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Knowledge, Attitude and Practices Regarding Biosafety Protocols among Dental Students and Professionals: A Cross-Sectional Study

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KEYWORDS

Biosafety, Dental Professionals, Infection Control, Professional Exposure, Knowledge, Attitudes, Practices, Personal Protective Equipment, Bloodborne Pathogens, Dental Education

ABSTRACT:

Background: Dental professionals are at increased risk of exposure to blood-borne pathogens, aerosols, and contaminated instruments during routine clinical procedures. Compliance with biosafety protocols is essential to prevent occupational risks and cross-infection. Assessing the knowledge, attitudes, and practices (KAP) of biosafety among students can help strengthen infection control strategies and educational programs.

Aim: To assess knowledge, attitudes, and practices regarding biosafety protocols among dental students, graduate students, and practicing dentists.

Materials and Methods: A cross-sectional survey was conducted from December 2 to December 31, 2025 among dental students, graduate students, and dentists. A validated 32-item questionnaire containing demographic data and closed-ended KAP questions was distributed via Google Forms. A total of 207 valid responses were analyzed using descriptive statistics, chi-square tests, and Karl Pearson correlation coefficients.

Results: The majority of participants demonstrated good knowledge of biosafety principles. 87.92% correctly identified biosafety and 92.75% identified appropriate personal protective equipment (PPE). Knowledge regarding post-exposure control measures (81.16%), sharps handling (81.64%) and vaccination requirements (82.61%) was satisfactory. However, knowledge gaps were observed in identifying transmission routes (61.35%), waste management (61.35%) and standard precautions (62.32%). Attitudinal assessments revealed predominantly positive perceptions, with over 85% supporting mandatory biosafety training and recognizing its role in occupational risk reduction. In fact, 78.26% reported using PPE regularly and 88.89% regularly sterilizing equipment. Notably, 30.43% reported occupational exposure, and these incidents are underreported.

Conclusions: Although dentists demonstrated satisfactory knowledge and positive attitudes regarding biosafety, gaps remain in specific technical areas and exposure reporting practices. Strengthening structured training programs, organizational support, and ongoing monitoring are essential to address knowledge and practice gaps and improve compliance with infection control requirements.

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Introduction

Since the World Health Organization's (WHO) 1946 definition of health as "a state of complete physical, mental, and social well-being and not merely the absence of disease," the concept of health has continued to evolve over time. The ability to function productively and perform daily activities is often considered a key indicator distinguishing a healthy individual from a diseased one.[1] A healthcare worker (HCW) is defined as a person whose duties involve direct or indirect contact with patients and their bodily fluids. This group includes nurses, physicians, pharmacists, technicians, dentists, students, contractors, emergency responders, public safety personnel, medical waste handlers, first aid providers, and volunteers. Due to the nature of their work, HCWs are at increased risk of acquiring infections through exposure to biological fluids and contaminated materials.[2] Given that "Prevention is better than cure", healthcare professionals must strictly adhere to established safety protocols and develop appropriate habits early in their careers. Over time, these habits become routine practices that protect both practitioners and patients and contribute to successful clinical outcomes. In stomatology and dental practice, the delivery of treatment inherently exposes both patients and practitioners to various health risks.[1] The concept of biosafety emerged in the 1970s, notably during the Asilomar Conference, where concerns about protecting researchers and the public from biological hazards were first formally discussed. Today, biosafety is defined as a set of measures aimed at preventing, minimizing, or eliminating risks associated with biological exposure, minimizing, or eliminating risks related to health, research and the environment.[3] Dental health care provider (DHCP) refers to all personal which are involved in direct (dentists, dental hygienists, dental assistants, dental laboratory technicians (in-office and commercial), students and trainees, contractual personnel) and indirect (administrative, clerical, housekeeping, maintenance, or volunteer personnel) patient care are at high risk of exposure to various infections as dental procedures are known to produce significant amounts of droplets and aerosols, which increase the potential for airborne transmission of infectious agents.[5,6,7,8] Research indicates that certain viruses like COVID-19 can remain viable in aerosols for several hours after a procedure and can persist on surfaces for extended periods. Consequently, the dental clinic environment presents a heightened risk of infection due to frequent exposure to saliva, blood, and aerosol or droplet generation during routine treatments. Moreover, many dental procedures are time-intensive, which further elevates the likelihood of contamination. Under these conditions, standard protective measures alone may not always be adequate to fully prevent disease transmission from dental workers to patients and vice versa.[4] Along with these common routes of transmission dental professionals are also at risk of transmission through contaminated instruments, accidental needle-stick injuries and from direct contact with infected oral lesions.[9,10,11,12,13] Although dental students are still in training and are not fully qualified professionals, they actively participate in clinical practice at their institutions and are also exposed to occupational hazards.[14] The obligation of health care workers, to ensure compliance with the regulations and principles of biosafety, training the new generations with an awareness of the existing biosafety standards, which groups the basic parameters of behaviour and is conceptualized as the set of preventive measures aimed at maintaining control of occupational risk factors from biological, physical or chemical agents, achieving the prevention of negative impacts, when facing harmful and risk agents. Hence assessing awareness, knowledge, and attitude of dental students and professionals towards biosafety practices during clinical care can provide valuable information to develop and enhance educational programs. This assessment also facilitates the safe return and continuation of in-person clinical education while protecting students, faculty and patients.[1]

