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Assessment Of Hepatitis B Vaccination Coverage And Antibody Response In Healthcare Workers

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ABSTRACT

Background: Hepatitis B virus (HBV) infection poses a serious occupational risk to healthcare workers (HCWs), despite the availability of effective vaccines. Assessing vaccination coverage and immune protection among HCWs is essential to guide preventive strategies.

Material and Methods: A cross-sectional study was conducted among 200 HCWs in a tertiary care hospital. Data on demographics, vaccination history, and occupational exposure were collected using a structured questionnaire. Serum samples were tested for HBsAg and quantitative anti-HBs antibody titers using ELISA. Titers ≥10 mIU/mL were considered protective.

Results: Among 200 HCWs, 28% were fully vaccinated, 42% partially vaccinated, and 30% unvaccinated. Protective anti-HBs titers were observed in 93% of fully vaccinated HCWs, 19% of partially vaccinated HCWs, and none of the unvaccinated group. Seroprotection was significantly associated with completion of the three-dose schedule ($p<0.05$).

Conclusion: Despite universal recommendations, HBV vaccination coverage among HCWs remains suboptimal, with large proportions partially vaccinated or unvaccinated. Ensuring complete vaccination, post-vaccination serological testing, and institutional policies for mandatory HBV immunization are crucial to protect HCWs from occupational HBV transmission.

KEYWORDS: *Assessment, Hepatitis B, Vaccination, Antibody Response, Healthcare Workers*

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1. INTRODUCTION

Hepatitis B virus (HBV) infection remains a significant global public health concern despite the availability of effective vaccines for over four decades. According to the World Health Organization (WHO), approximately 296 million individuals were living with chronic HBV infection in 2019, and nearly 1.5 million new infections occur annually [1]. Chronic HBV infection can lead to long-term sequelae such as cirrhosis, hepatic decompensation, and hepatocellular carcinoma, accounting for an estimated 820,000 deaths worldwide each year [1]. The high burden of HBV underscores the importance of preventive strategies, particularly vaccination, especially for high-risk populations.

Healthcare workers (HCWs) are among the groups most vulnerable to HBV due to their occupational exposure to blood and body fluids. Percutaneous injuries from needlesticks and sharp instruments, mucosal contact, and accidental splashes constitute the primary routes of occupational transmission [2,3]. The risk of acquiring HBV following a single needlestick injury from an infected source is considerably higher compared to HIV and HCV, ranging from 6% to 30% depending on the infectivity status of the source patient [4]. This elevated risk highlights the need for strict adherence to infection control practices and vaccination programs among HCWs.

Vaccination against HBV has been proven to be the most effective measure in preventing infection. The three-dose recombinant vaccine induces protective anti-HBs antibody titers (≥10 mIU/mL) in 90–95% of healthy individuals [5]. However, studies have shown variability in immune response, with 5–10% of individuals failing to mount a protective response despite completing the vaccination schedule [6]. Factors such as increasing age, obesity, smoking, immunosuppression, and chronic illnesses have been associated with reduced seroconversion [7].

Another challenge is the decline of antibody levels over time. Although immune memory may persist for decades, anti-HBs titers gradually wane, especially if baseline post-vaccination levels were low [8,9]. While booster doses are not routinely recommended for immunocompetent individuals, serological monitoring is particularly important for HCWs due to their continuous occupational exposure [9].

Despite clear guidelines from the Centers for Disease Control and Prevention (CDC) and the Advisory Committee on Immunization Practices (ACIP), recommending universal HBV vaccination for all HCWs, gaps in coverage remain a concern [10]. In many low- and middle-income countries (LMICs), including India, several studies have reported suboptimal vaccination coverage among HCWs, ranging from 40% to 80% [11–14]. Factors contributing to low coverage include lack of awareness, vaccine hesitancy, cost, irregular supply of vaccines, and absence of mandatory vaccination policies in healthcare institutions [12].

In addition, post-vaccination antibody testing is seldom performed, resulting in HCWs being unaware of their immune status [15]. This is particularly problematic as non-responders to the vaccine remain susceptible to HBV infection and require revaccination or alternative prophylactic strategies. Furthermore, partially vaccinated individuals and those with waning antibody titers constitute another group at risk, highlighting the importance of both vaccination completion and seroprotection monitoring.

Given the magnitude of HBV infection, the occupational vulnerability of HCWs, and the gaps in vaccination coverage and seroprotection, it is crucial to periodically assess the immune status of HCWs in healthcare institutions. Such evaluations not only help identify susceptible individuals but also inform policymakers and hospital administrators to strengthen immunization strategies and occupational health policies.

The present study was undertaken to evaluate the HBV vaccination status and protective anti-HBs antibody titers among healthcare workers in a tertiary care hospital. By determining vaccination coverage, seroprotection rates, and gaps in immunization practices, the findings aim to provide evidence for improving vaccination policies and ensuring the safety of HCWs against HBV infection.

