



Original Research Article

Burden of Hepatitis B Virus Infection and Vaccination Status Among Healthcare Personnel: A Tertiary Care Hospital–Based Study

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Abstract: **Background:** Healthcare personnel (HCP) are at an elevated risk for Hepatitis B Virus (HBV) infection due to occupational exposure. This study aims to assess the seroprevalence of HBV, vaccination status and adherence to universal safety precautions among HCP at a tertiary care hospital. **Methods:** A cross-sectional study was conducted on 167 healthcare workers (Doctors / MBBS Students / CRMI and Housekeeping staff). Serological markers (HBsAg, Anti-HBs, HBe, Anti-HBe, Anti-HBc IgM, Anti-HBc IgG) were analyzed using ELISA. Vaccination status and adherence to safety precautions were assessed via questionnaire. **Results:** The overall prevalence of HBsAg was 1.2% (2/167). While 89 participants (53.3%) showed protective immunity (Anti-HBs ≥ 10 mIU/ml), a significant disparity was observed in vaccination coverage. Among doctors/students, 53.5% were fully vaccinated, whereas 0% of housekeeping staff were fully vaccinated. A concerning 83.8% of participants reported recapping needles, a high-risk practice. **Conclusion:** While active infection rates are low, there is a critical gap in vaccination coverage among support staff. Occupational safety training is urgently needed to address the high rate of needle recapping.

Keywords: Hepatitis B, Health Personnel, Occupational Exposure, Hepatitis B Vaccines, Needlestick Injuries.

INTRODUCTION

Hepatitis B Virus (HBV) infection remains a formidable global public health challenge. According to the WHO Global Hepatitis Report 2024, an estimated 254 million people were living with chronic hepatitis B infection in 2022, resulting in approximately 1.1 million deaths, primarily from cirrhosis and hepatocellular carcinoma^[1]. The burden is disproportionately high in the Western Pacific and African regions, which account for nearly two-thirds of the global disease burden. India bears the second-highest burden of HBV globally, following China. Recent estimates suggest that approximately 29.8 million (2.9 crore) Indians are chronically infected^[1,2]. India is classified as an area of

intermediate HBV endemicity, with a general population prevalence ranging between 2% to 4%^[3]. Healthcare Personnel (HCP) represent a high-risk cohort within this landscape. Studies indicate that the prevalence of HBV among HCP in India can be 2 to 4 times higher than in the general population due to occupational exposure to blood and body fluids^[4]. Despite the availability of effective vaccines, Vaccine coverage among Indian HCP remains inconsistent, with studies reporting full immunization rates between 16% and 60% across different states^[5]. In Tamil Nadu, the seroprevalence of HBsAg has been reported to vary significantly between urban and rural populations. A large-scale community-based study by Kurien et al. (2018) in Tamil Nadu reported

an overall HBsAg prevalence of 1.63%, with a notably higher prevalence in rural areas (2.52%) compared to urban centers (1.47%)^[6]. Furthermore, specific high-risk pockets exist; for instance, a study among the Irula tribal population in the neighbouring Dharmapuri district reported a seroprevalence of 3.63%^[7]. In the specific context of Salem, limited data exists regarding occupational safety. However, a recent hospital-based study by Gayathri Devi et al. (2023) conducted at the Government Mohan Kumaramangalam Medical College Hospital in Salem reported an HBsAg seroprevalence of 2.0% among antenatal mothers^[8]. This local prevalence, mirroring the national intermediate endemicity, underscores the persistent risk of horizontal and vertical transmission within the district's healthcare facilities.

While general prevalence data for Tamil Nadu exists, there is a paucity of recent literature specifically addressing the *occupational safety gap* among healthcare workers in Salem's tertiary care sector. Salem serves as a critical healthcare hub for central Tamil Nadu, receiving a high volume of referrals from surrounding rural districts where HBV prevalence is historically higher^[6]. Furthermore, previous studies in the region have largely focused on patients (e.g., antenatal mothers or tribal groups) rather than the healthcare workforce. Therefore, the primary aim of this study was to estimate the serological burden of Hepatitis B Virus (HBV) infection, assess the immunological protection levels and evaluate the compliance with Standard Universal Safety Precautions among healthcare personnel in a tertiary care hospital in Salem, Tamil Nadu.

