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Self-reported Hepatitis B Vaccination Status among Dental Health Care Providers and Students at Dental Colleges

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ABSTRACT

Objectives: Hepatitis B virus (HBV) infection remains an occupational risk for dental health care providers due to exposure to blood, saliva, sharp instruments, and contaminated surfaces. Although vaccination is effective, completion of the three-dose schedule is often inconsistent. This study aims to determine the self-reported hepatitis B vaccination status of dental faculty, staff, and clinically exposed dental students at five dental colleges in Pakistan, and to compare complete vaccination coverage across participant categories.
Methods: A multicentre cross-sectional study was conducted during the 2024–2025 academic year. A census-style, consecutive sample of eligible participants, comprising faculty members, staff, third-year dental students, and final-year dental students, was included. Participants who reported receiving all three doses of the hepatitis B vaccine were classified as fully vaccinated. In comparison, those who did not report completion of three doses were classified as not fully vaccinated. The primary outcome was self-reported complete vaccination status, not serologically confirmed immunity. Descriptive statistics, chi-square testing, Cramer's V, and unadjusted odds ratios were used for analysis.
Results: Overall, 395 of 1,038 participants were fully vaccinated, giving a vaccination coverage of 38.1%. Vaccination coverage was 42.0% among faculty, 33.2% among staff, 46.1% among third-year students, and 32.0% among final-year students. Participant category was significantly associated with vaccination status, $\chi^2 = 13.81$, $p = 0.003$. Bonferroni-corrected pairwise comparisons showed significant differences between staff and third-year students and between third-year and final-year students. Compared with faculty, staff had 8.8 percentage points lower vaccination coverage, and final-year students had 10.1 percentage points lower coverage. Among students, vaccination coverage declined significantly from the third year to the final year (χ^2 for trend = 8.15, $p = 0.004$).
Conclusion: Self-reported completion of hepatitis B vaccination was suboptimal across all participant groups. The findings support the need for a structured institutional vaccination pathway, verification of vaccine records where feasible, reminder systems for dose completion, and post-vaccination anti-HBs testing for individuals with ongoing clinical exposure.
Keywords: Hepatitis B; Vaccination status; Dental healthcare workers; Dental students; Occupational health; Cross-sectional study

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Introduction

Hepatitis B is a vaccine-preventable viral infection that can lead to acute hepatitis, chronic liver disease, cirrhosis, and hepatocellular carcinoma. Although effective vaccines have been available for decades, HBV continues to cause preventable morbidity and mortality, especially in

settings where vaccination coverage, infection control systems, and early diagnosis remain inconsistent. The global burden is not evenly distributed; it is concentrated in regions with higher endemicity and limited preventive infrastructure, particularly in parts of Africa and the Western Pacific region. Therefore, the issue is not simply the availability of the vaccine, but whether high-risk groups are identified, vaccinated, and appropriately followed up.[1, 2]

Healthcare workers are among the occupational groups most vulnerable to HBV exposure. Their risk is linked to contact with blood and body fluids, handling of sharp instruments, and exposure to contaminated equipment or surfaces. Dental health care providers occupy a particularly important position within this risk profile. Routine dental procedures often involve sharp instruments, high-speed devices, saliva mixed with blood, and close contact with oral tissues. Even when overt bleeding is not obvious, dental procedures can create opportunities for exposure through microtrauma, splatter, aerosols, or accidental injuries.[3-5]

Dental training institutions deserve special attention because they combine patient care, student learning, and clinical service delivery within a single environment. Faculty members and senior students perform or supervise procedures, while dental staff often assist chairside, clean instruments, manage contaminated waste, and support clinical flow. These overlapping roles mean that HBV prevention cannot be limited to dentists alone. A safe institutional policy must include all categories of workers and trainees who may encounter blood, saliva, sharps, or contaminated materials.[6-8]

