Hepatitis B virus infection status and associated factors among health care workers in selected hospitals in Kisumu County, Kenya: a cross-sectional study.

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Abstract (293)

Background: Poorly managed medical waste produced at the health facilities are potential source of infections including occupational exposure to Hepatitis B Virus (HBV). This study evaluated the prevalence of HBV infection among healthcare workers (HCW) in Kisumu County.

Methods: We determined the prevalence of HBV infections among 192 HCW from nine purposively selected high volume public hospitals in Kisumu County. A structured questionnaire was administered, and 4.0 ml of venous blood sample collected for Hepatitis B surface antigen (HBsAg), hepatitis B surface antibody (anti-HBs) and total hepatitis B core antibody (anti-HBc) testing using enzyme immunoassay (EIA).

Results: Of the 192 HCW sampled, 52.1% were males and 78.7% are married, the median participants age was 34.4 years with interquartile range (IQR) of 11 years. Most participants had between 1-5 years of service while 43.8% had ≥2 doses of HBV vaccine.
The respective prevalence of HBsAg, anti HBs and anti HBc was 18.8% (95% CI: 13.5-25.0%), 63.0% (95% CI: 55.8-69.9%) and 44.8% (95% CI: 37.6-52.1%). Higher proportion of HBV positive was found in HCW who had worked for less than one year and who had not received any dose of HBV vaccine at 37.5% and 35.9 % respectively.. Significant risk of HBV lifetime exposure was noted among HCW with one vaccine dose, those with no known exposure and highest in those with knowledge on HBV transmission (aOR, 7.97; 95% CI, 2.10-153.3, p-value=0.008). HCW who had received ≥2 doses of HBV vaccine (aOR, 0.03; 95% CI, 0.01-0.10, p-value= <0.0001) had significant HBV protection. Duration of service was not associated with HBV among HCW.

Conclusion: Prevalence of HBV infection was high among HCW in Kisumu County . Ministry of health Kenya should strengthen comprehensive infection prevention and control practices to reduce lifetime exposure to HBV infection among HCW.

Key words: Hepatitis B virus infection, Health care workers, HBV Vaccine

Background:

Globally, it is estimated that 257 million people are living with chronic hepatitis B (CHB) viral infection, HBV epidemic mostly affects WHO African and Western Pacific Regions (1). Prevalence of HBV infection in Africa is averagely more than 10% while pooled HBV prevalence in HCW was 6.81% (95% CI 5.67–7.95) classifying the region as one of high endemic area (2-5). In 2007, the Prevalence of HBV infection in Kenya was estimated to be 2–5%, while 31% of the Kenyan population was found to have been previously exposed to HBV (6).

Global mortality due to viral hepatitis was about 1.4 million in 2016 (7, 8), of those deaths approximately 47% were due to HBV infection (9). HBV is highly infectious and is mainly transmitted through vertical transmission, percutaneous blood, sexual and body fluid contacts(10). Health care services in hospitals is aimed at restoring health and saving lives (11), these services also generate infectious medical waste that if poorly managed could be potential source for hospital acquired infections (HAI) which include HBV (12). The risk of HAI increases when basic infection prevention and control (IPC) practices in health care settings are not well laid out and adhered to. There is limited data on occupational exposure to HBV infection and its prevalence among HCW in Kenya. This study estimated the prevalence of HBV infection and exposures among HCW in Kisumu County.

Methods

Study aim, design, and setting

We conducted descriptive cross-sectional study between May 2020 and April 2021 to estimate HBV infection prevalence and risk factors among HCW in nine largest public hospitals in Kisumu County. These hospitals provide primary and referral medical care services, trainings, and have different structural establishments depending on the hospital level. The hospitals generate varying nature and type of medical waste depending on their capacity and medical services/procedure offered.

Study population and characteristic of the participants

A total of 192 HCW **(**nursing officers, medical officers, clinical officers, medical laboratory technologists, medical waste handlers, HIV testing counsellors, and mortuary technicians) were included in the study. Probability proportional to size (PPS) sampling was used to identify number of participants in each selected health facility and service delivery points, simple random sampling from duty roster was used to sample the participants**.**

Data collection and Laboratory Procedures

A structured questionnaires was administered to collect sociodemographic data after obtaining informed consent. 4.0 ml of venous blood sample was collected in ethylene-diamine-tetra-acetic acid (EDTA) (Becton, Dickinson and Company, Franklin Lakes, New Jersey, USA) for evaluating HBV infection based on three biomarkers: hepatitis B surface antigen (HBsAg), antibodies against hepatitis B surface antigen (anti-HBs), and antibodies against total hepatitis B core antigen (anti-HBc). Current HBV infection was determined by testing for HBsAg using Murex HBsAg version 3 kit; immunity to HBV infection was established by testing for anti-HBs using ETI-AB-AUK-3 Diasorin anti-HBs EIA kit; and past exposure to HBV infection was assessed by testing for anti-HBc using Murex anti-HBc (total) kit. All tests were done as

per the manufacturers' kit instructions without modifications. HBV current infection was defined as individual's blood is serologically positive for HBsAg while HBV lifetime exposure are individuals whose blood is serologically positive for either HBsAg (current infection) or anti-HBc (may indicate a current or past resolved infection).

Data analysis

Data was analysed using SPSS version 16.0 (SPSS Inc., Chicago, IL, USA). Results were summarized using descriptive statistics. Logistic regression models were used for bivariate and presented as odd ratios (OR) with 95% confidence intervals (CI). Multivariable analyses were performed for factors attaining p-values ≤0.2 in bivariate analysis to determine independent factors associated with HBV infection (positive for HBsAg or anti-HBc) among HCWs and presented as adjusted OR (aOR). A threshold p-value of less than 0.05 was considered statistically significant. The models were adjusted for age and gender.

Ethical considerations

The study received ethical approval form JOOTRH ethics review board IERC/JOOTRH/244/20 and National Commission for Science, Technology & Innovation (NACOSTI) granted research permit to conduct the study (licence no: NACOSTI/P/20/6300). Permissions to collect data from hospitals within Kisumu County was granted by Kisumu County Director of Health. All HBV susceptible HCW were referred for HBV vaccination through Kenya Expanded program for immunization (KEPI).

