

Evaluation of Infection Control Awareness and Compliance among Undergraduate Dental Students in the Teaching Hospital of Karachi & Lahore, Pakistan

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ABSTRACT

BACKGROUND: Infection control is a critical component of dental education and clinical practice. Dental students are at high risk of cross-contamination due to frequent exposure to blood and saliva during patient care. Adequate knowledge and compliance with infection control protocols are essential to prevent the transmission of infectious diseases in the dental setting.

OBJECTIVE: To assess the knowledge, attitude, and practice (KAP) regarding infection control among undergraduate dental students staying at the teaching hospital of Karachi, Pakistan

METHOD: A descriptive cross-sectional study was conducted among undergraduate dental students from a selected teaching hospital in Karachi and Lahore . A self-administered, structured questionnaire was used to evaluate students' knowledge, attitude, and practice related to infection control measures including hand hygiene, use of personal protective equipment, sterilization, and waste management. Data were analyzed using descriptive and inferential statistics to determine the association between demographic variables

Online ISSN

3007-3197

Print ISSN

3007-3189

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RESULT:

Most participants demonstrated satisfactory knowledge of basic infection control measures; however, gaps were identified in compliance with standard precautions, particularly in consistence use of protective barriers and proper sterilization techniques. A positive attitude towards infection control was observed, though actual practices were not always aligned with knowledge levels. Statistically significant differences were noted between clinical and preclinical students ($p < 0.05$)

CONCLUSIONS:

Although dental students showed adequate awareness and positive attitudes towards infection control, inconsistencies in practical application highlight the need for continuous training, stricter supervision, and reinforcement of infection control protocols within dental institutions.

Keywords: Infection Control, Dental Students, Knowledge, Attitude, Practice, Cross-Contamination, Karachi, Pakistan.

Introduction:

Health-care Related Infections (HAIs) also described as ‘Nosocomial Infections’ have a significant threat to the human life.⁽¹⁾ HAIs are associated with the medical or surgical interventions. Health care practitioner when potentially exposed to an asymptomatic or pre-symptomatic infected patient developed a significant risk of infection.^(2, 3) History has proved that the presence of potential pathogenic microorganism in the inside atmosphere of health care institutions creates a high risk of infection.^(4, 5)

Disease-causing potential pathogens

Dentists are at high risk to the pathogenic microorganisms due to their close proximity with the patients’ oral cavity and body fluids.⁽⁶⁾ Dental teaching hospitals perform a large number of invasive treatments periodically inside a limited operating room where a remarkable amount of aerosols are generated. Notably, these aerosols contain a broad spectrum of pathogens and with the use of potentially critical instruments, there is a significant risk of infection from blood-borne diseases like Mycobacterium Tuberculosis (TB), Human Immunodeficiency Virus (HIV), Herpes Simplex Virus, Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV), or droplet-borne infections like Methicillin-resistant Staphylococcus aureus (MRSA), Coronavirus (COVID-19), Influenza and Severe Acute Respiratory Syndrome (SARS).⁽⁷⁻¹⁰⁾ Furthermore, with the increase of pathogens in the healthcare environment that are resistant to antimicrobial drugs, an alarming situation has been created.⁽¹¹⁾

Mode of transmission of infection in dental practices

These pathogens can be transmitted in the dental clinics: (a) directly through blood, mucosal fluids and patients’ belongings, (b) indirectly through contaminated equipment like critical instruments and surfaces, (c) contact of the mucosal-droplets containing pathogens (aerosols) from an infected individual through sneezing, coughing or with the use of contaminated dental instruments (d) by airborne pathogens remained in the clinic atmosphere for a long period.⁽⁸⁾ Therefore, infection control measures have to be

Online ISSN

3007-3197

Print ISSN

3007-3189

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ensured by proper hand hygiene, maintaining sterilized instrumentation and environment, and with utilization of personal protective equipment (PPE).

