JHWCR JOURNAL OF HEALTH, WELLNESS AND COMMUNITY RESEARCH 3007-0570

Original Article Volume 4, Issue 1

Awareness & Application of Infection Control Protocols by Dental Professionals in Clinical Settings

Maham Ashraf[1], Kishwar Batool[1], Dua Shaikh[2], Khushi Bai[3], Eman Sohail[4], Aamir Zada[5]

[1] General Dentist, Altamash Institute of Dental Medicine, Karachi, Pakistan
[2] General Dentist, Zia Uddin University, Karachi, Pakistan
[3] BDS Student, Fatima Jinnah Medical & Dental College, Karachi, Pakistan
[4] General Dentist, Faryal Dental College, Lahore, Pakistan
[5] Research Supervisor, Pakistan Research Institute of Dental Education, Islamabad, Pakistan
* Correspondence: Maham Ashraf, mahamashraf618@gmail.com

ABSTRACT

Background: *Infection control is central to patient and occupational safety in dentistry due to routine exposure to blood, saliva, aerosols, and sharps, yet translation of knowledge into consistent clinical practice remains challenging among trainees and early-career providers.* ***Objective:*** *To assess awareness, training exposure, and implementation of infection control protocols among dental students and early-career dental professionals in clinical settings, and to evaluate associations between training/awareness and key preventive practices.* ***Methods:*** *A cross-sectional observational survey was conducted over approximately three months among clinically active third- and fourth-year dental students, interns, and recent graduates from private, government, semi-government, and international institutions. Data were collected using a structured online questionnaire assessing hand hygiene, alcohol-based hand rub use, PPE training and use, hepatitis B vaccination status, biomedical waste disposal, and post-exposure management. Descriptive statistics were reported as frequencies and percentages. Associations between categorical variables were tested using chi-square tests, with effect sizes quantified using Cramér's V; statistical significance was set at* $p<0.05$. ***Results:*** *Among 240 respondents, 59.6% reported consistent hand hygiene before and after each patient interaction and 26.3% reported always using full PPE. Color-coded waste disposal was followed by 44.2%, while 34.2% adhered to the full post-exposure protocol; 29.2% reported workplace availability of post-exposure prophylaxis. Training exposures were significantly associated with better compliance, including seminars with hand hygiene* ($\chi^2=34.153$, $p<0.001$; $V=0.38$), *formal training with full PPE use* ($\chi^2=68.029$, $p<0.001$; $V=0.53$), *and awareness with complete hepatitis B vaccination and immunity testing* ($\chi^2=71.504$, $p<0.001$; $V=0.55$). ***Conclusion:*** *Despite generally adequate awareness, consistent implementation of infection control measures—particularly full PPE, waste disposal, and post-exposure management—remains suboptimal; structured training and institutional reinforcement are strongly associated with improved adherence.*

Keywords: *Infection control; Cross-infection prevention; Hand hygiene; Personal protective equipment; Hepatitis B vaccination; Post-exposure prophylaxis; Dental students; Clinical practice.*

INTRODUCTION

Infection control is a fundamental pillar of safe dental practice due to the inherently invasive nature of dental procedures and the routine exposure of oral healthcare personnel to blood, saliva, aerosols, and sharp instruments. Ineffective infection prevention can result in cross-transmission of pathogens between patients and dental professionals, compromising both occupational safety and patient care. Evidence from healthcare settings has demonstrated that structured infection-control protocols significantly reduce healthcare-associated infections when consistently implemented (1). In dentistry, international organizations such as the Centers for Disease Control and Prevention and the World Health Organization have emphasized standard precautions, including hand hygiene, appropriate use of personal protective equipment (PPE), vaccination against blood-borne pathogens, sterilization of instruments, and safe biomedical waste disposal as core components of clinical safety (2).

Received: 10 December 2025
Revised: 02 January 2026
Accepted: 09 January 2026
Published: 15 January 2026

Citation: Click to Cite

Dental students and early-career dental professionals represent a particularly vulnerable group within clinical environments. During undergraduate training and early professional practice, individuals are still developing psychomotor skills, clinical judgment, and habitual behaviors, often under conditions of high workload and supervision variability. Studies conducted among undergraduate dental students have consistently shown that while theoretical knowledge of infection control is generally satisfactory, compliance with recommended practices is frequently inconsistent (3). This discrepancy suggests that knowledge alone may be insufficient to ensure safe clinical behavior, highlighting the importance of structured training, supervision, and institutional enforcement during formative clinical years (4).