In Pakistan and other resource-limited settings, the risk of HBV transmission is shaped by both individual and system-level factors. Individual factors may include incomplete awareness of vaccine schedules, low perceived susceptibility, fear of injections, missed appointments, or uncertainty about previous vaccination. System-level factors may include a lack of mandatory vaccination policies, the absence of a centralized record system, limited access to vaccines on campus, poor follow-up for second and third doses, and inadequate post-vaccination monitoring. The persistence of low vaccine coverage in dental environments, therefore, reflects more than personal choice; it may indicate gaps in institutional prevention systems.[9-11]

A common methodological problem in studies of HBV prevention is the inappropriate use of the term immune status when only vaccination history has been assessed. Completion of three vaccine doses improves the likelihood of protection, but it does not prove serological immunity. Anti-HBs testing is required to document protective antibody response, and some vaccinated individuals may not develop adequate titers. For this reason, the present study deliberately focuses on self-reported vaccination status rather than confirmed immune status. This distinction is important for accurate interpretation, transparent reporting, and appropriate institutional planning.[12]

This study aimed to determine the proportion of clinically exposed dental faculty, staff, and students at five participating dental colleges in Pakistan who reported completing the three-dose hepatitis B vaccine schedule and to examine whether coverage differed by participant category. It was hypothesized that vaccination coverage would vary across participant categories because faculty, staff, and students may differ in clinical responsibilities, access to institutional reminders, and exposure to professional training. The study was designed to generate practical, local evidence to guide vaccination campaigns, record verification, and future serological follow-up within the participating institutions.

Materials and Methods

Study Design and Setting

This multicentre cross-sectional study was conducted at Dental College HITEC-IMS, University College of Dentistry Lahore, Bolan Dental College, Dow Dental College, and DeMontmorency Dental College during the 2024-2025 academic year. The study was planned as an analytical institutional survey to estimate hepatitis B vaccination coverage among personnel and students with actual or expected clinical exposure and to identify groups requiring targeted preventive intervention. This institution-based cross-sectional study is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of Dental College HITEC-IMS before data collection (approval

number: Dental/HITEC/IRB/78). Participants were informed of the study's purpose, and participation was voluntary. Data was handled confidentially and reported in aggregate form without personal identifiers.

Participants and Eligibility Criteria

Eligible participants included dental faculty members, dental staff, third-year dental students, and final-year dental students. These groups were selected because they were directly involved in, or preparing for, clinical dental work. First- and second-year students were excluded because they had not yet entered routine clinical practice. Participation was voluntary, and informed consent was obtained before data collection.

Sampling Approach and Sample Size Justification

A census-style, consecutive-sampling approach was used rather than a probability sample. All eligible and available participants who consented during the data collection period were included, producing a final analytical sample of 1,038. Because the primary purpose was to estimate institutional coverage and plan programs, no priori hypothesis-based sample size calculation was performed. However, with 1,038 participants and an observed complete vaccination coverage of 38.1%, the 95% confidence interval around the overall estimate was 35.1% to 41.0%, indicating approximately ±3 percentage points of precision for the main prevalence estimate. The non-probability, multi-institutional sampling approach limits external generalizability and is therefore considered a limitation of the study.

Data Collection and Study Variables

Data were collected using a structured pro forma developed for the institutional needs assessment; the pro forma recorded participant category and self-reported hepatitis B vaccination status. Vaccination cards, employee health records, or institutional databases were not available for verification during data collection. Data on gender, age, years of clinical experience, prior needlestick injury, HBV knowledge, attitudes, and vaccination barriers were not collected in this phase of the project.

Operational Definition of Vaccination Status

The outcome variable was complete hepatitis B vaccination status. Participants who reported receiving all three doses of the hepatitis B vaccine were classified as fully vaccinated. Participants who did not report completion of three doses were classified as not fully vaccinated. This category may include individuals who never received the vaccine as well as those who received only one or two doses. The study did not measure anti-HBs titers; therefore, the results reflect self-reported vaccination completion and should not be interpreted as confirming immune status.

Statistical Analysis

Data was analyzed using descriptive statistics, including frequencies, percentages, and 95% confidence intervals where appropriate. Hepatitis B vaccination coverage was calculated as the proportion of participants who reported receiving all three doses of the hepatitis B vaccine. The association between participant category and vaccination status was assessed using Pearson's chi-square test. Cramer's V was calculated to estimate the strength of association.

