

Uptake of Hepatitis B Vaccine and Associated Factors among Healthcare Workers in District Hospitals in Pemba, Zanzibar, Tanzania

Bakar Khamis^{1,4}, Hussein Mohamed², Francis August³*

¹Department of Epidemiology and Biostatistics, School of Public Health and Social Sciences, Muhimbili University of Health and Allied Sciences, P O Box 65015, Dar es Salaam, Tanzania

²Department of Environmental and Occupational Health, School of Public Health and Social Sciences, Muhimbili University of Health and Allied Science, P O Box 65015, Dar es Salaam, Tanzania

³Department of Development Studies, School of Public Health and Social Sciences, Muhimbili University of Health and Allied Science, P O Box 65015, Dar es Salaam, Tanzania

⁴Zanzibar Public Health Emergency Operation Centre, Ministry of Health, P O Box 304, Chakechake Pemba, Zanzibar

*Correspondence: Bakar Khamis; Email: sadisuzae2016@gmail.com

Abstract

Background: Hepatitis B virus vaccine remains a strategic intervention to combat the spread of Hepatitis B infection. However, the status of uptake is not well documented among healthcare workers in various levels of health facilities in Zanzibar. The study was conducted to assess the uptake of the Hepatitis B vaccine and associated factors among healthcare workers in district hospitals in Pemba, Zanzibar by using the health belief model.

Methods: A Hospital-based cross-sectional analytic study design was conducted among healthcare workers in service in district hospitals of *Micheweni, Wete, and Chakechake* in Pemba, Zanzibar from December 2021 to July 2022. Considering proportional sampling, participants were randomly selected from each facility according to a calculated total sample size of 210. An interviewer-administered questionnaire was used to collect data. The descriptive analysis was performed where bivariable and multivariable analyses were conducted via modified Poisson regression in STATA version 17.

Results: Among 210 healthcare workers enrolled, 58 % had ever received the hepatitis B vaccine. Gender and perceived susceptibility were associated with the uptake of the vaccine. Being a woman healthcare worker had a 57 % higher prevalence of receiving hepatitis B vaccine compared to men in District Hospital (APR =1.57, 95% CI =1.21-2.024). Healthcare workers with high perceived susceptibility had a higher prevalence of HBV vaccine uptake (APR =1.56, 95% CI = 1.10 -2.32)

Conclusion: The uptake of the Hepatitis B vaccine among healthcare workers in the district hospitals of *Micheweni, Wete, and Chakechake* in Pemba, Zanzibar is below WHO's target of 90% coverage. Therefore, health education should be provided to increase perceived susceptibility among HCWs. Health facility management should prepare special campaigns to influence men healthcare workers to uptake the HBV vaccine. Further studies should be conducted to assess implementation fidelity of HBV vaccine and address factors associated with full vaccination among healthcare workers in district hospitals in Pemba Zanzibar

Keywords: Uptake of vaccine, health belief models, hepatitis B vaccine, Zanzibar.

Introduction

Hepatitis B is a remarkable global public health topic

that can cause a significant life threat (liver cancer, cirrhosis, and other chronic diseases) (1;2). Worldwide, 296 million people are living with hepatitis B, and 1.1 million deaths are reported annually (3). Second to the WHO Western Pacific Region, the WHO African Region carries one of the highest burden of infection, with 81 million people chronically infected (4). The estimated prevalence of Hepatitis B Virus (HBV) among Healthcare Workers (HCWs) in East Africa ranges between 4.5% and 7% (5–9). Even though the magnitude of HBV among HCWs is not well documented in Zanzibar, the approximate magnitude of HBV positivity for its general population in Zanzibar ranges from 1.3% to 6% (10;11). In this epidemiological context, the estimated considerable prevalence could increase the risk of exposure and infection of healthcare workers operating in this setting (1).

The Hepatitis B vaccine has been proven as an evidence-based intervention and is a key strategy to combat the spread of Hepatitis B infection (12), aiming at the lifetime protection of individuals after completion of the required three doses (13). In the East Africa region, some countries are committed to offering free HBV vaccines to healthcare workers in service in government health facilities to ensure accessibility; notwithstanding these measures in place, a low vaccine uptake among healthcare workers was observed (5;14). The HBV vaccination rate is 48% in Kenya (6), and 57.8% in Uganda (5), and 54.6–67% in Tanzania (14). The low uptake of the HBV vaccine might cause a significant impact such as increased infection of HBV and its sequelae (morbidity and mortality), an economic burden in the health sector due to the extensive use of government resources for treatment, and, at the individual level, it might cause a catastrophic health expenditure (15;16). The previous studies conducted in this region documented reasons for low uptake of the HBV vaccine which include, but are not limited to, the cost of the vaccine, awareness, attitude, knowledge, availability, accessibility, absence of guidelines and policy (5;14;17).

