

Dental Students' Knowledge, Attitude, and Practice towards Infection Control. An Overview and Updates

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Abstract

Infection control in dental clinics is an important measure to prevent cross infection of microbial pathogens between patients and dental care providers. Dental students should have the optimum knowledge, attitude and practice in this regard. It is essential to explore the studies in the literature that concern this topic. Therefore, the current review highlights the knowledge, attitude, and practice towards infection control in dental training clinics.

Keywords

Infection Control, Dental Students, Artificial Intelligence

1. Introduction

Infection is a worldwide challenge in healthcare systems, it is a primary contributor to morbidity, diagnostic, and treatment interventions [1].

Infection control refers to a set of measures established within the dental setting to avoid or minimize the transmission of pathogenic agents between patients and dental healthcare workers, as well as to limit the spread of infection outside the dental facility. These measures include standard and transmission-based precautions, such as proper hand hygiene, appropriate utilization of personal protective equipment, safe work practices, complete environmental cleaning and disinfection [2].

Knowledge, attitude, and practice (KAP) are the three essential elements of the dynamic system of life. Knowledge is identified as information acquired through various aspects, including reading, experience, and comprehension. Attitude refers to the manner, feeling, or position toward something; it includes

mind perceptions and self-orientation. Practice reflects compliance with rules and knowledge that leads to action. Subsequently, having the right knowledge, positive attitude, and good practice is essential for healthcare providers while serving their patients [3].

To guarantee effective infection control, three essential components must be present: knowledge, attitude, and practice (KAP). Knowledge gives one the information needed to perform appropriately and adopt the right attitude for outstanding practice [3]. The primary aim of infection control policies and procedures, implemented in hospitals and other healthcare environments, is to reduce infection rates and prevent the transmission of infections [4]. In dental environments, infection management is imperative and vital [5]. Cross-infections in dental environments are uncommon [6]; nevertheless, this may be attributed to inadequate recording, lack of information, and reporting [7]. The American Center for Disease Control and Prevention (CDC) asserts that the risk of cross-infection persists despite the limited reporting of such instances in dental care clinics from 2005 to 2015. Due to the significant consequences for patients in contaminated or infectious oral health facilities, it is essential that these conditions be explored and regularly evaluated [8]. It is very important to explore and review the studies in the literature, which concern this topic. Therefore, the current review highlights the knowledge, attitudes, and practices of dental students towards infection control in teaching dental clinics. While dental students remain the core focus of this review, select key studies involving dental faculty, practicing clinicians, and broader health science students are explicitly integrated. This inclusion is intended to establish a crucial baseline of comparison, illustrating how infection control compliance transitions from academic training to active professional practice.

2. Infection in Dental Clinics

Dentists are particularly vulnerable to cross-infection because numerous pathogens naturally thrive in the mouth cavity, where the wet conditions encourage the growth of pathogens [9]. Furthermore, the risk of infection from oral cavity-colonizing microorganisms is increased by direct contact with blood and saliva. Blood-borne infections such as the Hepatitis B (HBV) and C virus (HCV), the Human Immunodeficiency Virus (HIV), *Mycobacterium tuberculosis* (TB), streptococci, and other bacteria and viruses that colonize the upper respiratory tract and oral cavity [10].

In 2012, Laheij *et al.* conducted a study that reviewed the literature to ascertain the probability for infection and cross-transmission of bacteria and viruses particularly pertinent to the dental practice environment, including HBV, HCV and HIV. The study determined that the transmission and infection of HBV present the most danger for both dentists and patients [11].

A study performed in the late 1970s [12], showed that dentists were likely exposed to HBV infection three times more than the general population. In 1991, the Occupational Safety and Health Administration (OSHA) of the United States

Department of Labor established the Blood-borne Pathogens Standard to protect workers from exposure to blood-borne pathogens, including HBV, HCV, and HIV.