Because the overall chi-square test was statistically significant, post hoc pairwise comparisons were performed among the four participant categories using 2 × 2 Pearson chi-square tests. To control for multiple comparisons, the Bonferroni correction was applied across six pairwise comparisons, giving an adjusted significance threshold of $p < 0.0083$. Unadjusted p-values are reported in the table, and results were interpreted against the Bonferroni-adjusted threshold.

Unadjusted odds ratios with 95% confidence intervals were calculated using faculty members as the reference category. Absolute risk differences were also calculated to provide clinically interpretable estimates of vaccination coverage differences between groups. Absolute risk difference was expressed as percentage points and calculated as the vaccination rate in the comparison group minus the vaccination rate in the reference group. Among students, a chi-square test for linear trend was used to assess whether vaccination coverage declined with increasing clinical seniority from the third year to the final year. A p-value < 0.05 was considered statistically significant for the primary analysis.

Results

The final sample included 1,038 participants. Faculty members accounted for 314 participants (30.3%), staff for 337 (32.5%), third-year students for 193 (18.6%), and final-year students for 194 (18.7%). Overall, 395 participants (38.1%) reported complete hepatitis B vaccination, and 643 (61.9%) were not fully vaccinated (Table 1).

Vaccination coverage varied across participant categories. Complete vaccination was reported by 132 faculty members (42.0%), 112 staff members (33.2%), 89 third-year students (46.1%), and 62 final-year students (32.0%). The highest coverage was observed among third-year students, while the lowest coverage was observed among final-year students and staff.

The chi-square test showed a statistically significant association between participant category and vaccination status (chi-square = 13.81, df = 3, p = 0.003). Cramer's V was 0.12, indicating a small association. In unadjusted comparisons using faculty as the reference group, staff and final-year students had significantly lower odds of reporting complete vaccination, whereas third-year students did not differ significantly from faculty (Table 2).

Table 1: Self-reported Hepatitis B Vaccination Status by Participant Category

Participant category	Total n (%)	Fully vaccinated n (%)	Not fully vaccinated n (%)	Vaccination coverage 95% CI
Faculty	314 (30.3)	132 (42.0)	182 (58.0)	36.7-47.6
Staff	337 (32.5)	112 (33.2)	225 (66.8)	28.4-38.4
Third-year students	193 (18.6)	89 (46.1)	104 (53.9)	39.2-53.2
Final-year students	194 (18.7)	62 (32.0)	132 (68.0)	25.8-38.8
Total	1,038 (100.0)	395 (38.1)	643 (61.9)	35.1-41.0

† Fully vaccinated refers to self-reported completion of three hepatitis B vaccine doses. Not fully vaccinated includes participants who did not report completing three doses; this may include incomplete vaccination or no vaccination at all.

Table 2: Chi-Square Test of Association Between Participant Category and Vaccination Status

Variable	Chi-square	df	p-value	Effect size
Participant category vs. vaccination status	13.81	3	0.003	Cramer's V = 0.12

† A p-value of 0.05 or less was considered statistically significant. Cramer's V indicates that the association was statistically significant but small in magnitude.

Post-Hoc Pairwise Analysis

Because the overall association between participant category and hepatitis B vaccination status was statistically significant, post hoc pairwise comparisons were conducted using the Bonferroni correction. The adjusted significance threshold was $p < 0.0083$ for the six pairwise comparisons. After correction, statistically significant differences were observed between staff and third-year students, and between third-year and final-year students (Table 3). Although faculty differed nominally from staff and final-year students, these comparisons did not remain statistically significant after Bonferroni correction. This indicates that the most robust difference was between the higher vaccination coverage observed among third-year students and the lower coverage observed among staff and final-year students.

