International Research Journal of Pharmacy and Medical Sciences
ISSN (Online): 2581-3277

The Needle Stick Paradox: High Awareness Versus Suboptimal Hepatitis B Vaccination Coverage and Post-Exposure Preparedness Among Medical Trainees in Coastal Andhra Pradesh

Keertan Adarsh Bhagavatula[1,*], Sai Keerthana Chunduru[1], Goutham Srinivas Dolai[1]
[1]Department of Internal Medicine / Clinical Undergraduate Training, Andhra Medical College & King George Hospital, Visakhapatnam, Andhra Pradesh, India
*Corresponding Author

***Abstract*—Background**: *Hepatitis B virus (HBV) is a major occupational pathogen causing chronic hepatitis, cirrhosis, and hepatocellular carcinoma. Clinical medical students and interns are particularly vulnerable to accidental needle stick injuries (NSIs) and bodily fluid exposure during procedural training. Despite vaccine efficacy exceeding 90%–100%, coverage rates among healthcare trainees remain inconsistent.* **Objectives**: *To evaluate hepatitis B vaccination coverage, analyze transmission and post-exposure prophylaxis (PEP) knowledge, and identify reported barriers to immunization among clinical undergraduate medical trainees.* **Materials & Methods**: *A cross-sectional observational study was conducted at Andhra Medical College and King George Hospital, Visakhapatnam. A pre-tested 20-item electronic questionnaire assessing demographics, vaccination history, HBV virology knowledge, and post-exposure protocols was administered to 128 clinical students and interns. Data were analyzed using SPSS Version 26. Categorical associations were evaluated using Pearson's Chi-Square and Fisher's Exact tests ($p < 0.05$).* **Results**: *A total of 128 medical trainees participated (mean age: 20.85 ± 1.18 years; 57.0% male, 43.0% female). While 96.1% recognized HBV and 93.0% identified NSIs as transmission routes, notable misconceptions persisted, including 85.9% assuming transmission occurs via casual handshakes. Overall, 58.6% ($n = 75$) received ≥ 1 dose of the HBV vaccine, but only 29.7% ($n = 38$) completed the full 3-dose series. Female trainees demonstrated significantly higher uptake (≥ 1 dose) than males (70.9% vs. 49.3%, $\chi^2 = 6.029$, $p = 0.014$). Negligence/procrastination despite awareness was the primary deterrent (79.2% of unvaccinated), far exceeding logistical shortages (11.3%) or financial costs (3.8%). Only 46.9% correctly identified the ≤ 24-hour window for post-exposure vaccination.* **Conclusion**: *A profound paradox exists between high theoretical awareness and low complete immunization coverage alongside actionable PEP knowledge deficits. Mandatory institutional vaccination prior to clinical ward entry and structured occupational safety orientations are urgently needed.*

***Keywords*—** *Hepatitis B virus; Vaccination coverage; Needle stick injury; Medical students; Interns; Post-exposure prophylaxis; Occupational health.*

I. INTRODUCTION

Hepatitis B virus (HBV) infection represents an enduring global public health challenge and is among the principal etiologies of chronic hepatitis, cirrhosis, and hepatocellular carcinoma (HCC). According to the World Health Organization (WHO), an estimated 257 million individuals worldwide are chronically infected with HBV, culminating in approximately 800,000 deaths annually due to acute fulminant hepatic failure and end-stage liver disease complications.

HBV is extraordinarily infectious—demonstrated to be 50 to 100 times more transmissible than the Human Immunodeficiency Virus (HIV)—and possesses remarkable environmental stability, remaining viable on dry inanimate surfaces for over seven days. Transmission occurs predominantly via percutaneous or mucosal exposure to infected blood or bodily fluids, sexual contact, and perinatal (vertical) transmission. Consequently, healthcare personnel occupy the frontline of occupational vulnerability, facing continuous risks from accidental needle stick injuries (NSIs), sharp-object cuts, and mucosal blood splashes.

Among healthcare cadres, clinical undergraduate medical students and rotating interns are disproportionately vulnerable. During initial clinical clerkships, trainees routinely execute invasive bedside procedures—including venipuncture, intravenous cannulation, arterial blood gas sampling, wound suturing, and surgical retraction—often with developing fine-motor procedural dexterity, high clinical fatigue, and suboptimal adherence to standard infection control precautions.