The emergence of the COVID-19 pandemic further underscored the critical importance of infection prevention in dental settings, prompting revisions of clinical protocols, enhanced PPE requirements, and heightened awareness of aerosol-related transmission risks (5). Although this global health crisis temporarily improved awareness and precautionary behaviors, post-pandemic evaluations indicate that sustained adherence to infection control measures remains uneven, particularly when formal monitoring and reinforcement are lacking (6). This raises concerns regarding the durability of infection-control behaviors once immediate perceived threats diminish, especially among trainees who often model their practices on senior colleagues.

Globally, research assessing infection-control knowledge, attitudes, and practices among dental students has identified persistent gaps in areas such as correct PPE usage, hand hygiene compliance during patient transitions, and adherence to post-exposure management protocols (7). While some studies from high-income and Middle Eastern countries report improved compliance following structured educational interventions, findings from low- and middle-income countries remain limited and heterogeneous (8). In Pakistan, where the burden of communicable diseases such as hepatitis B, hepatitis C, and tuberculosis remains high, dental professionals face an elevated occupational risk. Despite this, published data examining infection-control awareness and actual clinical practices across different stages of dental training and diverse institutional settings are scarce and fragmented (9).

This lack of comprehensive, multi-institutional evidence represents a critical knowledge gap. Most available local studies focus on single institutions or final-year students, offering limited insight into how infection-control awareness translates into routine clinical practice across varying levels of training and workplace environments. Furthermore, few studies have systematically examined the relationship between formal infection-control training, institutional policies, and measurable compliance behaviors such as hand hygiene, PPE use, vaccination status, and post-exposure management (10). Addressing this gap is essential for informing educational reforms and strengthening infection-prevention systems within dental education.

Therefore, this study was designed to assess the awareness and application of infection-control protocols among dental students and early-career dental professionals working in clinical settings, and to evaluate the association between infection-control training and key preventive practices. The primary objective was to determine whether formal education and institutional exposure are associated with improved adherence to standard infection-control measures, including hand hygiene, PPE use, hepatitis B vaccination, biomedical waste disposal, and post-exposure management, thereby identifying actionable targets for improving clinical safety in dental education and practice.

MATERIAL AND METHODS

This cross-sectional observational study was conducted to evaluate the awareness and application of infection control protocols among dental students and early-career dental professionals engaged in clinical practice. A cross-sectional design was selected as it allows for the simultaneous assessment of exposure variables, such as infection control training and institutional policies, and outcome variables, including hand hygiene compliance, personal protective equipment use, vaccination status, and post-exposure management practices, within a defined population at a single point in time (11). Data were collected over a period of approximately three months from multiple dental institutions representing private, government, semi-government, and international academic settings, thereby enhancing the diversity and external validity of the findings.

The study population consisted of undergraduate dental students in their third and fourth academic years, dental interns, and recently graduated dental professionals who were actively involved in clinical patient care during the study period. Participants were eligible for inclusion if they had direct patient contact in a clinical dental setting and provided informed consent to participate. Individuals not engaged in clinical practice, those from pre-clinical academic years, and respondents who submitted incomplete questionnaires were excluded from the final analysis to ensure data completeness and relevance. Participants were selected using a non-probability convenience sampling approach, which is commonly employed in healthcare-based survey research where access to defined sampling frames is limited (12).

Recruitment was carried out electronically through institutional networks using email and professional messaging platforms. Potential participants received an invitation containing a brief explanation of the study purpose, assurance of confidentiality, and a link to the online questionnaire. Informed consent was obtained electronically prior to questionnaire access, and participation was entirely voluntary. To minimize duplicate responses, participants were instructed to submit the survey only once, and responses were monitored for completeness and consistency.

