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# Burden of Hepatitis-B Infections and Risk Factors among Healthcare Workers in Resource Limited Setting, Addis Ababa, Ethiopia

**Gizachew Taddesse Akalu[1]*, Addis Tamire Woldemariam[2], Abate Bane Shewaye[3], Dereje Assefa Geleta[4], Abebe Habteselasie Demise[5], Melaku Tesfaye Debele[6] and Kassu Desta Tullu[7]**

*[1]Ethiopian Medical Laboratory Association, Addis Ababa, Ethiopia*

*[2]Office of the Minister, Federal Ministry of Health, Addis Ababa, Ethiopia*

*[3]Addis Ababa University, College of Health Sciences, School of Medicine, Department of Internal Medicine, Addis Ababa, Ethiopia*

*[4]International Organization for Migration, Addis Ababa, Ethiopia*

*[5]Ethiopian Public Health Institute, Addis Ababa, Ethiopia*

*[6]International Clinical Laboratories, Addis Ababa, Ethiopia*

*[7]Addis Ababa University, College of Health Sciences, School of Allied Health Sciences, Department of Clinical Laboratory Sciences, Addis Ababa, Ethiopia*

***Corresponding Author:** Gizachew Taddesse Akalu, Ethiopian Medical Laboratory Association, Addis Ababa, Ethiopia.

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## Abstract

Hepatitis-B virus infection is a serious global health problem, with an estimated 2 billion people infected worldwide and 350 million suffering from chronic hepatitis-B virus infection. About 3 million healthcare workers face occupational exposure to bloodborne viruses each year of which 2 million are exposed to hepatitis-B viral infections. Hospital-based cross – sectional study was conducted from November 1, 2013 to May 2014 and convenient sampling method was applied. Blood samples from 313 healthcare workers were collected and their sera were analyzed for markers of hepatitis-B virus using Chemiluminescent Microparticle Immunoassay. The study revealed that the seroprevalence of hepatitis-B viral infection was 2.6% among the sample of Health Care Workers (HCW) and the prevalence of life time exposure was 25.6%. Prevalence of needle stick and sharp injuries were 33.9% and 35.5% respectively. Exposure to blood (COR: 9.351, 95% CI: 1.164 - 75.095, $p < 0.012$), history of jaundice and prior diagnosis of liver disease (COR: 3.096, 95% CI: 1.051 - 9.120, $p < 0.032$), and lack of HBV vaccination ( $\chi^2 = 11.145$, $p < 0.002$), were independent risk factors potentially associated with hepatitis-B infections. This study revealed high prevalence of current and life time exposures to hepatitis-B viral infections among HCWs. Exposure to potentially infectious body fluids, needle stick and sharp injuries was also high. Yet, only a small proportion of HCWs (1.6%) were vaccinated against hepatitis-B virus. This study calls for continuous medical education and training on infection prevention and safety including vaccination, compliance with universal precautions, increasing access to safer injection technologies, and post exposure management to improve the safety of HCWs, their families, and patients.

***Keywords:*** *Hepatitis-B Virus; Risk Factors; Healthcare Worker; Ethiopia*

## Abbreviations

Abs: Antibodies; Ags: Antigens; Anti-HBcAg: Antibody for Hepatitis-B core Antigen; Anti-HBeAg: Antibody for Hepatitis-B e Antigen; Anti-HBsAg: Antibody for Hepatitis-B surface antigen; CDC: Center for Disease prevention and Control; DNA: Deoxyribonucleic Acid; ELISA: Enzyme-Linked Immunosorbent Assay; EPI: Expanded program for immunization; HBcAg: Hepatitis-B core Antigen; HBIG: Hepatitis-B

immunoglobulin; HBsAg: Hepatitis-B surface antigen; HBV: Hepatitis-B virus; HCC: Hepatocellular carcinoma; HCWs: Health care workers; PEP: Post Exposure Prophylaxis; PPE: Personal Protective Equipment; Ups: Universal precautions; NSI: Needle sticks injury; RNA: Ribonucleic Acid; SPs: Standard Precautions; SOP: Standard Operation Procedure; WHO: World Health Organization.