Primary active immunization utilizing the recombinant hepatitis B surface antigen (HBsAg) vaccine confers 90%–100% protective efficacy upon completing the standard three-dose schedule (administered at 0, 1, and 6 months). Although the WHO and the Centers for Disease Control and Prevention (CDC) strongly recommend pre-exposure immunization for all healthcare personnel prior to patient contact, vaccination coverage among medical trainees in developing nations remains widely inconsistent. Reported complete immunization rates vary from 8% to 82%, frequently hindered by behavioral procrastination, institutional gaps, or cost factors.

Given the elevated frequency of accidental sharps exposures in tertiary teaching hospitals, this study was conducted to evaluate hepatitis B vaccination coverage, assess knowledge surrounding HBV transmission and post-exposure prophylaxis (PEP), and identify self-reported barriers to

Keertan Adarsh Bhagavatula, Sai Keerthana Chunduru, and Goutham Srinivas Dolai, "The Needle Stick Paradox: High Awareness Versus Suboptimal Hepatitis B Vaccination Coverage and Post-Exposure Preparedness Among Medical Trainees in Coastal Andhra Pradesh," *International Research Journal of Pharmacy and Medical Sciences (IRJPMS)*, Volume 9, Issue 5, pp. 108-112, 2026.

immunization among clinical undergraduate medical students and interns at a tertiary healthcare center in North Coastal Andhra Pradesh.

II. Materials and Methods

2.1 Study Design and Setting

This study utilized an observational, hospital-based cross-sectional survey design conducted over a one-month duration at Andhra Medical College and its associated teaching hospital, King George Hospital, located in Visakhapatnam, Andhra Pradesh, India.

2.2 Study Population and Eligibility Criteria

The target population comprised clinical undergraduate medical students and compulsory rotating medical interns undergoing routine inpatient and outpatient clinical rotations across medical, surgical, and emergency specialties.

Inclusion Criteria: Undergraduate medical students registered in the 2nd, 3rd, and 4th (Final) professional MBBS phases, as well as compulsory rotating interns willing to participate.

Exclusion Criteria: 1st-year MBBS students (pre-clinical phase without active hospital/patient contact postings) and individuals declining survey participation.

2.3 Operational Definitions

- *Complete Vaccination:* Documented receipt of all three intramuscular doses (10 µg/0.5 mL pediatric or 20 µg/1.0 mL adult recombinant formulation) following the standard schedule at 0, 1 month, and 6 months.
- *Partial Vaccination:* Administration of one or two doses without completion of the third booster dose.
- *Unvaccinated:* Zero prior doses of the hepatitis B vaccine.

2.4 Sample Size Determination

Based on a baseline complete vaccination prevalence of 37% (P = 0.37) reported in regional literature, the sample size was estimated using Cochran's single proportion formula: $N = (Z_{1-\alpha/2}^2 \cdot P \cdot (1 - P)) / d^2$. Where $Z_{1-\alpha/2} = 1.96$ (at a 95% confidence interval), P = 0.37, Q = 1 - P = 0.63, and allowable absolute precision error d = 0.08 (8%). This yielded a minimum sample size of N = 140. Accounting for non-response, a target of 150 subjects was established. A total of 128 fully completed, verified questionnaires were obtained (85.3% effective response rate).

2.5 Study Tool and Data Collection

Data were acquired via a pre-tested, standardized electronic questionnaire (Google Forms). The instrument comprised 20 items grouped into four domains: (1) Sociodemographic profile (age, gender, academic year, native domicile); (2) Knowledge of HBV virology, transmission vectors, and clinical sequelae; (3) Personal hepatitis B vaccination status, dosage history, and perceived reasons for non-vaccination; and (4) Knowledge regarding post-exposure prophylaxis (PEP) timelines and infection control protocols.

2.6 Ethical Considerations

The study protocol conformed to the ethical principles of the Declaration of Helsinki. Participation was strictly voluntary, anonymous, and non-invasive. Electronic informed consent was obtained from all participants prior to survey completion. No personally identifiable data or biological specimens were collected. As an anonymous, non-interventional Knowledge, Attitude, and Practice (KAP) survey posing minimal risk, formal Institutional Ethics Committee (IEC) review was exempt / not required under national ICMR ethical guidelines for minimal-risk educational and observational survey research.