Odds Ratios and Absolute Risk Differences

To improve interpretability, odds ratios were supplemented with absolute risk differences. Compared with faculty members, staff had 8.8 percentage points lower vaccination coverage, while final-year students had 10.1 percentage points lower coverage. Third-year students had slightly higher vaccination coverage than faculty members; however, this difference was not statistically significant (Table 4). Absolute differences are clinically useful because they show the actual gap in vaccination coverage between groups, whereas

odds ratios express relative differences in the odds of being vaccinated.

Table 3: Pairwise Post-Hoc Comparisons of Hepatitis B Vaccination Status by Participant Category

Pairwise comparison	Vaccination coverage compared	χ^2 value	Unadjusted p-value	Bonferroni-adjusted p-value	Interpretation
Faculty vs Staff	42.0% vs 33.2%	5.38	0.020	0.120	Not significant after correction
Faculty vs Third-year students	42.0% vs 46.1%	0.81	0.369	1.000	Not significant
Faculty vs Final-year students	42.0% vs 32.0%	5.16	0.023	0.139	Not significant after correction
Staff vs Third-year students	33.2% vs 46.1%	8.65	0.003	0.020	Significant after correction
Staff vs Final-year students	33.2% vs 32.0%	0.09	0.763	1.000	Not significant
Third-year vs Final-year students	46.1% vs 32.0%	8.15	0.004	0.026	Significant after correction

† Bonferroni correction was applied for six pairwise comparisons. The Bonferroni-adjusted significance threshold was $p < 0.0083$ for unadjusted p-values. Adjusted p-values were calculated as unadjusted $p \times 6$ and capped at 1.000.

Table 4: Odds Ratios and Absolute Risk Differences for Complete Hepatitis B Vaccination

Participant category	Vaccinated/Total n (%)	Unadjusted OR for vaccination, 95% CI	Absolute risk difference vs faculty, percentage points, 95% CI
Faculty	132/314 (42.0%)	Reference	Reference
Staff	112/337 (33.2%)	0.69 (0.50 to 0.94)	−8.8 (−16.2 to −1.4)
Third-year students	89/193 (46.1%)	1.18 (0.82 to 1.69)	+4.1 (−4.8 to +13.0)
Final-year students	62/194 (32.0%)	0.65 (0.44 to 0.94)	−10.1 (−18.6 to −1.5)

† Odds ratios represent the odds of being fully vaccinated, using faculty as the reference group. The absolute risk difference represents the difference in complete vaccination coverage between faculty and the general population. Negative values indicate lower vaccination coverage than the faculty.

Trend Across Student Seniority

Among clinically exposed students, vaccination coverage declined from 46.1% among third-year students to 32.0% among final-year students. The absolute reduction in coverage among final-year students compared with third-year students was 14.1 percentage points, 95% CI: −23.8 to −4.5. The chi-square test for linear trend showed a statistically significant decline in vaccination coverage with increasing student seniority (χ^2 for trend = 8.15, $p = 0.004$). This finding supports the existence of a seniority paradox, in which students with greater clinical exposure reported lower vaccination coverage.

Discussion

This study demonstrates suboptimal self-reported hepatitis B vaccination coverage among dental faculty, staff, and students who were clinically exposed. Overall, only 395 of 1,038 participants reported completing the three-dose hepatitis B vaccine schedule, resulting in a

vaccination coverage of 38.1%. Conversely, 643 participants, representing 61.9% of the study population, were not fully vaccinated. This finding is concerning because all included groups either provide clinical dental care, support clinical services, or are undergoing clinical training in environments where exposure to blood, saliva, contaminated instruments, and sharp injuries may occur. In this context, incomplete vaccination is not only an individual health concern but also an institutional gap in infection prevention.