Results

Sociodemographic characteristic of HCW

Of the 192 HCW sampled, 52.1% were males and 78.7% are married, the median participants age was 34.4 years with interquartile range (IQR) of 11 years. Most participants had between 1-5 years of service. Varied results were observed in HCW IPC training and capacity building: while capacity building on personal protective equipment (PPE) usage was 73.4%, trainings on waste management was 30.2% and infectious agents found on waste was 32.3%.

There was moderate knowledge on HBsAg transmission, prevention/control and waste disposal at 56.8%, 53.7% and 30.2% respectively. HBV vaccine completion rate was low at 43.8% of HCW receiving ≥2 vaccine doses while 40.6% being susceptible to HBV infection. Whereas 90.6% of health care workers agreed that PPEs are generally available within the work settings, 77.6% felt that they were inadequate. There was low daily usage of PPEs: Apron/dust coat 65.1%, gumboots (waste handlers) 13.5%, gloves 44.8% and mask wearing while on duty 56.3%. There was good access to hand hygiene 96.4% and availability of waste management bins (black, yellow, red) 95.8% with low waste segregation at 29.7% while 67.2 % of waste were incinerated at site or networked to facilities with incinerator. Higher proportion (53.1%) of HCW had either contact or needle stick injury exposure (Table 1).

Table1: Socio-demographic characteristics and risk factors of the study population (N= 192)

Variables	Frequency	Percent (%)
Sex		
Female	92	47.92
Male	100	52.08
Age (years)		
20-29	65	33.85
30-39	83	43.23
40-49	23	11.98
≥50	21	10.94
Marital status		
Single	37	19.27
Married	151	78.65
Widowed/Separated/Divorced	4	2.08
Years of service (years)		
Less than 1	8	4.17
1-5	85	44
6-10	51	26.56
>10	48	25
Cadre		
Doctors	8	4.17
Clinical Officer	29	15.1
Nursing officer	39	20.31
Laboratory technologist	55	28.65
Mortuary attendance	7	3.65
HIV testing counsellor	17	8.85
Medical waste handlers	37	19.27
HBV Vaccine uptake		

≥2 doses	84	43.8
1 dose	30	15.6
Not vaccinated	78	40.6
History of exposure		
Needle Stick Injury	91	47.4
Contact Exposure	11	5.7
No Known Exposure	90	46.9
History of Blood transfusion		
No	189	98.4
Yes	3	1.6
Knowledge on HBsAg Transmission		
No	83	43.2
Yes	109	56.8
Knowledge on HBsAg Prevention and control		
No	89	46.4
Yes	103	53.7
Training on PPE full module		
No	141	26.6
Yes	51	73.4
Training on infectious agent on waste full module		
No	130	67.7
Yes	62	32.3
Training on waste management full module		
No	134	69.8
Yes	58	30.2
Knowledge on waste disposal		
No	90	46.9
Yes	102	53.1
Availability of PPEs		
No	18	9.4
Yes	174	90.6
Adequacy of PPEs		
No	149	77.6
Yes	43	22.4
Daily use of apron/Dust coat		
No	67	34.9
Yes	125	65.1
Daily use of gumboots (Waste handlers only)		
No	32	86.5
Yes	5	13.5
Daily use of gloves		

No	106	55.2
Yes	86	44.8
Daily use of mask when on duty		
No	84	43.8
Yes	108	56.3
Access to hand hygiene		
No	7	3.7
Yes	185	96.4
Availability of waste management materials (All 3 waste bins)		
No	8	4.2
Yes	184	95.8
Proper waste segregation		
No	135	70.3
Yes	57	29.7
Waste disposal Method (Incineration)		
No	63	32.8
Yes	129	67.2

Values are presented as numbers and (%).

Prevalence of HBV Biomarkers among HCW in Kisumu County, 2020 (N= 192)

In table 2 below, the respective prevalence of HBsAg, anti HBs and anti HBc was 18.8% (95% CI: 13.5-25.0%), 63.0% (95% CI: 55.8-69.9%) and 44.8% (95% CI: 37.6-52.1%) respectively. Highest prevalence of HBsAg was seen among, HCW who had worked for less than one year 37.5% (95% CI: 8.5-75.5), HBV unvaccinated HCW 35.9% (95% CI: 25.3-47.6), HCW who has had blood transfusion 33.3% (95% CI: 0.84-90.6) and HIV testing counselors 29.4% (95% CI: 10.3-56).

Anti HBc prevalence was highest among HCW with one dose of HBV vaccine 83.3% (95% CI: 65.3-94.4), those with less than one year in service 75.0% (95% CI: 34.9-96.8), waste handlers not using gumboots 68.8% (95% CI: 50.0-83.9) and HBV unvaccinated HCW 66.7% (95% CI: 55.1-76.9).

There is moderate HBV immunity or recovery level among HCW, the carders with highest anti HBs positivity were laboratory scientist 74.6% (95% CI: 61.0-85.3), clinical officers 65.5% (95% CI:45.7-82.1) and Nursing officers 64.1% (95% CI: 47.2-78.8). HTS counselors had the lowest immunity or recovery level at 35.3% (95% CI: 14.2-61.7).

Table 2: Prevalence of hepatitis B virus markers among HCW in Kisumu County, 2020 (N= 192)

Characteristic	Prevalence of HBsAg Biomarker	Prevalence of Anti-HBs Biomarker	Prevalence of Anti-HBc Biomarker