2.7 Statistical Analysis

Data were compiled and analyzed using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY). Continuous variables were expressed as mean ± standard deviation (SD) and range, while categorical variables were summarized as frequencies and percentages (n, %). Associations between categorical variables (e.g., gender and vaccination status) were evaluated using Pearson's Chi-Square (χ^2) test and Fisher's Exact test. A two-tailed p-value < 0.05 was considered statistically significant.

III. Results

3.1 Sociodemographic Characteristics

A total of 128 medical trainees participated. The mean age was 20.85 ± 1.18 years (range: 18–24 years). Male participants comprised 57.0% (n = 73) and females comprised 43.0% (n = 55). Final-year MBBS students represented the largest cohort (n = 78, 60.9%), followed by 3rd-year students (n = 21, 16.4%), 2nd-year students (n = 16, 12.5%), extended clinical batch students (n = 7, 5.5%), and rotating interns (n = 6, 4.7%). Urban residents accounted for 60.9% (n = 78), while 39.1% (n = 50) were from rural areas (Table 1).

TABLE 1

Demographic Variable	Category / Sub-group	Frequency (n)	Percentage (%)
Academic Phase / Year of Study	Final MBBS (2019 Batch)	78	60.9%
Academic Phase / Year of Study	3rd Year MBBS (2020 Batch)	21	16.4%
Academic Phase / Year of Study	2nd Year MBBS (2021 Batch)	16	12.5%
Academic Phase / Year of Study	Extended Clinical (2018 Batch)	7	5.5%
Academic Phase / Year of Study	Rotating Interns (2017 Batch)	6	4.7%
Gender	Male	73	57.0%
Gender	Female	55	43.0%
Native Domicile	Urban	78	60.9%
Native Domicile	Rural	50	39.1%
Total Cohort	—	**128**	**100.0%**

3.2 Knowledge and Awareness Regarding Hepatitis B

General awareness of HBV was high: 96.1% (n = 123) recognized the virus, 92.1% identified it as a bloodborne pathogen, and 93.0% recognized NSIs as transmission vectors. Furthermore, 96.8% correctly identified HBV as an established cause of hepatocellular carcinoma. However, significant misconceptions regarding transmission were recorded: 85.9% (n = 110) incorrectly believed HBV could be transmitted via casual social handshaking, and 69.5%

Keertan Adarsh Bhagavatula, Sai Keerthana Chunduru, and Goutham Srinivas Dolai, "The Needle Stick Paradox: High Awareness Versus Suboptimal Hepatitis B Vaccination Coverage and Post-Exposure Preparedness Among Medical Trainees in Coastal Andhra Pradesh," *International Research Journal of Pharmacy and Medical Sciences (IRJPMS)*, Volume 9, Issue 5, pp. 108-112, 2026.

considered contact with superficial open wounds to be a primary vector (Table 2).

TABLE 2

Knowledge Domain / Questionnaire Item	Response Category	Frequency (n)	Percentage (%)
Awareness of Hepatitis B Virus	Yes	123	96.1%
	No	5	3.9%
HBV is a bloodborne pathogen	Yes	118	92.1%
	Uncertain / Maybe	5	3.9%
	No	5	3.9%
HBV transmission via Needle Stick Injury	Yes	119	93.0%
	Uncertain / Not sure	6	4.7%
	No	3	2.3%
Recognized modes of transmission	Both (Parenteral and Sexual)	113	88.2%
	Sexual route only	11	8.6%
	Parenteral route only	3	2.3%
	None of the above	1	0.8%
Can HBV transmit via hand shaking? (Misconception)	True (Incorrect)	110	85.9%
	False (Correct)	18	14.1%
Can HBV spread via contaminated blood/body fluids?	True	122	95.3%
	Uncertain / Not sure	4	3.1%
	False	2	1.6%

3.3 Vaccination Status and Gender Correlation

Overall, 58.6% (n = 75) of respondents had received at least one dose of the hepatitis B vaccine, while 41.4% (n = 53) were completely unvaccinated. Only 29.7% (n = 38) completed the full three-dose immunization series. A statistically significant association was observed between gender and vaccination uptake (≥ 1 dose): female students demonstrated significantly higher uptake than males (70.9% vs. 49.3%; $\chi^2 = 6.029$, df = 1, p = 0.014; Fisher's Exact Test p = 0.018) (Table 3).