Medical aspect of infection control in dental practices

All dental practitioners have to ensure adequate infection prevention and control measures for patients' safety and for their own health. The aerosol dynamics of dental teaching hospitals, where undergraduate dental students are trained with a huge amount of patient flow, contain more potential pathogenic organisms.⁽¹²⁾ It is therefore necessary that thorough and vigorous training of infection control must be provided to the dental personnel especially to undergraduate dental students to avoid cross contamination between patients and doctors.⁽¹³⁾ The medical aspect of infection control requires a proper protocol of hand hygiene, utilization of PPE including gloves, masks, eyewear and protective gowns, disinfection/sterilization of critical instruments, surface cleaning, rubber dam isolation to prevent contact of blood/mucosal fluid with the dental personnel. Biohazardous waste produced in the dental office must be treated within the protocol provided in the CDC guidelines. Contaminated needles are disposed immediately in puncture-proof containers to prevent accidental needle injuries. Dental unit waterlines are purged at the beginning of day and anti-microbial treatments used to prevent microbial biofilm growth and contamination.^(14, 15)

Legal and financial aspects of infection control in dental practices

Dental practices must comply with infection control regulations set by agencies like Occupational Safety and Health Administration (OSHA), Centers for Disease Control and Prevention (CDC), Asia Pacific Society of Infection Control (APSIC) and state dental boards to protect patients and staff. These Regulations cover areas like sterilization, cleaning, waste disposal, vaccine requirements. Failure to follow standards of care can result in malpractice liability if inadequate practices lead to patient or staff illness/injury.^(16, 17) Establishing infection control in dental practices requires financial stability. There are costs associated with setting up adequate infection control systems - sterilizers, autoclaves, washer-disinfectors, PPE, sharps containers etc. Employees need regular training and certification in areas like sterilization, OSHA standards which have associated program/course fees.⁽¹⁸⁻²⁰⁾ Therefore, while necessary for compliance and patient safety, comprehensive infection control does present an ongoing financial investment for dental practices.

The risk of infection transmission can be significantly minimized by adhering to the infection prevention protocols allocated by CDC and Ministry of National Health Services Regulations and Coordination (NHSR&C), Government of Pakistan. Nevertheless, infectious diseases are prevalent in the dental field globally, including in Pakistan. Furthermore, there was limited amount of research available on the statistics of dental teaching institutions' compliance to the modified infection control protocols to prevent the spread of infection among undergraduate students. Therefore, this research aims to determine the knowledge, attitude and practical application of different techniques of infection control being practice in the government-funded dental teaching hospitals of Karachi, Pakistan. The awareness among undergraduate dental students towards the protocols of infection control has been analyzed to identify whether the

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3007-3197

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3007-3189

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existed knowledge is sufficient or should government has to design specific training programs for the students.

Methodology:

Research design

A cross-sectional research analysis was conducted in the duration of 6 months between September 2024 to February 2025. The research settings had been set up in the departments of dentistry of two main teaching hospitals Jinnah Medical and Dental College and Shalamar Medical and Dental College Lahore.

Sample size and technique

Simple Random Sampling technique was used to collect data. Research participants were selected random. Sample size was calculated to estimate the prevalence of adequate infection –control compliance with 95% confidence and 5% margin of error, resulting in a target of $n = 385$ students per hospital. After applying a 15% allowance for non-response, N invited = 282 per hospital were invited.

Inclusion criteria

Participations were voluntary after consent; all research participants had been provided with the informed consent form including the purpose of this research. The targeted research participants were the undergraduate dental students enrolled in JMDC and SMDC were physically present during the period of this research. Students who were studying in clinical years i.e. students enrolled in 3rd and 4th professional years of their dental school were included. Students of either gender male or female were included if they signed the informed consent form.

Exclusion criteria

Undergraduate dental students who were not enrolled in the dental schools of either of these institutions were excluded from this research. Dental students who were not present physically in the dental clinics during the course of this research were excluded. Newly admitted dental students and students of initial/preclinical years i.e. 1st year and 2nd year dental students were excluded from this research. Participants who had not signed the informed consent were also excluded.