## Introduction

Hepatitis-B viral (HBV) infection is a common infectious disease that accounts for two billion past or recent infections globally. Of these, 350 million people remain chronically infected and become carriers of the virus [1-2]. In Ethiopia, different sero-epidemiological studies have shown that HBV is a major public health problem with an estimated prevalence of 5.7 to 7% [3-5].

HBV infection is the most commonly blood borne virus in the healthcare setting. Interaction with patients infected with HBV is likely to pose unavoidable safety risks for the health care workers (HCW's) [6,7]. The risk of HBV infection among HCWs is estimated to be 3 to 5 times higher than in the general population, particularly in surgeons, pathologists, physicians, laboratory technicians, nurses, and other non-medical staff like housekeepers. The global annual estimate of HCW's exposed to HBV infections are estimated at 5.9% [8,9]. Research findings indicate 10 - 30% of HCWs exhibit serologic evidence of past or present HBV infection [10,11]. In developing countries, 40 - 60% of HBV infections in HCWs are attributed to occupational hazard [8,9].

HBV is preventable and controlled through pre-exposure vaccination and practicing standard safety precautions [12]. However, Hepatitis-B vaccination coverage among HCWs is very low in developing countries. The main reasons for this heightened risk include poor awareness of the risk factors, and low priority given by the health managements in government and private hospitals in universal precautions [13].

Hepatitis-B vaccine was included in the national program of immunization (NPI) since 2005 in Ethiopia. However, vaccination against HBV is not compulsory in HCWs in the country and yet only few proportion of HCWs admitted that they were vaccinated. In addition, periodic surveillance for assessing occupational exposures is very rudimentary and calls for better attention. This study was done with the aim of assessing the burden and risk factors of HBV infection among HCWs at the study site.

## Materials and Methods

### Study design and area

An institution-based cross-sectional study was conducted to determine hepatitis-B sero-positivity, associated risk factors, and vaccination coverage among HCWs at St Paul Hospital Millennium Medical College from November 2013 to May 2014. St Paul Hospital Millennium Medical College, located in Addis Ababa the capital city of Ethiopia. This Hospital is the second largest specialized teaching hospital in Ethiopia. At the time of the study, the hospital employed 1486 HCWs. Of this total number of employees, 145 were doctors; 141 medical officers (including medical laboratory technologists, pharmacists, and radiographers); 419 nurses and midwives; and 781 general service providers (including cleaners and patient porters).

### Study Population

Study participants were recruited using consecutive convenient sampling method from the staff of St Paul Hospital Millennium Medical College. All HCWs who came in contact with patients, handled blood and body fluids, and/or handled clinical wastes were included in the study. Doctors, nurses, midwifery nurses, laboratory technicians, cleaners, patient porters and other general service providers (particularly in the departments of surgery), as well as department of gynecology, medical laboratory, medical and emergency wards were included. HCWs not frequently exposed to blood and other body fluids, or those working less than six months, or those staff working only in administrative positions were excluded from the study.

### Laboratory Examinations

Sample collection and questionnaire administration was done by trained laboratory personnel. Venous blood samples were collected and processed, and sera were tested for HBV infection markers at International Clinical Laboratories, a Joint Commission International Accredited Laboratory located in Addis Ababa, Ethiopia. The serum sample was kept in the refrigerator at 4°C per international protocols. All sera were screened for hepatitis-B surface antigen (HBsAg) and Hepatitis-B core antibody (anti-HBc) markers using the ARCHITECT i2000SR automated analyzer from Abbott Laboratories. HBsAg positive samples were confirmed by the Abbot ARCHITECT system HBsAg confirmation kit. All sera were also further tested for the presence of Hepatitis-B surface antibody (Anti-HBs).

### Data collection and analysis

A structured, tested and coded questionnaire was used to collect socio-demographic data and associated risk factors from each participant. Data collection was conducted after explaining the objectives of the study and receiving consent from each of the study participant. Data was checked for completeness, accuracy and consistency during sample collection and administration of questionnaire. Sample collectors were trained. In addition, to ensure protocols standard operating procedures (SOPs) were followed properly during both sample collection and laboratory analysis. Positive and negative controls were used.