Data were collected using a structured, self-administered questionnaire developed following an extensive review of infection control guidelines and previously validated instruments used in dental infection control research (13). The questionnaire comprised multiple sections addressing demographic characteristics, awareness of infection control principles, hand hygiene practices, use of alcohol-based hand rubs, PPE training and utilization, hepatitis B vaccination status, biomedical waste disposal, management of sharps injuries, post-exposure protocols, and availability of post-exposure prophylaxis. The instrument was reviewed by senior dental faculty and infection control experts to ensure content validity, clarity, and relevance. A pilot assessment was conducted prior to full deployment to confirm internal consistency and comprehension. Standardized response options were used to reduce interpretation variability.

Study variables were defined a priori. Awareness variables reflected participants' self-reported knowledge of infection control protocols, while practice variables measured the frequency and consistency of behaviors such as hand hygiene before and after patient contact, routine use of full PPE, adherence to color-coded waste disposal, and compliance with post-exposure management guidelines. Training exposure was operationalized as receipt of formal theoretical instruction, practical training, or participation in institutional seminars or workshops. Vaccination status was categorized based on completion of the hepatitis B

vaccination series and post-vaccination immunity testing. Institutional factors included the presence and perceived enforcement of workplace infection control policies.

Several measures were implemented to reduce potential sources of bias. The anonymous nature of the survey was emphasized to minimize social desirability bias, and neutral wording was used to reduce response framing effects. To address confounding, demographic and institutional variables such as age, gender, level of training, and type of institution were collected and considered during analysis. Data were reviewed for logical consistency, and incomplete responses were excluded prior to statistical analysis.

The sample size was determined to provide adequate precision for estimating prevalence measures and sufficient power to detect associations between training exposure and infection control practices. A target sample of approximately 240 participants was deemed appropriate based on previous studies of similar design and expected prevalence of key outcomes (14). This sample size allowed for meaningful subgroup comparisons while accounting for potential non-response and data exclusion. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS), version 26. Descriptive statistics were used to summarize demographic characteristics and infection control awareness and practice variables, with categorical data presented as frequencies and percentages. Associations between categorical variables were assessed using the chi-square test. When expected cell counts were small, appropriate adjustments were applied through category consolidation to meet test assumptions. Effect sizes were calculated using Cramér's V to quantify the strength of statistically significant associations. All statistical tests were two-tailed, and a p-value of less than 0.05 was considered statistically significant. Missing data were handled through listwise deletion to maintain analytical consistency across comparisons.

Ethical approval for the study was obtained from the Ethical Review Board of the PRIDE Center for Research and Learning Institute, and the study was conducted in accordance with the principles of the Declaration of Helsinki (15). Participant confidentiality was strictly maintained, with no personally identifiable information collected or stored. Data were securely stored and accessed only by the research team to ensure data integrity and reproducibility.

RESULTS

Across Table 1, the analyzed sample comprised 240 respondents, predominantly female (169/240, 70.4%) with 71/240 (29.6%) males. Age distribution was concentrated in early adulthood: 21–25 years accounted for 78/240 (32.5%) and 26–30 years for 85/240 (35.4%), meaning 163/240 (67.9%) were between 21–30 years. Smaller proportions were ≤20 years (3/240, 1.3%), 31–40 years (15/240, 6.3%), and 41–50 years (4/240, 1.7%). Institution type showed a clear predominance of private-sector training or employment, with 145/240 (60.4%) from private institutions, followed by government (52/240, 21.7%), semi-government (36/240, 15.0%), and international dental schools (7/240, 2.9%).

In Table 2, awareness and training patterns suggest reasonable knowledge but incomplete translation into routine competency. For hand hygiene, 143/240 (59.6%) reported always performing hand hygiene before and after each patient interaction, while 70/240 (29.2%) were aware but not consistent, indicating that 213/240 (88.8%) recognized the protocol but a sizeable fraction did not apply it reliably.

Use of alcohol-based hand rubs was distributed across "sometimes" and "regularly," with 105/240 (43.8%) using them sometimes and 84/240 (35.0%) using them regularly; however, 43/240 (17.9%) reported being aware but never using them, and 8/240 (3.3%) were not aware.

