International Journal of Multidisciplinary Research and Growth Evaluation.

Assessment of Hepatitis B Surface Antibody Levels and Post-Vaccination Immunity among Healthcare Workers in Rural Hospitals in Bo District, Sierra Leone

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Article Info

ISSN (Online): 2582-7138
Impact Factor (RSIF): 8.04
Volume: 07
Issue: 05
Received: 27-06-2026
Accepted: 29-07-2026
Published: 31-08-2026
Page No: 121-131

Abstract
Hepatitis B virus (HBV) infection is a major occupational hazard among healthcare workers (HCWs), particularly in sub-Saharan Africa, where high endemicity and low vaccination coverage increase transmission risk. This study assessed HBV serological profiles, vaccination coverage, and occupational determinants among HCWs at Bo Government Hospital and Mercy United Methodist (UMC) Hospital in Bo District, Sierra Leone. An analytical cross-sectional study was conducted among 296 HCWs selected through proportionate stratified random sampling. Data were collected using structured questionnaires, while blood samples were tested for HBsAg, total anti-HBc, and anti-HBs using chemiluminescence immunoassay (CLIA) on the MAGLUMI 4000 Plus platform. Participants were classified according to active infection, naturally acquired immunity, vaccine-induced immunity, or susceptibility. Data were analyzed using descriptive statistics and Pearson's chi-square test at a 5% significance level.

Of the 296 HCWs, 64.5% (n = 191) were completely susceptible to HBV, 10.8% (n = 32) had active infection, 10.8% (n = 32) had naturally acquired immunity, and 13.9% (n = 41) had vaccine-induced immunity. Vaccination coverage was inadequate, with 75.7% (n = 224) never vaccinated and only 18.9% (n = 56) completing the recommended three-dose schedule. All HBsAg-positive cases occurred among unvaccinated or partially vaccinated HCWs. HBsAg prevalence increased significantly with duration of employment, from 4.5% among those employed for less than one year to 14.8% among those employed for more than five years ($\chi^2 = 8.94$, $p = 0.003$), indicating cumulative occupational risk. Although females had slightly higher prevalence than males (11.8% vs. 9.3%), comparable infection rates among male and female State Registered Nurses suggested that professional role was more influential than biological sex.

The study highlights substantial gaps in occupational HBV protection among HCWs, including high susceptibility, low vaccination uptake, and persistent occupational transmission risk. Universal HBV vaccination, pre-employment screening, post-vaccination testing, strengthened infection prevention, and institutional occupational health policies are urgently needed to protect HCWs and support HBV elimination efforts in Sierra Leone.

DOI: https://doi.org/10.54660/.IJMRGE.2026.7.5.121-131

Keywords: Hepatitis B virus, healthcare workers, serological profiles, HBsAg, anti-HBc, anti-HBs, vaccination, occupational exposure, Bo District, Sierra Leone

Introduction

Hepatitis B Virus (HBV) infection remains one of the most persistent and consequential infectious diseases confronting global public health despite the existence of an effective vaccine for more than four decades. HBV is a hepatotropic DNA virus belonging to the Hepadnaviridae family that infects liver cells and causes a spectrum of clinical outcomes ranging from

asymptomatic infection and acute hepatitis to chronic hepatitis, liver cirrhosis, hepatic decompensation, and hepatocellular carcinoma (WHO, 2024; Terrault *et al*., 2018). Unlike many vaccine-preventable infectious diseases whose burdens have declined substantially over recent decades, hepatitis B continues to represent a major source of morbidity and mortality worldwide, reflecting persistent inequalities in healthcare access, vaccination coverage, diagnostic capacity, and treatment availability, particularly in low- and middle-income countries (Polaris Observatory Collaborators, 2022).

Globally, HBV infection remains a leading cause of chronic liver disease. According to the World Health Organization (2024), approximately 296 million individuals were living with chronic HBV infection in 2023, while nearly 1.5 million new infections occur annually. The disease contributes to approximately 820,000 deaths each year, primarily through complications associated with cirrhosis and hepatocellular carcinoma. These figures underscore the continuing public health significance of HBV and highlight the substantial gap between available preventive technologies and their effective implementation. Recent epidemiological analyses further indicate that HBV accounts for a significant proportion of global liver cancer cases, making it one of the few human carcinogens for which highly effective preventive interventions already exist (McGlynn *et al*., 2021; Polaris Observatory Collaborators, 2022).

A distinctive feature of HBV epidemiology is the age-dependent probability of chronic infection following exposure. Evidence indicates that approximately 90% of neonates infected through vertical transmission progress to chronic infection, compared with 20–30% of children infected before five years of age and less than 5% of immunocompetent adults infected later in life (Trépo *et al*., 2014; Spearman *et al*., 2017). Consequently, countries with high levels of early childhood transmission often experience sustained endemicity, creating large reservoirs of chronic infection that perpetuate community transmission and increase future risks of liver-related morbidity and mortality.