The Zanzibar Revolutionary Government, through the Ministry of Health, has recognized the importance of the hepatitis B vaccine for healthcare workers and takes it as an Infection Prevention and control (IPC)

measure in healthcare settings. The initial plan was to provide a free hepatitis B vaccine to frontline healthcare workers (10), and since 2018, the hepatitis B vaccine has been recognized as a necessary measure for healthcare workers in Zanzibar's health system (18). HBV vaccine is currently provided for free to healthcare workers via government sources and payable for travelers via Port Health Unit. Moreover, Healthcare workers can also find and pay for HBV vaccine from private sources or port health unit when the HBV vaccine is not available at the Health facilities. However, the status of uptake of HBV vaccine among healthcare workers in service in district hospitals in Pemba (Zanzibar) is not well documented. The previous studies conducted in tertiary hospitals in Tanzania have not included Zanzibar to assess the uptake of the HBV vaccine. Additionally, these studies did not provide data related to the health belief model (HBM), which is important to fully understand factors associated with uptake (14;19). To fill these gaps, the present study aims to assess the hepatitis B vaccine uptake and its associated factors among HCWs in district-level hospitals in Pemba Island, Zanzibar, to provide detailed information about how HCWs perceive the intervention and predict measures to plan behavior change interventions related to HBV vaccine uptake. Data will provide a basis for implementation research to ensure vaccination for healthcare workers from the perspective of the health belief model (HBM) (20).

Materials and Methods

Study design:

This was a hospital-based cross-sectional analytic study.

Study Area

This study was carried out in the three district hospitals in Pemba Zanzibar (Chake-Chake, Wete, and Micheweni), that are owned by the government and operated under the Ministry of Health of Zanzibar.

The Chake-Chake district hospital was the only district hospital located in the Kusini Pemba region (Mkoani district has no district hospital) while the other two district hospitals are located in the Kaskazini Pemba region. These district hospitals receive referral cases from first and second-line primary healthcare Units (PHCU and PHCU plus) and from the Primary

Healthcare Centre (PHCC) which is referred to as a cottage hospital.

Study population

The study population consisted of healthcare workers in district hospitals of Pemba-Zanzibar.

Sample size

The sample size was determined using a single population approach with a 95% confidence level and a 5% precision. The initial sample size was calculated using the following assumptions: setting a 5% margin of error (d) and a 95% confidence level ($\alpha=0.05$) and using the proportion of HCWs immunized against HBV in a previous study conducted by Aroan et al. 2017 in National Hospital, Tanzania, which was 33.6% (14). The total sample size was then calculated by using the following formula:

$$n = \frac{Z^2 \times p(100-p)}{d^2}$$

whereby:

n= desired minimum sample size,

z = value of Standard Normal deviate, =1.96 at 95% confidence

p = proportion of healthcare workers who received at least one dose of HBV vaccine =33.6% (Aroan et al. 2017)

d = marginal error = 5%.

The estimated sample was adjusted for a non-response rate of 5.9% in a previous study conducted in Uganda (5). The District hospitals in Pemba have a total of 490 healthcare workers, the following formula for a population of less than 10,000 was applied

$$nf = \frac{n}{\frac{(n)}{N}+1}$$

Where nf = desired sample size for a population less than 10,000

n = calculated sample size for a population greater than 10,000

N= total number of populations at a study site

The final estimated sample was 210.

Sampling

All three district hospitals located at Pemba Island namely Micheweni, Wete, and Chakechake were selected purposively. The total number of respondents in each hospital was determined based on proportion to their size using a proportionate sampling formula ($n_j=(N_j/N)*n$). Where n_j =number of participants required in a respective health facility, N_j =total

number of healthcare workers (study population) in respective health facility N =Total number of healthcare workers in the study area ($N=490$) and n =calculated sample size ($n=210$). Therefore, required participants in each hospital were 70 in Chakechake, 43 in Micheweni, and 97 in Wete Hospital. Finally, simple random selection was used to choose participants from each facility, whereby a sampling frame was obtained from the relevant hospital management.