	N(%)	% (95%CI)	N(%)	% (95%CI)	N(%)	% (95%CI)
Overall	36/192	18.8(13.5-25.0)	121/192	63.0(55.8-69.9)	86/192	44.8(37.6-52.1)
Carder						
Doctors	2/8	25.0(3.19-65.1)	5/8	62.5(24.5-91.5)	3/8	37.5(8.5-75.5)
Clinical Officer	6/29	20.7(8-39.7)	19/29	65.5(45.7-82.1)	14/29	48.3(29.5-67.5)
Nursing officer	8/39	20.5(9.3-36.5)	25/39	64.1(47.2-78.8)	15/39	38.5(23.4-55.4)
Laboratory technologist	7/55	12.7(5.3-24.5)	41/55	74.6(61.0-85.3)	18/55	32.7(20.7-46.7)
Mortuary attendance	0/7	0.0(0-41.0)	4/7	57.1(18.4-90.1)	4/7	57.1(18.4-90.1)
HTS counsellor	5/17	29.4(10.3-56)	6/17	35.3(14.2-61.7)	8/17	47.1(23.0-72.2)
Waste handlers	8/37	21.6(9.8-38.2)	21/37	56.8(39.5-72.9)	24/37	64.9(47.5-79.8)
Sex						
Male	12/100	12(6.4-20.0)	69/100	69.0(59.0-77.9)	46/100	46.0(36.0-56.3)
Female	24/92	26.1(17.5-36.3)	52/92	56.5(45.8-66.8)	40/92	43.5(33.2-54.2)
Age(Years)						
20-29	10/65	15.4(7.6-26.5)	41/65	63.1(50.2-74.7)	25/65	38.5(26.7-51.4)
30-39	15/83	18.1(10.5-28.1)	56/83	67.5(56.3-77.4)	35/83	42.2(31.4-53.5)
40-49	6/23	26.1(10.2-48.4)	11/23	47.8(26.8-69.4)	14/23	60.9(38.5-80.3)
≥50	5/21	23.8(8.2-47.2)	13/21	61.9(38.4-85.1)	12/21	57.1(34.0-78.2)
Marital status						
Single	7/37	18.9(8.0-35.2)	20/37	54.1(36.9-70.5)	15/37	40.5(24.8-57.9)
Married	28/151	18.5(12.7-25.7)	98/151	64.9(56.7-72.5)	69/151	45.7(37.6-54.0)
Widowed/Separated/Divorced	1/4	25(0.6-80.6)	3/4	75.0(19.4-99.4)	2/4	50.0(6.8-93.2)
Years of service(Years)						
<1	3/8	37.5(8.5-75.5)	4/8	50.0(15.7-84.3)	6/8	75.0(34.9-96.8)
1-5	13/85	15.3(8.4-24.7)	51/85	60.0(48.8-70.5)	31/85	36.5(26.3-47.6)
6-10	10/51	19.6(9.8-33.1)	38/51	74.5(60.4-85.7)	26/51	51.0(36.6-65.3)
>10	10/48	20.8(10.5-35.0)	28/48	58.3(43.2-72.4)	23/48	47.9(33.3-62.8)
HBV Vaccine uptake						

1 dose	4/30	13.3(3.8-30.7)	20/30	66.7(47.2-82.7)	25/30	83.3(65.3-94.4)
≥2 doses	4/84	4.8(1.31-11.8)	77/84	91.7(83.6-96.6)	9/84	10.7(5.0-19.4)
Not vaccinated	28/78	35.9(25.3-47.6)	24/78	30.8(20.8-42.2)	52/78	66.7(55.1-76.9)
History of exposure						
Needle Stick Injury	8/91	8.8(3.9-16.6)	65/91	71.4(61.0-80.4)	37/91	40.7(30.5-51.5)
Contact Exposure	0/11	0.0(0.0-28.5)	8/11	72.7(39.0-94.0)	2/11	18.2(2.3-51.8)
No Known Exposure	28/90	31.1 (21.8-41.7)	48/90	53.3(42.5-63.9)	47/90	52.2(41.4-62.9)
Blood transfusion						
No	35/189	18.5(13.3-24.8)	119/189	63.0(55.7-69.9)	85/189	45.0(37.8-52.4)
Yes	1/3	33.3(0.84-90.6)	2/3	66.7(9.4-99.2)	1/3	33.3(0.8-90.6)
Knowledge on HBsAg Transmission						
No	18/83	21.7(13.4-32.1)	40/83	48.2(37.1-59.4)	43/83	51.8(40.6-62.9)
Yes	18/109	16.5(10.1-24.8)	81/109	74.3(65.1-82.2)	43/109	39.5(30.2-49.3)
Knowledge on HBsAg Prevention and control						
No	20/89	22.5(14.3-32.6)	45/89	50.6(39.8-61.3)	46/89	51.7(40.8-62.4)
Yes	16/103	15.5(9.2-24.0)	76/103	73.8(64.2-82.0)	40/103	38.8(29.4-48.9)
Training on PPE full module						
No	28/141	19.9(13.6-27.4)	81/141	57.5(48.9-65.7)	65/141	46.1(37.7-54.7)
Yes	8/51	15.7(7.0-28.6)	40/51	78.4(64.7-88.7)	21/51	41.2(27.6-55.8)
Training on infectious agent on waste full module						
No	28/130	21.5(14.8-29.6)	75/130	57.7(48.7-66.3)	64/130	49.2(40.4-58.1)
Yes	8/62	12.9(5.7-23.9)	46/62	74.2(61.5-84.5)	22/62	35.5(23.7-48.7)
Training on waste management full module						
No	26/134	19.4(13.1-27.1)	80/134	59.7(50.9-68.1)	65/134	48.5(39.8-57.3)
Yes	10/58	17.2(8.6-29.4)	41/58	70.7(57.3-81.9)	21/58	36.2(24.0-49.9)
Knowledge on waste disposal						
No	21/90	23.3(15.1-33.4)	49/90	54.4(43.6-65.0)	47/90	52.2(41.4-62.9)