Data Presentation and Analysis

Table 1

Hypothesis	Statement
H_1	HCWs with incomplete or no HBV vaccination (0–2 doses) will have significantly higher prevalence of anti-HBc and HBsAg compared to those fully vaccinated (≥3 doses).
H_2	There will be a positive association between length of service and anti-HBc prevalence, attenuated among fully vaccinated HCWs.
H_3	After adjusting for exposure and vaccination status, male HCWs will have higher HBsAg prevalence, while female HCWs will show greater anti-HBs persistence.
H_4 (revised)	Length of service (tenure) is positively associated with HBsAg positivity.

Data presentation: Descriptive statistics, frequencies, percentages, and cross-tabulations derived from questionnaire analysis and serological testing are used to present the findings. Each hypothesis is evaluated in turn, with statistical tests (chi-square) and significance levels ($p < 0.05$, 95% CI) reported where applicable. A summary of key results and hypothesis testing outcomes is provided in Section 4.8.

Assessment of Non-Response Bias

The assessment of non-response bias constitutes an essential component of methodological quality assurance in epidemiological and cross-sectional research. Non-response bias arises when individuals who decline participation differ systematically from those who participate with respect to characteristics related to the study outcome. Such differences may distort prevalence estimates, weaken the validity of statistical associations, and compromise the representativeness of the study findings. Consequently, evaluating whether participants and non-participants differ on available characteristics is considered good epidemiological practice and provides important evidence regarding the internal validity of the study.

In the present study, potential non-response bias was assessed by comparing 296 participants with the 43 healthcare workers who declined participation. Comparisons were conducted using available demographic and occupational variables, including gender, mean age, and professional cadre. Statistical significance was evaluated using the Chi-square test for categorical variables and the independent samples *t*-test for continuous variables. The findings revealed no statistically significant differences between participants and non-participants across any of the variables examined, suggesting that the recruited sample was broadly representative of the healthcare workers initially approached for participation.

Comparison of Gender Distribution

Gender represents an important demographic characteristic in HBV epidemiological studies because differences in occupational exposure, vaccination uptake, risk perception, health-seeking behaviour, and compliance with infection prevention measures may exist between male and female healthcare workers. Therefore, substantial differences in gender composition between respondents and non-respondents could potentially introduce selection bias.

The results indicate that 60.1% of study participants were female, compared with 58.1% among non-participants, representing an absolute difference of only 2.0 percentage points. Statistical analysis yielded a p-value of 0.80, indicating that this difference was not statistically significant. From an epidemiological perspective, this finding demonstrates that male and female healthcare workers were equally likely to participate in the study. The absence of a significant gender difference suggests that participation was not influenced by sex-related factors such as perceived susceptibility to HBV, willingness to undergo serological testing, or concerns regarding confidentiality. Consequently, the gender composition of the analytical sample closely reflects that of the healthcare workers initially recruited.

The similarity in gender distribution strengthens confidence that the observed HBV prevalence estimates are unlikely to

have been influenced by differential participation between male and female healthcare workers. This is particularly important because gender has been associated with differences in occupational risk behaviours and healthcare utilization in several previous HBV studies.

Comparison of Age Distribution

Age is another important determinant of HBV epidemiology because cumulative occupational exposure generally increases with age and duration of professional service. Older healthcare workers may have experienced more occupational exposure opportunities, different vaccination policies during their professional careers, or greater cumulative risk of acquiring HBV infection. Therefore, systematic age differences between participants and non-participants could potentially bias prevalence estimates.

The mean age of study participants was 34.2 years (SD = 8.5), while non-participants had a mean age of 33.8 years (SD = 9.1). The difference between the two groups was only 0.4 years, with a p-value of 0.78. Statistically, this negligible difference indicates that participants and non-participants belonged to essentially the same age distribution. The observed difference is considerably smaller than the standard deviations of both groups, suggesting that it lacks practical as well as statistical significance.

This finding implies that healthcare workers across different age groups demonstrated comparable willingness to participate in the study. Younger and older healthcare workers were therefore proportionately represented within the analytical sample, reducing concerns that age-related occupational exposure or vaccination history might have biased the study findings.

Furthermore, similar age distributions enhance confidence that subsequent analyses examining relationships between age and HBV serological status are unlikely to be substantially influenced by selection bias arising from differential participation.

Comparison of Professional Cadre

Professional cadre constitutes an important occupational variable because different healthcare professions experience varying levels of occupational exposure to blood and body fluids. Nurses, laboratory personnel, physicians, surgical staff, and other healthcare professionals differ in their routine clinical activities, frequency of invasive procedures, and risk of needle-stick injuries. Consequently, disproportionate participation by professional groups could distort estimates of HBV prevalence and occupational risk. In this study, 48.3% of participants were State Enrolled Community Health Nurses (SECHNs) compared with 44.2% among non-participants, representing an absolute difference of 4.1 percentage points. Statistical analysis produced a p-value of 0.61, indicating no statistically significant difference. This result demonstrates that participation was not influenced by professional category. The proportional representation of SECHNs among participants closely resembled that observed among healthcare workers who declined participation. The absence of significant cadre-related differences is particularly important because SECHNs constituted the largest occupational group within the study population. Had this professional category been substantially overrepresented or underrepresented, estimates of HBV prevalence could have been biased due to differences in occupational exposure patterns.