Materials and Methods

After obtaining Institutional Ethical Approval (EC/NEW/INST/2021/2435), a questionnaire consisting of 32 carefully selected questions dividing them into two sections 1. Demographic Questions: 7 (Q1 to Q7) 2. Close-Ended Questions: 25 (Q8 to Q32) was distributed to dental students, postgraduates, and dentists through Google Forms via a WhatsApp link. The survey began on December 2, 2025 and ended on December 31, 2025, with 207 valid respondents. This study was developed based on literature review, questionnaire development and validation, and implementation of a pilot project. Participants were adequately informed about the survey

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protocol and informed consent was obtained prior to participation to ensure compliance with ethical standards. Strict measures were taken to protect the confidentiality of participants' demographic information. Frequency distributions and percentages were carefully examined to identify patterns and trends within the dataset, thereby facilitating a detailed understanding of participants' views, knowledge, and attitudes. The collected data was subjected to statistical analysis using various methods such as frequency percentage, standard deviation (SD), chi-square analysis, and correlation between knowledge and attitude scores using Karl Pearson correlation coefficient.

Results

Demographic Profile of Participants:

A total of 207 participants were included in the study.

Age group: The majority of participants were 18-24 years old (62.8%), followed by 24-30 years old (28.99%), 30-45 years old (5.8%), and 45 years old or older (2.42%).

Gender: The proportion of women in the sample (73.91%) was higher than that of men (26.09%).

Educational Qualification: Regarding professional title, the majority of participants were undergraduate students (58.94%), followed by graduate students (20.77%), practicing dentists (12.08%), and professors (8.21%). Regarding work experience, majority (58.94%) had less than 1 year, 33.33% had 1 to 5 years, 1.45% had 6 to 10 years, and 6.28% had more than 10 years. Majority of the participants were in academicians (69.08%), while the rest were in the private sector (29.02%), and 2.9% in the public sector.

The knowledge assessment revealed different levels of awareness among the respondents. The majority (87.92%) were correctly aware of the meaning of biosafety in the dental environment, while 12.08% lacked knowledge. Regarding the guidelines that dental professionals must follow, 74.40% responded correctly, whereas 25.60% did not. Concerning post-exposure management, 81.16% correctly identified the first step after accidental exposure to blood borne pathogens, while 18.84% were unaware. Most respondents (92.75%) correctly selected the most effective combination of personal protective equipment (PPE), but only 7.25% lacked knowledge in this area. When knowledge of participants was assessed regarding biosafety, a varied level of awareness was noted. When knowledge about the most common transmission routes of blood-borne infections was observed in 61.35% of participants, while 38.65% answered incorrectly. Similarly, 81.64% correctly identified the most important biosafety protocols for handling sharps, while 18.36% did not. Regarding sterilization methods, 77.29% knew the standard temperature and time for autoclave sterilization instruments, while 22.71% did not have knowledge. Only 61.35% answered correctly about proper disposal of blood contaminated waste and 38.65% were not aware. Awareness about major bloodborne pathogens of concern in dental practice was recognized by 69.57% of respondents, of whom 30.43% lacked knowledge. Most of the participants (82.61%) were correctly aware of the required vaccination obligations for dental professionals, while 17.39% were not. Knowledge about recommended vaccination protocols was present in 74.40% of respondents. Finally, 62.32% correctly described standard infection precautions, while 37.68% could not. (Figure 1)