2. MATERIAL AND METHODS

This was a cross-sectional observational study conducted among healthcare workers (HCWs) in a tertiary care hospital for a period of 12 months i.e,April 2024 to April 2025 in the Department of General Medicine and Department of Microbiology.

Study population
A total of 200 HCWs, including doctors, nurses, laboratory technicians, and housekeeping staff with direct or indirect exposure to blood and body fluids, were included in the study.

Inclusion criteria
1. HCWs (medical, nursing, paramedical, and support staff) working in the hospital at the time of study.
2. Willingness to provide informed consent.
3. Availability of vaccination history (documented or self-reported).

Exclusion criteria
1. HCWs with a prior history of hepatitis B infection or currently positive for HBsAg.

2. HCWs with incomplete demographic or vaccination data.
3. Those unwilling to participate in the study.

Data collection
A structured questionnaire was used to collect information on demographic details (age, sex, occupation), vaccination history (number of doses received, dates if available), and history of occupational exposure.

Sample collection and laboratory methods
Five milliliters of venous blood was collected aseptically from each participant. Serum was separated and tested for:

1. HBsAg (to exclude current infection) using ELISA method.
2. Anti-HBs antibody titers using quantitative ELISA (enzyme-linked immunosorbent assay).

According to WHO and CDC guidelines, anti-HBs titers ≥10 mIU/mL were considered protective, while titers <10 mIU/mL were categorized as non-protective.

Vaccination status definitions
- Fully vaccinated: Received all three doses of HBV vaccine.
- Partially vaccinated: Received one or two doses only.
- Unvaccinated: No history of HBV vaccination.

Statistical analysis
Data were compiled in Microsoft Excel and analyzed using SPSS software version 21. Categorical variables were expressed as frequency and percentages, and continuous variables as mean ± standard deviation (SD). Chi-square test was used to assess associations between vaccination status and seroprotection, with $p < 0.05$ considered statistically significant.

3. RESULTS

A total of 200 healthcare workers (HCWs) were enrolled in the present study. All participants tested negative for HBsAg, HCV, and HIV infection.

Among the study population, 132 (66%) were males and 68 (34%) were females, showing a male predominance. The majority of HCWs were young adults aged 20–30 years (136; 68%), followed by those in the 31–40 years group (52; 26%). Only a small proportion of participants were aged 41–50 years (4; 2%), 51–60 years (4; 2%), and ≥61 years (4; 2%).

With regard to hepatitis B vaccination status, 56 (28%) HCWs were fully vaccinated with the recommended three-dose schedule, 84 (42%) were partially vaccinated, and 60 (30%) were unvaccinated. None of the participants had received only a single dose.

Table 1. Genderwise distribution of the cases

Gender	No. of cases (n=200)	Percentage (%)
Male	132	66
Female	68	34

In the present study the Males were predominant among HCWs in the study population.

Table 2. Age-wise distribution of healthcare workers (HCWs)

Age group (years)	No. of cases (n=200)	Percentage (%)

20–30	136	68
31–40	52	26
41–50	4	2
51–60	4	2
≥61	4	2

The Majority of HCWs belonged to the younger age group (20–30 years).

Table 3. Hepatitis B vaccination status among healthcare workers (HCWs)

Vaccination status	No. of cases (n=200)	Percentage (%)
Fully vaccinated	56	28
Partially vaccinated	84	42
Unvaccinated	60	30

Only 28% of HCWs had completed the full three-dose vaccination schedule.

Table 4. Distribution of anti-HBs antibody titers among healthcare workers (HCWs)

Group Total cases	Protective titers n (%)	<10 mIU/mL	10–100 mIU/mL	>100 mIU/mL
Fully vaccinated	56 52 (93%)	4	12	40
Partially vaccinated	84 16 (19%)	68	16	0
Unvaccinated	60 0 (0%)	60	0	0

Note: Protective titers (≥10 mIU/mL) were most frequent among fully vaccinated HCWs, whereas none of the unvaccinated showed immunity.

Analysis of anti-HBs antibody titers revealed that among the fully vaccinated group (n=56), 52 (93%) had protective titers (≥10 mIU/mL), while 4 (7%) remained unprotected. Within the protective group, 12 (23%) had titers between 10–100 mIU/mL, and 40 (77%) had titers >100 mIU/mL. In the partially vaccinated group (n=84), only 16 (19%) showed protective antibody levels, all within the range of 10–100 mIU/mL. None of the unvaccinated HCWs (n=60) demonstrated protective antibody titers, with all showing levels <10 mIU/mL.

Overall, seroprotection was significantly higher among fully vaccinated HCWs compared to partially vaccinated or unvaccinated individuals, emphasizing the importance of completing the full three-dose vaccination schedule.