Instead, the findings indicate that recruitment procedures successfully captured healthcare workers from the major professional categories without evidence of systematic occupational selection bias.

Interpretation of Statistical Findings

An important feature of the non-response assessment is that all p-values exceeded the conventional significance threshold of 0.05.

Specifically:

Gender: $p = 0.80$

Age: $p = 0.78$

Professional cadre: $p = 0.61$

These results indicate that any observed differences between participants and non-participants are most likely attributable to random sampling variation rather than systematic differences. The consistently high p-values strengthen confidence that the analytical sample accurately represents the healthcare workers initially approached for recruitment.

It is equally important to recognize that statistical significance should always be interpreted alongside effect size. In the present study, the observed differences were not only statistically non-significant but also extremely small in practical terms, only 2% difference in female representation, only 0.4-year difference in mean age, and only 4.1% difference in SECHN representation. These minimal differences further support the conclusion that meaningful demographic differences between respondents and non-respondents were absent.

Implications for Internal Validity

The absence of statistically significant demographic differences substantially strengthens the internal validity of the study.

Internal validity refers to the extent to which study findings accurately reflect the true characteristics of the source population without distortion arising from systematic error.

Selection bias represents one of the most important threats to internal validity in cross-sectional research. If healthcare workers possessing particular demographic or occupational characteristics were substantially more likely to participate than others, the estimated prevalence of HBV infection and associated risk factors might become biased. However, because participants and non-participants were remarkably similar with respect to gender, age, and professional cadre, there is little evidence that participant selection systematically influenced the study results.

Consequently, the prevalence estimates reported in subsequent analyses are likely to provide an accurate reflection of HBV epidemiology among healthcare workers in the participating hospitals.

Overall Interpretation

Overall, the assessment of non-response bias provides strong evidence that systematic selection bias was minimal in the present study. Participants and non-participants were highly comparable with respect to gender, age, and professional cadre, with no statistically significant differences observed across these variables ($p > 0.05$ for all comparisons). These findings indicate that participation was unlikely to have been influenced by major demographic or occupational characteristics, thereby enhancing the representativeness, internal validity, and credibility of the study.

To assess potential non-response bias, the following comparisons were made between participants (n=296) and non-participants (refusals, n=43).

Table 2: Interpretation of the Statistical Tests Used to Assess Non-Response Bias

Characteristic	Participants (n=296)	Non-participants (n=43)	Difference	p-value
Gender (% female)	60.1%	58.1%	+2.0%	0.80
Mean age (years)	34.2 (SD 8.5)	33.8 (SD 9.1)	+0.4 years	0.78
Professional cadre (% SECHN)	48.3%	44.2%	+4.1%	0.61

To evaluate whether non-response bias may have influenced the study findings, statistical comparisons were performed between participants and non-participants using appropriate inferential statistical tests. Specifically, the Chi-square (χ^2) test was employed to compare categorical variables, namely gender and professional cadre, while the independent samples *t*-test was used to compare the continuous variable of age. The selection of these statistical tests was methodologically appropriate because each test corresponds to the level of measurement of the variables being analyzed. The Chi-square test is widely used to determine whether there is a significant association or difference between categorical variables, whereas the independent *t*-test assesses whether the means of a continuous variable differ significantly between two independent groups.

Interpretation of the Chi-square Test Results

The Chi-square test was applied to examine whether the proportions of female healthcare workers and the distribution of professional cadres differed significantly between participants and non-participants.

For gender, the analysis yielded a p-value of 0.80, while the comparison of professional cadre produced a p-value of 0.61. Both values are substantially greater than the conventional level of statistical significance ($\alpha = 0.05$). Consequently, the null hypothesis, that there is no difference in gender distribution or professional cadre between participants and non-participants, cannot be rejected.

Interpretation of the Independent Samples *t*-Test

The independent samples *t*-test was used to compare the mean age of participants and non-participants. Age is a continuous variable and is therefore appropriately analyzed using a *t*-test when comparing two independent groups.

The mean age of participants was 34.2 years, compared with 33.8 years among non-participants, resulting in a mean difference of only 0.4 years. The corresponding p-value of 0.78 indicates that this difference is not statistically significant. The lack of a significant age difference has important epidemiological implications. Age is frequently associated with cumulative occupational exposure, duration of healthcare service, vaccination opportunities, and the likelihood of previous HBV infection. Older healthcare workers may have experienced more occupational exposure incidents, while younger workers may have benefited from more recent vaccination policies. Therefore, systematic age differences between respondents and non-respondents could potentially influence estimates of HBV prevalence and immunity.

Absence of Statistically Significant Differences

The finding that no statistically significant differences were observed between participants and non-participants on the available demographic variables represents one of the strongest indicators of the study's methodological robustness. Statistical significance is commonly assessed using a significance level of 5% ($\alpha = 0.05$). A p-value greater than 0.05 suggests that any observed difference between groups is likely attributable to random variation rather than to a true underlying difference.

In this study:

Gender: $p = 0.80$

Age: $p = 0.78$

Professional cadre: $p = 0.61$

All three p-values are substantially above 0.05, indicating that there is insufficient statistical evidence to conclude that participants differed from non-participants with respect to these characteristics.