Biosafety Attitudes and Practices of Participants

Participants had mainly positive attitudes towards biosafety practices. The majority (87.92%) agreed that biosafety measures are necessary to protect both professionals and patients. Similarly, 86.47% believed that adherence to biosafety protocols would significantly reduce occupational accidents, and 88.41% supported mandatory regular biosafety training for dentists. Additionally, 87.92% emphasized the need for further implementation of biosafety protocols in dental education. The majority of respondents (86.96%) reported consistently practicing good hand hygiene before and after patient treatment. 69.08% of participants expressed confidence in understanding biosafety principles, while 26.57% remained neutral. Regarding the availability of resources, 69.08% felt that their practice provided adequate biosafety equipment and supplies.(Figure 2) Regarding actual practice, 78.26% of patients reported regularly using personal protective equipment (PPE) and 88.89% reported regularly sterilizing instruments used during dental procedures. The majority (91.79%) stated that they follow established biosafety guidelines in clinical

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practice. However, 30.43% reported occupational exposures such as needle stick injuries. Only 30.43% of those arrested reported the incident, highlighting the gap between positive attitudes and crime reporting behaviour. The majority (86.47%) recognized that reporting occupational exposures is important for proper post-exposure management. (Figure 3)

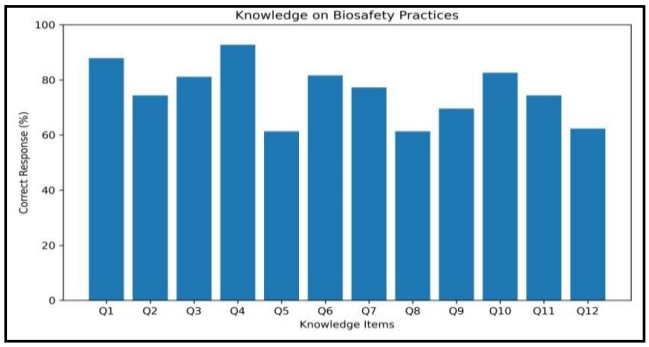

Figure 1: Knowledge on biosafety practices [Percentage of correct responses for each knowledge item (Q1–Q12) among participants]

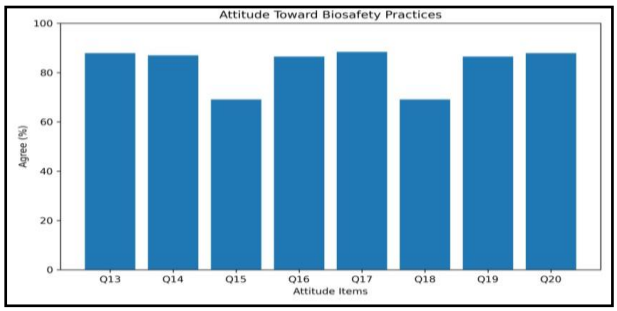

Figure 2: Attitude toward biosafety practices [Percentage of participants agreeing with each attitude item (Q13–Q20) related to biosafety in dental settings]

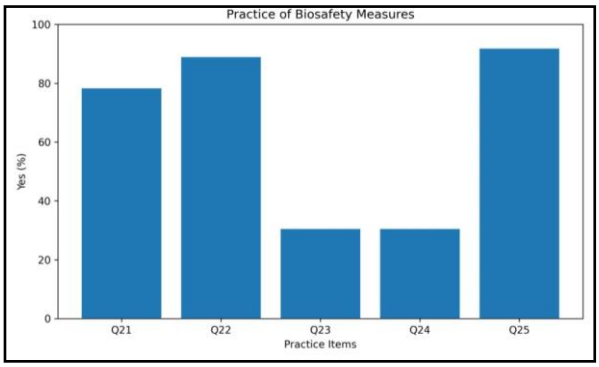

Figure 3: Practice of biosafety measures [Percentage of participants reporting adherence to each practice item (Q21–Q25) related to biosafety in dental settings]

