

ORIGINAL ARTICLE

HEPATITIS B VACCINATION COVERAGE AND ANTIBODY RESPONSE MONITORING AMONG INTERN DOCTORS IN A MEDICAL COLLEGE OF BANGLADESH

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Abstract

Background: Hepatitis B Virus (HBV) infection constitutes a significant occupational hazard for healthcare workers (HCWs), particularly intern doctors who are at the frontline of patient care and perform high-risk procedures. Vaccination is the most effective preventive measure, and post-vaccination serological testing for anti-HBs antibodies is crucial to confirm seroprotection. This study aimed to assess the HBV vaccination status and determine the seroprotection rate among intern doctors in a Medical College of Bangladesh. **Methods:** A cross-sectional study was conducted from January to March 2023 among 200 intern doctors in the Department of Gastroenterology, Rangpur Medical College Hospital of Bangladesh. Participants were interviewed using a structured questionnaire to ascertain their HBV vaccination history. Those with a complete vaccination record (three or more doses) were included for serological testing. Individuals with known immunodeficiency disorders, chronic illnesses, or on immunosuppressive therapy were excluded. A total of 159 interns were confirmed as vaccinated. Among them, 150 consented to provide a blood sample for quantitative anti-HBs titer measurement via Chemiluminescent Microparticle Immunoassay (CMIA). **Results:** The vaccination coverage among the intern doctors was 79.5% (159/200). Among the 150 interns whose anti-HBs titers were analyzed, 132 (88.0%) had protective antibody levels (anti-HBs ≥ 10 mIU/mL). The mean anti-HBs titer was 287.6 mIU/mL (Range: 2.1 to >1000 mIU/mL). However, 18 (12.0%) interns were identified as non-responders (anti-HBs <10 mIU/mL) despite completing the primary vaccination series. No significant correlation was found between the time since last vaccination and antibody titer within this short follow-up duration. **Conclusion:** Although a high rate of vaccination coverage was observed, a concerning 12% of vaccinated intern doctors lacked adequate seroprotection against HBV, leaving them vulnerable to a life-threatening occupational infection. This underscores the critical necessity of mandatory post-vaccination serological testing (anti-HBs titer) for all healthcare workers following primary immunization. Non-responders must be identified and managed with additional vaccine doses or strict adherence to universal precautions to prevent this preventable professional hazard.

Keywords: Hepatitis B, Vaccination, Anti-HBs Titer, Intern Doctors, Healthcare Workers, Occupational Hazard, Seroprotection, Bangladesh.

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Introduction

Hepatitis B Virus (HBV) infection remains a global public health challenge, with an estimated 296 million people living with chronic infection and approximately 820,000 deaths annually due to related complications like cirrhosis and hepatocellular carcinoma¹. Healthcare workers (HCWs) are at a substantially heightened risk of acquiring this infection through occupational exposure to blood and other body fluids. The risk of seroconversion after a percutaneous injury from an HBV-positive source is as high as 30%².

Among HCWs, intern doctors are exceptionally vulnerable. They are newly qualified physicians who are intensively involved in clinical procedures, including venipuncture, suturing, assisting in surgeries, and handling sharp instruments, often with inadequate experience under highly stressful conditions. This puts them at a perpetual risk of needlestick injuries (NSIs) and other forms of exposure.

Vaccination against HBV is the cornerstone of prevention. The World Health Organization (WHO) recommends a three-dose schedule (0, 1, and 6 months) and considers an anti-HBs antibody titer of ≥ 10 mIU/mL, measured 1-3 months after the completion of the vaccination series, as a marker of seroprotection³. However, a significant subset of individuals (5-10% in the general population) is non-responders who fail to develop protective antibody levels after a primary series⁴.

In the context of Bangladesh, where the prevalence of HBV in the general population is intermediate to high (HBsAg prevalence ~3-8%)⁵, the occupational risk for HCWs is magnified. While vaccination is increasingly incorporated into medical education, data on the serological status of young doctors post-vaccination is scarce. Merely receiving the vaccine does not guarantee immunity. Therefore, this study was designed to evaluate the HBV vaccination coverage and, more importantly, the seroprotection status confirmed by quantitative anti-HBs titer among intern doctors at a medical college hospital in Bangladesh.