Importantly, statistical interpretation should consider both statistical significance and practical significance. The observed differences were not only statistically insignificant but also extremely small in magnitude.

Table 3: A: Participant Recruitment and Response Rate

Recruitment Stage	Bo Government Hospital	Mercy UMC Hospital	Total
Total eligible HCWs (sampling frame)	810	80	890
Number approached for recruitment	310	35	345
Number who refused participation	38	5	43
Number with incomplete data	5	1	6
Final analytical sample (N)	**267**	**29**	**296**
Response rate	86.1%	82.9%	85.8%

Socio-Demographic and Occupational Characteristics of Participants

The study involved 296 healthcare professionals. Table 4.1 summarizes the distribution of participants by hospital and professional cadre, reflecting the stratified random sampling method used. State Enrolled Community Health Nurses (SECHNs) comprised the majority of participants (48.3%). This is explained by three factors: (1) SECHNs represent the largest professional cadre in Sierra Leone's rural health workforce due to their lower training requirements and broader deployment; (2) proportionate stratified sampling allocated sample sizes based on each cadre's population size (SECHNs constituted approximately 48.3% of the combined workforce, see Table 3.1); and (3) the rural hospital setting

disproportionately employs SECHNs for frontline primary care roles. Participants also included State Registered Nurses (SRNs) (25.0%), midwives (7.8%), Community Health Officers (CHOs) (5.4%), laboratory technicians (3.4%), optometrists (7.1%), mortuary attendants (1.7%), and medical doctors (2.7%).

Table 4: Distribution of Study Participants by Professional Cadre and Hospital

Professional Cadre	Bo Government Hospital (BGH)	Mercy Hospital	Total	Percentage (%)
Doctors	7	1	8	2.7%
CHO	13	3	16	5.4%
SRN Nurse	66	8	74	25.0%
Midwife (MW)	20	3	23	7.8%
SECHN Nurse	133	10	143	48.3%
Lab Technician	7	3	10	3.4%
Optometrist	17	4	21	7.1%
Mortuary Attendant	4	1	5	1.7%
Total	267	29	296	100%

The bar chart below displays the absolute number of participants from each professional cadre across the two study hospitals: Bo Government Hospital (BGH) and Mercy UMC Hospital (Mercy). Several patterns are evident from the figure:

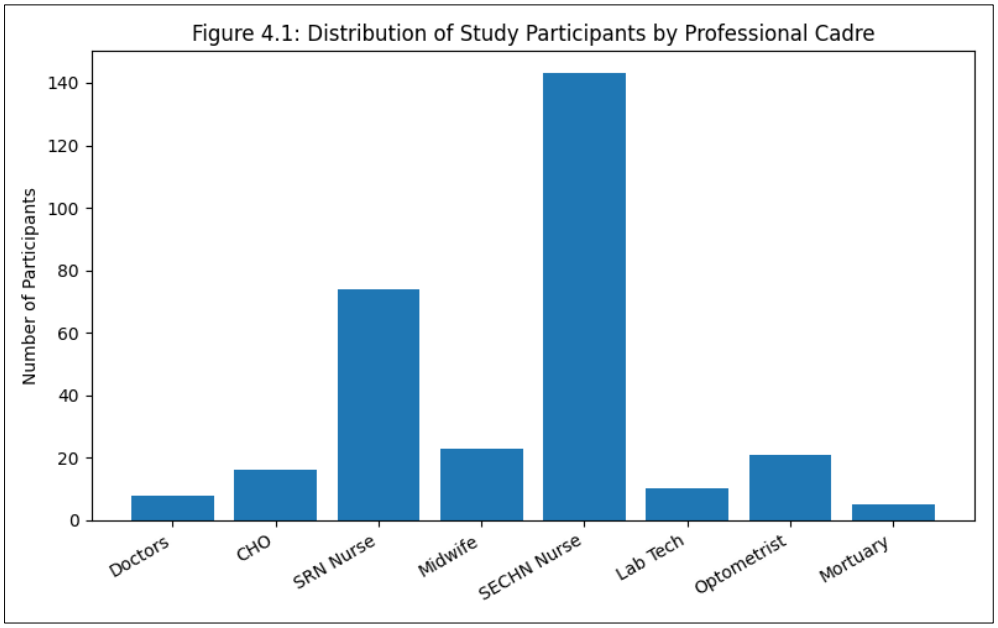

Fig 1

BGH contributed substantially more participants (n=267) than Mercy (n=29), reflecting the proportionate allocation of the stratified random sample based on the actual workforce sizes of the two facilities (BGH: 810 employees; Mercy: 80 employees).

SECHNs were the largest cadre at both hospitals, with 133 participants from BGH and 10 from Mercy. This dominance reflects the cadre's numerical majority in the source population and their central role in frontline service delivery in rural Sierra Leone.

Midwives were predominantly from BGH (n=20), with only 3 sampled at Mercy. This is explained by Mercy Hospital's specialization in maternal and child health, where midwifery services are delivered by a small number of staff who were proportionately selected in the random sample.