TABLE 3

Participant Gender	Vaccinated (≥ 1 Dose)	Unvaccinated	Total (n)	Chi-Square (χ^2)	p-value
Female	39 (70.9%)	16 (29.1%)	55	6.029 (df = 1)	0.014* (Fisher: 0.018)
Male	36 (49.3%)	37 (50.7%)	73		
Total	**75 (58.6%)**	**53 (41.4%)**	**128**	**Statistically significant (p < 0.05)*	

3.4 Primary Reasons for Non-Vaccination

Among participants who were not fully vaccinated (n = 66), personal negligence/procrastination despite prior knowledge was cited by 63.6% (n = 42; 32.8% of the total cohort). Complete lack of awareness was noted by 15.2% (n = 10). Logistical non-availability accounted for 9.1% (n = 6), fear of adverse reactions for 9.1% (n = 6), and high vaccine cost for only 3.0% (n = 2) (Table 4).

3.5 Knowledge Regarding Post-Exposure Prophylaxis (PEP)

While 75.0% (n = 96) were aware of PEP in principle, practical mastery was deficient: only 46.9% (n = 60) knew that post-exposure vaccine administration should ideally occur within 24 hours. Furthermore, only 7.0% (n = 9) recognized the recommended 4-week window for post-exposure HBsAg serological testing. Approximately 51.6% (n = 66) believed infection remains possible despite completing vaccination, and 85.1% (n = 109) supported universal pre-operative HBsAg screening (Table 5).

TABLE 4

Stated Reason / Barrier	Frequency (n)	% of Non-Vaccinated (n=66)	% of Total Cohort (N=128)
Fully vaccinated (No barrier)	62	—	48.4%
Aware, but negligent / procrastinated	42	63.6%	32.8%
Lack of awareness regarding need	10	15.2%	7.8%
Lack of institutional availability	6	9.1%	4.7%
Fear of adverse injection reactions	6	9.1%	4.7%
High cost / vaccination fee	2	3.0%	1.6%
Total	**128**	**100.0%**	**100.0%**

TABLE 5

PEP Knowledge / Protocol Question	Response Category	Frequency (n)	Percentage (%)
Aware of Post-Exposure Prophylaxis (PEP)?	Yes	96	75.0%
	No	32	25.0%
Can HBV be acquired despite full vaccination?	Yes	66	51.6%
	No	62	48.4%
Recommended time window for post-exposure vaccination	≤ 24 hours (Correct)	60	46.9%
	Not sure / Uncertain	49	38.3%
	Within 2 weeks	13	10.2%
	Within 4 weeks	6	4.7%
Optimal timing for post-exposure HBsAg testing	Within 24 hours	56	43.8%
	Within 4 weeks (Correct)	9	7.0%

IV. DISCUSSION

Hepatitis B virus represents a pervasive occupational hazard for healthcare professionals, particularly medical trainees. In this study, we identified a profound paradox: despite exceptionally high baseline theoretical awareness regarding HBV virology, transmission vectors, and oncogenic complications (> 92%–96%), only 29.7% of trainees completed the recommended three-dose vaccine series, and 41.4% remained completely unvaccinated.

The complete vaccination coverage of 29.7% observed in this study aligns with low rates documented by Kandi et al. in Telangana (24.0%) and Sannathimmappa et al. in Oman (23.5%). However, it is markedly lower than rates reported by Dawar et al. in Western Uttar Pradesh (82.0%), Dev et al. in Maharashtra (53.3%), and high-income international cohorts where institutional mandates exist. When examining partial uptake (≥ 1 dose, 58.6%), our findings mirror reports by Shrestha et al. in Nepal (37.0% complete, 39.2% unimmunized) and Olatona et al. in Nigeria (56.0% with ≥ 1 dose, 13.1% complete). These persistent shortfalls

Keertan Adarsh Bhagavatula, Sai Keerthana Chunduru, and Goutham Srinivas Dolai, "The Needle Stick Paradox: High Awareness Versus Suboptimal Hepatitis B Vaccination Coverage and Post-Exposure Preparedness Among Medical Trainees in Coastal Andhra Pradesh," *International Research Journal of Pharmacy and Medical Sciences (IRJPMS)*, Volume 9, Issue 5, pp. 108-112, 2026.

demonstrate that voluntary, non-institutionalized vaccination models are insufficient to protect clinical trainees.