Discussion

This study assessed dentists' knowledge, attitudes, and practices (KAP) regarding biosafety protocols. The results show an overall satisfactory level of knowledge and mainly positive attitudes towards biosafety practices, although at the practical level, implementation is relatively uneven. A high proportion of respondents demonstrated adequate knowledge of core biosafety concepts. Nearly 88% correctly understood the term biosafety in dental settings, and over 90% identified the most effective combination of personal protective equipment (PPE). Knowledge regarding post-infection management (81.16%), handling of sharps (81.64%), and need for vaccination (82.61%) was also satisfactory.These results are consistent with the study by Nidarkar et al. were 90.8% of dental students were aware of the term biosafety and 81.3% understood proper biosafety practices during the COVID-19 pandemic. Similarly, high levels of awareness of infection control protocols were observed among the dental students who participated in this study. However, several knowledge gaps were evident in this study. Only 61.35% correctly identified the most common route of transmission of blood-borne infections, and 62.32% correctly understood the concept of "standard precautions." Additionally, the number of correct answers regarding waste management (61.35%) and bloodborne pathogens (69.57%) was relatively low. These results demonstrate that although there is a wealth of theoretical knowledge regarding general biosafety principles, certain technical aspects need strengthening. Similar gaps were noted in a study conducted among laboratory workers during the COVID-19 pandemic a study published by Liu H et al, in which some participants showed incomplete understanding of transmission routes and biosafety levels. This trend highlights that even healthcare professionals may have partial knowledge in specialized areas of biosafety. The attitudinal domain of the current study revealed overwhelmingly positive perceptions of biosafety. More than 85% of respondents agreed that biosafety practices are necessary to protect dentists and patients, and 88.41% supported mandatory regular biosafety training. Furthermore, 86.47% believe that compliance significantly reduces occupational risks. These results are consistent with Nidarkar et al. report that 89.7% of participants believed that compliance

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with biosafety measures would help limit the spread of infection. Dentists' positive attitude may reflect the increased global awareness and interest in infection prevention following the COVID-19 pandemic.[15] However, approximately 28.50% of participants expressed neutrality regarding the adequacy of biosafety equipment in their practices and expressed concerns regarding infrastructure or logistics. The study done by Liu H et al found similar deficiencies in resource availability, including a lack of PPE, with 65.8% of respondents reporting inadequate PPE availability.[16] This suggests that a positive attitude alone is not enough without appropriate institutional support and resources. Within practice areas, 78.26% reported regular use of PPE by all patients and 88.89% reported regular sterilization of equipment, reflecting compliance with infection control principles. However, 30.43% reported occupational exposures (e.g. needle stick injuries) and a similar proportion reported such exposures, demonstrating the need for improved exposure prevention and reporting mechanisms. The knowledge and practice gap observed in this study mirrors the findings of previous research. Although awareness was high, only 48.1% of students felt they could perform procedures safely during the pandemic, according to a study done by Nidarkar et al.,[15] reflecting the gap between theoretical knowledge and clinical confidence. Similarly, the Liu H et al study found that despite good awareness, infrastructure limitations and inadequate training hinder the implementation of biosafety in practice. This reinforces the idea that actual behaviour is influenced not only by knowledge and attitudes, but also by environmental, organizational, and systemic factors.

Integration of knowledge, attitudes and practices

Our findings support the classic KAP framework that knowledge influences attitudes, and attitudes influence practice. Although respondents demonstrated strong knowledge and favourable attitudes, actual compliance was slightly lower, particularly in terms of exposure prevention and full compliance with standard precautions. Relatively high levels of occupational exposure suggest the need for continued monitoring, simulation-based training, and enrichment programs. Regular continuing education workshops, competency assessments, and systematic adherence to infection control guidelines can help close this gap in knowledge and practice.

Implications for Dental Education and Policy

Given that dentistry inherently involves exposure to blood, saliva, and aerosols, strict adherence to biosafety protocols is non-negotiable. The findings emphasize the need for:

1. Strengthening training modules on standard precautions and waste management
2. Ensuring adequate provision of PPE and sterilization infrastructure
3. Reinforcing vaccination compliance
4. Encouraging prompt reporting of occupational exposures
5. Implementing regular biosafety audits in dental institutions

Institutional commitment, along with continuous professional development programs, is essential to translate positive attitudes into consistent practice.

Limitations

Because this is a survey-based cross-sectional study, responses may be influenced by self-report bias and social desirability bias. Furthermore, clinical practice was not directly observed. Future longitudinal and observational studies may provide a deeper understanding of actual compliance behaviour.

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