Methodology

Study Design and Setting

This was a hospital-based cross-sectional study conducted at the Department of Microbiology in a tertiary care teaching hospital located in Salem, Tamil Nadu. The institution serves as a major referral centre for the district, catering to a diverse patient population from both urban and rural backgrounds. The study was carried out over a period of six months from April 2024 to October 2025.

Study Population

The study population comprised healthcare personnel (HCP) who are at varying degrees of risk for occupational exposure to blood and body fluids. The participants were stratified into two distinct occupational cohorts:

1. Clinical Group: Doctors, undergraduate medical students (MBBS) and Compulsory Rotatory Medical Interns (CRMI).

2. Support Group: Housekeeping and sanitary staff involved in waste management and ward cleaning.

Eligibility Criteria

- **Inclusion Criteria:** All healthcare personnel (doctors, students, interns and housekeeping staff) working in the institution for a minimum period of six months irrespective of their age, gender and vaccination who provided written informed consent were included in the study.
- **Exclusion Criteria:** Personnel with a known history of chronic liver disease unrelated to Hepatitis B, those on immunosuppressive therapy and staff who refused to consent were excluded from the study.

Sample Size Calculation

The sample size was calculated based on the prevalence of Hepatitis B infection among healthcare workers reported in a previous study by Sukriti et al. (2018), which observed a prevalence of approximately 10% in a similar tertiary care setting^[5]. Using the formula for sample size estimation for a single proportion:

$$n \geq Z^2 \cdot p(1 - p) / d^2$$

Where:

- $Z = 1.96$ (Standard normal variate at 95% confidence interval)
- $p = 0.10$ (Prevalence of 10%)
- $d = 0.05$ (Absolute error of margin / precision)
- $n = 1.96 \times 1.96 \times 0.10(1-0.10) / 0.05 \times 0.05 = 138$

To account for potential non-response or data attrition, the sample size was increased by 20% and a total of 167 participants were recruited for the study.

Sampling Technique

A stratified random sampling technique was employed. The workforce was first stratified by designation (Doctors/Students vs. Housekeeping) and participants were randomly selected from the employee roster within each stratum to ensure representation from different wards and departments (e.g., Surgery, Medicine, ICU, Casualty).

Data Collection

Data collection was a two-step process:

1. Questionnaire: A pre-tested, structured questionnaire was provided to collect demographic details, vaccination history (fully, partially, or non-vaccinated), history of needle stick injuries (NSI) and Knowledge, Attitude and Practice (KAP) regarding Standard Universal Precautions.

Questions specifically targeted high-risk behaviors such as needle recapping and glove usage.

2. Sample Collection: Under strict aseptic conditions, 3–5 ml of venous blood was collected from each participant in a vacutainer. The blood was allowed to clot at room temperature, centrifuged at 3000 rpm for 10 minutes and the serum was separated. Aliquots were stored at -20°C until further analysis.

Operational Definitions

- Fully Vaccinated: Participants who had received all three standard doses of the Hepatitis B vaccine (0, 1 and 6 months).
- Partially Vaccinated: Participants who had received one or two doses but did not complete the schedule.
- Unprotected: Individuals with anti-HBs titres < 10 mIU/ml.
- Protected: Individuals with anti-HBs titres ≥ 10 mIU/ml.
- Standard Universal Precautions: defined as per the CDC guidelines, including hand hygiene, use of PPE (gloves, gowns) and safe disposal of sharps.

Laboratory Analysis

Serological markers were analyzed using commercial Enzyme-Linked Immunosorbent Assay (ELISA) kits (DIAPRO KIT) following the manufacturer's instructions. The following markers were tested:

- HBsAg (Hepatitis B surface Antigen): To detect active infection.
- Anti-HBs (Antibody to HBsAg): Quantitative estimation to determine immunity. Titres were measured in mIU/ml.

- Anti-HBe (Antibody to HBeAg): To assess viral replication and infectivity phases.
- Total Anti-HBc (Antibody to HBcAg): To detect past or current infection.

Quality Assurance

Strict quality control measures were implemented. Internal positive and negative controls provided with the ELISA kits were run with every batch of samples to validate the results. All borderline results were retested in duplicate. The laboratory equipment was calibrated regularly according to standard operating procedures (SOPs).