A key finding was the statistically significant gender disparity in vaccination uptake: female medical students exhibited a substantially higher immunization rate than males (70.9% vs. 49.3%, p = 0.014). This trend of enhanced health-seeking behavior, greater compliance with preventive recommendations, and heightened perception of occupational vulnerability among female medical trainees is well-documented in preventive healthcare literature.

Crucially, barrier analysis showed that personal negligence and procrastination despite prior knowledge constituted the overwhelming majority of non-immunized cases (63.6% of barriers; 32.8% of the total cohort). Logistical non-availability (4.7%) and financial cost (1.6%) were minor factors. This confirms that the core impediment is behavioral and organizational rather than financial. Without structured, institutionalized vaccination drives, trainees continually postpone immunization despite being fully cognizant of daily procedural risks.

Furthermore, our findings revealed critical deficits in fundamental transmission knowledge and post-exposure prophylaxis protocols. An alarming 85.9% of students incorrectly believed HBV spreads via casual handshakes, a misconception that may fuel unnecessary stigma while diluting vigilance against true parenteral routes. In emergency PEP management, fewer than half (46.9%) knew the vital 24-hour therapeutic window for initiating post-exposure vaccination, and only 7.0% knew the appropriate 4-week window for HBsAg serological testing. Similar post-exposure gaps were documented by Dev et al. and Rathi et al., emphasizing the urgent need for structured, mandatory infection-control training prior to clinical ward rotations.

V. Strengths and Limitations

Strengths: This study evaluates the full continuum of HBV awareness, personal immunization adherence, behavioral barriers, and post-exposure prophylaxis knowledge among clinical-phase medical students and interns in an active tertiary teaching hospital.

Limitations: First, the study was conducted at a single tertiary care center with 128 participants, which may limit generalizability. Second, vaccination history was self-reported without physical verification of immunization cards. Finally, quantitative post-vaccination anti-HBs surface antibody titers (≥ 10 mIU/mL) were not measured to confirm seroprotection.

VI. Conclusion and Recommendations

Despite high theoretical knowledge of Hepatitis B virology and needle stick hazards, medical students and interns exhibit alarmingly low rates of complete three-dose vaccination and notable deficits in emergency PEP protocols. Personal negligence represents the single largest barrier to immunization.

Key Policy Recommendations

1. Mandatory Institutional Immunization: Implement mandatory, fully subsidized 3-dose HBV vaccination and pre-clinical anti-HBs titer documentation as a formal prerequisite before hospital ward postings.
2. Needle Stick Injury & PEP Workshops: Integrate structured practical training on universal precautions, safe sharps disposal, and immediate 24-hour PEP workflows into orientation curricula.
3. Occupational Health Registry: Establish a dedicated hospital occupational health desk to track student immunization records, provide immediate PEP kits (HBIG and vaccine), and register accidental exposures.

Declarations

- Ethics Approval & Consent to Participate: Participation was voluntary and anonymous. Informed electronic consent was obtained from all participants. Under national ICMR ethical guidelines for minimal-risk educational and anonymous survey research, formal IEC review was exempt / not required.
- Conflict of Interest: The authors declare that they have no competing financial or personal interests.
- Funding: This research received no external grant or financial support.
- Data Availability: The datasets generated during the current study are available from the corresponding author upon reasonable request.