Yes	15/102	14.7(8.5-23.1)	72/102	70.6(60.8-79.2)	39/102	38.2(28.8-48.4)
Availability of PPEs						
No	4/18	22.2(6.4-47.6)	8/18	44.4(21.5-69.2)	7/18	38.9(17.3-64.3)
Yes	32/174	18.4(12.9-25.0)	113/174	64.9(57.4-72.0)	79/174	45.4(37.9-53.1)
Adequacy of PPEs						
No	31/149	20.8(14.6-28.2)	89/149	59.7(51.4-67.7)	74/149	49.6(41.4-58.0)
Yes	5/43	11.6(3.9-25.1)	32/43	74.4(58.8-86.5)	12/43	27.9(15.3-43.7)
Daily use of apron/Dust coat						
No	16/67	23.9(14.3-35.9)	38/67	56.7(44.0-68.8)	37/67	55.2(42.6-67.4)
Yes	20/125	16.0(10.1-23.6)	83/125	66.4(57.4-74.6)	49/125	39.2(30.6-48.3)
Daily use of gumboots (Waste handlers only)						
No	8/32	25.0(11.5-43.4)	17/32	53.1(34.7-70.9)	22/32	68.8(50.0-83.9)
Yes	0/5	0.0(0.0-52.2)	4/5	80.0(28.4-99.5)	2/5	8.3(5.3-85.3)
Daily use of gloves						
No	18/106	17.0(10.4-25.5)	74/106	69.8(60.1-78.4)	56/106	52.8(42.9-62.6)
Yes	18/86	20.9(12.9-31.2)	47/86	54.7(43.6-65.4)	30/86	34.9(24.9-45.9)
Daily use of mask when on duty						
No	15/84	17.9(10.4-27.7)	55/84	65.5(54.3-75.5)	40/84	47.6(36.6-58.8)
Yes	21/108	19.4(12.5-28.2)	66/108	61.1(51.3-70.3)	46/108	42.6(33.1-52.5)
Access to hand hygiene						
No	2/7	28.6(3.7-71.0)	3/7	42.9(9.9-81.6)	3/7	42.9(9.9-81.6)
Yes	34/185	18.4(13.1-24.7)	118/185	63.8(56.4-70.7)	83/185	44.9(37.6-52.3)
Availability of waste management materials (All 3 waste bins)						
No	2/8	25.0(3.2-65.1)	4/8	50.0(15.7-84.3)	4/8	50.0(15.7-84.3)
Yes	34/184	18.5(13.2-24.9)	117/184	63.6(56.2-70.5)	82/184	44.6(37.3-52.1)
Proper waste segregation						
No	28/135	20.7(14.3-28.6)	79/135	58.5(49.7-66.9)	66/135	48.9(40.2-57.6)
Yes	8/57	14.0(6.3-25.8)	42/57	73.7(60.3-84.5)	20/57	35.1(22.9-48.9)

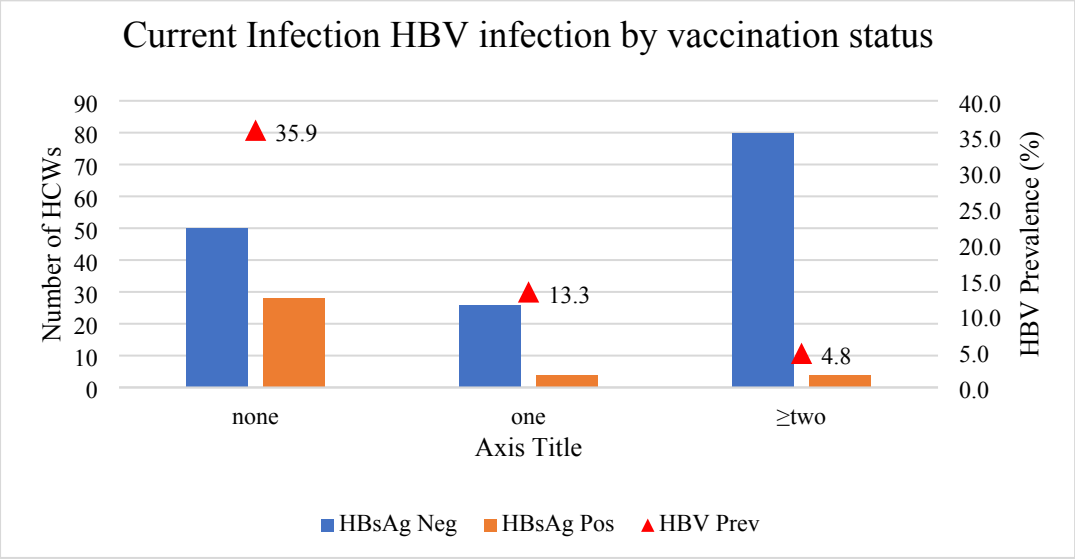
Waste disposal Method (Incineration)						
No	10/63	15.9(7.9-27.3)	42/63	66.7(53.7-78.1)	28/63	44.4(31.9-57.5)
Yes	26/129	20.2(13.6-28.1)	79/129	61.2(52.3-69.7)	58/129	45.0(36.2-54.0)

Values are presented as number (%); CI, confidence interval; HBsAg, hepatitis B surface antigen; Anti-HBc; hepatitis B core antibody; Anti-HCV, antibody hepatitis C virus.

HBV infection by Vaccine uptake.

The prevalence of HBV was highest among healthcare workers who had not received any dose of HBV vaccine (at 35.9%), those who received one dose of HBV vaccination had a prevalence of 13.3%, while those who received two or more doses of HBV vaccination had a prevalence of 4.8% (Figure 1). Notably, none of the 69 HCWs who reported receiving all the three required doses of HBV vaccination were detected with HBV infection.

Figure 1: HBV infection by Vaccination status



Factors associated with Current HBV infection

Table3 shows that female HCW were more likely to have current HBV infection compared to their male counterparts (aOR, 3.22; 95% CI, 1.06-9.75, p-value< 0.05). Additionally, HCW without a history of known exposure had increased odds of current HBV infection compared to those with a previous needle stick injury (aOR, 5.37; 95% CI, 1.81-15.92, p-value< 0.001). However, HCW who reported receiving ≥2 doses of HBV vaccination had reduced likelihood of current HBV infection. (aOR, 0.05; 95% CI, 0.01-0.20, p-value <0.001) respectively. None of the other sociodemographic characteristics were associated with current infection of HBV among HCW.

Table 3: Factors associated with current HBV infection among HCW in Kisumu County.