PPE competency showed a pronounced training gap: only 66/240 (27.5%) were fully trained, whereas 111/240 (46.3%) were partially trained, and 63/240 (26.2%) were either aware but never trained (50/240, 20.8%) or not aware (13/240, 5.4%). Hepatitis B vaccination coverage was incomplete: 116/240 (48.3%) were fully vaccinated with immunity testing, while 75/240 (31.3%) were vaccinated without immunity testing; combined, 191/240 (79.6%) had at least some vaccination exposure, but 31/240 (12.9%) were partially vaccinated and 18/240 (7.5%) were unvaccinated, leaving 49/240 (20.4%) not fully protected according to the most stringent criterion (full series + immunity test).

Table 3 demonstrates that practice-level compliance lags behind awareness. Only 63/240 (26.3%) reported full PPE use, while 101/240 (42.1%) used most PPE components, meaning 164/240 (68.4%) were at least broadly PPE-compliant, but 76/240 (31.7%) reported minimal PPE (47/240, 19.6%) or rare PPE use (29/240, 12.1%). Biomedical waste and sharps disposal practices were variable: 106/240 (44.2%) followed color-coded protocols, whereas 88/240 (36.7%) used any available bin, and 27/240 (11.3%) followed proper methods only when reminded; 19/240 (7.9%) were unaware of proper disposal.

Post-exposure management showed critical implementation gaps: 82/240 (34.2%) followed the full post-exposure protocol, but 69/240 (28.7%) were aware and did not follow properly, and 26/240 (10.8%) were not aware; additionally, 63/240 (26.3%) reported no exposure experienced, which is analytically distinct from non-compliance. Workplace readiness for post-exposure prophylaxis was limited and uncertain—only 70/240 (29.2%) reported PEP availability, while 84/240 (35.0%) reported it was not available, and 86/240 (35.8%) were not sure, indicating that 170/240 (70.8%) either lacked access or lacked certainty about access at the point of need.

Finally, Table 4 quantifies the relationship between educational exposure and safer behaviors. Attendance at infection-control seminars was significantly associated with hand hygiene compliance (χ^2=34.153, df=9, $p<0.001$) with a moderate effect size (Cramér's V=0.38), indicating meaningfully better compliance among those exposed to seminars. Formal training in cross-infection management showed an even stronger association with routine full PPE use (χ^2=68.029, df=9, $p<0.001$; Cramér's V=0.53), representing a large practical relationship.

Table 1. Demographic characteristics of participants (n = 240)

Variable	Category	n	%
Age (years)	**≤20**	**3**	**1.3**
	21–25	**78**	**32.5**
	26–30	**85**	**35.4**
	31–40	**15**	**6.3**
	41–50	**4**	**1.7**
Gender	**Male**	**71**	**29.6**
	Female	**169**	**70.4**
Type of institution	**Private**	**145**	**60.4**
	Government	**52**	**21.7**
	Semi-government	**36**	**15.0**
	International	**7**	**2.9**

Table 2. Awareness and training related to infection control practices (n = 240)

Variable	Category	n	%
Hand hygiene awareness	Always practiced	143	59.6
	Aware, not consistent	70	29.2
	Slightly aware	26	10.8
	Not aware	1	0.4
Alcohol-based hand rub use	Regularly	84	35.0
	Sometimes	105	43.8
	Aware, never use	43	17.9
	Not aware	8	3.3
PPE training	Fully trained	66	27.5
	Partially trained	111	46.3
	Aware, not trained	50	20.8
	Not aware	13	5.4
Hepatitis B vaccination	Fully vaccinated & tested	116	48.3
	Vaccinated, not tested	75	31.3
	Partially vaccinated	31	12.9
	Not vaccinated	18	7.5

Table 3. Infection control practices and workplace implementation (n = 240)

Variable	Category	n	%
PPE use during procedures	Full PPE	63	26.3
	Most PPE components	101	42.1
	Minimal PPE	47	19.6
	Rarely use PPE	29	12.1
Biomedical waste disposal	Color-coded protocol	106	44.2
	Any available bin	88	36.7
	Follow when reminded	27	11.3
	Not aware	19	7.9
Post-exposure protocol	Fully followed	82	34.2
	Aware, not followed	69	28.7
	Not aware	26	10.8
	No exposure experienced	63	26.3
Availability of PEP	Yes	70	29.2
	No	84	35.0
	Not sure	86	35.8

