

Biosafety practices among dental undergraduates in AIMST University: A cross-sectional study

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ABSTRACT

Introduction

Biosafety practices are vital in dental education and clinical settings to prevent cross-contamination and safeguard both patients and healthcare professionals.

Aims & Objectives

This study assessed the knowledge and attitude of undergraduates towards biosafety practices.

Design

A cross-sectional study was performed among 172 undergraduate dental students at AIMST University.

Methods

A self-administered online questionnaire was used.

Results

Year 5 students showed the lowest proportion of satisfactory biosafety knowledge (87.8%, $n = 43$), though differences across years were not statistically significant ($p = 0.1638$). However, only 51.0% ($n = 25$) demonstrated a satisfactory attitude, with a significant association between attitude and year of study ($p < 0.001$). This indicates a decline in constructive attitudes over time despite consistent knowledge levels. Factors such as clinical fatigue, desensitization, or lack of ongoing reinforcement may contribute to this discrepancy. The findings reveal no significant relation between biosafety knowledge and attitudes, especially among final-year students.

Conclusion

It is recommended that targeted interventions such as refresher courses, workshops, simulation-based training, and case-based discussions are regularly conducted. Biosafety education should be integrated throughout all academic years, supported by regular assessment and feedback, to ensure students maintain both competence and commitment to safe clinical practice.

Key words

Communicable disease, biosafety, cross-infection, COVID-19

INTRODUCTION

The global outbreak of infectious diseases, particularly the COVID-19 pandemic, has had immediate and far-reaching implications for healthcare systems worldwide, with the field of dentistry being among the most severely affected. Based on *The New York Times Magazine*, while healthcare professionals were broadly recognized as being at elevated hazard of acquiring COVID-19, dental clinicians represented the most vulnerable subgroup.¹ This heightened susceptibility is primarily accredited to the dental procedures, many of them are aerosol-generating and therefore capable of dispersing infectious droplets into the clinical environment. This significantly increases the risk of transmission for both practitioners and patients. Given the intrinsic risk associated with dental interventions, the implementation of rigorous biosafety protocols and individualized assessments of patients' clinical status are essential in mitigating the potential for disease transmission.² To effectively disrupt the transmission chain, it is imperative that all members of the dental team possess a comprehensive understanding of infection pathways, are able to identify clinical signs and symptoms of infections, and adhere strictly to established contamination prevention and control (IPC) policies.

Since the pandemic, infection control protocols in dentistry have undergone numerous revisions in response to emerging scientific evidence.³ The continuous updates issued by national and international health authorities have done a critical part in reducing the infection spread in both the short and long term. Nonetheless, there remains a paucity of research evaluating the extent of knowledge and awareness amongst dental undergraduate students regarding these updated biosafety measures.⁴ This knowledge gap may lead to inconsistencies in the application of infection control practices, thereby posing an ongoing risk within clinical settings. In the current context, many dental undergraduates express legitimate concerns regarding their susceptibility to infection and the potential for disease transmission during clinical practice. While such concerns are well-founded, they are frequently exacerbated

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Contributions

Undergraduate students **60%** Lim Ee En Liew Denlee Leong Suki Lew Zhe Xuan Vaishnavi Vedom Supervisor guided from beginning to the end of this study in designing, conduction of study and preparation and final proofing of the manuscript **40%**

by insufficient knowledge of appropriate infection control measures and biosafety protocols. Enhancing awareness and education in this domain is of paramount importance.⁵⁻⁶ The present study was to assess the level of knowledge and awareness regarding biosafety practices amongst dental undergraduate students at AIMST University.

MATERIALS AND METHODS

Sample Collection

The questionnaire study was conducted at the Faculty of Dentistry, AIMST University, Kedah. A pretest was conducted randomly among 10 clinical-year students prior to the distribution of the online questionnaire. The students who participated in the pretest were able to understand and answer the questions clearly. The study targeted the undergraduate dental students from Year 3, 4 and 5. Then, the online questionnaire was randomly distributed amongst AIMST dental students currently studying Year 3, 4 and 5. A final sample of 172 was considered based on the Sample Size Calculator for One-Proportion Estimation⁷ with consideration given to precision and other relevant parameters.

Data collection

The online survey consisted of different sections. Demographic information of the respondents, followed by two separate sections were taken. The demographic information included the student ID number and current year of study. The respondents' consent was obtained to ensure that the respondents were informed and understood that their participation was voluntary, and their confidentiality and privacy were protected.