Table 3: Factors associated with current HBV infection among HCW in Kisumu County

Characteristic	**HWC (%)**	N(%)	OR (95% CI)	p-value	aOR(95% CI)	p-value
Overall	N(%)	36 (18.8)				
Cadre						
Doctors	8(4.2)	2(25.0)	1			
Clinical Officer	29(15.1)	6(20.7)	0.78(0.12 -4.90)	0.793		
Nursing officer	39(20.3)	8(20.5)	0.77(0.13 -4.59)	0.778		
Laboratory technologist	55(28.7)	7(12.7)	0.44(0.07 -2.61)	0.364		
Mortuary attendance	7(3.7)	0(0.0)	-			
HTS counsellor	17(9.9)	5(29.4)	1.25(0.19 -8.44)	0.819		
Waste handlers	37(19.3)	8(21.6)	0.83(0.14 -4.91)	0.835		
Sex						
Male	92(47.9)	12(12.0)	1		1	
Female	100(52.1)	24(26.1)	2.59(1.21 -5.54)	0.014	3.22(1.06-9.75)	0.039
Age(years)						
20-29	65(33.9)	10(15.4)	1			
30-39	83(43.2)	15(18.1)	1.21(0.51 -2.91)	0.665		
40-49	23(12.0)	6(26.1)	1.94(0.62 -6.12)	0.258		

≥50	21(10.9)	5(23.8)	1.72(0.51-5.76)	0.38		
Marital status						
Single	37(19.3)	7(18.9)	1			
Married	151(78.7)	28(18.5)	0.98(0.39-2.45)	0.958		
Widowed/Separated/Divorced	4(2.1)	1(25.0)	1.42(0.13-15.87)	0.772		
Years of service(years)						
<1	8(4.2)	3(37.5)	1		1	
1-5	85(44.3)	13(15.3)	0.30(0.06-1.42)	0.128	0.56(0.08-3.98)	0.56
6-10	51(26.6)	10(19.6)	0.41(0.08-1.99)	0.267	1.89(0.17-21.55)	0.607
>10	48(25.0)	10(20.8)	0.44(0.09-2.15)	0.31	1.61(0.1-25.91)	0.738
HBV Vaccine uptake						
Not vaccinated	78(40.6)	28(35.9)	1		1	
1 dose	30(15.6)	4(13.3)	0.27	0.028	0.31(0.06-1.54)	0.153
≥2 doses	84(43.8)	4(4.8)	0.09	<0.0001	0.05(0.01-0.20)	<0.0001
History of exposure						
Needle Stick Injury	91(47.4)	8(8.8)	1		1	
Contact Exposure	11(5.7)	0(0.0)	1(-)		1(-)	
No Known Exposure	90(46.9)	28(31.1)	4.69(2.00-10.98)	<0.001	5.37(1.81-15.92)	<0.001
Blood transfusion						
No	189(98.4)	35(18.5)	1			
Yes	3(1.6)	1(33.3)	2.20(0.19-24.95)	0.525		
Knowledge on HBsAg Transmission						
No	83(43.2)	18(21.7)	1			
Yes	109(56.8)	18(16.5)	0.71(0.35-1.48)	0.364		
Knowledge on HBsAg Prevention and control						
No	89(46.4)	20(22.5)	1			
Yes	103(53.7)	16(15.5)	0.63(0.31-1.32)	0.222		
Training on PPE full module						
No	141(26.6)	28(19.9)	1			

Yes	51(73.4)	8(15.7)	0.75(0.32 -1.78)	0.514		
Training on infectious agent on waste full module						
No	130(67.7)	28(21.5)	1		1	
Yes	62(32.3)	8(12.9)	0.54(0.23 -1.27)	0.156	1.53(0.31-7.57)	0.604
Training on waste management full module						
No	134(69.8)	26(19.4)	1			
Yes	58(30.2)	10(17.2)	0.87(0.39 -1.93)	0.725		
Knowledge on waste disposal						
No	90(46.9)	21(23.3)	1		1	
Yes	102(53.1)	15(14.7)	0.57(0.27 -1.18)	0.129	0.49(0.13-1.86)	0.297
Availability of PPEs						
No	18(9.4)	4(22.2)	1			
Yes	174(90.6)	32(18.4)	0.79(0.24 -2.56)	0.692		
Adequacy of PPEs						
No	149(77.6)	27(19.6)	1		1	
Yes	43(22.4)	5(11.6)	0.50(0.18 -1.38)	0.181	0.47(0.13-1.72)	0.256
Daily use of apron/Dust coat						
No	67(34.9)	16(23.9)	1		1	
Yes	125(65.1)	20(16.0)	0.61(0.29 -1.27)	0.185	0.57(0.20-1.64)	0.297
Daily use of gumboots (Waste handlers only)						
No	32(86.5)	5(13.5)	1			
Yes	5(13.5)	32(86.5)	1(-)	`-		
Daily use of gloves						
No	106(55.2)	18(17.0)	1			
Yes	86(44.8)	18(20.9)	1.29(0.63 -2.67	0.486		
Daily use of mask when on duty						
No	84(43.8)	15(17.9)	1			

Yes	108(56.3)	21(19.4)	1.11(0.53-2.31)	0.78		
Access to hand hygiene						
No	7(3.7)	2(28.6)	1			
Yes	185(96.4)	34(18.4)	0.56(0.10-3.02)	0.503		
Availability of waste management materials (All 3 waste bins)						
No	8(4.2)	2(25.0)	1			
Yes	184(95.8)	34(18.5)	0.68(0.13-3.52)	0.645		
Proper waste segregation						
No	135(70.3)	28(20.7)	1			
Yes	57(29.7)	8(14.0)	0.62(0.27-1.47)	0.28		
Waste disposal Method (Incineration)						
No	63(32.8)	10(15.9)	1			
Yes	129(67.2)	26(20.2)	1.34(0.60-2.98)	0.476		

Values are presented as number (%); OR, odds ratio; aOR, adjusted odds ratio; 95% CI, confidence interval.

Factors associated with lifetime exposure to HBV infection among HCW in Kisumu County, 2020.

In logistic regression analysis Table 4, HCW who received a single dose of HBV vaccination had increased likelihood of lifetime exposure to HBV infection compared to HCW without history of vaccination (aOR, 6.25; 95% CI, 1.29-30.30, p-value<0.05). Conversely, HCW who reported receiving ≥2 doses of HBV vaccination had reduced likelihood of lifetime exposure to HBV infection compared to those without HBV vaccination (aOR, 0.03; 95% CI, 0.01-0.10, p-value= <0.0001) HCW who reported having knowledge on HBsAg transmission had higher odds of lifetime exposure to HBV infection compared to their counterparts without knowledge on HBV transmission (aOR, 7.97; 95% CI, 2.10-153.39, p-value<0.01). None of the other sociodemographic characteristics were significantly associated with current infection of HBV in HCW (Table 4).