Medical doctors were the smallest clinical cadre (BGH: n=7; Mercy: n=1), consistent with the limited physician workforce in district-level hospitals in Sierra Leone.

The figure confirms that the final sample achieved adequate representation across all professional cadres, supporting the validity of subsequent cadre-specific serological analyses.

Participant Recruitment and Response Rate

Table 4.1A summarizes the participant recruitment process and response rate for the study conducted among healthcare workers (HCWs) at Bo Government Hospital and Mercy UMC Hospital. The recruitment outcomes demonstrate the effectiveness of the sampling strategy, the representativeness of the analytical sample, and the overall quality of the data collection process. High response rates and low levels of incomplete data are important indicators of methodological rigor because they minimize selection bias and enhance the internal validity of study findings. The recruitment flow further illustrates transparency in participant selection, allowing readers to evaluate the extent to which the final sample reflects the target population.

Overall Recruitment Process

The sampling frame consisted of 890 eligible healthcare workers, of whom 810 (91.0%) were employed at Bo Government Hospital and 80 (9.0%) worked at Mercy UMC Hospital. This unequal distribution reflects the actual staffing capacities of the two hospitals rather than a sampling

imbalance. As the largest referral hospital in the district, Bo Government Hospital naturally employs a substantially larger workforce comprising diverse professional cadres and specialized clinical departments. Consequently, its larger representation within the sampling frame appropriately mirrors the healthcare workforce composition within the study area. From this sampling frame, 345 healthcare workers were approached to participate in the study, representing approximately 38.8% of all eligible healthcare workers across both hospitals. Recruiting nearly two-fifths of the entire eligible workforce demonstrates a robust sampling effort and provides a sufficiently large study population for reliable statistical analysis. The proportion recruited from each hospital also reflects the proportional allocation strategy employed during sampling, thereby maintaining representativeness across study sites.

Recruitment at Bo Government Hospital: Among the 810 eligible healthcare workers at Bo Government Hospital, 310 individuals were approached for recruitment. This represents approximately 38.3% of the hospital's eligible workforce. Of those approached, 38 healthcare workers declined participation, corresponding to a refusal rate of approximately 12.3% among those invited. Although participant refusal is an unavoidable aspect of survey-based research, the refusal rate observed is relatively low for occupational epidemiological studies involving healthcare professionals. Healthcare workers often face demanding clinical responsibilities, heavy workloads, shift rotations, emergency duties, and time constraints, all of which can reduce willingness to participate in research. Therefore, securing participation from nearly nine out of every ten invited healthcare workers demonstrate effective participant engagement and confidence in the research process. Furthermore, only five questionnaires were excluded because of incomplete data. This represents merely 1.6% of the approached, indicating that nearly all recruited healthcare workers completed the questionnaire satisfactorily. Such a low proportion of incomplete responses reflects several positive aspects of the study, including clear questionnaire design, effective data collection procedures, adequate participant understanding, appropriate supervision during questionnaire administration, and careful quality control throughout data collection. Ultimately, 267 healthcare workers from Bo Government Hospital constituted the final analytical sample, producing a response rate of 86.1%. Response rates exceeding 80% are generally regarded as excellent in epidemiological and public health research because they substantially reduce the likelihood of non-response bias.

Recruitment at Mercy UMC Hospital: Mercy UMC Hospital contributed 80 eligible healthcare workers to the sampling frame. From this population, 35 healthcare workers were invited to participate, representing approximately 43.8% of the hospital workforce. Among those approached, only five individuals refused participation, while one questionnaire was excluded because of incomplete information. Consequently, 29 healthcare workers were retained for statistical analysis. The resulting response rate of 82.9% remains exceptionally high despite being slightly lower than that observed at Bo Government Hospital. Given the relatively small workforce at Mercy UMC Hospital, the recruitment of nearly one-third of all eligible healthcare workers provides adequate representation of that institution. The slightly lower response rate may simply reflect random variation arising from the hospital's smaller sample size rather than systematic differences in participant willingness. Small changes in participant numbers can produce relatively larger percentage differences when the denominator is limited.

Overall Response Rate and Analysis of Participant Refusal

The overall response rate is a critical indicator of the methodological quality, validity, and reliability of epidemiological studies, particularly those employing cross-sectional survey designs. In prevalence studies involving healthcare workers (HCWs), response rate is especially important because it reflects the extent to which the final analytical sample accurately represents the target population. A high response rate minimizes the risk of systematic errors arising from non-participation and enhances confidence in the generalizability of the findings within the study setting. In the present study, the recruitment process yielded an overall response rate of 85.8%, reflecting a highly successful participant recruitment strategy and demonstrating strong cooperation from healthcare professionals across the two participating hospitals.

A total of 345 healthcare workers were approached and invited to participate in the study from an eligible sampling frame of 890 HCWs. Among those invited, 43 individuals declined participation, representing an overall refusal rate of 12.5%, while only six questionnaires (1.7%) were excluded because of incomplete information. Consequently, 296 healthcare workers were retained for the final statistical analysis. These figures indicate that more than eight out of every ten eligible participants who were approached completed all study procedures successfully, including questionnaire administration and serological testing.