Survey

A structured questionnaire was developed for this research purpose based on the infection control protocols. The questionnaire was distributed among the participants in hard copies through personal interviews. The questionnaire took about 5 to 10 minutes to complete. This structured questionnaire is divided into parts containing the demographic information, immunizations of research participants, knowledge of infection control, and the extend of practical application in the dental clinics.

Statistical Analysis

Descriptive statistical tools (percentages and means) were used to analyze the data.

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3007-3197

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Comparative analysis between different variables was conducted with the use of Chi-square test. P-value < 0.05 was contemplated to be statistically significant. Statistical analysis was executed by using SPSS version 26.

Results:

A total of 282 undergraduate dental students participated in this research after fulfilling the inclusion criteria and exclusion criteria. **Table 1** demonstrates socio-demographic elements of research participants. Out of 282 participants, 191 (67.7%) were females and 91 (32.3%) were males. Two-thirds participants (186) were enrolled in JMDC while the one-third participants (96) were enrolled in SMDC respectively. Almost 50% (142) participants were studying in 3rd professional year while the remaining 50% (140) participants were studying in their 4th professional year.

Majority of research participants (81.2%) have agreed on the importance of immunization/vaccination of undergraduate dental students that it should be compulsory for every dental student while few participants (18.8%) have disagreed because of the fact that essential vaccination comes with potential side effects and have a significant financial burden on students.

Although 207 (73.4%) students agreed that they have accurate knowledge of employment of Personal Protective Equipment but further investigation revealed that only 57.8% students were aware with the correct donning sequence and 49.3% students have correct knowledge of doffing chronology. Comparative analysis demonstrates no significant relation between teaching institutions and awareness of donning and doffing chronology, $\chi^2(1.399)$, $p0.211$ and $\chi^2(1.47)$, $p0.211$ respectively. Most frequently used PPE were Gloves (97.5%) and face masks (93.6%) followed by protective eyewear (68.4%) and gowns (35%). Majority of participants 218 (77.3%) disposed of contaminated Personal Protective Equipment in a biohazard bag and 246 (87.2%) executed hand hygiene post-treatment after removing PPE. 81.2% (229) participants suffered shortage and insufficient supply of PPE by their teaching hospital/university and 72.7% (205) participants had to purchased PPE on their own. To avoid self-contamination 46% (130) undergraduate students used scoop technique during needle handling while only 32.6% (92) students used pre-treatment prophylaxis mouthwash in patients. 4th professional year students (62.9%) used surface disinfectant after every patient were more cautious as compare to 3rd year students (35.2%) who only used surface disinfectant at the end of the day, $p0.001$.

Following an exposure to blood or body fluid with visible blood, 43.6% participants were fully aware of the preventive steps to take, while only 39.7% (112) of participants knew the ideal management of torn gloves during the dental procedure. About 196 (69.5%) undergraduate students did not attend any sort of training course or session on the infection prevention and control protocols. Further investigation revealed that about 85 (43.4%) students acknowledged that they did not have availability of these courses by their teaching institutes, 63 (32%) participants responded that the courses offered by private institutes are expensive while 37 (18.9%) were not aware of the availability of training courses, and 11 (5.6%) considered it was unnecessary to attend the course. A chi-square test revealed a significant association between year of study and training sessions attended. The 4th professional year students (42.9%) were more likely to attend