Data collection instruments

The study used an interviewer-administered questionnaire with close-ended questions to collect data from HCWs on Hepatitis B vaccine uptake and associated factors among healthcare workers. To answer the study objectives and to explore factors associated with uptake of HBV vaccine among healthcare workers in Pemba, a questionnaire was prepared through consultation of the co-investigators of the study with experience in the field and by reviewing literature related to the topic (6;14;21–25). The questionnaire included structured questions which were organized into four main themes: (a) the background, which included socio-demographic variables; (b) Vaccination history; self-reported vaccination history; (c) Health belief model (HBM). In this last section, a 5-point Likert-scale response measure was used to measure among respondents the perceived susceptibility (two questions), perceived severity (four questions), perceived benefits (four questions), perceived barriers (four questions), self-efficacy (three questions) and cue to action (three questions). The psychometric scale questions were adopted and modified from previous studies (26–30). The questionnaire was pre-tested for quality purposes among Healthcare workers (5% of study participants) at Vitongoji Hospital and minor corrections were made before actual data collection. Data from the pre-test was not included in the study. The data collection tool was prepared in English and then translated into Kiswahili which is the mother tongue of respondents in Pemba, Zanzibar. Interviewer-administered questionnaire was installed in the Kobo toolbox app to allow data collection using a smartphone.

Study Variables

In this study, the outcome variable (Hepatitis B vaccine uptake) was measured by self-reported vaccination history because the hospitals had no HBV

vaccine-specific records, and tracking of vaccination cards was not feasible during data collection. The respondents were asked if they ever received the HBV vaccine, and dichotomous responses (yes, no) were used to measure the outcome variable. The response “yes” was considered when healthcare workers had ever received any number of HBV vaccine. The independent variables were age, sex, education level, working experience, cadre/profession, knowledge, attitude, perceived susceptibility, perceived severity, perceived benefit, perceived barriers, cue to action, and self-efficacy

Data analysis

The data analysis was conducted via the statistical software STATA version 17. The internal reliability of the items was checked for all six HBM components. The Cronbach’s alpha coefficient values were 0.73 in perceived susceptibility, 0.72 for perceived severity, 0.78 for perceived benefits, 0.52 for perceived barriers, 0.89 for self-efficacy, and 0.60 for the cue to action. Cronbach’s alpha coefficient of 0.6 was considered significant.

The responses to each question of the HBM components were categorized between 1 and 5, where 1 corresponds to strongly disagree and 5 to strongly agree. The maximum scores were 10 for susceptibility and 20 for perceived severity, perceived benefits, and perceived barriers. The maximum scores were 15 for self-efficacy and cue to action. A participant was considered as having “high perceived susceptibility” if he/she answered questions and got a score of 80% and above, while he/she was considered as having “low perceived susceptibility” if he/she scored below 80% (31;32). The same procedure was repeated for other HBM components.

In descriptive analysis, the categorical variables, such as sex, were reported using frequencies and percentages. A histogram was used to verify the normality of the continuous data. A mean and standard deviation were presented for data that had a normal distribution like age. In the bivariable analysis, modified Poisson regression was used to determine the relationship between each independent variable and the study outcome. The incidence risk rate (IRR)

results were presented and interpreted as crude prevalence ratio (CPR). All variables with a p-value of less than 0.25 in the bivariable analysis stage were chosen for the multivariable analysis to identify variables linked to hepatitis B vaccine uptake and to control for all confounding factors. Associations were expressed as adjusted prevalence ratio (APR), for 95% confidence intervals (CI) and were considered significant if $p < 0.05$. A multi-collinearity check was carried out using variance inflation factor (VIF) before multivariable analysis. However, no collinearity was observed since all variables had VIF values less than 5.

Results

Social-demographics characteristics of study participants (n=210)

A total of 210 eligible healthcare workers consented and enrolled in the study. The mean age (SD) of respondents was 36.8 (± 11) years. The majority of respondents belonged to the age group of 20-29 years. The majority of respondents were female 124 (59.0%). More than half of 143 (68.1%) study participants had a diploma education or above. Detailed information on the social-demographic characteristics of study participants is presented in Table 1.

Table 1: Social-demographic Characteristics of Study Participants (N=210)

Variable	Frequency (n)	Percentage (%)
Age Category		
20-29	74	35.2
30-39	60	28.6
40-49	36	17.1
≥50	40	19.1
Mean age (Sd) = 36.8 (11.1) years		
Sex		
Male	86	41.0
Female	124	59.0
Education level		
Secondary	67	31.9
Diploma	108	51.4
Degree and above	35	16.7
Cadre		
Medical doctors /clinical officers	43	20.5
Nurse	75	35.7
Health orderly/cleaner	67	31.9
Others*	25	11.9
Department		
Surgical/obs*	66	31.4
Medical	36	17.1
Laboratory technician	19	9.1
OPD	75	35.7
Supportive services	14	6.7
Working experience		
1-5years	106	50.5
6-10years	15	7.1
>10years	89	42.4

Surgical/obs means a surgical department, obstetrics and gynecology departments*

Others means Laboratory tech and Health officer*

Uptake of hepatitis B vaccine among healthcare workers

When analyzing vaccine uptake among respondents, 122/210 (58%) had ever received at least one dose of hepatitis B vaccine. Among participants, 66/210(31%) were full vaccinated, 57/210(27%) were partially vaccinated and 88/210(42%) of respondents were unvaccinated.