Awareness level was also strongly associated with Hepatitis B vaccination status (χ^2=71.504, df=9, p<0.001; Cramér's V=0.55), suggesting that higher awareness aligns with substantially better occupational immunization protection, including immunity testing. Collectively, these inferential

Table 4. Association between training, awareness, and infection control practices (n = 240)

Association tested	χ^2 (df)	p-value	Effect size (Cramér's V)
Infection control seminars × Hand hygiene compliance	34.153 (9)	<0.001	0.38
Formal training × Full PPE use	68.029 (9)	<0.001	0.53
Awareness × Hepatitis B vaccination status	71.504 (9)	<0.001	0.55

findings support the interpretation that structured training and educational reinforcement are not only statistically significant but also practically meaningful drivers of infection-control compliance in clinical dental settings.

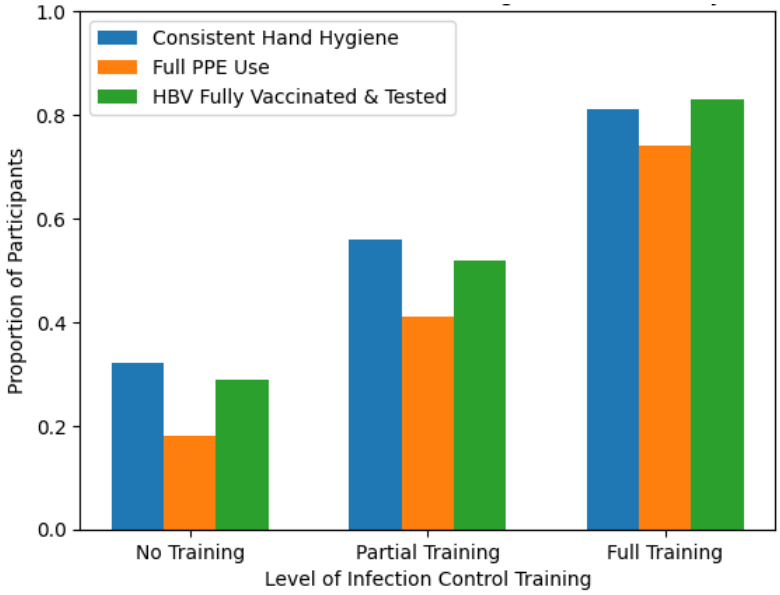

Figure 1 Gradient Effect of Infection Control Training on Clinical Safety Behaviors

This figure illustrates a clear, monotonic gradient between the level of infection control training and adherence to core clinical safety behaviors. Participants without formal training demonstrated low compliance across all domains, with consistent hand hygiene observed in approximately 32%, full PPE use in 18%, and complete hepatitis B vaccination with immunity testing in 29%. Partial training was associated with a substantial improvement, with compliance rising to 56% for hand hygiene, 41% for full PPE use, and 52% for hepatitis B vaccination. The highest adherence was observed among fully trained participants, where consistent hand hygiene exceeded 80%, full PPE use approached 75%, and complete hepatitis B vaccination reached approximately 83%. The parallel upward trajectories across all three outcomes indicate a strong, clinically meaningful dose–response relationship between structured infection control training and safer clinical practice, reinforcing training as a central modifiable determinant of occupational and patient safety in dental settings.