The data was analyzed using SPSS version 20.0. The Chi-square test was used for bivariate analysis to determine the association between categorical variables with main outcomes. Multivariate logistic regression model was computed to assess exposure to risk factors by job category, age, sex, practice area, vaccination status and service year as dependent confounding risk factors. Only those dependent and confounding risk factors with a P- value < 0.05 were considered statistically significant. The strength of association between dependent and independent variables was measured using odds ratio using a 95% confidence interval (CI).

### Ethics Statement

Ethical clearance was obtained from the Research and Ethical Review Committee (Protocol number: DRERC 063.13.MLS) of the department of clinical laboratory sciences, school of allied health sciences, college of health sciences, Addis Ababa University and St Paul Hospital Millennium Medical College Institutional Review Board (Reference: IRB PM. 23.82). Written informed consent was obtained from all the study participants and confidentiality was maintained throughout the study.

## Results

### Socio-demographic characteristics of the study subjects

Among 313 HCWs included in the study, 67.34% (211/313) were females and 32.6% (102/313) were males. Their age ranged from 21 to 60 years with mean age of 31 ± 8.8 years. Nurses (41.9%) and cleaners (14.4%) accounted for the highest proportion. Pharmacists and porters had the lowest proportion 5.4% (17/313) and 5.8% (18/3130) respectively, as summarized in figure1. Majority of the HCWs (28.2%) were employed for 2-5 years while 23.7% were employed for 5 - 10 years.

### The Magnitude of HBV Infections among HCWs

Eight (2.6%) of HCWs were found to be positive for HBsAg. All of whom were also positive for anti-HBc antibody. Though it was not statically significant (p > 0.05) the HBsAg positivity rate was higher in males (3.9%) than females (1.9%). The prevalence of HBV infections was highest in the age group of 31 to 35 (4.2%), followed by 26 to 30 (3.2%), and 21 to 25 (2.0%) (Table1). The general service providers had the highest prevalence of current HBV infection (8.1%), followed by patient porters (5.6%), cleaners (4.4%), and laboratory technicians (3.3%). Married HCWs had higher prevalence and life time exposure to HBV infections (32.6%) than unmarried counter parts (19.6%). However, age and gender were not associated with statistically significant difference in HBsAg positivity.

| Age Group ( in Years) | HBV Markers | | | |
|---|---|---|---|---|
| | HBsAg (+) Anti-HBC (+) | Anti-HBC (+) Anti-HBs (+) | Anti-HBs (+) | Anti-HBs (-) |
| | % (Number) | % (Number) | % (Number) | % (Number) |
| 21 - 25 | 2.0(2/102) | 20.6(21/102) | 2.9(3/102) | 74.5(76/102) |
| 26 - 30 | 3.2(3/95) | 26.3(25/95) | 8.4(7/95) | 62.1(59/95) |
| 31 - 35 | 4.3(2/47) | 29.8(14/47) | 0(0/47) | 66.0(31/47) |
| 36 - 40 | 0.0(0/28) | 28.6(8/28) | 0(0/28) | 71.4(20/28) |
| 41 - 45 | 11.1(1/9) | 22.2(2/9) | 22.2(2/9) | 44.4(4/9) |
| 46 - 50 | 0(0/19) | 31.6(6/19) | 0(0/19) | 68.4(13/19) |
| > 50 | 0(0/13) | 30.7(4/13) | 15.4(3/13) | 53.9(7/13) |
| Total | 2.6 (8/313) | 25.6 (80/313) | 4.8 (15/313) | 67.0 (210/313) |

***Table 1:*** *Prevalence of HBV by age of HCWs at St Paul Hospital Millennium Medical College; Addis Ababa, Ethiopia (n = 313).*

Life time exposure to HBV infection in this study was 25.6% (80/313) of which cleaners, patient porters, and general service providers had a prevalence of 35.6%, 33.3%, and 27.0% respectively (Table 2).