3. Infection Transmission in Dental Clinics

The transmission of infection between patients and clinicians in a clinical setting is known as cross-infection. During dental operations, infections can spread through direct contact with body fluids or indirectly through infected tools [13]. In dental procedures, infection transmission may occur via direct contact with blood, saliva, injury from an anesthetic needle, splash exposure to mucous membranes, droplets, aerosols, or indirect contact via contaminated tools and surfaces (Figure 1). Accidental exposure to pathogens in dental facilities can be prevented by adhering to safety procedures and applying infection control protocols [14] [15].

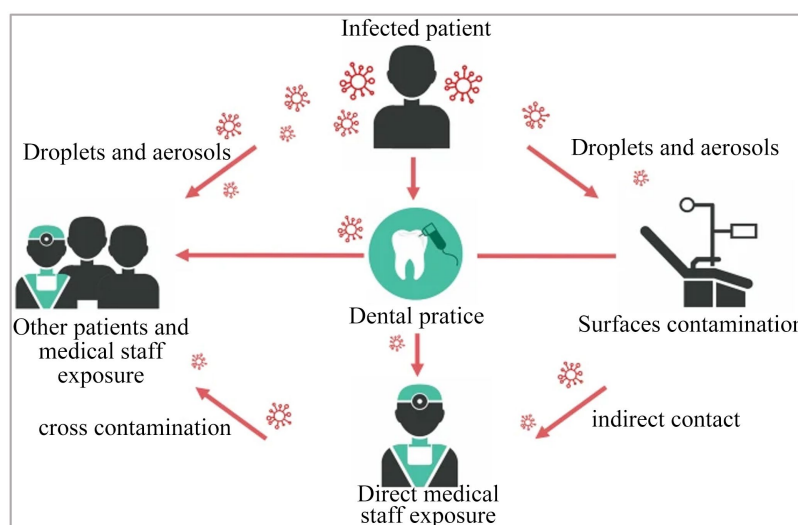


Figure 1. Cross-infection cycle in dental clinics [16].

4. Infection Control Protocols in Dental Clinics

Infection control strategies comprise contact, droplet, and airborne precautions, determined by the transmission method of the infectious agent [17]. Health care personnel who fail to implement appropriate infection control measures during patient care are at an increased risk of contracting infectious illnesses [18].

CDC adopted the term “standard precautions” in 1996 to represent a more inclusive strategy for preventing virus transmission [19]. Standard precautions involve augmenting general preventative actions to protect healthcare workers and patients from pathogens in healthcare facilities [19].

Strategies to protect health workers include implementation of standard precautions; vaccination against relevant infectious diseases; provision of personal protective equipment (PPE); effective disinfection and cleaning of surfaces and equipment to eradicate pathogens; sterilization of instruments; and appropriate

handling of sharp instruments and management of exposure, as advised by the World Health Organization (WHO) [20].

Standardized infection control protocols are the most effective strategy for reducing cross-infection in dental facilities. Dental institutions must ensure the enforcement of protocols associated with prevention and transmission within the dental setting. Also, it is essential to emphasize the importance of vaccination for all those delivering oral health care [10] [14].

5. Infection Control among Dental Students in Local Studies

A study was conducted at Al-Quds University (AQU) that assessed the infection control protocols at dental clinics within the Hebron district of Palestine, focusing on adherence to guidelines for infection control (Al-Quds University [AQU] 2017). Merely 5.5% of dentists attended infection control training courses in the past two years, and only 19.3% were given access to the protocol when required. Most dentists showed a positive attitude towards handwashing protocols and commitment to hand hygiene practices. Also, variations were spotted among males and females in hand washing, dental clinic surroundings disinfection, and sterilization of dental instruments. Dentists' attitude score towards infection control was estimated at 65.82%, while compliance was 44.1%. The study outlined that there was insufficient implementation of infection control protocols in Palestinian dentists' clinics [21]. Assessment of the Infection Control System in Dental Clinics in Hebron District [21].

Another study was also conducted at Al-Quds University showed that the majority of Al-Quds University (AQU) dental students and interns demonstrated good knowledge of key sterilization principles, particularly autoclave operation. The students also reflected on strong compliance with the essential protective tools (PPE), such as gloves and masks [22].

