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Knowledge, Attitude, and Practice of Infection Control Regarding COVID-19 among Thai Dental Students

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Abstract

The objective of this study was to investigate the knowledge, attitudes, and practices concerning COVID-19 dental practice guidelines. A questionnaire was distributed to undergraduate dental students at the Faculty of Dentistry, Chulalongkorn University, who practiced in the clinic during the academic year 2022 through online platforms. Data was collected during December 2022 and February 2023. One hundred and fifty-seven responses were received and analyzed, resulting in a 53.95% response rate. The average knowledge score was 6.52 out of 10, with a standard deviation of 1.175. Among all respondents, 53.5% provided all correct answers related to general knowledge of COVID-19. However, only 10.2% and 8.9% accurately answered all questions regarding self- and interpersonal transmission prevention, and environmental contamination prevention, respectively. More than 80% of the participants exhibited a positive attitude toward infection control protocols. In contrast, 65.6% and 46.5% expressed positivity towards social distancing and COVID-19 risk assessment questionnaires, respectively. In accordance with the COVID-19 dental practice guidelines, practices that were consistently followed by over 80% of the respondents included wearing personal protective equipment during dental treatments, instructing patients to use antimicrobial mouthwash before treatment, and disinfecting dental unit surfaces before and after procedures. Additionally, more than 50% of UGs requested a laundry delivery room for long-sleeved gowns near treatment areas, as well as an increase in the availability of alcohol gel and air purifiers. In conclusion, while UGs exhibited positive attitudes, their knowledge and adherence to COVID-19 dental guidelines were lacking. Urgent actions are needed to enhance UGs' understanding and compliance with these guidelines.

Keywords: Attitude, COVID-19, Dental practice, Infection control, Knowledge

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Introduction

In December 2019, incidents of unexplained pneumonia were reported, which were later attributed to the microorganism SAR-CoV-2, referred to as COVID-19.[1,2] This virus can spread through respiratory droplets and aerosols released by infected individuals.[3,4] Since then, COVID-19 has rapidly disseminated globally. This pandemic has profoundly affected not only people's physical health but also their mental health, as well as their social, economic, and cultural well-being.[5,6] Despite the administration of effective COVID-19 vaccinations, the pandemic remains severe in most parts of the world. It is necessary to adjust our lives to coexist with this disease, a situation often termed the "new normal".[7]

The dental profession is classified as having a high risk of contracting COVID-19 infection due to direct contact with patients' naso/oropharyngeal secretions. Additionally, dental procedures involving air-driven instruments or ultrasonic scalers with water spray for cooling can generate aerosols.[8,9] The COVID-19 virus remained viable in aerosols for up to three hours with a half-life of 1.5 hours and can survive longer on stainless steel and plastic with an average half-life of approximately 5.6 h and 6.8 h, respectively.[10] Evidence also indicates that asymptomatic infected individuals contribute to the spread of COVID-19.[3,4] Therefore, dental practitioners need to modify their routines to minimize the risk of contracting and transmitting the pathogen to their staff, patients, families, and the environment.[11,12] In routine dental practices, airborne precautions are employed instead of universal precautions. Dentists and dental healthcare workers, including dental students, must wear appropriate personal protective equipment (PPE) such as long-sleeve gowns, waterproof isolation gowns, hair covers, boot or shoe covers, N95 masks, and face shields. They must rigorously clean their hands before and after dental procedures. Surfaces in contact with patients, whether from droplets or aerosols, must be thoroughly cleaned and disinfected before a new patient is seen.[11-13] Interestingly, adherence to airborne precautions remains unclear.

During the ongoing pandemic, dental students were educated on the correct utilization of PPE and the implementation of airborne precautions. However, due to their limited clinical experience, it is crucial to explore their understanding, attitudes, and practices regarding these precautions. This study holds significance as it can contribute to establishing effective infection control measures within the context of the evolving "new normal" in dental practice.