| Job Category | HBsAg (+) %(N) | Anti-HBs (+) Anti-HBc (+) %(N) | Anti-HBs (+) % (N) | Anti-HBs (-) %(N) |
|---|---|---|---|---|
| Doctors | 0.0 (0/35) | 22.8(8/35) | 25.7(9/35) | 51.4(18/35) |
| Nurses | 0.8(1/131) | 24.4(32/131) | 3.0(4/131) | 72.5(94/131) |
| Laboratory | 3.3(1/30) | 26.7(6/30) | 6.6(2/30) | 70.0(21/30) |
| Pharmacy | 0.0(0/17) | 11.8(2/17) | 0(0/17) | 88.2(15/17) |
| Cleaners | 4.4(2/45) | 35.6(16/45) | 0(0/45) | 60.0(27/45) |
| Porters | 5.6(1/18) | 33.3(6/18) | 0(0/18) | 61.1(11/18) |
| GSP | 8.1(3/37) | 27.0(10/37) | 0(0/37) | 64.8(24/37) |
| Total | 2.6(8/313) | 25.6(80/313) | 4.8(15/313) | 67.0(210/313) |

***Table 2:*** *The Magnitude of Hepatitis B viral markers with job categories of HCWs in St .Paul Hospital Millennium Medical College; Addis Ababa, Ethiopia (n = 313).*

*HBsAg = Hepatitis B surface antigen; Anti-HBs = Antibody to Hepatitis B surface antigen; Anti-HBc = Antibody to Hepatitis B core antigen; GSP = General Service Provider: includes Data Recorders, Ambulance Drivers; Laundry and Mourn Workers*

As to the correlation of HBV infection between departments of practice, HCWs practicing in outpatient departments (31.2%) had higher prevalence and life time exposure to HBV infections, while ICU and Pharmacy departments (3.7%) had least prevalence (Figure 1).

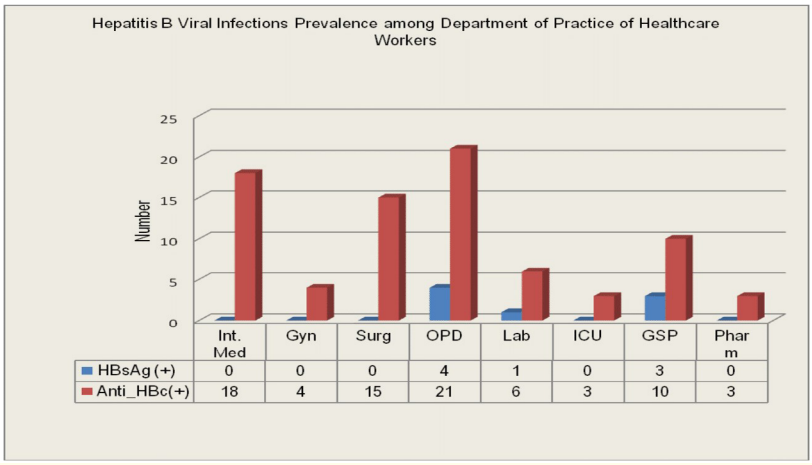


***Figure 1:*** *The Magnitude of Hepatitis B viral markers among department of practice of HCWs in St. Paul Hospital Millennium Medical College; Addis Ababa, Ethiopia (n = 313).*

## Vaccination status of HCWs

Vaccination status of HCWs shows 6.4% (20/313) received at least two dose vaccinations against HBV, but only 1.6% (5/313) had completed the full three doses vaccination series. Doctors reported higher compliance rates of completing all three vaccinations doses than their colleagues. However, among the 20 vaccinated HCWs, 25% (5/20) had no serological evidence of immunization (anti-HBs < 10 mIU per ml) for HBV infection. About 25.6% (80/313) of HCWs tested were positive for anti-HBC and anti-HBs markers, which indicate resolution of HBV infection following a natural course of infection (Table 2).