Menawi *et al.* (2021) aimed to investigate the knowledge and compliance degree with infection control procedures in dentist clinics in the Palestinian areas of Nablus and Tulkarm. The results outlined that there was medium compliance (70%) with infection control protocols in Nablus and Tulkarm dentists' facilities [23].

Al-Sharif and Hussein (2023) attempted to evaluate the knowledge and compliance of infection control standards across dentists in the West Bank and Jerusalem. The research included a self-administered questionnaire provided to dentists in the West Bank and Jerusalem. The study sample involved 395 dentists. The findings indicated that overall dentists' adherence to infection control standards was poor as only 18.5% of dentists expressed good compliance. This study also highlighted that compliance is correlated with age, work experience, and year of graduation [24].

6. Vaccination Compliance and Barriers

Vaccination protocols serve as the foundational line of defense against blood-borne occupational pathogens. Globally, significant disparities exist in coverage

rates among dental students. In regional studies, Alharbi *et al.* (2019) conducted a cross-sectional study to evaluate KAP regarding infection control protocols among dental college staff and students at King Saud University (KSU) in Riyadh, Saudi Arabia. The sample comprised 317 dental staff members, third, fourth, and fifth-year students. A questionnaire comprising three KAP sections was distributed to the participants. The findings showed that dental staff and students at KSU had strong infection control compliance. On the other hand, the study identified a gap in knowledge of fundamental infection control principles. Unexpectedly, the Third-year students expressed higher knowledge and compliance level. Furthermore, students had better compliance than their teachers. The study investigation of HBV vaccination revealed a high percentage of participants who received the HBV vaccine (93.1%) [13].

Halboub *et al.* (2015) conducted a study at Sana'a University in Yemen. The study assessed the fourth and fifth-year dental students' KAP towards infection control. This cross-sectional study involved a self-administered questionnaire. The students' response rate was 72% and 71.7% were vaccinated against the HBV. Only a small portion of students tested their immunity level after vaccination (9.5%). The students showed a high compliance towards wearing gloves during dental procedures (96.6%). This study had also identified a gap in using face masks and eyewear as only 53.8% and 14% of students used them respectively [10].

Hand Hygiene Protocols and Personal Protective Equipment (PPE) Compliance:

El-Saaidi *et al.* (2021) conducted a cross-sectional study in four public dental schools in Egypt to verify dental students' KAP of infection control. A self-administered questionnaire was used to collect responses. The overall response rate was only 60.1%. The study revealed that students' knowledge was low in spite of their positive attitude and practice. The Female students showed higher knowledge of sterilization techniques and better practices in the use of personal protective equipment (PPE). The fourth-year students had better scores than in the fifth students in infection control practices. This study also found that 30% of students were unvaccinated; this is a high percentage when combined with findings that 60% and 38% experienced needles and sharp injury [25].

Salih (2021) reported dental students' KAP of infection control. This research was applied in the Pedodontics Clinics, Faculty of Dentistry of the University of Baghdad, Iraq. The findings showed a high compliance amongst students with glove usage at 98.2% and consistent PPE use (100%). 84.04% of students were vaccinated against HBV. Occupational injuries were mainly due to needle sticks; this incident was the highest among the postgraduate students' group [26].

Asif *et al.* (2018) conducted a study at the College of Dental Medicine in King Khalid University in Saudi Arabia (KSU) to evaluate students' KAP toward infection control using a self-administered questionnaire. Most participant students were males (82%). The study revealed poor compliance with protective eyewear which was used by only 22% of students. About 90% of students had received HBV

vaccination and their practices were positive as, 98.7% reported wearing gloves during dental procedure. Besides, only 40.5% of all students expressed willingness to treat patients with infectious diseases [27].

Saleem *et al.* (2023) went further than evaluating infection control KAP. Their study was dedicated to reviewing practices of post-exposure prophylaxis (PEP). The study conducted a self-administered questionnaire among fifth-year students in private institutions in Egypt. The study found a knowledge gap in the students understanding of PEP administration in case of needle or sharp injury. Surprisingly, 47.5% of students reported that PEP should be administered following any needle stick injury [28].