Materials and methods

A cross-sectional descriptive study was conducted at the Faculty of Dentistry, Chulalongkorn University (FDCU). This study received approval from the Human Research Ethics Committee of the Faculty of Dentistry, Chulalongkorn University (HREC-DCU 2022-050). The participants included undergraduate dental students (UGs) in their clinical years (4th – 6th year) studying at FDCU during the academic year 2022 (August 2022 – May 2023). Qualitative interviews were conducted to explore inappropriate practices or issues related to the COVID-19 Guidelines[14] observed in the UG clinics. These interviews continued until no new inappropriate practice or issue was provided. Subsequently, a self-rating questionnaire was developed based on the interview findings and administered through Google Forms. The questionnaire consisted of two items collecting the demographic data (sex and studying year) and four sections of COVID-19 related items, including i) knowledge of COVID-19 prevention (ten items), ii) attitudes toward COVID-19 dental practice guidelines (seven items), iii) practices according to COVID-19 dental practice guidelines (13 items), and iv) additional needs from the provided facilities (six items). The questions are shown in Table 1. For the knowledge evaluation, participants had to select only one from the provided four choices on each item, and they would get one score for each correct answer. The experts in oral healthcare evaluated the questionnaire for validity using the Item-Objective Congruence Index (IOC). Items were

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selected for precision in questions, knowledge accuracy, and attitude and behavior interpretability. Additionally, the experts assessed the content validity of initial questionnaire questions. Cronbach's alpha coefficient was calculated to determine the internal consistency (IC) of the questionnaire's items which was ≥ 0.8 in the present study.

Data was collected during December 2022 and February 2023. The questionnaire was repetitively sent twice every four weeks during three months of the data collection period via the group Line to increase the number of participants. Out of the 291 students in the target group, 157 responses were received.

Table 1 *Assessment questions of knowledge, attitudes, practices, and additional needs for COVID-19 prevention*

Knowledge of COVID-19 prevention
General knowledge
1. How SARS-CoV-2 can be transmitted?
2. What are the common symptoms of COVID-19 patients?
Self and interpersonal transmission prevention
3. Which dental procedure can generate an aerosol?
4. Which of the following dental devices cannot reduce aerosol emissions?
5. What is the correct sequence for removing personal protective equipment (PPE)?
6. How long should a patient hold an antimicrobial mouth rinse (e.g., 0.2% povidone-iodine, 1% hydrogen peroxide, 0.2% chlorhexidine)?
Environmental contamination prevention
7. How to disinfect dental clinical contact surfaces?
8. What is the proper level of disinfectant for disinfecting dental clinical contact surfaces?
9. Which of the following dental waste disposal is correct?
10. What is the correct method to disinfect dental impressions?
Attitude toward COVID-19 dental practice guidelines
1. The proper wearing of personal protective equipment (PPE) can prevent the transmission of COVID-19.
2. Disinfecting the dental clinical contact surfaces can prevent contact transmission of COVID-19.
3. Proper use of aerosol prevention devices can reduce aerosol generated from dental procedures.
4. The efficacy of dental impression disinfection depends on contact time with disinfectant.
5. The proper duration of rinsing the antimicrobial mouthwash affects the effectiveness of pre-procedure oral microbial reduction.
6. Social distancing between students, supervisors, and patients can prevent the transmission of COVID-19.
7. The COVID-19 risk assessment questionnaire can screen patients efficiently.
Practice according to COVID-19 dental practice guidelines
1. How often do you use aerosol prevention devices, such as high-power suction and EasyPrep®, during a dental procedure using an air-driven handpiece or ultrasonic scaler?
2. How often do you use a rubber dam while using an air-driven handpiece?
3. How often do you wear personal protective equipment (PPE) during dental treatment?
4. How often do you wear personal protective equipment (PPE) during dental treatment as an assistant?
5. How often do you change personal protective equipment (PPE) between each patient?
6. How often do you clean your face shield between each patient?
7. How often do you suggest patients hold antimicrobial mouthwash before a dental procedure?
8. How often do you screen patients with the COVID-19 risk assessment questionnaire?
9. How often do you follow the protocol of COVID-19 by keeping your distance from others?
10. How often do you take off your gloves before contact with environmental surfaces or stuff?
11. How often do you disinfect the dental clinical contact surfaces before and after a dental procedure?
12. How often do you separate dental waste as infected, recyclable, and sharp waste?
13. How often do you disinfect a dental impression before pouring casts?

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Table 1 *Assessment questions of knowledge, attitudes, practices, and additional needs for COVID-19 prevention (cont.)*

Additional needs from the provided facilities
1. More effective distribution of COVID-19 dental practice guidelines
2. More alcohol gel in various locations
3. Changing room to change the uniform before and after doing dental work
4. More air purifiers in various locations
5. Laundry delivery room for long sleeve gowns
6. Other additional needs

All participants provided their consent by completing the questionnaire and submitting their responses.