Health Belief Factors (n=210)

The health belief model (HBM) was used to assess health belief factors associated with the uptake of the

Hepatitis B vaccine. Regarding perceived susceptibility, out of 210 respondents, 162 (77.1%) perceived that they were at a high risk of contracting HBV infection. Concerning perceived severity, 111 (52.8%) of respondents perceived high severity caused by HBV infection (Table 2).

Table 2: Participants' responses regarding Health belief components (N=210)

Variable	Frequency (n)	Percentage (%)
Perceived susceptibility		
Low	48	22.9
High	162	77.1
Perceived severity		
Low	99	47.2
High	111	52.8
Perceived benefit		
Low	80	38.0
High	130	62.0
Perceived barrier		
Low	203	96.7
High	7	3.3
Self-efficacy		
Low	22	10.5
High	188	89.5
Cue to action		
Low	183	87.1
High	27	12.9

Factors associated with HBV vaccine uptake among healthcare workers

According to bivariable analysis, socio-demographic factors were initially associated with vaccine uptake. Specifically, female gender (CPR=1.42, 95% CI= 1.10-1.84) and educational level. Having a diploma was associated with increased uptake (CPR 1.59; 95% CI=1.15-2.19), that increased for having a high degree or above (CPR=1.84, 95% CI=1.30-2.62). Being a health cleaner was associated with a decreased HBV vaccination rate (CPR= 0.56, 95% CI= 0.40-0.79).

Additionally, two health belief factors (perceived susceptibility and self-efficacy) were significantly associated with uptake of the HBV vaccine, and participants with a high perceived susceptibility had a 96% (CPR =1.96, 95% CI = 1.29-2.98) higher prevalence of reporting HBV vaccination compared to those with low perceived susceptibility. Higher self-efficacy was associated with the uptake of the HBV vaccine (CPR =1.92, 95% CI = 1.03-3.59) compared to those with low self-efficacy (Table 3)

Table 3: Factors associated with uptake of Hepatitis B vaccine among Healthcare Workers in District Hospitals Pemba, Zanzibar (N=210)

Variable	CPR*(95 %CI)	P-value	Variable	CPR*(95 %CI)
Age Category			Perceived susceptibility	
20-29	1		Low	1
30-39	1.06(0.79-1.41)	0.705	High	1.96(1.29-2.97)
40-49	0.88(0.60-1.29)	0.517	Perceived severity	
≥50	1.15(0.85-1.55)	0.38	Low	1
Sex			High	1.12(0.89-1.42)
Male	1		Perceived benefit	
Female	1.42(1.10-1.84)	0.008*	Low	1
Education level			High	1.17(0.91-1.50)
Secondary	1		Perceived barrier	
Diploma	1.59(1.15-2.19)	0.005*	Low	1
Degree and above	1.84(1.30-2.62)	0.001*	High	0.48(0.15-1.57)
Cadre			Self-efficacy	
Nurse	0.89(0.69-1.14)	0.355	Low	1
Health orderly/cleaner	0.56(0.40-0.79)	0.001*	High	1.92(1.03-3.59)
Others	0.89(0.63-1.26)	0.503	Cue to action	
Medical doctor/ clinician	1		Low	1
Working experience			High	1.02(0.73-1.43)
1-5years	1			
6-10years	1.16(0.78-1.72)	0.465		
>10years	0.99(0.78-1.27)	0.973		
Attitude				
Negative attitude	0.87(0.49-1.55)	0.631		
Positive attitude	1			
Knowledge				
Good knowledge	3.50(1.24-9.85)	0.018*		
Moderate knowledge	3.46(1.16-10.34)	0.026*		
Poor knowledge	1			