Table 4: Factors associated with lifetime exposure to HBV infection among Health care workers in Kisumu County, 2020.

Characteristics	**HCW (%)**	**N(%)**	**OR (95%CI)**	***p-value***	**aOR (95% CI)**	***p-value***
Sex						
Female	92(47.9)	40(43.5)	1			
Male	100(52.1)	46(46.0)	1.11(0.63-1.96)	*0.726*		
Age						
20-29	65(33.9)	25(38.5)	1		1	
30-39	83(43.2)	35(42.2)	1.17(0.60-2.26)	*0.649*	1.18(0.37-3.77)	*0.784*
40-49	23(12.0)	14(60.9)	2.49(0.94-6.60)	*0.067*	1.77(0.28-11.37)	*0.547*
50-59	18(9.4)	10(55.6)	2.00(0.70-5.75)	*0.198*	3.41(0.33-34.81)	*0.301*
>=60	3(1.6)	2(66.7)	3.2(0.28-37.15)	*0.352*	0.27(0.01-7.98)	*0.452*
Marital status						
Single	37(19.3)	15(40.5)	1			
Married	151(78.7)	69(45.7)	1.23(0.59-2.56)	*0.572*		
Widowed/Separated/Divorced	4(2.1)	2(50.0)	1.47(0.19-11.59)	*0.716*		

Year of service						
Less than 1 year	8(4.2)	6(75.0)	1		1	
1-5 years	85(44.3)	31(36.5)	0.19(0.04-1.01)	***0.051***	0.13(0.01-2.79)	*0.193*
6-10 years	51(26.6)	26(51.0)	0.35(0.06-1.88)	*0.22*	0.57(0.02-15.34)	*0.741*
More than 10 years	48(25.0)	23(47.9)	0.31(0.06-1.67)	*0.172*	0.31(0.01-9.82)	*0.509*
Carder						
Doctors	8(4.2)	3(37.5)	1		1	
Clinical Officer	29(15.1)	14(48.3)	1.56(0.31-7.75)	*0.59*	0.72(0.05-10.26)	*0.811*
Nursing officer	39(20.3)	15(38.5)	1.04(0.22-5.01)	*0.959*	0.49(0.04-6.59)	*0.589*
Laboratory technologist	55(28.7)	18(32.7)	0.81(0.17-3.78)	*0.789*	0.47(0.05-4.87)	*0.527*
Mortuary attendance	7(3.7)	4(57.1)	2.22(0.28-17.63)	*0.45*	0.39(0.02-8.56)	*0.578*
HTS counsellor	17(9.9)	8(47.1)	1.48(0.27-8.27)	*0.654*	0.73(0.05-9.71)	*0.811*
Waste handlers	37(19.3)	24(64.9)	3.08(0.63-14.98)	*0.164*	2.00(0.17-22.84)	*0.578*
HBV Vaccine uptake						
Not vaccinated	78(40.6)	52(66.7)	1		1	
1 dose	30(15.6)	25(83.3)	2.5(0.86-7.28)	0.093	6.25(1.29-30.30)	0.023
≥2 doses	84(43.8)	9(10.7)	0.06(0.03-0.14)	<0.0001	0.03(0.01-0.10)	<0.0001
History of exposure						
Needle Stick Injury	91(47.4)	37(40.7)	1		1	
Contact Exposure	11(5.7)	2(18.2)	0.32(0.07-1.59)	0.165	0.10(0.01-1.40)	0.087
No Known Exposure	90(46.9)	47(52.2)	1.59(0.89-2.87)	0.12	3.55(1.34-9.43)	0.011
Blood transfusion						
No	189(98.4)	85(45.0)	1			
Yes	3(1.6)	1(33.3)	0.61(0.05-6.86)	0.69		
Knowledge on HBsAg Transmission						
No	83(43.2)	43(51.8)	1		1	

Yes	109(56.8)	43(39.5)	0.61(0.34-1.08)	0.089	17.97(2.10-153.39)	0.008
Knowledge on HBsAg Prevention and control						
No	89(46.4)	46(51.7)	1		1	
Yes	103(53.7)	40(38.8)	0.59(0.33-1.05)	0.075	0.34(0.06-2.12)	0.25
Training on PPE full module						
No	141(26.6)	65(46.1)	1			
Yes	51(73.4)	21(41.2)	0.82(0.43-1.57)	0.545		
Training on infectious agent on waste full module						
No	130(67.7)	64(49.2)	1		1	
Yes	62(32.3)	22(35.5)	0.57(0.30-1.06)	0.075	0.65(0.10-4.21)	0.652
Training on waste management full module						
No	134(69.8)	65(48.5)	1		1	
Yes	58(30.2)	21(36.21)	0.60(0.32-1.14)	0.117	2.37(0.32-17.28)	0.395
Knowledge on waste disposal						
No	90(46.9)	47(52.2)	1		1	
Yes	102(53.1)	39(38.2)	0.57(0.32-1.01	0.053	0.41(0.11-1.47)	0.17
Availability of PPEs						
No	18(9.4)	7(38.9)	1			
Yes	174(90.6)	79(45.4)	1.31(0.48-3.53)	0.598		
Adequacy of PPEs						
No	149(77.6)	74(49.7)	1		1	
Yes	43(22.4)	12(27.9)	0.39(0.19-0.82)	0.013	0.49(0.16-1.56)	0.228
Daily use of apron/Dust coat						
No	67(34.9)	37(55.2)	1		1	

Yes	125(65.1)	49(39.2)	0.52(0.29-0.95)	0.034	0.73(0.26-2.03)	0.549
Daily use of gumboots (Waste handlers only)						
No	32(86.5)	22(68.8)	1			
Yes	5(13.5)	2(8.3)	0.82(0.13-5.01)	0.827		
Daily use of gloves						
No	106(55.2)	56(52.8)	1		1	
Yes	86(44.8)	30(34.9)	0.48(0.27-0.86)	0.013	0.40(0.16-1.01)	0.052
Daily use of mask when on duty						
No	84(43.8)	40(47.6)	1			
Yes	108(56.3)	46(42.6)	0.82(0.56-1.45)	0.487		
Access to hand hygiene						
No	7(3.7)	3(42.9)	1			
Yes	185(96.4)	83(44.9)	1.08(0.24-4.98)	0.917		
Availability of waste management materials (All 3 waste bins)						
No	8(4.2)	4(50.0)	1			
Yes	184(95.8)	82(44.6)	0.80(0.20-3.31)	0.763		
Proper waste segregation						
No	135(70.3)	66(48.9)	1		1	
Yes	57(29.7)	20(35.1)	0.57(0.30-1.07)	0.081	0.94(0.28-3.19)	0.991
Waste disposal Method (Incineration)						
No	63(32.8)	28(44.4)	1			
Yes	129(67.2)	58(45.0)	1.02(0.56-1.87)	0.946		

Values are presented as number (%); OR odds ratio; aOR, adjusted odds ratio; CI, confidence interval.