The first section was used to investigate the knowledge of AIMST dental undergraduate students towards biosafety practices in dental clinics in the context of infection control. This section consisted of 25 multiple choice questions, designed in accordance with Guidelines on Infection Control in Dental Practice⁸ in which the respondents had to answer with one choice from options A, B, or C. One mark was given for the most suitable option and no mark was allocated if the answer was incorrect. (Appendix I)

The second section was used to measure the attitudes of AIMST dental students towards biosafety in the context of clinical procedures. This section comprised of 20 questions that the respondents had to answer with a 6-point Likert scale based on their degree of agreement to the statements and clinical practices, ranging from score 1 to 6 (1=strongly disagree, 2=disagree, 3=slightly disagree, 4=slightly agree, 5=agree, 6=strongly agree). (Appendix II)

Data analysis

Both sections in the present study were assessed using an online questionnaire produced with Google. Knowledge related to infection control was evaluated with a quiz format, where correct answers were pre-set and automatically scored out of 25 points in the first section. Scores were interpreted as unsatisfactory (0–15) or satisfactory (16–25), with higher scores indicating better knowledge. In the second section, attitudes towards biosafety in clinical procedures were assessed using a 20-item questionnaire with a 6-point Likert scale, ranging from 1 (strongly disagree) to 6 (strongly agree). Total scores ranged from 24 to 144, and were categorized as inadequate (24–124) or adequate (125–144), with higher scores reflecting more positive attitudes. Scoring for the 6-point Likert-scale responses according to their options (1

point=strongly disagree, 2 points=disagree, 3 points=slightly disagree, 4 points=slightly agree, 5 points=agree, 6 points=strongly agree) was automated using Scorecery and all results were compiled and categorized in Excel for easier interpretation.

RESULTS

Among the 172 AIMST dental students, the reply by Year 3 dental students was 42.86% (n=72), for Year 4 dental students 29.65% (n=51), and for Year 5 dental students 28.49% (n=49). (Table I)

Table I. Distribution of respondents by year of study

Year	(n)	(%)
3	72	42.86
4	51	29.65
5	49	28.49
Total	172	100

Section 1: Assessment of knowledge of AIMST Dental Students towards biosafety practices

Table II shows assessment knowledge level of AIMST Dental Students towards biosafety in terms of percentage of total dental undergraduate students which obtain Unsatisfactory or Satisfactory score. For Year 3 Dental Students, percentage of students who obtained Satisfactory Score is 95.8% (n=69), with 4.2% (n=3) under Unsatisfactory Score Range. There are 96.1% (n=49) Year 4 Dental Students obtained Satisfactory score, 3.9% (n=2) under Unsatisfactory Score Range. To our surprise, Year 5 Dental Students have the lowest Satisfactory score percentage out of three Year of Study, which is 87.8% (n=43). Fisher's Exact Test was carried out to present a comparison between the two variables, which is Knowledge Level and Year of Study, and were found to be not significant (P= 0.1638).

Table II. Assessment of knowledge of AIMST Dental Students towards biosafety.

Knowledge Level ^b			
Year of Study	Unsatisfactory n (%)	Satisfactory n (%)	p-value ^a
Year 3	3 (4.2)	69 (95.8)	0.1638
Year 4	2 (3.9)	49 (96.1)	
Year 5	6 (12.2)	43 (87.8)	

^aFisher's Exact Test. ^bUnsatisfactory (0-15); Satisfactory (16-25)

Oral healthcare workers are high-risk groups exposed to pathogenic microorganisms in daily practices. Contaminated instruments, environmental surfaces or equipment could be possible sources of cross infection through indirect transmission.⁹

According to the Guideline for Disinfection and Sterilization in Healthcare Facilities 2008 (updated in May 2019) recommended by Centers for Disease Control and Disinfection (CDC), dental instruments that penetrate soft tissue, contact bone or other sterile tissue are classified as critical items, they must be heat purified or disposed after each use. Semi critical items are instruments that directly contact oral tissues but no penetration of soft tissues or bone, they should be heat sterilized or processed with high

level disinfection after each use. Non critical items (clinical contact and housekeeping surfaces) which only contact intact skin should be covered with protective barriers or disinfected with low to intermediate-level disinfectants.¹⁰ From the responses of the questionnaire, some respondents were found to have inadequate knowledge in determining the appropriate disinfection procedure to disinfect housekeeping surfaces and dental handpieces, which could be due to lack of emphasis on biosafety practices in curriculum and inadequate infection control training in dental clinics. Failure of disinfection and sterilization of non-disposable equipment properly may contribute to incomplete removal of pathogenic microbes and increase the risks of occupational exposure to saliva and blood-borne diseases.¹¹