CPR*crude Prevalence Ratio

Multivariable Modified Poisson regression confirmed the association of gender with vaccine uptake, with women being more prone to get the vaccine. Women healthcare workers had 57% (APR =1.57, 95% CI =1.21-2.024) higher prevalence of HBV vaccine

uptake compared to men. Additionally, healthcare workers who perceived high susceptibility had a 56 % (APR =1.56, 95% CI = 1.10 -2.32) higher prevalence of HBV vaccine uptake compared to participants with low perceived susceptibility (Table 4)

Table 4: Factors associated with HBV vaccine uptake among healthcare workers in District hospitals Pemba, Zanzibar: multivariable analysis (N=210)

Characteristics	n	Uptake of HBV vaccine (n =Ever received) (%)	APR (95% CI)	P-value
Sex				
Male	86	40(46.5%)	1	
Female	124	82(66.1%)	1.57(1.21-2.024)	≤ 0.001*
Education level				
Secondary	67	27(40.3%)	1	
Diploma	108	69(63.9%)	1.66(0.69-4.02)	0.260
Degree and above	35	26(74.3%)	2.0(0.81-4.96)	0.132
Knowledge				
Poor	17	3(17.7%)	1	
Moderate	18	11(61.1%)	2.26(0.75-6.83)	0.147
Good	175	108(61.7%)	2.41(0.79-7.41)	0.124
Perceived susceptibility				
Low	48	16(33.3%)	1	
High	162	106(65.4%)	1.56(1.10 -2.32)	0.026*
Perceived benefit				
High	130	80(61.5%)	1.06(0.84-1.33)	0.635
Low	80	42(52.5%)	1	
Perceived barrier				
Low	203	120(59.1%)	1	
High	7	2(28.6%)	0.47(0.16-1.34)	0.157
Self-efficacy				
low	22	7 (31.8%)	1	
High	188	115(61.2%)	1.13(0.58-2.18)	0.727

Discussion

The present study revealed that 58% of participants had ever received the hepatitis B vaccine in three district hospitals in Pemba Zanzibar, Tanzania. This finding is comparable to findings from the previous study conducted in tertiary hospitals in Kenya, Uganda, and Tanzania in which HBV vaccination

ranged between 48% and 57.8% (5,6,33). The prevalence of HBV vaccination among healthcare workers is higher compared to previous studies done in Nigeria (14.2%) (22), Ethiopia (44.2%) (24), Sudan (37.7%) (34) and Somalia (24.1%) (35). The observed difference could be explained by the existence of new policy guidelines for occupational health and safety

for HCWs and the availability of Zanzibar Integrated IPC guidelines in district hospitals in Pemba, which recommended free vaccination of pre-service and in-service workers against vaccine-preventable diseases, including HBV and protection of frontline healthcare workers. On the other hand, our study results revealed a low uptake of the Hepatitis vaccine compared to many studies conducted in Europe and Asia (21;36;37). It can be suggested that the limited access to the hepatitis B vaccine in the Zanzibar context could be a possible reason for the observed low uptake and may be due to resource scarcity and unavailability of free vaccines in health facilities. Our study did not assess the availability of vaccines in health facilities, and this could be considered a limit, that should be addressed in further investigations. Although, the HBV vaccination rate among HCWs in District hospitals in Pemba is greater than the combined rate of African nations, it is still much below the recommended level of 90%. This implies that effort is required to increase access to vaccines and to put in place promotion mechanisms for immunization.

When analysing data according to gender, women HCWs had a higher prevalence ratio of being vaccinated against hepatitis B compared to men (APR =1.57, 95% CI =1.21-2.024). The possible explanation for this could be due to high exposure to HBV testing services offered during pregnancy as a part of PMTCT (38). Gestational screening can help women understand their status and is an occasion to sensitize women towards HBV vaccine uptake. An increased uptake among women healthcare workers was also observed in other settings, including studies conducted in Pakistan and Uganda (37;39). In contrast, no difference in uptake according to gender was observed in studies conducted in Nigeria, Sudani, and Kenya (6;22;34). Our findings indicate that health facility management should take the appropriate steps to protect men healthcare workers.

Study results revealed that perceived susceptibility influenced the uptake of the HBV vaccine among HCWs. Comparable results were observed in studies conducted in Pakistan (26) and Iran (27). In contrast, the negative association between perceived susceptibility and HBV uptake was reported by Mariam, 2020 and Nankya-Mutyoba et al. 2019 in

studies conducted in Ethiopia (24) and Uganda (28) respectively. Other study conducted in Vietnam revealed no association between perceived susceptibility and vaccine uptake (30). The possible reason for this difference could be due to diversity in the study population and measures used to categorize risk perception and other health belief factors.