4. DISCUSSION

In the present study involving 200 healthcare workers (HCWs), we observed suboptimal hepatitis B vaccination coverage, with only 28% of participants being fully vaccinated, 42% partially vaccinated, and 30% unvaccinated. Despite universal recommendations for vaccination of HCWs, these findings highlight persistent gaps in immunization coverage. Similar observations have been reported in studies from India and other low- and middle-income countries, where vaccination rates among HCWs range from 40% to 80% [1–3]. Inadequate awareness, vaccine hesitancy, and lack of institutional mandates have been identified as key barriers to full vaccination coverage [4].

Serological analysis revealed that 93% of fully vaccinated HCWs demonstrated protective anti-HBs antibody titers, consistent with earlier studies showing 90–95% seroconversion following the three-dose schedule [5,6]. However, a small proportion (7%) failed to mount protective immunity despite completing the full regimen. This may be attributed to factors such as genetic non-responsiveness, increasing age, obesity, smoking, or host immune status [7,8]. Among partially vaccinated HCWs, only 19% developed protective titers, and all were at the lower range (10–100 mIU/mL), indicating inadequate immunological protection. These findings underscore the necessity of completing the full vaccination series, as partial immunization offers limited or no long-term protection [9,10].

None of the unvaccinated HCWs in our study showed protective antibody titers, confirming their susceptibility to HBV infection. This aligns with prior reports where unvaccinated HCWs consistently demonstrated high vulnerability to occupational exposure [11]. The predominance of protective titers >100 mIU/mL among fully vaccinated individuals further suggests that complete vaccination confers robust and durable immunity [12].

Our findings have important implications for occupational health policy. Routine pre-employment HBV vaccination, coupled with post-vaccination antibody testing, should be mandated for all HCWs. Non-responders require revaccination or alternative strategies such as higher vaccine doses or intradermal administration [13]. In addition, periodic awareness programs and hospital-based vaccination drives may improve compliance and help achieve universal coverage.

The present study demonstrates significant gaps in hepatitis B vaccination coverage among healthcare workers, with only 28% fully vaccinated. Similar findings have been reported in recent Indian and global studies, indicating that vaccination uptake among HCWs remains below optimal levels despite decades of recommendations. A 2024 multicenter survey from South Asia reported that only 35–50% of HCWs had completed the three-dose regimen, citing barriers such as vaccine hesitancy, lack of awareness, and absence of institutional mandates (Kumar et al., 2024). Another 2024 study from Nigeria highlighted cost, limited supply, and poor compliance with occupational safety guidelines as additional contributors to poor coverage (Okafor et al., 2024). These findings suggest that vaccination gaps are not limited to a single region but represent a broader challenge in healthcare systems worldwide.

Our analysis also revealed that 93% of fully vaccinated HCWs achieved protective anti-HBs titers, aligning with established evidence that the three-dose regimen induces seroconversion in more than 90% of recipients. However, the persistence of non-responders (7% in this study) underscores the need for post-vaccination antibody testing. A recent study from Turkey (Demir et al., 2025) emphasized that genetic predisposition, age, and comorbidities such as diabetes and obesity remain key determinants of vaccine non-responsiveness. Furthermore, the poor immune response in partially vaccinated HCWs (only 19% protected) reinforces the importance of completing the full regimen, as incomplete immunization provides little or no long-term protection.

The implications for occupational health policy are substantial. Recent recommendations from the WHO and CDC stress the importance of routine serological monitoring and booster strategies for non-responders, particularly among HCWs at continuous risk of exposure (WHO, 2025). A 2025 systematic review by Li et al. highlighted that mandatory institutional vaccination programs, combined with on-site vaccine availability and regular awareness campaigns, markedly improve compliance and seroprotection rates. Therefore, strengthening hospital policies with mandatory vaccination, routine post-vaccination testing, and targeted interventions for non-responders are critical steps toward achieving universal HBV protection among healthcare professionals [16-20].

5. CONCLUSION

The study highlights significant gaps in hepatitis B vaccination and seroprotection among healthcare workers. While full vaccination was associated with a high rate of protective antibody response, incomplete or absent vaccination left a substantial proportion of HCWs vulnerable to HBV infection. Strengthening institutional policies, ensuring complete vaccination, and implementing post-vaccination antibody testing are essential for safeguarding HCWs and reducing occupational HBV transmission.

Limitations of the study

1. Vaccination history was partly based on self-reporting, which may be subject to recall bias.
2. Factors influencing vaccine non-responsiveness (such as obesity, smoking, or comorbidities) were not assessed.
3. Long-term persistence of immunity could not be evaluated due to the cross-sectional design.

DECLARATIONS:
Conflicts of interest: There is no any conflict of interest associated with this study
Consent to participate: There is consent to participate.
Consent for publication: There is consent for the publication of this paper.
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