Another finding of the survey is there was a possible lack of knowledge among participants about the appropriate disinfectants to be used for disinfecting study stone casts and cast metal removable partial dentures among AIMST dental students, which might be due to inadequate knowledge in dental material sciences and the disinfectants available. Various studies have recommended that impressions taken should be cleaned under running water to remove blood and saliva, followed by spraying or immersing in appropriate disinfectant before the impression is sent to the dental laboratory. Disinfection of casts and models using sodium hypochlorite was reported to be effective, no dimensional changes and surface details distortion were reported. On the other hand, cast partial denture to be disinfected in 2% glutaraldehyde solution for 10 minutes.¹²

Findings revealed that most respondents have adequate knowledge in hand hygiene and use of personal protective equipment (PPE) during dental practices. Most of them are aware of the sequences of donning and removing PPE, and the significance of good hand hygiene in averting the extent of infections. CDC has provided guidelines to put on PPE in the following sequence: gown, mask or respirator, eye protection and gloves. PPE is removed in the following sequence: gloves, eye protection, gown and mask. It is directed to rinse hands with soap and water or alcohol-based hand sanitizer immediately after removing PPE.¹³

Based on the findings, the respondents are found to be knowledgeable in determining the most appropriate management of needle stick injuries, which is a common percutaneous injury that can occur when giving local anesthesia, recapping and disposal of used needles. Based on the guidelines (CDC) and the National Institute for Occupational Safety and Health (NIOSH), the wound should be washed instantly with soap and running water, following which reporting the incident to the supervisor and seeking medical treatment is done. The respondents are also aware of the scoop technique which is used to recap used needles.¹⁴

In the aspect of virus transmission and vaccination, the knowledge level of participants can be considered to be mostly adequate for the schedule for intervals between Viral Hepatitis B (VHB) immunization doses and the route of transmission of VHB. However, there is a decrease in the right responses regarding the mode of infection spread of SARS-CoV-2 are being questioned in the questionnaire, which might indicate the knowledge level of AIMST dental students regarding SARS-CoV-2 still needs to be improved. This situation might be caused by the knowledge of VHB that was delivered well in the existing curriculum even before

the pandemic, while studies of virology and effectiveness of vaccination of SARS-CoV-2 are still carried out.¹⁵

Section 2: Assessment of Attitude of AIMST Dental Students towards biosafety

For Question 3, the statement that PPE should be regularly worn during clinical procedures is almost universally agreed by all dental Students, except for Shoe Cap, which is disagreed by a higher percentage of students, consisting of 8.3% (n=6) of Year 3 dental Students, 5.9% (n=3) of Year 4 Dental Students, and 4.1% (n=2) of Year 5 Dental Students. Most of the students from each year of study agree on the statements that they have good understanding of infection control methods in the AIMST dental polyclinic, and good confidence in the knowledge and competence of control of infection in AIMST clinical training.

For Year 3 Dental Students, percentage of students who obtained favourable Score is 62.5% (n=45), with 37.5% (n=27) under unfavourable Score Range. There are 92.2% (n=47) Year 4 Dental Students obtained favourable score, 7.8% (n=4) under unfavourable Score Range. Year 5 Dental Students have the lowest Satisfactory score percentage out of three Year of Study, which is 51.0% (n=25). Chi Square Test was carried out to present a comparison between the two variables, which is Attitude Level and Year of Study, and were significant ($P = <0.001$). (Table III)

Table III. AIMST Dental Student's attitude towards biosafety by percentage of total percentage in each year of study grouped via Likert Scale score range

Attitude Level ^b			
Year of Study	Unfavorable n (%)	Favorable n (%)	p-value ^a
Year 3	27 (37.5)	45 (62.5)	< 0.001
Year 4	4 (7.8)	47 (92.2)	
Year 5	24 (49.0)	25 (51.0)	

^a Chi Square Test. ^b Unfavorable (Score 0-124); Favorable (Score 125-144)

Dental professionals are at heightened risk due to close patient contact and routine aerosol-production. All students in the present study agreed that COVID-19 immunization, including booster doses, should be mandatory in clinical settings. This reflects a strong awareness of vaccination's role in preventing severe disease. Research from Weber State University and the University of Utah Health shows booster doses provide enhanced protection against the Delta and Omicron variants. CDC data further indicates that a third dose significantly reduces the risk of hospitalization and death.¹⁶⁻¹⁷

Some respondents disagreed with the need to treat emergency cases in negative pressure isolation rooms, possibly due to concerns about delayed care. However, current guidelines recommend postponing elective treatment for COVID-19-positive patients while allowing emergency procedures with appropriate precautions.