Data Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 29.0. Categorical variables (e.g., vaccination status, occupation) were expressed as frequencies and percentages. Continuous variables (e.g., antibody titres) were expressed as means and standard deviations. The Chi-square test was used to compare categorical variables between groups (e.g., vaccination rates between doctors and housekeeping staff). A p-value of < 0.05 was considered statistically significant.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee (IEC) of Vinayaka Mission's Kirupananda Variyar Medical College and Hospitals in Salem. Written informed consent was obtained from all participants after explaining the purpose of the study in their vernacular language (Tamil or English). Confidentiality of the participants' medical data was strictly maintained throughout the study.

Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

RESULTS

The study included a total of 167 healthcare personnel (HCP) working at a tertiary care hospital in Salem. The participants were categorized into two primary occupational groups (**Figure 1**): 114 (68.3%) were clinical staff (Doctors, MBBS students and CRMIs) and 53 (31.7%) were support staff (Housekeeping).

The serological analysis of the 167 samples indicated a low prevalence of active Hepatitis B infection within the study cohort. Specifically, HBsAg positivity was detected in only 2 cases (1.2%). Regarding infectivity and past exposure markers, both seropositive cases tested negative for Anti-HBe and total anti-HBc, suggesting that HBsAg positivity could be due to the recent vaccination uptake. In terms of overall immunity, 89 cases (53.3%) tested positive for Anti-HBs antibodies, reflecting some degree of immune response, whether vaccine-induced or natural.

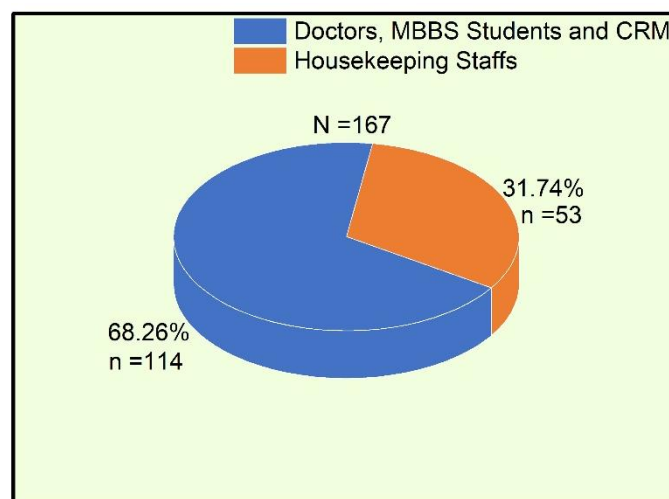


Figure 1: Designation of healthcare workers (N = 167).

A significant disparity in vaccination coverage was observed between the occupational groups, as detailed in **Table 1**. While 61 (36.5%) of the total participants were fully vaccinated, this coverage was heavily skewed towards the clinical staff. A Chi-square test performed to compare "Fully Vaccinated" versus "Incomplete Vaccination" (Partial + None) status confirmed that this occupational disparity is highly statistically significant ($\chi^2 = 44.68$, $p < 0.0001$). The data highlight a critical gap: 0% of the housekeeping staff were fully vaccinated, despite a vast majority (94.3%) having initiated the vaccine schedule. In stark contrast, 53.5% of doctors and students had completed the full course of vaccination.

Table 1: Hepatitis B Vaccination Status Among Healthcare Personnel (n=167)

Vaccination Status	Total Participants (n=167)	Clinical Staff (Doctors/Students) (n=114)	Support Staff (Housekeeping) (n=53)
Fully Vaccinated	61 (36.5%)	61 (53.5%)	0 (0.0%)
Partially Vaccinated	101 (60.5%)	51 (44.7%)	50 (94.3%)
Not Vaccinated	5 (3.0%)	2 (1.8%)	3 (5.7%)

Protective immunity was defined as an Anti-HBs titre ≥ 10 mIU/ml. The quantitative analysis of antibody titres mirrored the vaccination trends observed above as shown in

Table 2 and **Figure 2**. While 61.4% of the clinical group demonstrated protective titres, only 35.8% of the housekeeping staff were protected. This leaves a significant majority of the support workforce vulnerable to infection.