Statistical analysis

Statistical analysis was carried out using IBM SPSS® Statistics version 29 (IBM Corp., Chicago, Illinois, USA). Descriptive statistics were performed to analyze demographic data, knowledge score, attitudes score, and practice score. The differences among the three years of UGs were analyzed using ANOVA and Chi-square test at a significant level of $p<0.05$. The results pertaining to the knowledge section were presented as frequencies of correct and incorrect answers for each question, along with the mean and standard deviation (SD) of scores. The results from the attitude section were presented as frequencies of each response category (absolutely agree, agree, neutral, disagree, and absolutely disagree) for each question. In the practice section, the results were presented as frequencies of responses for each answer category (always, often, sometimes, rarely, and never) for each question. Lastly, the results regarding additional needs were presented as frequencies of each response category.

Results

Out of a total of 291 clinical-year UGs, 157 responses were received and included in the data analysis, yielding a response rate of 53.95%. Most respondents were the fifth-year UG (45.9%). Female respondents constituted 65.6% of the total, outnumbering male respondents by 34.4% (Table 2).

Table 2 *Demographic data of the respondents*

Variable	Category	Number of respondents	Percentage of respondents
Gender	Male	54	34.4
	Female	103	65.6
Clinical year	4th-year	50	31.8
	5th-year	72	45.9
	6th-year	35	22.3

Knowledge of COVID-19 prevention

With a maximum knowledge score of 10, the mean score and SD were 6.52 and 1.17, respectively. The distribution of obtained scores is depicted in Figure 1A. In the section on general knowledge (total score = 2), 84 UGs (53.5%) achieved a score of 2, while 70 (44.6%) and 3 (1.9%) attained scores of 1 and 0, respectively. For self- and interpersonal transmission prevention (total score = 4), 16 UGs (10.2%) achieved a score of 4, whereas 67 (42.7%), 64 (40.8%), and 10 (6.4%) achieved scores of 3, 2, and 1, respectively. Regarding environmental contamination prevention (total score = 4), 14 UGs (8.9%) achieved a score of 4, while 63 (40.1%), 58 (36.9%), 21

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(13.4%), and 1 (0.6%) achieved scores of 3, 2, 1, and 0, respectively. The percentages of UGs who answered correctly for each item are displayed in Figure 1B. The least correct percentage (22.3%) was the sequence for removing PPE (Q5). Moreover, less than 50% gave correct answers on how to dispose of dental waste (Q9) and disinfect the impressions (Q10).

The mean knowledge scores of each year's clinical students are shown in Table 3. The Kruskal Wallis one-way ANOVA analysis revealed significant differences in environmental contamination prevention knowledge among the three UGs ($p<0.001$). The 4th-year UGs had significantly higher knowledge scores in this section than the 5th- and 6th-year UGs ($p<0.001$ and $p=0.07$, respectively, Bonferroni correction). There are no significant differences in the general, and self and interpersonal transmission prevention knowledge scores among the three years of UGs.