Hepatitis B virus (HBV) transmission, often through needle stick injuries or exposure to infected fluids, remains a concern in dentistry. All respondents supported mandatory HBV vaccination, likely reflecting early and consistent training on infection control protocols. Students demonstrated good

understanding of clinical hygiene practices, including hand hygiene, PPE use, and patient rights. There was strong agreement on the use of low-speed hand pieces, rubber dams, and high-volume suction to reduce aerosol-related risks. High-speed hand pieces, operating at 250,000–400,000 RPM, produce significantly more aerosols than low-speed tools. While most respondents prioritized key PPE components such as gloves, gowns, masks, and head caps, shoe covers were viewed as less essential—likely due to limited use in training clinics.^{18–21} Questionnaire based additional studies relevant to the present study have been summarized below. (Table IV)

Table IV. Questionnaire based Studies – Biosafety practices

Aragão MG <i>et al.</i> , 2022 ²²	142 Undergraduates – aware of the necessity of biosafety requirements in their routine dental practices
Halboub ES <i>et al.</i> , 2015 ²³	Senior dental graduates Sana'a University – low compliance with the recommended infection protocol standard, despite having an appropriate level of knowledge
Benarji KA <i>et al.</i> ; 2021 ²⁴	Insufficient information and practices towards infection control and prevention protocols
El-Saaidi C <i>et al.</i> ; 2021 ²⁵	Positive attitudes and behaviors toward infection prevention with poor knowledge.
Alharbi G <i>et al.</i> , 2019 ²⁶	Dental students at KSU showed high level of perception towards guidelines on infection control, despite lacking knowledge in basic infection control.
Basheer SN <i>et al.</i> , 2022 ²⁷	Dental healthcare professionals in Jazan region have a better level of perception towards COVID-19 prevention and reducing its spread.
Ataş O <i>et al.</i> , 2020 ²⁸	Students have positive attitude but inadequate knowledge towards the prevention of COVID-19 transmission.
Acosta-Gío AE <i>et al.</i> , 2008 ²⁹	Dental undergraduates are concerned about blood borne pathogens and have improper understanding due to lack of knowledge on HIV and HBV transmission.
Ehsani M <i>et al.</i> , 2013 ³⁰	Dental students from Babol University have inadequate level of knowledge and awareness towards biosafety protocols and more continuing education is required.
Ebrahimipour A <i>et al.</i> , 2016 ³¹	Students have a adequate level of knowledge and high level of adherence towards infection control guidelines due to the mandatory university rules.
Shilpa BS <i>et al.</i> , 2020 ³²	Dental professionals have high level of knowledge and awareness regarding bioethics and biosafety issues and agree that biological effects of the biomaterials used should be explained to the patients before treatment procedures.
Khandelwal V <i>et al.</i> , 2017 ³³	Dental students have adequate level of knowledge regarding hepatitis B infection, however, almost half of the clinical year students have not received hepatitis B vaccinations, putting them at risk of infection.

The study was limited to clinical-year dental undergraduates at AIMST University, reducing generalizability. Increasing the sample size and diversity would enhance the reliability and applicability of findings.

CONCLUSION

This study found that Year 3 dental students at AIMST University demonstrated the highest level of knowledge and positive attitudes toward biosafety practices compared to students in other years. This is likely due to the enclosure with prevention and control of infection lectures in the Year 3 curriculum, which recently reinforced these principles. The findings highlight the need for continuous evaluation and training for Year 4 and 5 students to enhance their understanding and adherence to biosafety protocols. To support safe clinical practice, it is recommended that mandatory immunization programs, regular training workshops, and ongoing educational sessions be implemented. Additionally, strict monitoring of student compliance with infection control guidelines is vital to safeguard both patients and dental professional. Further research is encouraged to validate these findings and contribute to achieving infection-free clinical practice.

Declaration

None.

Conflict of interest

None.

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None.

Ethics statement

Institutional ethics approval obtained prior to the study (AUHEC/FOD/2022/13).

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Online CPD in 6 Easy Steps



The Continuing Professional Development (CPD) section provides for twenty general questions and five ethics questions. The section provides members with a valuable source of CPD points whilst also achieving the objective of CPD, to assure continuing education. The importance of continuing professional development should not be underestimated, it is a career-long obligation for practicing professionals.