Table 2: Immunological Protection Levels by Occupation (n=167)

Occupation	Unprotected (<10 mIU/ml)	Protected (≥ 10 mIU/ml)	χ^2	p-Value	Odds Ratio
Doctors, Students & CRMI	44	70	9.51	0.02	2.85 (95% CI: 1.45-5.58)
Housekeeping Staff	34	19			
Total	78	89			

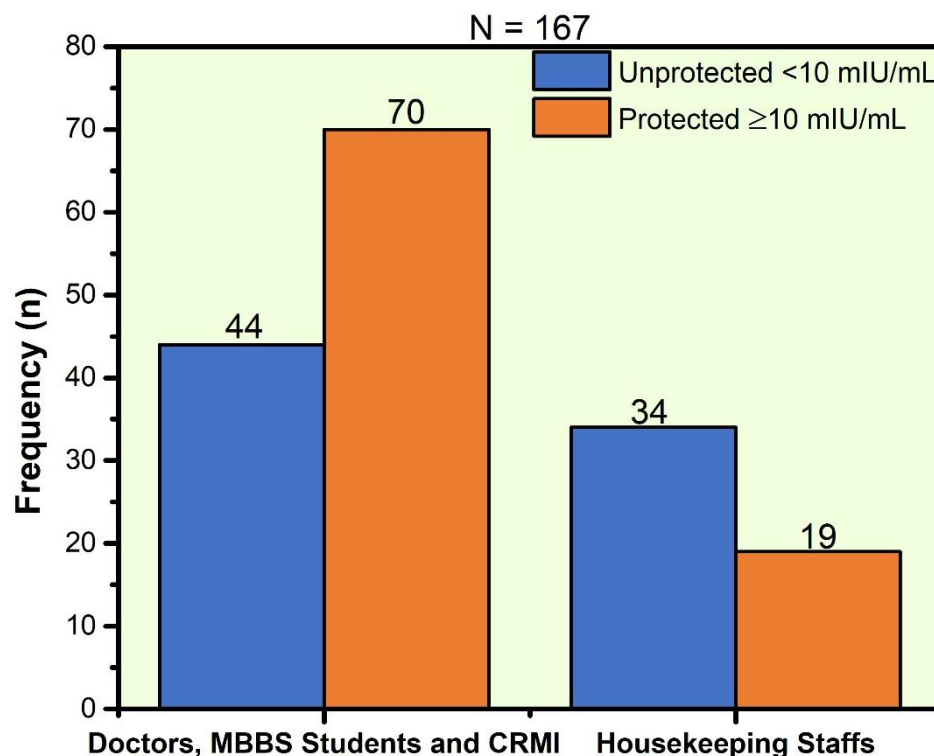


Figure 2: Anti-HBs titers of the healthcare workers (N =167)

The prevalence of occupational exposure was assessed through self-reported history of needle stick injuries. A total of 32 participants (19.2%) reported sustaining at least one needle stick injury during their tenure, while the remaining 135 participants (80.8%) reported no such incidents. Participants' adherence to safety protocols showed high compliance in general hygiene but exposed critical gaps in sharps handling practices, as summarized in **Table 3**.

Table 3 : Compliance with Standard Universal Safety Precautions (n=167)

Standard Universal Precaution	Yes (n)	No (n)	Compliance Rate (%)
Hand Hygiene & Personal Protective Equipment (PPE)			
Cleaning hands properly after each procedure	158	9	94.6%
Wearing ward coats	155	12	92.8%
Wearing gloves before taking blood/body fluids	110	4	96.5%
Changing gloves between patients	147	20	88.0%
Sharps & Waste Management			
Disposal of sharp objects	151	16	90.4%
Safe management of clinical waste	148	19	88.6%
Recapping the needle	140	27	16.2% *
Environmental Control			
Disinfecting reusable equipment	145	22	86.8%
Ensuring adequate procedures for routine cleaning	148	19	88.6%

**Note: For "Recapping the needle," a "No" response indicates compliance with safety standards. Therefore, only 16.2% (27 participants) followed the safe practice of NOT recapping, while 83.8% (140 participants) engaged in the high-risk practice of recapping.*

DISCUSSION

The results highlight a dual burden, a gap in biological protection (vaccination) among housekeeping staff and a gap in behavioral safety (needle recapping) across the entire cohort. While general hygiene compliance (hand washing, glove use) is excellent, the specific practice of recapping needles remains a pervasive risk factor. The present study observed an overall HBsAg seropositivity of

1.2% (2/167) among healthcare personnel. The 2 HBsAg cases, along with the negative results for anti-HBe and total anti-HBc, indicate a recent vaccination history for the participants. Indeed, there is a possibility to acquire transiently HBsAg positivity within four weeks of Hepatitis B vaccination [9–11]. This finding aligns with the classification of India as a country of intermediate to low endemicity for occupational HBV transmission.