From a methodological perspective, an overall response rate of 85.8% is considered excellent for hospital-based cross-sectional studies involving healthcare professionals. Healthcare workers often operate under demanding clinical schedules characterized by shift duties, emergency services, patient overload, administrative responsibilities, and unpredictable work demands. Such occupational pressures frequently reduce participation in research activities. Therefore, achieving participation from nearly nine out of every ten invited healthcare workers demonstrates effective study planning, efficient recruitment procedures, and strong institutional collaboration. It further suggests that the research topic, hepatitis B virus (HBV) infection among healthcare workers, was perceived by participants as professionally important and relevant to their occupational health and safety.

The high response rate substantially strengthens the scientific quality of the study by reducing the potential for non-response bias. Non-response bias occurs when individuals who decline participation differ systematically from those who participate in ways that influence the study outcome. For example, healthcare workers with previous HBV infection, inadequate vaccination status, occupational exposure, or poor knowledge regarding HBV might theoretically be either more or less willing to participate than their colleagues. If such differences exist, prevalence estimates derived from the participating sample may either overestimate or underestimate the true burden of HBV within the source population. However, because only 12.5% of invited healthcare workers declined participation, the probability that

systematic differences between respondents and non-respondents substantially distorted the study findings is considerably reduced. Consequently, the observed prevalence of HBV serological markers is more likely to represent the actual epidemiological situation among healthcare workers within the participating hospitals.

HBV Serological Profiles among Healthcare Workers

The serological profiles of participants were interpreted based on the combination of results for HBsAg, anti-HBc, and anti-HBs. The overall distribution is presented in Table 8.

Table 5: Overall HBV Serological Profile of Healthcare Workers (N=296)

Profile	HBsAg	anti-HBc	anti-HBs	Interpretation	No.	(%)	95% CI
1	+	+	-	Chronic or Acute Infection	32	10.8	7.7–14.7
2	-	+	-	Isolated Anti-HBc	0	0.0	0.0–1.2
3	-	+	+	Resolved Infection (Naturally Immune)	32	10.8	7.7–14.7
4	-	-	+	Vaccine-Induced Immunity	41	13.9	10.3–18.2
5	-	-	-	Susceptible (No immunity/no infection)	191	64.5	58.9–69.8
Total					296	100	

Serological Profile of Hepatitis B Virus (HBV) Infection and Immunity among Healthcare Workers

Table 8 presents the comprehensive hepatitis B virus (HBV) serological profiles of the 296 healthcare workers (HCWs) who participated in this study. The interpretation of these profiles was based on the combined detection of three key HBV serological markers, hepatitis B surface antigen (HBsAg), total hepatitis B core antibody (anti-HBc), and hepatitis B surface antibody (anti-HBs). These biomarkers collectively distinguish individuals with current infection, previous exposure, vaccine-derived immunity, natural immunity following infection, and complete susceptibility to HBV. The distribution of these serological patterns provides valuable insight into the epidemiological status of HBV infection, immunity, and occupational vulnerability among healthcare personnel.

Overall Conclusion

The serological profile presented in Table 4.2 reveals a healthcare workforce with substantial vulnerability to HBV infection, characterized by a predominance of susceptible individuals, a clinically important prevalence of active HBV infection, limited vaccine-induced immunity, and evidence of previous natural exposure among a minority of participants. While the absence of isolated anti-HBc positivity simplifies serological interpretation, the lack of molecular testing means that occult HBV infection cannot be completely excluded. Collectively, these findings highlight significant deficiencies in occupational HBV prevention and underscore the urgent need for strengthened vaccination programmes, routine screening, continuous surveillance, and comprehensive occupational health policies to protect healthcare workers and reduce HBV transmission within healthcare settings.

Figure 4.2: HBV Serological Profile

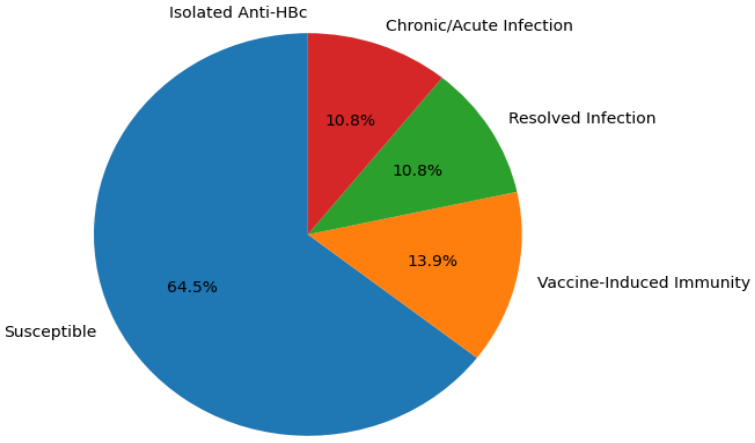

Fig 2: Overall HBV Serological Profile of Healthcare Workers (N=296)

The pie chart below represents the distribution of HBV serological profiles among healthcare workers.