## Potentials for Exposure to Risk Factors among HCWs

Among the HCWs, 179/313 (57.2%) reported exposure to blood and blood products, 139/313 (44.4%) reported a history of exposure to body fluids, and 119/313 (38%) reported an occurrence of blood or body fluid splashes to their exposed faces. Thirty percent of the incidences occurred within the last six months. Participants were queried on their consistent use of gloves each time they carried out a procedure as a means of preventing risk of infection, and consistent use of gloves was reported in 156/313 (49.8%) of HCWs. In this study, nurses (48.9%), porters (44.4%) and the laboratory technicians (40%) were the leading non-complaints to consistently use gloves, while 71.4 % of doctors reported consistent use of gloves. Frequency of occupational exposure to risk factors in HCWs is summarized in Table 3.

| Type (Exposure) | Prevalence of Exposure by Professional Category | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Doct N = 35 | Nurse N = 131 | Lab. N = 30 | Pharm. N = 17 | Cleaner N = 45 | Porter N = 18 | GSP N = 37 | Total N (%) |
| Needle Stick Injury | 12 | 69 | 5 | 2 | 10 | 2 | 6 | 106(33.9) |
| Sharp Injury | 11 | 47 | 5 | 6 | 20 | 5 | 17 | 111(35.5) |
| Blood and BP* | 27 | 110 | 11 | 2 | 15 | 9 | 5 | 179(57.2) |
| Body Fluid | 26 | 84 | 7 | 0 | 13 | 6 | 3 | 139(44.4) |
| Liver Disease | 2 | 7 | 0 | 1 | 1 | 0 | 3 | 14(4.5) |
| Operation | 8 | 16 | 3 | 3 | 5 | 2 | 10 | 47(15.0) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Tattooing | 0 | 8 | 2 | 2 | 3 | 4 | 2 | 21(6.70 |
| Blood Trans | 1 | 8 | 1 | 0 | 0 | 1 | 4 | 15(4.8) |
| Caring Hepatitis Pt* | 31 | 104 | 7 | 1 | 10 | 5 | 7 | 165(52.7) |

***Table 3:*** *Frequency and history of Exposure to Risk Factors among the 313 HCWs in St Paul Hospital Millennium Medical College; Addis Ababa, Ethiopia.*

*Blood and BP* = blood and blood products; Caring Hepatitis Pt* = Caring of Hepatitis patients; Doct = Doctors; Lab=Laboratory; Phar = Pharmacy; GSP = General Service Provider*

Overall, 12.8% (40/313) of HCWs had at least one exposure to needle stick injuries and 11.8% (37/313) reported a history of repeated exposure to sharp injuries. Among all professional categories, majority of the nurses reported exposure to blood and blood products in 83.9 % (110/131) and needle stick injuries in 52.7 % (69/131). Doctors reported 74.2% (26/35) had been exposed to potentially infectious materials from body fluids as a result of patient care and treatment. When asked about formal training in safety precautions and infection prevention control, only 25.2% (79/313) of the HCWs admitted receiving both training sessions.

## Risk Factors for HBV infections

The univariate analysis shows that, in the socio-demographic characteristics among HBsAg and ant-HBC positive HCWs, the crude odds ratio of being HBV infected indicates a greater risk in males than females (COR=1.357, 95% CI: 0.676 - 2.276). Exposure to blood and blood products demonstrates a statistically significant association with HBV infection (COR = 9.351, 95% CI: 1.164 - 75.095).

Following univariate analysis, significant risk factors for HBV infection among the HCWs were found to include: history of exposure to blood and blood products (COR = 9.351, 95% CI: 1.164 - 75.095); history of jaundice and diagnosed liver disease (COR = 3.096, 95% CI: 1.051 – 9.120) and vaccination status ($\chi^2$ = 11.145, P = 0.002). The variables found to be associated with HBV infection in the univariate analysis were entered into the logistic regression model controlling confounders and for evaluating the effects of risk variables on HBV infection among the studied group. Following the multivariate analysis, history of jaundice and diagnosed liver disease remained statistically significant as a risk factor with HBV infection among HCWs (OR = 4.092; 95%CI: 1.060 - 9.513); P = 0.039. Vaccination status also showed a strong statistical association ($\chi^2$ = 11.145, P = 0.002) (Table 4).