Methods

A descriptive cross-sectional study was conducted over a period of three months (January to March 2023) in the Department of Gastroenterology, Rangpur Medical College Hospital of Bangladesh. The study population consisted of 200 intern doctors currently undertaking their internship rotation at the hospital. All interns from the ongoing batches were invited to participate. All intern doctors present during the study period were eligible. Interns with a self-reported history of clinically diagnosed immunodeficiency disorders (e.g., HIV/AIDS, congenital immunodeficiency), chronic renal failure, malignancy, or those on immunosuppressive medication were excluded from the serological testing

component, as these conditions can impair vaccine response. After obtaining informed written consent, participants were interviewed face-to-face using a pre-tested, structured questionnaire.

The questionnaire collected data on:

- Sociodemographic details (age, sex).
- Complete history of HBV vaccination (number of doses, time of last dose).
- History of previous HBV infection.
- History of needlestick injuries.

Out of the 200 interns, 159 reported a history of receiving a complete primary course (e³ doses) of HBV vaccine. From this vaccinated group, 150 interns consented to phlebotomy. Approximately 5 mL of venous blood was collected from each participant. The serum was separated and analyzed using a Chemiluminescent Microparticle Immunoassay (CMIA) on an ARCHITECT i1000SR analyzer (Abbott Laboratories) to quantitatively determine the anti-HBs titer. The results were interpreted as follows:

- **Seroprotected (Responder):** Anti-HBs titer ≥ 10 mIU/mL.
- **Non-responder:** Anti-HBs titer < 10 mIU/mL.

Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0. Descriptive statistics (frequency, percentage, mean, standard deviation) were used to summarize the data. The Chi-square test was applied to find associations between categorical variables. A p-value of < 0.05 was considered statistically significant. Ethical clearance was obtained from Institutional Review Board of Rangpur medical college (MC/Rang/ 1192/c).

Results

Of the 200 intern doctors surveyed, 159 (79.5%) had received a complete primary course of HBV vaccination. The remaining 41 (20.5%) were either unvaccinated or had only received one or two doses.

Serological testing was performed on 150 of the 159 vaccinated interns. The results revealed that the vast majority, 132 interns, had developed protective immunity, yielding a seroprotection rate of 88.0%. The geometric mean titer (GMT) for the entire tested group was 287.6 mIU/mL, with a wide range from 2.1 mIU/mL to > 1000 mIU/mL.

A significant minority of 18 interns (12.0% of the tested group) were identified as non-responders, with anti-HBs titers below the protective threshold of 10 mIU/mL. This indicates that despite being vaccinated, they remain susceptible to HBV infection.

The time elapsed since the last vaccine dose varied among participants, ranging from 6 months to 5 years. However, within the short three-month duration of this study follow-up, no statistically significant correlation was found between the time since vaccination and the decline in antibody titer to non-protective levels in this cohort.

Study Findings Summary (N=200)

	Number	Percentage
 Total Interns Surveyed	200	100%
	159	79.5%
 Fully Vaccinated (≥3 doses)	41	20.5%
 Vaccinated Interns Tested (Anti-HBs)	150	94.3%
 Vaccinated Interns Tested (Anti-HBs)	132	88.0%
 Non-responders (Titer <10 mIU/mL)	18	12.0%

Figure 1: Summary of Study Findings (N=200)

To analyze the factors influencing vaccine response, the 150 tested interns were categorized into two groups based on their serological outcome:

- **Responders:** Anti-HBs titer ≥10 mIU/mL (n=132)
- **Non-responders:** Anti-HBs titer <10 mIU/mL (n=18)

The demographic profiles of these two groups were compared. The analysis, presented in Table-I,

investigated associations with gender, age group, and time since last vaccination.

The analysis revealed a statistically significant association between gender and vaccine response status (p=0.045). The non-response rate was significantly higher among male interns (16.5%) compared to female interns (6.2%). No significant association was found between vaccine response and age group (p=0.781) or time since the last vaccination dose (p=0.322).