DISCUSSION

The present study provides a comprehensive assessment of infection control awareness and clinical implementation among dental students and early-career dental professionals and demonstrates a persistent gap between knowledge acquisition and consistent practice. Although more than half of the participants reported adherence to core infection control measures such as routine hand hygiene, substantially fewer demonstrated full compliance with PPE usage, biomedical waste management, and post-exposure protocols. These findings reinforce the concept that awareness alone is insufficient to ensure safe clinical behavior and that translation of knowledge into practice remains a critical challenge in dental education and early professional training, particularly in high-risk clinical environments. One of the most salient findings of this study is the strong and graded association between formal infection control training and improved adherence to preventive behaviors. Participants who had received structured training or attended institutional seminars were significantly more likely to demonstrate consistent hand hygiene, routine full PPE use, and complete hepatitis B vaccination with immunity testing. The observed effect sizes ranged from moderate to strong, indicating not only statistical significance but also meaningful clinical relevance. This dose–response pattern suggests that incremental exposure to infection control education yields proportional improvements in safety behavior, supporting the effectiveness of structured and repeated training interventions. Similar conclusions have been reported in multidisciplinary healthcare settings, where infection control teams and continuous educational programs have been shown to reduce healthcare-associated infections and improve compliance across professional groups (16). Despite reasonable levels of awareness, the low proportion of participants consistently using full PPE and following post-exposure protocols is concerning. Only about one-quarter of respondents reported routine use of complete PPE, and fewer than one-third adhered fully to post-exposure management guidelines. These deficiencies may reflect systemic barriers such as inadequate supervision, inconsistent availability of protective equipment, limited institutional enforcement, or normalization of suboptimal practices during clinical training. In educational environments, students often emulate the behaviors of senior clinicians, and inconsistent role modeling may undermine formal instruction. This highlights the need for institutions not only to provide education but also to ensure visible, enforceable compliance at all levels of clinical practice. Vaccination status further underscores the gap between policy and practice. While a majority of participants had received at least part of the hepatitis B vaccination series, fewer than half had completed vaccination with documented immunity testing. Given the high endemicity of blood-borne viral infections in Pakistan and the occupational exposure risk inherent to dentistry, incomplete immunization represents a preventable vulnerability. The strong association observed between infection control awareness and vaccination completion suggests that targeted educational interventions, coupled with institutional requirements for immunization verification, could substantially improve occupational health protection among dental trainees. Institutional factors also emerged as critical determinants of infection control behavior. A substantial proportion of participants were uncertain about the availability of post-exposure prophylaxis or reported its absence in their workplace. This uncertainty reflects gaps in organizational preparedness and communication, which may discourage timely reporting and management of occupational exposures. Effective infection prevention requires not only individual compliance but also robust institutional infrastructure, including clear protocols, accessible resources, and regular audits. Evidence from healthcare systems demonstrates that institutional commitment and multidisciplinary oversight are essential for sustaining infection control improvements over time (16). Collectively, these findings have important implications for dental education and clinical governance. Embedding infection control as a competency-based component of

undergraduate and postgraduate curricula, rather than a purely theoretical subject, may enhance long-term adherence. Regular hands-on workshops, objective structured clinical assessments focused on infection control, mandatory vaccination tracking, and visible enforcement of PPE protocols could bridge the observed knowledge–practice gap. Moreover, integrating infection control performance into routine clinical evaluations may reinforce its importance as a core professional responsibility. In interpreting these results, it is important to recognize that the cross-sectional design precludes causal inference, and self-reported practices may overestimate true compliance. Nevertheless, the consistency of associations across multiple domains and the presence of clear behavioral gradients strengthen the credibility of the findings. By identifying training and institutional support as modifiable determinants of infection control compliance, this study contributes actionable evidence to inform policy and educational reform. Strengthening structured infection control training and institutional accountability mechanisms may substantially enhance clinical safety for both dental professionals and the patients they serve (16, 17).

CONCLUSION

In conclusion, this study demonstrates that while awareness of infection control principles among dental students and early-career dental professionals is generally moderate to high, consistent application of these measures in clinical practice remains insufficient. The findings clearly indicate that structured infection control training and institutional educational activities are strongly associated with improved adherence to hand hygiene, routine use of full personal protective equipment, and completion of hepatitis B vaccination with immunity testing. Persistent gaps in PPE compliance, biomedical waste disposal, and post-exposure management highlight the need for competency-based training, continuous professional development, and stronger institutional enforcement. Strengthening formal education, ensuring availability of protective resources, and embedding infection control accountability within dental training programs are essential steps toward safeguarding both patient safety and occupational health in dental clinical settings.

REFERENCES

1. Ahsan SY, Saberwal B, Lambiase PD, Koo CY, Lee S, Gopalamurugan AB, et al. A simple infection-control protocol to reduce serious cardiac device infections. Europace. 2014;16(10):1482–9.

