sup> In the USA, employers are obliged to provide all employees at risk of infection with health education, vaccination and personal protective equipment, and institutions to develop policies regarding removal of nonimmune employees from high-risk exposure activities.<sup>[30]</sup> In Kenya, no systematic vaccination administration, assessment, and monitoring

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program exist in public health facilities (Olilo P, Senior Clinical Officer, JOOTRH, Personal communication May 25<sup>th</sup>, 2016).

Our analysis could only be restricted to data documented in the register. It is possible that there are a number of injuries that are not reported by health workers and this may have underestimated the results of our evaluation. Details regarding details on the device that caused the exposure and the actual injury and the reasons for noncompletion of preexposure prophylaxis, which may have enhanced the recommendations from our analysis, were missing from the register.

## Conclusions

Despite timely PEP initiation, low rates of completion and follow-up negate its intended benefits. Full benefits of pre-PEP and PEP for Hepatitis B are not being exploited due to low rates of preexposure HBV vaccination and HBV testing and lack of documentation of HBV PEP.

We therefore recommend the enforcement universal precaution practices including health education for hospital staff regarding PEP and symptomatic management of side effects, the introduction of departmental registers for timely documentation of injuries,<sup>[23]</sup> documentation of mechanisms of NSI with a view to formulate strategies to reduce them, and availing HBV infection prevention measures. After PEP initiation for HIV prophylaxis, health education and symptomatic management of side effects should be provided.<sup>[31]</sup> Further research to investigate the high number of NSI, need for parenteral medication, reasons for noncompletion of PEP, and nonreporting of injuries is recommended.

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## Conflicts of interest

There are no conflicts of interest.

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