Hepatitis B remains an important occupational hazard in dental settings because dental professionals routinely work in close contact with blood and oral fluids and frequently handle sharp instruments. Previous literature has shown that healthcare workers, including dental personnel, are at greater risk of HBV exposure than the general population, particularly when vaccination coverage, infection-control compliance, and post-exposure protocols are inadequate. Therefore, the low level of complete vaccination observed in this study suggests a need for stronger institutional systems to ensure that all clinically exposed individuals are protected before entering routine patient-care areas.[13-16]

A key finding of the present study was that vaccination coverage differed significantly across participant categories. The overall chi-square test showed a statistically significant association between participant category and hepatitis B vaccination status, indicating that vaccination uptake was not uniform across faculty, staff, third-year students, and final-year students. However, the post-hoc pairwise comparisons provide a more precise interpretation of this association. After applying Bonferroni correction for six pairwise comparisons, the most robust differences were observed between staff and third-year students, and between third-year and final-year students. In contrast, although faculty appeared to have higher vaccination coverage than staff and final-year students, these differences did not remain statistically significant after correction for multiple comparisons.

This pattern suggests that the vaccination gap is not simply a contrast between senior professionals and students. Instead, it appears to reflect differences in how vaccination is monitored, encouraged, or reinforced across professional and training stages. Staff had lower vaccination coverage than faculty, suggesting that non-teaching personnel are less consistently included in academic orientation programs, faculty development sessions, or formal occupational health checks. This is important because staff members may still have substantial exposure to clinical environments, contaminated instruments, waste, and patient-care areas. Their protection should therefore be treated as an essential component of institutional infection prevention rather than as an optional individual responsibility.

The lower vaccination coverage among final-year students compared with third-year students is particularly important. Third-year students had the highest reported vaccination coverage, while final-year students had one of the lowest. This finding represents a concerning "seniority paradox": students with greater cumulative clinical exposure and more frequent patient contact reported lower complete vaccination coverage than students at an earlier stage of clinical training. Ideally, vaccination coverage should increase as students progress into more intensive clinical work. The observed decline may reflect the absence of repeated vaccination checks after the initial transition into clinical training, a lack of reminders to complete vaccination, weak documentation systems, or reduced institutional reinforcement as students advance to senior clinical years. The significant trend across student seniority supports the need for vaccination verification not only at the start of clinical training but also at later stages of the dental program.

The addition of absolute risk differences helps make these findings more clinically interpretable. Compared with faculty members, staff had 8.8 percentage points lower vaccination coverage, while final-year students had 10.1 percentage points lower coverage. These absolute differences are important because they show the actual size of the vaccination gap rather than just the relative odds of vaccination. For institutional planning, absolute gaps are easier to translate into action. For example, they can help estimate how many additional staff members or students would need to complete vaccination to bring coverage closer to an acceptable occupational health standard. Thus, the use of both odds ratios and absolute risk differences strengthens the practical relevance of the findings.

The findings of this study are broadly consistent with previous reports from Pakistan and other comparable settings, where hepatitis B vaccination coverage among healthcare workers, dental students, and dental assistants has often remained below ideal levels despite awareness of occupational risk. Studies from local dental and healthcare settings have reported similarly inadequate vaccination coverage, suggesting that

the problem is not isolated to a single institution or group. International comparisons also show that vaccination coverage may be higher in some settings, but even among vaccinated healthcare workers, serological protection is not guaranteed. This distinction is important because completion of the vaccine schedule does not always confirm immunity. Anti-HBs testing after completion of the vaccine series remains the appropriate method for confirming protective immune response, especially among individuals with frequent occupational exposure.[6-11,17-20]

An important strength of the revised interpretation is that the study is framed as an assessment of self-reported hepatitis B vaccination status rather than immune status. The present data indicate whether participants completed three vaccine doses, but they do not confirm protective antibody levels. This limitation must be clearly acknowledged because vaccination history and confirmed immunity are not the same thing. Some individuals who complete vaccination may fail to develop adequate antibody titers, while others may incorrectly recall their vaccination history. Therefore, the findings should be interpreted as evidence of inadequate vaccination coverage and as a basis for institutional prevention planning, not as evidence of confirmed immune protection.