Discussion

Indeed the burden of Hospital acquired infection like Hepatitis B infection is high in developing sub-Saharan African countries like Kenya (13). Despite the availability of guidelines and treatment options, occupational risks related to hepatitis virus exposure is still a major concern for those who handle hospital waste like health care workers (14). This study documented high prevalence and lifetime exposure to HBV infection in Kisumu county, Kenya at 18.8% and 44.8% respectively, the subpopulations with the highest HBV infection are: HCW who had worked for less than 1 year at 37.5%,HBV unvaccinated HCW at 35.9%, HCW with previous history of blood transfusion at 33.3% and HIV testing counselor at 29.4%. The HBV prevalence among HCW in this study is higher compared to 2.7% prevalence in general population(15). This prevalence is higher than what was found in other studies both in Kenya and Africa : pooled prevalence in Africa 6.8%, Kenya 4.0 %, southern Ethiopia 1.3%, north west Ethiopia 6.0 %, Tripoli Libya 2.3% and 6.3% in Addis Ababa, (2-5, 14, 16). A study in Kisumu, Siaya and Homabay county found that the prevalence of HBV among adolescent was 3.4% while dual infection of HBV and HIV in Kisumu county hospital, one of our study site was 47% among patient presenting with jaundice in the clinic (17, 18). The high prevalence in this study could be attributed to increased HBV infection risk of exposure on HCW as highlighted in this study where 53.7% of HCW has had either needle stick or contact exposure, inadequate trainings, observed knowledge gaps, poor infection prevention infrastructure, low Hepatitis B virus vaccine coverage and low-adherence universal infection prevention and control measures (consistent use of PPE, proper waste segregation and disposal) as shown in table 1. Low training coverage on waste management, infectious agent on waste and inadequacy of PPE at 30.2%,32.2%, 22.4% respectively could be the cause to high needle stick injury, contact exposure and poor adherence to standard precautions. The findings on inadequate HCW capacity building, poor adherence on IPC standard and additional precautions are in concurrence with other studies which pointed to poor waste management and lack of training and capacity building to staff (16, 19, 20). Health care system administrators should ensure adequate PPEs are available, accessible and properly used by HCW, IPC trainings should be done to all health care workers with provision of annual refresher.

Hepatitis B surface antibody (anti-HBs) prevalence in this study was 63.0%, these were HCW who have recovered from infection or immunised HBV. Anti HBS positivity was highest in laboratory technologists 74.6%, clinical officers 65.5%, and Nursing officers 64.1%. Laboratory technologists were the highest immunized carder, this may be attributed to the

implementation of laboratory quality management system and international organization for standardization ISO 15189 which required that all laboratory personnel must be vaccinated against blood borne pathogens (21). The low HBV immunity rate and non-completion of vaccine doses is comparable to prior studies done in the region showing low HBV vaccine uptake and non-completion of vaccine dosses(2, 16). The benefit vaccination as HBV infection prevention measure has been documented, this study also found HCW who are fully vaccinated had no lifetime exposure while unvaccinated HCW had highest 61% lifeline exposure to HBV infection (22).Findings in this study highlights the need to capacity build HCW on the benefits of getting full vaccine dose and need to avail the vaccine for all health care workforce. . significant risk of lifetime exposure to HBV infection was noted among HCW with one vaccine dose, those with no known exposure and highest in those who had Knowledge on HBsAg transmission while significant HBV protection was seen in HCW who had adequate PPE and those using gloves and dust coat consistently. A study in Southern Ethiopia found HBV lifetime exposure was higher in MWH older than 40 years(2) while population based Azar cohort study found that all age groups were exposed to HBV. In in Eastern Ethiopia, there was higher prevalence of HBV infection in trainees. (23, 24). There is need to have remedial measures that is aimed at reducing this high lifetime exposure rates by capacity building HCW, availing proper infrastructure for infection prevention and control, strengthening HBV vaccination and proper surveillance for HAI in all healthcare settings. Policy should be revised to enforce mandatory HAI pre-employment screening and vaccination for personnel working in healthcare settings.

Limitations for this study were that this was done during COVID 19 outbreak period when there was a lot of fucus on infection prevention to mitigate COVID 19 infections, in as much as this may have influenced the findings on the compliance with standard precautions, it strengthened the adherence to standard infection prevention measures. Also, during this COVID 19 period the government issued recommendations that elderly populations and those with comorbidities should work from home so we may have missed some eligible health care workers at the facilities. The study was conducted in nine highest volume government hospitals, these hospitals have the highest workload, produce the largest volume wastes, and have highest number of health care workers. We did not focus on lower level , private and faith-based health facilities where the situation could be worse or better. We only assessed HBV exposures that are related to health care settings therefore the generalizability is limited to health facilitiyrelated exposures. Health care workers are not done for thorough pre-

298 employment medical examination so it's difficult to point if the infections observed in this
299 study occurred before or after employment.

300 Conclusion

301 The prevalence of HBV infections among HCW is about 6 and 5-fold higher than general
302 population and adolescent blood donners respectively, this high prevalence needs multi
303 stakeholder approach to address.There was suboptimal training on waste management,
304 infectious agent on waste and PPE coupled with PPE inadequacy that could lead to high needle
305 stick injury poor adherence to universal/standard precautions.

306 There is need to ensure that adequate PPEs is available for HCW usage, trainings done to health
307 care workers on infection prevention and control.