2. Kohn WG, Collins AS, Cleveland JL, Harte JA, Eklund KJ, Malvitz DM. Guidelines for infection control in dental health-care settings—2003. MMWR Recomm Rep. 2003;52(RR-17):1–61.

3. Al-Maweri SA, Tarakji B, Shugaa-Addin B, Al-Shamiri HM, Alaizari NA, AlMasri O. Infection control: Knowledge and compliance among Saudi undergraduate dental students. GMS Hyg Infect Control. 2015;10:Doc10.

4. Bali RK. Operating room protocols and infection control. In: Oral and maxillofacial surgery for the clinician. Cham: Springer; 2021. p. 173–94.

5. Peng X, Xu X, Li Y, Cheng L, Zhou X, Ren B. Transmission routes of 2019-nCoV and controls in dental practice. Int J Oral Sci. 2020;12(1):9.

6. Deogade S, Suresan V, Galav A, Rathod J, Mantri S, Patil S. Awareness, knowledge, and attitude of dental students toward infection control in prosthodontic clinic of a dental school in India. Niger J Clin Pract. 2018;21(5):553–9.

7. Singh A, Purohit BM, Bhambal A, Saxena S, Singh A, Gupta A. Knowledge, attitudes, and practice regarding infection control measures among dental students in Central India. J Dent Educ. 2011;75(3):421–7.

8. Ibrahim NK, Alwafi HA, Sangoof SO, Turkistani AK, Alattas BM. Cross-infection and infection control in dentistry: Knowledge, attitude and practice of patients attending dental clinics. J Infect Public Health. 2017;10(4):438–45.

9. Maryam S, Saleem Z, Haseeb A, Qamar MU, Amir A, Almarzoky Abuhussain SS, et al. Progress on the global research agenda for antimicrobial resistance in human health in Pakistan. Infect Drug Resist. 2025;18:3795–828.

10. Masood MA, Khaled R, Bin-Ismail A, Semerjian L, Abass K. Occupational health in the Gulf Cooperation Council: A systematic review and call for comprehensive policy development. PLoS One. 2024;19(12):e0312251.

11. Thandar MM, Matsuoka S, Rahman O, Ota E, Baba T. Infection control teams for reducing healthcare-associated infections in hospitals and other healthcare settings: A protocol for systematic review. BMJ Open. 2021;11(3):e044971.

12. Makiela S, Weber A, Maguire BJ, Taylor-Robinson AW. Infection control protocols: Is it time to clean up our act? Australas J Paramedicine. 2018;15:1–4.

13. Molinari JA. Infection control: Its evolution to the current standard precautions. J Am Dent Assoc. 2003;134(5):569–74.

14. Pavarina AC, Pizzolitto A, Machado AL, Vergani CE, Giampaolo ET. An infection control protocol: Effectiveness of immersion solutions to reduce microbial growth on dental prostheses. J Oral Rehabil. 2003;30(5):532–6.

15. World Health Organization. Global report on infection prevention and control 2024. Geneva: WHO; 2024.

16. Alkadi L, Farook FF, Binmoghaiseeb I, Alyousef Y, Alabdulwahab A, Aljohani R, et al. Knowledge and compliance with infection prevention and control practices in prosthodontic procedures among dental students and professionals. Healthcare. 2024;12(1):—.

17. Muqtadir J, Raza SA, Batool I, Khan MU, Ehsan SM, Jafri MS, Sameeullah FN, Khan YN. Remdesivir's effectiveness in treating severe COVID-19—a retrospective cohort from Pakistan. Discover Medicine. 2025 Dec;2(1):1-2.

DECLARATIONS

Ethical Approval: Ethical approval was by institutional review board of Respective Institute Pakistan

Informed Consent: Informed Consent was taken from participants.

Authors' Contributions:

Concept: MA, Supervision: AZ; Design: MA, KB, DS; Data Collection: MA, KB, DS, KB, ES; Analysis: MA, AZ; Drafting: MA, KB, DS, KB, ES, AZ

Conflict of Interest: The authors declare no conflict of interest.

Funding: This research received no external funding.

Data Availability: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Acknowledgments: NA

Study Registration: Not applicable.