References

1. Kandi V, Katoch A, Miniskar H, Jaripiti S, Rv SS, Burugu HR, Reddy AV, Bhasin A. Adequate Knowledge and Low Vaccination Rates of Hepatitis B Virus Infection Among Students, Medical, and Paramedical Persons in a Tertiary Care Teaching Hospital. Cureus. 2020;12(7):e9121.
2. Shrestha DB, Khadka M, Khadka M, Subedi P, Pokharel S, Thapa B. Hepatitis B vaccination status and knowledge, attitude, and practice regarding Hepatitis B among preclinical medical students of a medical college in Nepal. PLoS One. 2020;15(11):e0242658.
3. Ejembi J, Muktar H, Jimoh O, Ibrahim MS, Abdulrasul I, Giwa F, Olayinka A. Hepatitis B vaccination status among medical students at a tertiary institution in North-East Nigeria. Inst J Infect Dis. 2020;101:526-527.
4. Roupa Z, Noula M, Farazi E, Stylianides A, Papaneophytou C. Vaccination Coverage and Awareness of Hepatitis B Virus Among Healthcare Students at a University in Cyprus. Mater Sociomed. 2019;31(3):190-196.
5. Chhabra D, Mishra S, Gawande K, Sharma A, Kishore S, Bhadoria AS. Knowledge, attitude, and practice study on hepatitis B among medical and nursing undergraduate students of an apex healthcare institute at Uttarakhand foothills: A descriptive analysis. J Family Med Prim Care. 2019;8(7):2354-2360.
6. Sannathimmappa MB, Nambiar V, Arvindakshan R. Hepatitis B: Knowledge and awareness among preclinical year medical students. Avicenna J Med. 2019;9(2):43-47.
7. Dawar R, Yasmin T, Jha A. Hepatitis B Awareness Among Medical Students And Their Vaccination Status In A Medical College In Western UP. Int J Sci Res. 2019;8(6):57-59.
8. Dev K, KS SK, Abhay G, Gajanan K, Akash S, Bisure K. Knowledge and Awareness of the Health Care Workers about the Hepatitis B Infection and their Vaccination Status in a Newly Started Medical College. J Assoc Physicians India. 2018;66(12):27-30.
9. Rathi A, Kumar V, Majhi J, Jain S, Lal P, Singh S. Assessment of knowledge, attitude, and practices toward prevention of hepatitis B infection among medical students in a high-risk setting of a newly established medical institution. J Lab Physicians. 2018;10(4):374-379.
10. Aroke D, Kadia BM, Anutebeh EN, Belanquale CA, Misori GM, Awa A, Mbanga CM, Ngek LT. Awareness and Vaccine Coverage of

Hepatitis B among Cameroonian Medical Students. Biomed Res Int. 2018;2018:3673289.
11. Akhter S, Rizwan ASM, Wahiduzzaman M. Vaccination Status and Awareness of Hepatitis B among Undergraduate Medical Students of Two Medical Colleges in Bangladesh. Med Today. 2017;28(1):27-30.
12. Batra V, Goswami A, Dadhich S, Kothari D, Bhargava N. Hepatitis B immunization in healthcare workers. Ann Gastroenterol. 2015;28(2):276-280.
13. Shah DP, Grimes CZ, Nguyen AT, Lai D, Hwang LY. Long-term effectiveness of accelerated hepatitis B vaccination schedule in drug users. Am J Public Health. 2015;105(6):e36-e43.
14. Maroof KA, Bansal R, Parashar P, Sartaj A. Do the medical, dental and nursing students of first year know about hepatitis B? A study from a university of North India. J Pak Med Assoc. 2012;62(1):25-27.
15. Giri P, Phalke D. Knowledge and vaccination status of hepatitis B amongst medical interns of Rural Medical College, Loni, Maharashtra, India. South East Asia J Public Health. 2014;3(2):19-22.

Study Metadata

- Study Setting: Andhra Medical College & King George Hospital, Visakhapatnam, Andhra Pradesh, India
- Target Cohort: Clinical Undergraduate Medical Students (MBBS) & Compulsory Rotating Medical Interns
- Study Design: Hospital-Based Cross-Sectional Observational Study

Keertan Adarsh Bhagavatula, Sai Keerthana Chunduru, and Goutham Srinivas Dolai, "The Needle Stick Paradox: High Awareness Versus Suboptimal Hepatitis B Vaccination Coverage and Post-Exposure Preparedness Among Medical Trainees in Coastal Andhra Pradesh," *International Research Journal of Pharmacy and Medical Sciences (IRJPMS)*, Volume 9, Issue 5, pp. 108-112, 2026.