Dagher *et al.* (2017) conducted a study in private dentistry clinics in Lebanon to assess dentists' knowledge of infection control protocols. The findings of this study revealed a high percentage (90.6%) of vaccination against HBV. The study also found a low eyewear usage similar to others reviewed in the literature, only 43% of dentists reported they used it [29].

In Morocco, Kadri *et al.* (2022) evaluated dentists' KAP in both the public and private sectors. The study was based on a self-administered questionnaire. Out of the 209 collected replies 58% were from the corporate sector and 32.7% were academics. Unlike previous studies, this study compared the differences between the groups based on the median. The dentist's knowledge in this study showed a high median score (21 out of a possible 24). The median attitude score was 3 out of 6 (relatively low). The dentists also showed a very poor median practice score (1 out of 8) [30].

7. Personal Protective Equipment (PPE) Compliance

The utilization of Personal Protective Equipment (PPE) remains a mixed domain where gloves and masks are universally adopted, but protective eyewear is widely neglected. Locally, Ayyad (2026) demonstrated that the majority of dental students and interns at Al-Quds University exhibited exceptional compliance with essential protective tools such as gloves and face masks [22]. This strong baseline is mirrored regionally and globally, with Salih (2021) reporting 98.2% glove compliance and 100% consistent general PPE usage in Iraq [26], while Azhar *et al.* (2022) found a similarly high compliance trend to PPE frameworks in public dental colleges in Karachi [31]. Gender differences were also highlighted by El-Saaidi *et al.* (2021) in Egypt, where female students displayed significantly better practices regarding PPE usage compared to male peers [25]. In Romania, Dincă *et al.* (2024) noted that while students possessed excellent knowledge regarding PPE types, they suffered from a poor underlying understanding of actual viral transmission risks [32].

However, protective eyewear compliance is universally poor across almost all datasets. Asif *et al.* (2018) revealed that only 22% of students at King Khalid University utilized protective eyewear [27]. Similarly low numbers were reported by Halboub *et al.* (2015) in Yemen, where only 14% of students wore clinical eyewear

[10]. This behavioral trend persists into postgraduate practice, as Dagher *et al.* (2017) noted that only 43% of private practice dentists in Lebanon wore appropriate protective eyewear [29].

8. Global Studies

In Bhopal in Central India Singh *et al.* (2011) performed a study involving 245 students in college stage. The study assessed dental KAP towards infection control utilizing a self-administered questionnaire. The study showed moderate levels of knowledge (3.75), attitude (3.4) and practice (3.35). The study revealed a significant linear correlation between attitude and practice ($r = 0.2$, $p < 0.01$). Surprisingly, a high percentage of students were unvaccinated against HBV, about 61.2%. The study recommended training on infection control protocols before graduation and obligatory HBV vaccination before entering clinical training stage [15].

A cross-sectional study was conducted at the dental college of the Foundation University Dental Collegian Rawalpindi in Pakistan. This study also assessed senior dental students' knowledge of infection control protocols. The study relied on a self-administered questionnaire to collect required data. It was revealed that over 50% of students didn't use antiseptics to sanitize their hands. Students had low knowledge regarding the standard autoclave temperature and only one-third of them used PPE during dental procedures operation. The study highlighted poor students' knowledge and practice despite their positive attitude [33].

Another Indian cross-sectional study from India by Mohan *et al.* (2024), evaluated the KAP of 222 dental students at the Rajendra Institute of Medical Sciences. Although 98.8% of students demonstrated knowledge about immunization, only 3.8% of students had received HBV vaccine. This highlights the gap between theoretical knowledge and real practice [34].

Azhar *et al.* (2022) a cross-sectional study in public dental college in Karachi compared KAP toward infection control. A self-administered questionnaire was used to collect data. The study found a high compliance to PPE and about 88.4% of students received HBV vaccine [31].

In the Northwestern Ethiopia, Anteneh *et al.* (2019)'s study was performed in the University of Gonder Comprehensive Specialized Hospital. The study involved health science students including dentists. The study is important as it highlights the gap in knowledge of PEP of HIV. Unfortunately, hardly 30% of medical students had sufficient knowledge of anti-HIV drugs and PEP [35].