| Risk Factor | Odds Ratio (95%CI) | P – Value |
|---|---|---|
| Age | 1 | 0.538 |
| Sex: | | |
| ▪ Male | 1.357(0.676 - 2.276) | 0.111 |
| ▪ Female | 1.444(0.850 - 2.451) | 0.241 |
| Blood and Blood Product contact | 9.351(1.164 - 75.095) | 0.012 |
| Body Fluids exposure | 5.592(0.696 - 44.913) | 0.065 |
| Needle Stick Injuries | 1.536 (0.315 - 7.481) | 0.454 |
| Sharp Injuries | 0.916 (0.223 - 3.761) | 0.483 |
| Jaundiced and Diagnosed Liver Disease | 3.096 (1.051 - 9.120) | 0.032 |
| History of Operation | 0.970 (0.950 - 0.991) | 0.268 |
| Blood Transfusion | 0.973 (0.955 - 0.992) | 0.672 |

| | | |
|---|---|---|
| Job Category | 1 | 0.171 |
| Department of Practice | 1 | 0.063 |
| Splash of Blood and Body Fluids | 1.200 (0.715 - 2.016) | 2.88 |
| Tattoo | 1.500 (0.583 - 3.860) | 0.271 |

***Table 4:*** *Risk factors: results from logistic regression model among all healthcare workers in St Paul Hospital Millennium Medical College; Addis Ababa, Ethiopia.*

## Discussion

In this study the magnitude of life time exposure and HBV infection was high among HCWs as 25.6% of study participants were positive for Anti-HBc marker and exposure to HBV infection with over all HBsAg seropositivity of 2.6%. A comparable intermediate endemicity level of current HBV infections among HCWs were reported from different parts of the world show; 4.9% of HBsAg sero-prevalence from Sudan [10], 5% of HBsAg sero-positivity from Turkey [14], 2.18% of HBsAg sero-prevalence with significant difference between vaccinated and non-vaccinated HCWs from Pakistan [15], 2.4% of HBsAg seroprevalence from Korea [16], and 2.8% of HBsAg prevalence from Syria [17]. However, the finding of current HBV infection in this study are much lower than reported by similar studies in Ethiopia which range from 7.3% to 9.7% [18-19]. Similar high prevalence were also reported from other countries like Yemen (9.9%), a highly endemic country [20], Senegal (17.8%) [21] and Uganda (8.1%) [22]. The reason for a relatively lower rates of HBV sero-prevalence in our study might be attributed to the difference in diagnostic technologies and markers used to measure the infections, difference in demographic characteristics, the difference in HBV geographical epidemiology, awareness on HBV transmission, efforts made to implement universal precautions by HCWs, and different degree of benefits due to the initiation of national and global immunization programs all over the world.

The low rate of consistent use of gloves (71.4% doctors and 40% laboratory professionals) could have contributed to the risk of HBV infection. In this study, needle stick and sharps injuries accounted for 33.9%, and 35.5% of all reported injuries respectively, including all the studied HCWs and their respective job categories. With regards to needle stick injuries, a similar study across Ethiopia revealed a prevalence of 17.5% for needle stick and 13.5% for sharps injury [23]. A similar report of needle stick injury prevalence in the Hawassa area indicated 35.8% [24]. This data indicates a variance in needle stick and sharps injuries between different healthcare settings in Ethiopia. The possible reasons for high prevalence of these needle stick and sharps injuries include lack of specific programme measures to address occupational challenges, lack of safer sharp devices, lack of information, and failure to adhere to standard precautions. In this study, exposure to blood and body fluids was also noted to be high, 57.2% and 44.4% ungloved and gloved HCWs, respectively. Similarly, 30.5% needle stick injuries, 25.7% sharps injuries, and 28.8% exposures to blood and body fluids were reported from eastern Ethiopia in the past [23-25].