Strength and Limitation

According to our knowledge, this study is the first to provide data on the current status of HBV vaccine uptake and associated factors among healthcare workers in district hospitals in Pemba, Zanzibar. Vaccine uptake was self-reported and did not include an antigen test to confirm the vaccination status, due to budget limitations. This could have led to social-desirable responses and consequent bias, which was mitigated by ensuring privacy and confidentiality as well as providing consent forms to participants to ensure their willingness to give truthful information.

Conclusion and recommendation

This study revealed that among healthcare workers in the district hospitals of *Micheweni, Wete and Chakechake* in Pemba, Zanzibar Pemba (Zanzibar) the uptake of the Hepatitis B vaccine is lower (58%) compared to national and WHO targets (90%). Gender is associated with uptake, with women having a higher prevalence of HBV vaccine uptake compared to men. Perceived susceptibility is a motivator of HBV vaccine uptake. Therefore, findings of this study recommend that health facility management should continuously provide health education that aims to create attention to HCWs to allow them to better understand their susceptibility. Specifically, health education and promotion materials should be focused on delivering HBV risk messages. Further study is warranted to assess the implementation fidelity of the HBV vaccine and address factors associated with full vaccination among healthcare workers in district hospitals in Pemba Zanzibar.

Ethical Consideration

The ethical clearance was obtained from the Senate, Research and Publication Committee of Muhimbili University of Health and Allied Science (MUHAS) and the Zanzibar Health Research Institute (ZAHRI) (Ref NO ZAHREC/05/ST/APR/2022/23). Permission to conduct the study was requested from the Second Vice President's Office and the office of Chief

Government Statistician (OCGS). The crucial information regarding the purpose of the study, risks, and benefits was explained to all participants enrolled in the study, and written informed consent was requested. The confidentiality and privacy of collected data were assured during the research process.

Funding

Funding for this study was provided by the MUHAS HIV Implementation Science (HIS) project to support implementation research at a training institution in Tanzania. The funder had no conflict of interest with results of this study.

Competing interests

The author declared that they have no competing interest

Authors' contribution

BK led the drafting of this manuscript, and FA provided support in the drafting of the manuscript and technical guidance. HM provided overall guidance to the drafting of the manuscript and its revision. All authors reviewed and approved the manuscript.

References

1. CDC. Viral Hepatitis [Internet]. 2021 [cited 2021 Dec 22]. p. 1. Available from: <https://www.cdc.gov/hepatitis/hbv/index.htm>
2. World Health Organization (WHO). Global Health Sector Strategy on Viral Hepatitis 2016–2021. 2021.
3. World Health Organization (WHO). Hepatitis; Overview [Internet]. 2021. p. 1. Available from: https://www.who.int/health-topics/hepatitis#tab=tab_1
4. World Health Organization (WHO). Hepatitis B [Internet]. 2021 [cited 2021 Dec 22]. p. 1. Available from: <https://www.who.int/news-room/fact-sheets/detail/hepatitis-b>
5. Id TS, Mukama T, Kibira SPS, Ndejjo R, Bukenya N, Paul Z, et al. Hepatitis B screening and vaccination status of healthcare providers in Wakiso district, Uganda. PLoS One [Internet]. 2020;15(7):1–13. Available from: <https://doi.org/10.1371/journal.pone.0235470>
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. J Public Health (Bangkok) [Internet]. 2018;41(4):765–71. Available from: <https://doi.org/10.1093/pubmed/fdy186>
7. Mueller A, Stoetter L, Kalluvya S, Stich A, Majinge C, Weissbrich B, et al. Prevalence of hepatitis B virus infection among health care workers in a tertiary hospital in Tanzania. BMC Infect Dis [Internet]. 2015;15(1):1–9. Available from: <http://dx.doi.org/10.1186/s12879-015-1129-z>
8. Shao ER, Mboya IB, Gunda DW, Ruhangisa FG, Temu EM, Nkwama ML, et al. Seroprevalence of hepatitis B virus infection and associated factors among healthcare workers in northern Tanzania. BMC Infect Dis [Internet]. 2018;18(1):1–10. Available from: <https://doi.org/10.1186/s12879-018-3376-2>
9. Kilonzo SB, Gunda DW, Mpondo BCT, Bakshi FA, Jaka H. Hepatitis B Virus Infection in Tanzania: Current Status and Challenges. Hindawi J Trop Med [Internet]. 2018;10(1155):1–10. Available from: <https://doi.org/10.1155/2018/4239646>
10. Zanzibar Integrated HIV, Hepatitis, Tuberculosis and LP (ZIHHTLP). Zanzibar Viral Hepatitis National Strategic Plan 2019–2024 [Internet]. Zanzibar; 2019. Available from: <https://www.globalhep.org/evidence-base/zanzibar-viral-hepatitis-national-strategic-plan-zvh-nsp-i-201920-202324>
11. Khatib A, Matiko E, Khalid F, Welty S, Ali A, Othman A, et al. HIV and hepatitis B and C co-infection among people who inject drugs in Zanzibar. BMC Public Health [Internet]. 2017;17(917):1–6. Available from: <https://doi.org/10.1186/s12889-017-4933-0>
12. Organization WH. Call to Action to Scale Up Global Hepatitis Response. Glob Partners' Meet Hepat. 2014;(March):4.
13. Mohanty P, Jena P, Patnaik L. Vaccination