308 From the study there was low uptake of HBV vaccination with HCW immunised either due to
309 vaccination or infection at 36.7 %, data also showed that there is significant relationship
310 between immunization status and positivity for HBV, the high lifetime exposure may be due
311 to high exposure to infections and low vaccination rates for personnel working in healthcare
312 settings. Policy should be revised to make it mandatory for pre-employment HBV vaccination
313 for most at risk populations like HCW and MWH.

314 No significant association was observed between HBV exposure and factors such as a history
315 of exposure, blood transfusion, use of PPE, Knowledge on HBsAg (transmission,
316 pathogenicity, treatment, prevention & control), training on (PPE, infectious agent, waste
317 management). None of the sociodemographic characteristics plus other factors such as carder
318 and departments were significantly associated with HBV exposure status for health care
319 workers.. There is need for proper surveillance for HAI in all healthcare settings.

320 Recommendation

321 There should be continuous training of HCW on universal precaution of infection prevention
322 measures. There is need to increase HBV vaccine coverage and improve HBV surveillance
323 among HCW.

324

325

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References

1. WHO. Global Hepatitis Report 2017_Geneva_World Health Organization_2017..pdf. 2017.
2. Amsalu A, Worku M, Tadesse E, Shimelis T. The exposure rate to hepatitis B and C viruses among medical waste handlers in three government hospitals, southern Ethiopia. Epidemiol Health. 2016;38:e2016001.
3. Anagaw B, Shiferaw Y, Anagaw B, Belyhun Y, Erku W, Biadgelegn F, et al. Seroprevalence of hepatitis B and C viruses among medical waste handlers at Gondar town Health institutions, Northwest Ethiopia. BMC research notes. 2012;5:55.
4. Franka E, El-Zoka AH, Hussein AH, Elbakosh MM, Arafa AK, Ghenghesh KS. Hepatitis B virus and hepatitis C virus in medical waste handlers in Tripoli, Libya. J Hosp Infect. 2009;72(3):258-61.
5. Atlaw D, Sahiledengle B, Tariku Z. Hepatitis B and C virus infection among healthcare workers in Africa: a systematic review and meta-analysis. Environ Health Prev Med. 2021;26(1):61.
6. Kisangau EN, Awour A, Juma B, Odhiambo D, Muasya T, Kiio SN, et al. Prevalence of hepatitis B virus infection and uptake of hepatitis B vaccine among healthcare workers, Makueni County, Kenya 2017. Journal of public health. 2018.
7. W.H.O. Progress report on HIV, viral hepatitis and sexually transmitted infections. Accountability for the global health sector strategies, 2016–2021. Geneva, World Health Organiation; 2019. Contract No.: CC BY-NC-SA 3.0 IGO.
8. WHO. Progress report on HIV, viral hepatitis and sexually transmitted infections

2019. 2019.
9. WHO. Global Health sector strategy on Viral Hepatitis 2016-2021: Towards Ending Viral Hepatitis. 2016.
10. Lok AS, McMahon BJ. Chronic hepatitis B. Hepatology. 2007;45(2):507-39.
11. Reynolds K, Thomas M, Dougan M. Diagnosis and Management of Hepatitis in Patients on Checkpoint Blockade. Oncologist. 2018;23(9):991-7.
12. Chartier Y, Emmanuel J, Pieper U, Prüss A, Rushbrook P, Stringer R, et al. WHO Library Cataloguing-in-Publication Data_Safe management of wastes from health_care activities _edited by Y. Chartier et al. _2nd ed..pdf. 2014.
13. Allegranzi B, Bagheri Nejad S, Combescure C, Graafmans W, Attar H, Donaldson L, et al. Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. Lancet. 2011;377(9761):228-41.
14. Shiferaw Y, Abebe T, Mihret A. Hepatitis B virus infection among medical aste handlers in Addis Ababa, Ethiopia. BMC research notes. 2011;4:479.
15. Ly KN, Kim AA, Umuro M, Drobenuic J, Williamson JM, Montgomery JM, et al. Prevalence of Hepatitis B Virus Infection in Kenya, 2007. Am J Trop Med Hyg. 2016;95(2):348-53.
16. Kisangau EN, Awour A, Juma B, Odhiambo D, Muasya T, Kiio SN, et al. Prevalence of hepatitis B virus infection and uptake of hepatitis B vaccine among healthcare workers, Makueni County, Kenya 2017. J Public Health (Oxf). 2019;41(4):765-71.
17. Otedo AE. HBV, HIV co-infection at Kisumu District Hospital, Kenya. East Afr Med J. 2004;81(12):626-30.
18. Awili HO, Gitao GC, Muchemi GM. Seroprevalence and Risk Factors for Hepatitis B Virus Infection in Adolescent Blood Donors within Selected Counties of Western Kenya. Biomed Res Int. 2020;2020:8578172.
19. Zhu S, Kahsay KM, Gui L. Knowledge, Attitudes and Practices related to standard precautions among nurses: A comparative study. J Clin Nurs. 2019;28(19-20):3538-46.
20. Sapkota B, Gupta GK, Mainali D. Impact of intervention on healthcare waste management practices in a tertiary care governmental hospital of Nepal. BMC Public Health. 2014;14:1005.
21. Aoyagi T. [ISO 15189 medical laboratory accreditation]. Rinsho Byori. 2004;52(10):860-5.
22. Mast EE, Margolis HS, Fiore AE, Brink EW, Goldstein ST, Wang SA, et al. A comprehensive immunization strategy to eliminate transmission of hepatitis B virus infection in the United States:

recommendations of the Advisory Committee on Immunization Practices (ACIP) part 1: immunization of infants, children, and adolescents. MMWR Recomm Rep. 2005;54(RR-16):1-31.

23. Tesfa T, Hawulte B, Tolera A, Abate D. Hepatitis B virus infection and associated risk factors among medical students in eastern Ethiopia. PLoS One. 2021;16(2):e0247267.

24. Pouri AA, Ghojazadeh M, Shirmohammadi M, Eftekhar-Sadat AT, Somi MH. Seroepidemiology and Risk Factors of Hepatitis B Virus Infection: A Population-Based Azar Cohort Study. Iran J Public Health. 2020;49(11):2152-60.