The logistic regression model indicates exposure to blood and blood products, jaundice and diagnosed liver disease, and vaccinations are strongly associated with each other, indicating the clustering nature of exposure incidents on groups of HCWs probably based on negligence and substandard compliances with infection prevention and safety precautions. This study suggested that exposure to blood and body fluids, needle sticks, and sharp injuries are still considerable burdens for HCWs. Although all HCWs who have contact with patients are at risk of exposure to blood and body fluids, needle sticks and sharps injuries, nurses experience the highest prevalence of injuries: 83.9% from blood and blood products, and 52.7% from needle stick injuries. Doctors are second at risk as 74.2% reported injuries from body fluids exposure. This is because nurses experience the majority of needle stick injuries globally [25] and is more likely to handle sharp devices in addition to having closer contact with patients.

Hepatitis-B vaccination among HCWs in this study was very low as only 1.6% was fully vaccinated and 4.8% incompletely vaccinated, with at least two scheduled doses. This is a critically low vaccination rate among the groups most at risk for HBV infection. According to

the WHO estimates vaccination compliance varies from 18 % in Africa to 77% globally [25]. A recent study in Kenya showed 12.8% of HCWs were vaccinated [26]. There are many potential reasons for low HBV vaccine coverage, the most common being unavailability of the vaccine at the health facility. While the vaccine is available on the market at a cost, HCWs workers generally rely on provision of the vaccination by their institutions. Other potential reasons identified in our study include lack of knowledge about severity of infection, and vaccine efficacy, and low risk perception of HBV infections. There is a moderate awareness among HCWs in this study that many countries in the WHO African region have implemented hepatitis-B vaccine in their routine national EPI since 2005 [27]. However, availability of a safe and efficacious vaccine and adoption of appropriate immunization strategies as the most effective means to prevent HBV infection are yet well advocated.

On the other hand, in our study 20.0% (1/5) of HCWs with a history of complete scheduled vaccination, and 26.6% (4/15) of HCWs with history of incomplete (at least two doses) scheduled vaccination had no serological evidence of immunity (anti-HBs < 10 mIU/ml). A similar study in India reported that of 153 HCWs (received three doses of scheduled vaccinations) only 70.6 (108/153) had serological evidence of immunity (anti-HBs > 10 mIU/ml) [28]. Another study in Iran reported 68.2% (103/129) had serological evidence of immunity (anti-HBs > 10 mIU/ml) with association between vaccination and adequate completion of its courses with higher anti-HBs titer [29], and in the booster dose of vaccine it was 94.3% and 100% with the first and second booster dose of vaccination, respectively [30]. This indicates a need to measure the concentration of anti-HBs titer in all vaccines after the third dose of scheduled vaccination and consider reassessment of vaccination in HCWs according to their anti-HBs levels 10 years after vaccination [31,32]. The possible justification for lack of adequate anti-HBs antibody formation may be due to the persistent exposure of HCWs to HBV infection, low level viremia, or infection with mutant forms of HBV from patients on certain antiviral treatments [33]. A variety of HLA class I and II antigens have also been reported to be associated with unresponsiveness to the vaccine in different ethnic populations [34].

We recognized certain limitations in this study. Due to insufficient immunoassay logistics provided, there is no data available from this study regarding IgM anti-HBc and HBeAg markers. This limited the study classifying whether infections are acute or chronic and whether the degree of infectivity correlates with a high level of HBV replication or not. Since the data regarding exposure to risk factors were collected by a self-administered questionnaire, there is a possibility of recall bias among the HCWs workers of their risk factors as well.

## Conclusion and Recommendation

The prevalence of life time exposure to HBV infection among HCWs is high. All categories of HCWs exposure to HBV indicated high risk and yet only a small proportion of HCWs were vaccinated against HBV infection. Besides the doctors, nurses and medical laboratory professionals, cleaners and patient porters were at a comparably high or increased risk of contracting HBV infection. The study's authors recommend increased compliance with universal precautions by all HCWs, access to safer injection technologies, HBV vaccination, post-exposure management and continuing medical education on infection prevention and safety precautions. Health facilities should be encouraged to establish surveillance systems for registering, reporting and managing of occupational exposures to HBV infection.

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## Conflict of Interest

The authors declare that they have no personal or financial relationship(s) which may have inappropriately influenced them in writing this manuscript.

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