The results support several practical institutional interventions. First, participating institutions should establish a centralized vaccination record for faculty, staff, and students. Second, documented hepatitis B vaccination should be required before entry into routine clinical work, including for students before clinical postings and for staff before assignment to patient-care or instrument-handling areas. Third, vaccination should be made easily accessible through on-campus vaccination drives or linked occupational health services so that cost, travel, and scheduling barriers do not prevent completion. Fourth, reminder systems should be implemented for the second and third vaccine doses, because incomplete schedules may contribute substantially to low coverage. Finally, post-vaccination anti-HBs testing should be introduced where feasible, particularly for individuals with repeated exposure to blood, saliva, sharp instruments, or contaminated clinical materials.

The study also highlights the need to include staff more actively in infection-prevention planning. Institutional vaccination programs in teaching hospitals and dental colleges often focus on students and faculty, while support staff may receive less attention despite having meaningful clinical exposure. The lower vaccination coverage among staff in this study suggests that future interventions should not be limited to dentists and students. Vaccination policies, reminders, documentation systems, and occupational health education should include all personnel who work in or around clinical areas.

This study has several strengths. It included a large sample of clinically relevant groups, allowing a more precise estimate of vaccination coverage than smaller institutional surveys. It also compared faculty, staff, and students separately, which helped identify priority groups for intervention. The revised analysis further strengthens the manuscript by moving beyond a single overall chi-square test and providing pairwise comparisons, odds ratios, absolute risk differences, and a trend analysis among students. These additions make the findings more useful for both academic interpretation and institutional decision-making.

However, several limitations should be acknowledged. Vaccination status was self-reported and was not verified through vaccination cards, medical records, or institutional databases; therefore, recall bias and social desirability bias are possible. The study did not include anti-HBs testing, so the actual level of immune protection could not be confirmed. The questionnaire did not assess barriers to vaccination, knowledge of HBV transmission, perceived risk, prior needlestick injuries, years of clinical experience, age, or gender. As a result, multivariable analysis and deeper causal interpretation were not possible. The cross-sectional design also provides only a snapshot of vaccination coverage during the study period. It cannot determine whether vaccination behavior changed over time or whether institutional policy changes influenced uptake.

Future research should combine record-verified vaccination history with anti-HBs serology and a short barrier-assessment questionnaire. Including variables such as age, gender, professional role, years of clinical exposure, prior needlestick injury, knowledge of HBV transmission, perceived risk, and access to vaccination would enable multivariable analysis and provide a clearer explanation of why vaccination remains incomplete. If institution-wise data are available, future analysis should also report vaccination coverage separately by dental college. This would help determine whether low coverage is a uniform problem across institutions or is driven by specific colleges that require targeted intervention.

Overall, this study identifies a serious and actionable gap in hepatitis B prevention among dental healthcare providers and clinically exposed dental students. The findings suggest that incomplete vaccination is not limited to one group but reflects broader weaknesses in institutional vaccination verification, follow-up, and occupational health monitoring. Addressing this gap requires more than awareness alone. A structured program involving mandatory documentation, accessible vaccination services, dose-reminder systems, staff inclusion, periodic audits, and, where feasible, post-vaccination serological testing would provide a stronger, more sustainable approach to protecting dental healthcare workers, students, and patients.

Conclusion

Self-reported hepatitis B vaccination completion among dental faculty, staff, and clinically exposed students at five dental colleges in Pakistan was suboptimal, with nearly two-thirds of participants not fully vaccinated. Participant category was significantly associated with vaccination status, but low coverage remained a concern across all groups. The study should be interpreted as an assessment of vaccination coverage, not immune status, because anti-HBs titers were not measured. A structured institutional program that includes verification of vaccination records, accessible on-campus vaccination, dose-completion reminders, and post-vaccination serological testing for high-risk groups is recommended.

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Author Contribution

SM conceptualized the study, designed the methodology, supervised data collection, performed the statistical analysis, and drafted the manuscript. ShM contributed to data collection, literature review, and critical revision of the manuscript. FH contributed to data interpretation and final manuscript preparation. All authors reviewed and approved the final version of the manuscript.

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Data Availability Statement

The dataset used in this study is available from the corresponding author upon reasonable request, subject to institutional data-sharing policies.

Conflict of Interest

The authors have no conflicts of interest to disclose.

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