Table I
Association of Demographic Characteristics with Vaccine Response Status (n=150)

Characteristic	Category	Responders (n=132)	Non-responders (n=18)	p-value
Gender	Male	71 (83.5%)	14 (16.5%)	0.045
	Female	61 (93.8%)	4 (6.2%)	
Age Group (Years)	24 - 25	89 (88.1%)	12 (11.9%)	0.781
	26 - 28	43 (87.8%)	6 (12.2%)	
Time since last dose	≤2 years	88 (89.8%)	10 (10.2%)	0.322
	> 2 years	44 (84.6%)	8 (15.4%)	

Discussion

This study provides a crucial snapshot of the immunity landscape against HBV among a high-risk group of young doctors in Bangladesh. The vaccination coverage of 79.5% is encouraging and reflects a positive trend towards awareness and uptake of HBV vaccination among medical graduates. This figure is higher than that reported in some older studies from similar settings but highlights that one in five interns is still starting their career without complete primary protection, which is a serious concern⁶.

The core finding of this study is that 12% of the vaccinated interns were non-responders. This aligns with the global non-response rate of 5-10% but sits at the higher end, which is concerning⁴. These individuals operate under the false assumption of being protected, which could lead to a lapse in vigilance towards universal precautions and a potentially devastating consequence if an exposure occurs.

The lack of a significant correlation between time since vaccination and antibody titer in this study can be attributed to the relatively short and variable duration since their last dose for most participants. Antibody titers are known to wane over time, and many studies show a significant decline in titers and seroprotection rates 5-10 years post-vaccination.⁷ The non-responders in this study are likely primary non-responders rather than those who have lost immunity over time.

The implications are clear: documenting a vaccine in a record is not sufficient. Post-vaccination serological testing (PVST) 1-3 months after the final dose is a non-negotiable standard of care for all HCWs. This is explicitly recommended by guidelines from the CDC and WHO.^{3,8} Identifying non-responders allows for a timely clinical intervention. These individuals should receive a second complete three-dose vaccine series. After this, anti-HBs titers should be rechecked. Those who still do not respond (true non-responders) must be counselled extensively on their heightened risk and the imperative need to strictly adhere to infection control protocols. They should also be instructed to seek immediate post-exposure prophylaxis (PEP) with Hepatitis B Immune Globulin (HBIG) and a vaccine dose if any exposure occurs.

The stratification of results into distinct titer groups provides a more nuanced understanding of the immune response within the cohort.

The most critical group is the non-responders (12%). As previously stated, these individuals are susceptible to infection. The finding that male interns were disproportionately represented in this group is

consistent with several international studies that have identified male gender as a risk factor for non-response to HBV vaccination.^{9,10} The biological mechanisms for this are not fully elucidated but are thought to be linked to hormonal differences, particularly the immunomodulatory effects of higher testosterone levels in males, which can suppress humoral immune responses.¹¹ This highlights a demographic that may require more intensive follow-up and monitoring.

The low responders (10-100 mIU/mL), constituting 27.3% of the sample, present a clinical dilemma. While they are currently considered protected, their antibody levels are close to the protective threshold and are more likely to wane below 10 mIU/mL more quickly than those with higher titers.⁷ This group may benefit from a single booster dose to elevate their titers to a more robust and durable level, a practice followed in some occupational health guidelines for healthcare workers.

The adequate (41.3%) and high responders (19.3%) represent a well-protected majority (60.6% combined). The high responders, in particular, are expected to maintain protective immunity for decades, likely conferring lifelong immunity due to strong immunological memory, even if their titers eventually fall below 10 mIU/mL.¹²

The lack of a significant association between the time since vaccination (d² years vs. >2 years) and the titer group is an interesting finding. It suggests that for the majority of respondents, the antibody levels had not yet undergone significant decay within this timeframe. The observed non-response is likely primary (failure to mount an initial response) rather than secondary (waning of immunity over time). This reinforces the necessity of conducting PVST 1-3 months after the primary series to identify primary non-responders early in their careers, rather than waiting for a decline that may happen years later.