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3007-3197

Print ISSN

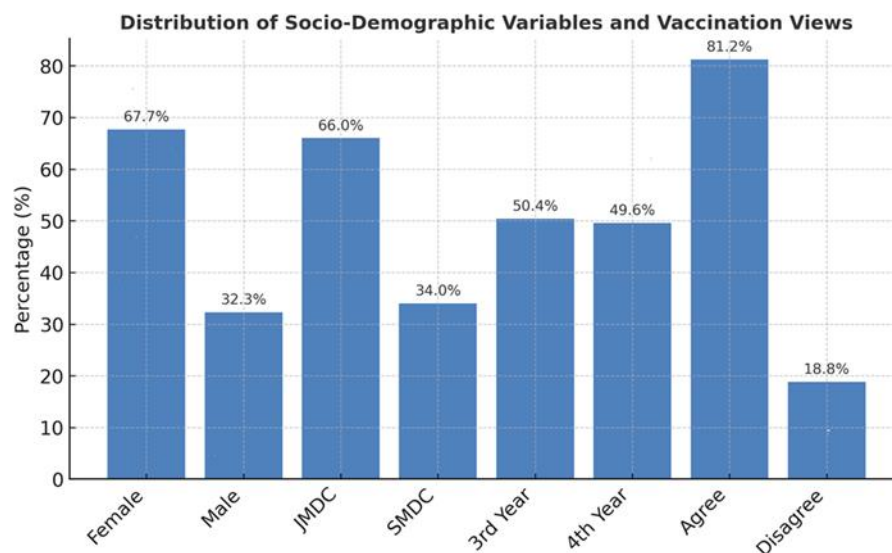
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training sessions in contrast to 3rd professional year students (18.3%), p0.001. 162 (57.4%) students were unaware about institutional policy and procedure on Infection Control.

Table 1 Socio-demographic characteristics of undergraduate dental students (n = 282)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Female	191	67.7
	Male	91	32.3
Institution	JMDC	186	66.0
	SMDC	96	34.0
Year of Study	3rd Professional Year	142	50.4
	4th Professional Year	140	49.6
View on Vaccination	Agree (should be compulsory)	229	81.2
	Disagree (due to side effects/cost)	53	18.8



Discussion:

In 1985, the Centers for Disease Control (CDC) presented Universal Precautions, and later introduced Standard Precautions in 1995. These precautionary measures set as standard guidelines for the prevention of infectious diseases and transmission of potential pathogens through blood, mucosal fluid or by aerosols. ⁽²¹⁾

Cross-infection is defined as the transmission of pathogens or microorganisms from

Online ISSN

3007-3197

Print ISSN

3007-3189

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one person or source to another (between patients and dental professionals), potentially causing infections. The CDC's Standard Precautions are deliberated to establish a sterile working environment and to inhibit the spread of Healthcare Associated Infections among patients and dental personnel. Knowledge and compliance to these precautionary measures are critical for cross-infection prevention. Similar literature is available worldwide about dental students' compliance towards cross-infection prevention, and there is a widespread opinion that dental students have to be more conscious to be protected from the risks of cross-infection.⁽²²⁾

Current literature reveals that Dentists and Dental personnel especially undergraduate dental students are at high risk of acquiring infection because of their close proximity with the patients' oral cavity and continuous exposure to potential pathogenic microorganisms through blood, mucosal fluids and aerosols, and even affected by needle injuries.^(6, 23) The risk of infection transmission can be reduced through strict compliance to Standard Precautions allocated by CDC. This present research reported the awareness, attitude and practical approach of infection prevention among undergraduate dental students of government-funded teaching hospitals of Karachi, Pakistan. These results corresponded with the results of other relevant researches in the field. Srivastava KC et al. conducted a research on 318 subjects in Saudi Arabia reported an average level of awareness (51.6%) but a good level of attitude (92.1%) of subjects towards infection control.⁽²⁴⁾ Similarly, another cross-sectional research conducted on 195 allied healthcare professionals reported a moderate level of awareness (58.2%) and a good level of attitude (80%)⁽²⁵⁾

To prevent cross-infection during dental treatments, adequate vaccination of dental professionals is the best procedure. Past literature revealed that the frequency of hepatitis B vaccination among dental professionals is found to be varies from 38% to 100%.^(23, 26, 27) Substantially, undergraduate dental students in the present research had positive attitudes regarding vaccinations as majority students (86.9%) reported have been vaccinated against COVID-19 and 75.5% students vaccinated against Hepatitis B, along with other vaccines. Rahman et al. reported a similar finding (65%)⁽²⁸⁾. Nevertheless, this frequency is significantly less than that reported in other relevant studies by Al-Maweri et al.⁽²⁶⁾ and Alavian et al.⁽²⁷⁾, which reported greater than 80% frequency of hepatitis B vaccination acquired by students.