- against Hepatitis B: A Scoping Review. *Asian Pacific J Cancer Prev* [Internet]. 2020;21(12):3453–9. Available from: <https://doi.org/10.31557/APJCP.2020.21.12.3453>
14. Aaron D, Nagu TJ, Rwegasha J, Komba E. Hepatitis B vaccination coverage among healthcare workers at the national hospital in Tanzania : how much , who and why ? *BMC Heal Serv Res* [Internet]. 2017;17(786):1–7. Available from: <https://doi.org/10.1186/s12879-017-2893-8>
15. Jia H, Li L, Li W, Hou T, Ma H, Yang Y, et al. Impact of Healthcare-Associated Infections on Length of Stay: A Study in 68 Hospitals in China. *Biomed Res Int* [Internet]. 2019;10(1155):1–7. Available from: <https://doi.org/10.1155/2019/2590563>
16. Abbas M, Robalo Nunes T, Martischang R, Zingg W, Iten A, Pittet D, et al. Nosocomial transmission and outbreaks of coronavirus disease 2019: the need to protect both patients and healthcare workers. *Antimicrob Resist Infect Control* [Internet]. 2021;10(1):1–13. Available from: <https://doi.org/10.1186/s13756-020-00875-7>
17. Maina AN, Bii LC. Factors affecting HBV vaccination in a Medical training College in Kenya : A mixed methods Study. *BMC Public Health* [Internet]. 2020;20(48):1–12. Available from: <https://doi.org/10.1186/s12889-020-8158-2>
18. Ministry of health Zanzibar (MoH). The Zanzibar Policy Guidelines for Occupational Health, Safety and Wellbeing of Workers in the Health System. Zanzibar; 2018.
19. Shao ER, Mboya IB, Lyamuya F, Temu E, Kilonzo S, Gunda DW, et al. Uptake of Cost-Free Hepatitis B Vaccination among Healthcare Workers in Northern Tanzania. *TMJ* [Internet]. 2021;32(2):39–56. Available from: <https://doi.org/10.4314/tmj.v32i2.424.g263>
20. Abraham C, Sheeran P. The health belief model. In: *Cambridge Handbook of Psychology, Health and Medicine*, Second Edition. 2014. p. 97–102.
21. KaraivazogloKu Ka, Triantos C, Lagadinou M, Bikas C, Michailidou M, Kalafateli M, et al. Acceptance of hepatitis B vaccination among health care workers in Western Greece. *Arch Environ Occup Heal* [Internet]. 2014;69(2):107–11. Available from: <http://dx.doi.org/10.1080/19338244.2012.750586>
22. Omotowo IB, Meka IA, Ijoma UN, Okoli VE, Obieniu O, Nwagha T, et al. Uptake of hepatitis B vaccination and its determinants among health care workers in a tertiary health facility in Enugu ,. *BMC Infect Dis* [Internet]. 2018;18(288):1–9. Available from: <https://doi.org/10.1186/s12879-018-3191-9>
23. Ayalew MB, Horsa BA. Hepatitis B Vaccination Status among Health Care Workers in a Tertiary Hospital in Ethiopia. *Hindawi Hepar Reserach Treat* [Internet]. 2017;10(1155):8. Available from: <https://doi.org/10.1155/2017/6470658>
24. Mariam TGMW. Hepatitis B Vaccination Uptake Rate and Predictors in Healthcare Professionals of Ethiopia. *Dovepress Risk Manag Healthc Policy*. 2020;13:2875–85.
25. Mengal H, Howteerakul N, Suwannapong N, Rajatanun T. Factors Relating to Acceptance of Hepatitis B Virus Vaccination by Nursing Students in a Tertiary Hospital , Pakistan. *J Heal Popul NJTR*. 2008;26(1):46–53.
26. Mirzaei Alavijeh M, Vaezi M, Jalilian F. Hepatitis B Vaccine Acceptability among Nurses: A Theory Based Conceptualization. *Middle East J Dig Dis* [Internet]. 2018;11(1):45–51. Available from: <https://doi.org/10.15171/mejdd.2018.127>
27. Morowatishaifabad MA, Zare Sakhvidi MJ, Gholianavval M, Masoudi Boroujeni D, Alavijeh MM. Predictors of Hepatitis B Preventive Behavioral Intentions in Healthcare Workers. *Saf Health Work* [Internet]. 2015;6(2):139–42. Available from: <http://dx.doi.org/10.1016/j.shaw.2014.12.001>
28. Nankya-Mutyoba J, Aizire J, Makumbi F, Ocama P, Kirk GD. Erratum: Correction to: Hepatitis B virus perceptions and health