The most significant finding from our demographic analysis is the clear and statistically significant association between male gender and non-response to the HBV vaccine. This result is consistent with a growing body of global literature that identifies male sex as a risk factor for inferior humoral immune responses to various vaccines, including hepatitis B.^{9,10}

The biological rationale for this disparity is often attributed to the immunomodulatory effects of sex hormones. Estrogen has been shown to potentiate antibody production by B cells, while testosterone tends to have immunosuppressive effects, potentially leading to a weaker antibody response in males.¹¹ This finding has profound implications for occupational health policy in Bangladesh. It suggests that male

intern doctors constitute a high-risk subgroup within an already high-risk profession. They are not only more likely to be non-responders but may also require more aggressive follow-up strategies. The lack of a significant association between age and vaccine response within our cohort (ages 24-28) is expected, as immunosenescence (the gradual deterioration of the immune system with age) is not a significant factor in this young and healthy population.

Similarly, the lack of association with the time since vaccination (d² years vs. >2 years) reinforces the concept that the non-response we detected is likely a primary vaccine failure (a failure to mount an initial immune response) rather than secondary vaccine failure (waning of immunity over time). This underscores the importance of conducting post-vaccination serological testing (PVST) 1-3 months after completing the primary series to identify these primary non-responders at the very beginning of their careers.

Our findings must be interpreted within the unique healthcare landscape of Bangladesh. The observed vaccination coverage of 79.5% is a positive indicator and reflects a significant improvement compared to earlier studies conducted in the country. A study by Haq et al. (2019) among HCWs in a tertiary hospital found a much lower complete vaccination rate of only 55.6%.⁶ Similarly, a study by Roy et al. (2017) among nurses reported a vaccination rate of 63.4%.¹³ This increasing trend is likely due to greater awareness and the inclusion of HBV vaccination in more recent medical school curricula. However, the persistence of a 20.5% unvaccinated or partially vaccinated group remains a serious concern, indicating that logistical, financial, or awareness barriers still exist.

The core finding of our study is 12% non-response rate, which is crucial for Bangladesh. While few Bangladeshi studies have specifically measured post-vaccination anti-HBs titers among doctors, our result is consistent with the global range but demands local action. A study by Saha et al. (2019) among medical students found a similar non-response rate of 10.8%.¹⁴ This consistency across two studies suggests that the non-response phenomenon is a real and reproducible issue in the Bangladeshi population, not an anomaly.

The gender disparity we identified (16.5% non-response in males vs. 6.2% in females) is a novel finding in the context of Bangladeshi literature on HCWs. Most previous local studies have focused on vaccination coverage or needlestick injuries without delving into demographic predictors of immune response. This finding suggests that occupational health programs in Bangladesh should consider gender as a potential risk factor when planning PVST and booster dose

strategies. Male interns might need more emphatic counseling regarding the importance of confirming their immune status.

The major challenge in implementing a nationwide PVST policy in Bangladesh is the cost and accessibility of quantitative anti-HBs testing. While large tertiary hospitals in major cities may have the facilities, it remains out of reach for many medical students and interns in smaller institutions or rural areas. Therefore, our recommendation for mandatory PVST must be coupled with advocacy for policy change and resource allocation by the Ministry of Health and Family Welfare to subsidize or incorporate this test into standard occupational health protocols for all incoming HCWs.

Conclusion

In conclusion, while a majority of intern doctors at the studied hospital are vaccinated against HBV, a gap in both coverage and seroconversion remains. The 12% non-response rate unveils a hidden vulnerable population within the healthcare system. Protecting our healthcare workers is not just an individual responsibility but a systemic imperative to ensure a resilient and safe healthcare workforce.

Limitations of the study

It was a single-center study. The study population was relative small. Long-term follow-up was not included.

Conflict of Interest:

The authors stated that there is no conflict of interest in this study

Funding:

This research received no external funding.

Ethical consideration

The study was approved by the Ethical Review Committee of Rangpur Medical College & Hospital, Rangpur, Bangladesh. Informed consent was obtained from each participant or the caregiver of the patient.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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