Our results are consistent with a similar tertiary care study by Sukriti et al. (2018) in New Delhi, which reported a prevalence of 1.1% among healthcare workers[5]. However, it is lower than the general population prevalence reported in Tamil Nadu (2.07%) by George et al., suggesting that while occupational exposure exists, the baseline infection rate in this specific hospital cohort is not disproportionately elevated compared to the community[12].

The most striking finding of this study is the statistically significant disparity in vaccination coverage between clinical and support staff. While 53.5% of doctors and students were fully vaccinated, 0% of the housekeeping staff had completed the full three-dose schedule. This finding mirrors the "inverse care law" observed in other Indian studies. For instance, Chaudhari et.al reported that while 57.7% of medical officers were vaccine-compliant[13] and another study by Batra et al showed that 0% of housekeeping personnel were fully vaccinated[14]. The 0% full coverage in our study is particularly alarming because housekeeping staff are often the first responders to hazardous waste spills and are frequently exposed to discarded sharps. The high rate of "partial vaccination" (94.3%) in this group suggests that, although vaccination drives have been initiated, a system should be established to ensure follow-up for the second and third doses.

Ideally, healthcare workers should maintain Anti-HBs titres ≥ 10 mIU/ml. In our study, only 53.3% of the total workforce was protected. This is significantly lower than findings from a tertiary care center in Chennai by Konda V et al., where 93.0% of healthcare workers demonstrated protective immunity[15]. The lower protection rate in our study (35.8% among housekeeping staff) correlates directly with the poor vaccination compliance rates, but it may also point to waning immunity in HCP who were vaccinated more than 10 years who have not received booster doses.

While adherence to general hygiene (hand washing, glove use) was high (>90%), the study revealed a dangerous behavioural gap, as 83.8% of participants reported recapping needles. A study by Annadurai et al. in India reported recapping practices in 30.5% of HCWs[16], while Askarian et al. reported rates of approx. 40%[17]. The 83.8% rate in Salem indicates a critical lack of awareness regarding the "Do Not Recap" policy, likely contributing to the 19.2% needle stick injury (NSI) prevalence observed in our cohort. This NSI rate is comparable to the 21.1% reported in a study by Jaybhaye et al., in a tertiary care hospital in 2014[18].

Limitations

The study relies on self-reported vaccination history

which may be subject to recall bias. Additionally, the sample size (n=167), while statistically valid for a single-center study, limits the ability to generalize findings to the entire state of Tamil Nadu.

Conclusion

The present study highlights a critical dichotomy in the occupational health landscape of tertiary care in Salem. While the overall serological burden of active Hepatitis B infection remains low (0%) and compliance with general hygiene measures like hand washing is commendable, the findings expose deep-seated systemic vulnerabilities. The most alarming observation is the stark "immunization gap" between occupational groups; while clinical staff possess moderate levels of protection, there is a complete absence of full vaccination coverage (0%) among housekeeping staff, leaving this essential workforce defenseless against potential infection. Furthermore, the study reveals a dangerous safety paradox where staff are diligent about hygiene yet engage in the high-risk practice of needle recapping at an alarming rate of 83.8%. Ultimately, the risk to healthcare personnel in this setting stems not from high viral endemicity but from preventable gaps in vaccine coverage and specific behavioral failures regarding sharps management.

Recommendations

To mitigate these risks, hospital administration must immediately prioritize a targeted "catch-up" vaccination campaign specifically for housekeeping and sanitation staff, making full immunization a mandatory condition of their employment to rectify the current inequity. Concurrent with this, educational interventions must move beyond general safety to focus specifically on "Sharps Management," aiming to eradicate the persistent habit of needle recapping through rigorous training and visual reminders. It is also recommended that occupational health policy shifts from relying on vaccination history to evidence-based monitoring; a biennial serological audit should be implemented to identify the significant portion of the workforce with waning immunity (titres < 10 mIU/ml) and administer booster doses accordingly. Finally, a robust, accessible and non-punitive system for reporting needle stick injuries must be reinforced to ensure that post-exposure prophylaxis is administered without delay.

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