In healthcare settings, the best preventive measure against cross-infection is the appropriate use of barrier techniques. A barrier can be created against pathogens by the proper utilization of PPE which includes the use of gloves, masks, eyewear and protective gowns.⁽¹⁸⁾ Our research has reported the highest compliancy with the use of gloves (97.5%) and face masks (93.6%), these outcomes are corresponding to the outcomes of past researches conducted in other countries like UAE⁽²⁸⁾, Saudi Arabia⁽²⁶⁾ and Germany⁽²³⁾. Nevertheless, the frequency of the use of protective eyewear and gowns were significantly low, 68.4% students used protective eyewear while only 35% students were wearing gowns at all times. However, noncompliance with the use of eyewear and gowns is not distinctive to Pakistan, significant negligence has also been found among dental students of other countries like UAE⁽²⁸⁾ and Saudi Arabia⁽²⁶⁾. Although majority students in our research have agreed that they have the appropriate knowledge of PPE but further investigation revealed that only half of the subjects were

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3007-3197

Print ISSN

3007-3189

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aware with the correct donning and doffing chronology. This lack of awareness has also been reported in the study conducted by Mahmood N., et al., among 204 frontline healthcare workers only 55.9% and 47.1% were have the accurate knowledge donning and doffing chronology respectively.⁽²⁹⁾

Besides PPE, an effective means to prevent the transmission of healthcare associated infections is to follow proper hand hygiene. It is mandatory for every healthcare worker to perform accurate hand hygiene before and after giving treatments. The recommended CDC guidelines for proper hand hygiene involves either the use of alcohol-based hand sanitizer (with 60% alcohol) or hands washing with soap and water (for minimum 20 seconds).^(18, 21) A good compliance has been reported in our research as majority of students execute proper hand hygiene following the removal of PPE. There was also positive compliance in handling the PPE waste as majority of students disposed of PPE in a biohazard bag. However, there was a significant shortage in the available of PPE by the teaching institutes as 72.7% students had to purchased PPE from outside which has creating a potential financial burden on the students. This concerning PPE shortage has also been reported in a similar research conducted by Mahmood N., et al.⁽²⁹⁾

The use of pre-treatment prophylaxis mouthwash with antiseptic solution is an effective means of preventing airborne (aerosols) microorganism transmission inside the dental clinics. In our research a significant noncompliance has been reported because only one-third participants used the pretreatment antiseptic mouthwashes in patients. This negligence points out the lack of awareness among the undergraduate dental students towards the aerosol dynamics generated in the dental environment. A similar negligence has also been reported in a study conducted in Saudi Arabia by Alharbi G. et al.⁽³⁰⁾

The clinical application of our research intends in the fact that there is a significant lack of awareness among undergraduate dental students regarding infection control compliance because more than two-third students have not attended any sort of training course or session on the infection prevention and control protocols.

Conclusion:

To conclude, undergraduate dental students in this research reported a moderate level of awareness and attitudes towards infection control. Furthermore, there were moderate compliance with the protocols of standard precautions allocated by CDC. There was a significant shortage of PPE have been reported which should be immediately address to the management of teaching institutes and state health authorities to ensure the adequate supply of PPE to all healthcare workers especially dentists and dental personnel to prevent contagious infection transmission. It should be mandatory for teaching institutes to arrange workshops and seminars on protocols of standard precautions for undergraduate dental students to overcome the challenges of noncompliance.

Limitations:

This research had several limitations that have to be consider: the limited sample size, the irregular gender distribution, the random selection of participants, and insufficiency of bias evaluation.

Online ISSN

3007-3197

Print ISSN

3007-3189

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3007-3197

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