Serological Profile by Professional Cadre

As seen in Table 9, the distribution of serological profiles differed among professional cadres. Several cadres had active infection (HBsAg positive), with SECHNs (n=16), SRNs (n=10), and midwives (n=8) having the highest raw numbers. All cadres exhibited the susceptible profile, but SECHNs (n=106) and SRNs (n=43) in particular.

Table 6: HBV Serological Profile by Professional Cadre

Cadre	Chronic/Acute (n)	Resolved Infection (n)	Vaccine Immunity (n)	Susceptible (n)	Total per Cadre
Doctors	0	2	6	0	8
CHO	2	2	5	7	16
SRN	10	11	10	43	74
Midwife	8	0	0	15	23
SECHN	**9**	15	13	106	**143**
Lab Technician	1	0	0	9	10
Optometrist	1	2	3	15	21
Mortuary Attendant	1	0	4	0	5
Total	**32**	**32**	**41**	**191**	**296**

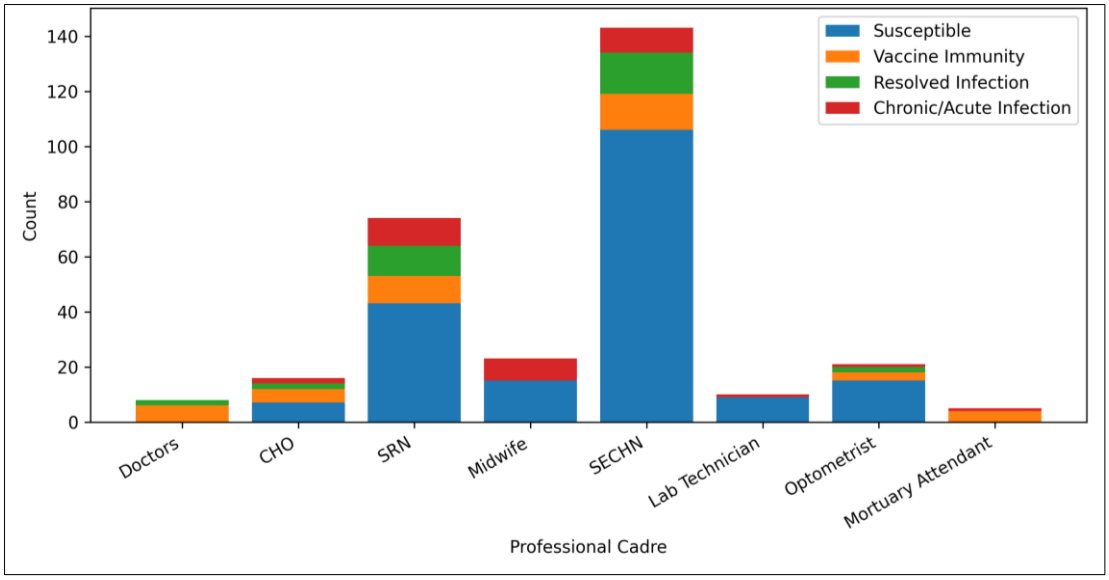

Fig 3: HBV Serological Profile by Professional Cadre

The stacked bar chart below shows the distribution of HBV serological profiles across professional cadres.

Midwives had the highest proportion of active infection (34.8%, 8 out of 23) and no cases of vaccine-induced or naturally acquired immunity among those tested.

SECHNs had the largest absolute number of susceptible individuals (106 out of 143, 74.1%) and 9 cases of active infection.

Medical doctors had the highest proportion of vaccine-induced immunity (75%, 6 out of 8).

Mortuary attendants showed an unexpectedly high proportion of vaccine-induced immunity (80%, 4 out of 5), which may reflect targeted workplace vaccination efforts for this high-exposure cadre.

Vaccination Status and Coverage among Healthcare Workers

Self-report and documented dose records were used to determine vaccination status. Of the 296 participants, 72 (24.3%) reported ever receiving at least one dose of the Hepatitis B vaccine. However, among these 72, dose count was unknown for 7 participants (2.4% of the total sample) who could not recall the number of doses received. These 7 individuals are excluded from dose-specific columns in Table 4.4 but are included in the denominator for overall coverage calculations where appropriate.

Vaccination Coverage Was Extremely Poor

Only 56 participants (18.9% of the total) had received the complete recommended three-dose series, which is required for reliable protection. An additional 10 participants had received only one dose, and 6 had received two doses.

A significant systemic failure in primary prevention is revealed by the evaluation of vaccination status. The coverage is appallingly low, as shown in Table 4.4. The recommended vaccination series was completed by only 18.9% of HCWs. This coverage rate stands in sharp contrast to the Healthy People 2020 target of 90% coverage for this category and the Advisory Committee on Immunization Practices' (ACIP) recommendation that all healthcare workers receive vaccinations. The crucial preventive role of the vaccine was demonstrated by the fact that all 32 cases of active HBV infection were discovered among the unvaccinated or partially vaccinated participants.