- seeking behaviors among pregnant women in Uganda: implications for prevention and policy (BMC health services research (2019) 19 1 (760)). BMC Health Serv Res [Internet]. 2019;19(1):982. Available from: <https://doi.org/10.1186/s12913-019-4516-0>
29. Wai CT, Wong ML, Ng S, Cheok A, Tan MH, Chua W, et al. Utility of the health belief model in predicting compliance of screening in patients with chronic hepatitis B. *Aliment Pharmacol Ther* [Internet]. 2005;21(10):1255–62. Available from: <https://doi.org/10.1111/j.1365-2036.2005.02497.x>
30. Ma GX, Fang CY, Shive SE, Toubbeh J, Tan Y, Siu P. Risk perceptions and barriers to Hepatitis B screening and vaccination among Vietnamese immigrants. *J Immigr Minor Heal* [Internet]. 2007;9(3):213–20. Available from: <https://doi.org/10.1007/s10903-006-9028-4>
31. Akibu M, Nurgi S, Tadese M, Dibekulum W. Attitude and Vaccination Status of Healthcare Workers against Hepatitis B I...: Discovery Service for De La Salle Health Sciences Institute. *Hindawi Sci* [Internet]. 2018;2018:1–8. Available from: <https://doi.org/10.1155/2018/6705305>
32. Olivier H, Tatsilong P, Noubiap JJN, Nansseu JRN, Aminde LN, Bigna JJR, et al. Hepatitis B infection awareness , vaccine perceptions and uptake , and serological profile of a group of health care workers in. *BMC Public Health* [Internet]. 2016;1–7. Available from: <http://dx.doi.org/10.1186/s12889-016-3388-z>
33. 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):1–14.
34. Alege JB, Gulom G, Ochom A, Kaku VE. Assessing Level of Knowledge and Uptake of Hepatitis B Vaccination among Health Care Workers at Juba Teaching Hospital , Juba City , South Sudan. *hindawi Advnances Prev Med* [Internet]. 2020;10(1155):11. Available from: <https://doi.org/10.1155/2020/8888409>
35. Hussein NA, Ismail AM, Jama SS. Assessment of Hepatitis B Vaccination Status and Associated Factors among Healthcare Workers in Bosaso, Puntland, Somalia 2020. *Biomed Res Int* [Internet]. 2022;10(1155):1–7. Available from: <https://doi.org/10.1155/2022/9074294>
36. Kistic-Tepavcevic D, Kanazir M, Gazibara T, Maric G, Makismovic N, Loncarevic G, et al. Predictors of hepatitis B vaccination status in healthcare workers in Belgrade, Serbia, December 2015. *Eurosurveillance* [Internet]. 2017;22(16):0–8. Available from: <http://dx.doi.org/10.2807/1560-7917.ES.2017.22.16.30515>
37. Soomar SM, Siddiqui AR, Azam SI, Soomar SM. Determinants of hepatitis B vaccination status in health care workers of two secondary care hospitals of Sindh , Pakistan : a cross-sectional study. *Hum Vaccin Immunother* [Internet]. 2021;00(00):1–6. Available from: <https://doi.org/10.1080/21645515.2021.1986332>
38. Zanzibar Intergrated HIV,hepatitis tuberculosis and LP. Health sector HIV and AIDS strategic Plan III ,2017-2022 Monitoring and Evaluation Plan. Ministry of health. Zanzibar; 2018.
39. Wibabara Y, Banura C, Kalyango J, Karamagi C, Kityamuwesi A, Amia WC, et al. Hepatitis B vaccination status and associated factors among undergraduate students of Makerere University College of Health Sciences. *PLoS One* [Internet]. 2019;14(4):1–9. Available from: <https://doi.org/10.1371/journal.pone.0214732>