A similar cross-sectional study was conducted in Romania. Dincă *et al.* (2024) formulated a questionnaire to evaluate dental students' KAP of infection control. The study showed a good student's knowledge of PPE but poor understanding of the viral transmission risk. The student's willingness to treat patients with infectious diseases was excellent [32].

A cross-sectional study was conducted in Peru to assess dental students' KAP. Using a validated questionnaire developed by Silva-Robles *et al.* (2025), data was collected from 503 dental students. The findings showed poor students' knowledge,

but their attitude was positive [36].

In Athens, a study was conducted at the National and Kapdoistian University to assess fifth year dental students' KAP. Antoniadou *et al.* (2025) found that vaccinated dental students had greater knowledge compared to their unvaccinated peers [37].

Another important aspect in dental clinics is the dental impressions disinfection. Binassfour *et al.* (2024) investigated KAP of dental health workers regarding dental impressions. This study gathered data by a questionnaire distributed via google form. This study found an average knowledge of dental impressions disinfection (54.6%). The dentist's attitude was neutral and only 25.1% were positive about disinfection of impressions [38].

Because KAP surveys lack a universal standardized metric, our comparison looks at main trends rather than direct statistical equivalents. We explicitly state that because the included studies utilize diverse questionnaires and scoring metrics, our comparisons focus on qualitative trends and relative percentages rather than direct quantitative equivalencies. This context has been added prior to drawing any cross-study conclusions.

9. Artificial Intelligence (AI) Applications in Infection Control Protocols

Infection control is obviously fundamental to maintaining safe dental settings. The growing fast smart world has recently led to emerging Artificial intelligence (AI) in various aspects of life. The idea of integrating sterilizing techniques with AI has become popular in the last few years [39].

Yet, the classical AI application in dental medicine is primary diagnosis. AI is being recently operated in cavities, vertical root cracks, and lesions identification. Several recent studies indicated remarkable efficiency and accuracy in dental diagnosis [40].

A systematic review was done by Ahmed *et al.* (2021); this review examined AI techniques and impacts on dental medicine. The study emphasized that AI facilitates precise patient care and diagnosis. This review underscored that AI contributes to more precise patient care by improving diagnostic accuracy, supporting individuals' treatment plans and facilitating precise clinical interventions [41].

In terms related to infection control, AI showed high capacity of infection prediction. Arab *et al.* 2025 found that AI assisted with surveillance systems topped conventional systems with its capacity to precisely identify infections and improve compliance to hand hygiene protocols. This study highlighted AI capacity to enhance early detection of outbreaks, optimize surveillance systems and support decision making through predictive analytes [42].

An Interesting recent study by Aldahlawi *et al.* (2025) evaluated the efficiency of an AI model in assessing proper hand sanitization in dental clinics. The AI model demonstrated 90.91% agreement with infection control standards with sensitivity of 85.7% specificity 100%. The study concluded that AI models for hand

hygiene assessment were reliable [43].

The AI perception is not yet fully favored in many different occupations including dentistry. Amiri *et al.* (2024) found that students hesitate to utilize AI despite its benefits as they have concerns about their future work opportunities being dominated by AI technology [44].

Further investigations are needed in this regard, mainly the benefits of using AI tools can be used to improve students' knowledge, attitudes and practices for infection control.

10. Conclusion

Infection control in dental clinics is essential and crucial, as indicated by numerous studies which investigated knowledge, attitudes and practices among dental students. Using questionnaires with dental students helps to assess their knowledge, attitudes and practices in infection control might improve that. However, the usage of artificial intelligence tools is scarce in the literature. Further investigations are needed in this regard.

Author Contributions

Conceptualization: Abu Hantash RO and Ayyad, A.

Resources: Ayyad A.

Writing: Ayyad A. and Abu Hantash RO.

Writing: original draft preparation, review and editing: Abu Hantash RO, Ayyad A, Abu Younis MH, and Habash FS.

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All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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