Table 7: Hepatitis B Vaccination Status by Age Group

Age Group	First Dose Only (n)	Second Dose Only (n)	Complete (3 Doses) (n)	Dose Count Unknown (n)	Total Vaccinated (≥1 dose)
20–24	4	0	3	0	7
25–29	2	0	3	0	5
30–34	1	2	20	0	23
35–39	1	0	20	0	21
40–44	1	1	4	0	6
45–49	1	0	2	0	3
50–54	0	1	2	0	3
>55	0	2	2	0	4
Total (known dose)	10	6	56	—	72
Dose unknown	—	—	—	7	(included in total)

Note: Of 296 participants, 72 (24.3%) reported ever receiving HBV vaccine. Among these, dose count was unknown for 7 participants (2.4% of total sample); these 7 are excluded from dose-specific columns but included in the "Total Vaccinated" count. The percentage fully vaccinated (≥3 doses) is calculated as 56/296 = 18.9%. The percentage unvaccinated (0 doses) is 296 − 72 = 224, or 224/296 = 75.7%. When including the 7 with unknown dose count in the unvaccinated/insufficient category for conservative estimation, the maximum possible fully vaccinated remains 56/296 = 18.9%.

Key findings from Table 4.4

A total of 224 participants (75.7% of the healthcare workforce) had never received any dose of the Hepatitis B vaccine.

Among those who started vaccination with known dose count (n=72, including unknown dose count would be 79 but 7 unknown), 56 (77.8% of vaccinees with known dose, 18.9% of total) completed the three-dose series.

The highest number of fully vaccinated individuals was in the 30–34 and 35–39 age groups (20 each), which may reflect targeted vaccination campaigns for mid-career HCWs.

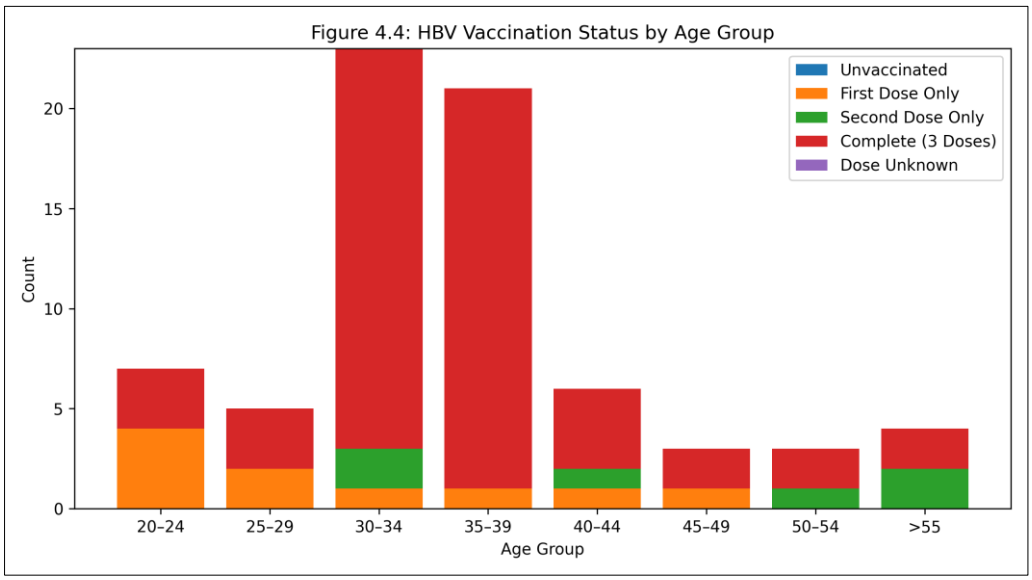

Fig 4: Hepatitis B Vaccination Status by Age Group

The stacked bar chart below presents the distribution of Hepatitis B vaccination status across different age groups. Unvaccinated values were not provided in the table and are shown as zero.

Recommendations

The findings of this study reveal a critical occupational health challenge requiring coordinated interventions from policymakers, healthcare institutions, professional bodies, and healthcare workers themselves. The following recommendations are proposed.

Recommendations for Government and National Health Policymakers

1. Establish a Mandatory National Hepatitis B Vaccination Policy for Healthcare Workers

The Ministry of Health should develop and enforce a national occupational health policy that mandates Hepatitis B screening and complete vaccination for all healthcare workers before deployment into clinical service. Vaccination status should become a prerequisite for recruitment, licensing, and continued employment in both public and private health facilities.

2. Integrate HBV Prevention into National Occupational Health Frameworks

Hepatitis B prevention should be incorporated into Sierra Leone's national occupational health and infection prevention policies. Dedicated budgetary allocations should be provided for routine vaccination, serological screening, surveillance, and post-exposure management of healthcare workers.

3. Establish a National Healthcare Worker HBV Surveillance System

A national electronic surveillance system should be developed to routinely monitor vaccination coverage, HBV

infection rates, occupational exposures, and post-exposure prophylaxis among healthcare workers. Such surveillance will facilitate evidence-based planning and evaluation of intervention programmes.

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How to Cite This Article
Zoker EM, Rogers MK. Assessment of hepatitis B surface antibody levels and post-vaccination immunity among healthcare workers in rural hospitals in Bo District, Sierra Leone. Int J Multidiscip Res Growth Eval. 2026;7(5):121-131. doi:10.54660/.IJMRGE.2026.7.5.121-131.

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