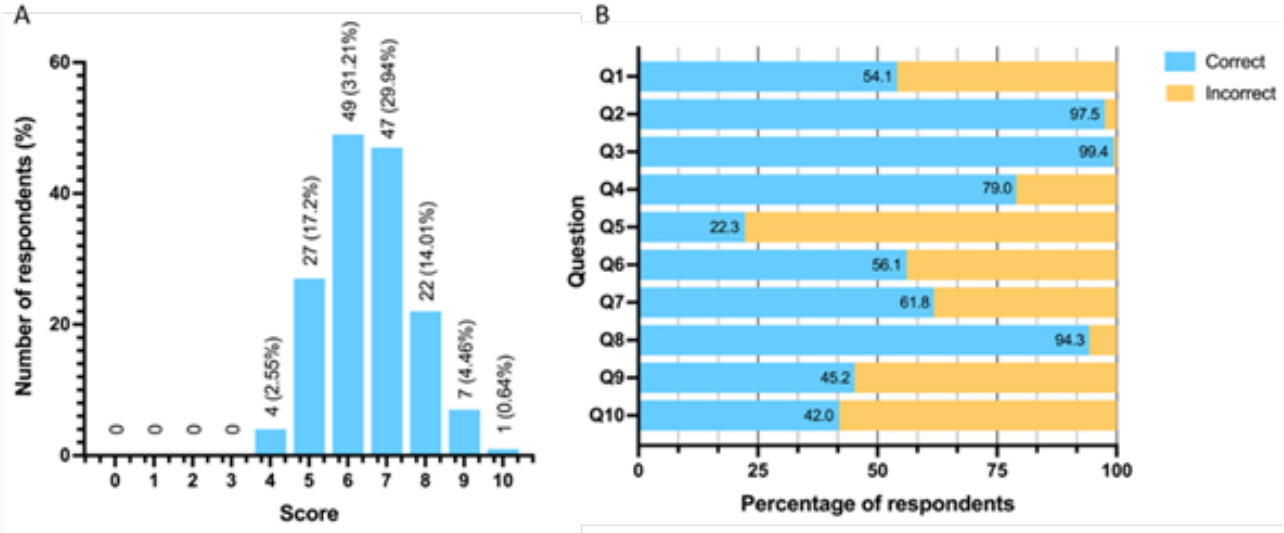

Figure 1 *Knowledge of COVID-19 prevention, (A) distribution of the knowledge score, (B) the percentage of respondents who answered correctly for each knowledge question.*

Table 3 *The mean score of knowledge*

Clinical year	Mean knowledge score ± SD		
	General knowledge	Self and interpersonal transmission prevention	Environmental contamination prevention*
4th-year	1.40 ± 0.076	2.38 ± 0.114	2.88 ± 0.109
5th-year	1.60 ± 0.061	2.60 ± 0.083	2.15 ± 0.100
6th-year	1.51 ± 0.095	2.77 ± 0.130	2.37 ± 0.124

** Significant differences among groups (ANOVA, p<0.05).*

Attitude toward COVID-19 dental practice guidelines

Over 80% of the UGs either agreed or strongly agreed with the statements concerning infection control (Q1- Q5). However, 65.6% agreed or strongly agreed that social distancing is effective in preventing COVID-19 transmission (Q6) and only 46.5% agreed or strongly agreed that the COVID-19 risk assessment questionnaire can efficiently screen patients (Q7). The percentage of responses to each question is shown in Figure 2.

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After re-classifying the group of strongly agree and agree to be the Positive Attitude group and the others were Neutral/negative Attitude group to reduce the number of cells that had expected count less than five for Chi-square analysis, there were no significant differences among the three years of UGs (p>0.05).

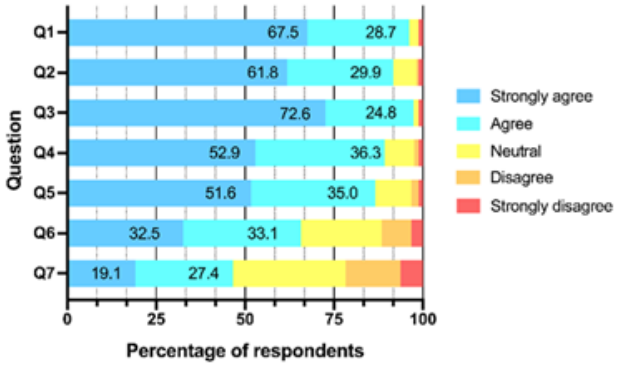

Figure 2 *Percentage of the respondents who agreed or strongly agreed with each attitude statement.*

Practice according to COVID-19 dental practice guidelines

During dental procedures, a little bit more than 50% of UGs always and usually use aerosol prevention tools like high-power suction, EasyPrep® (Triple A, Kuala Lumpur), and a rubber dam (Q1 and Q2).

More than 80% always or usually donned PPE when doing their clinical practices; however, many more UGs always donned PPE when they were operators than assistants (Q3 and Q4). Notably, 77.7% always changed their PPE between patients (Q5). Furthermore, 42.7% always cleaned their face shield before treating the next patient (Q6). While 80.3% always disinfected contact surfaces before and after procedures (Q11), 77.7% always properly segregated dental waste into categories such as infected, recyclable, and sharp waste (Q12), and 63.7% always remove their gloves before touching environmental surfaces or equipment (Q10). Only 43.3% always disinfected dental impressions before making plaster dental models (Q13).

Before dental procedures, 86% of students always advised patients to rinse with an antimicrobial mouthwash (Q7). Only 20.4% of students always triage patients using the COVID-19 risk assessment questionnaire (Q8), and 19.1% always maintain a physical distance from others (Q9). The percentage of responses to each question was shown in Figure 3.

To reduce the number of cells that had expected count less than 5 for Chi-square analysis, UGs who "always" follow the guidelines were classified into Always group and the others were Not-always group. The significant differences were found between groups in the three following practices:1) wearing PPE when serving as an assistant (p=0.005), 2) cleaning the face shield before providing care to the next patient (p=0.018), and 3) disinfecting the dental clinical contact surfaces before and after a dental procedure (p=0.021).

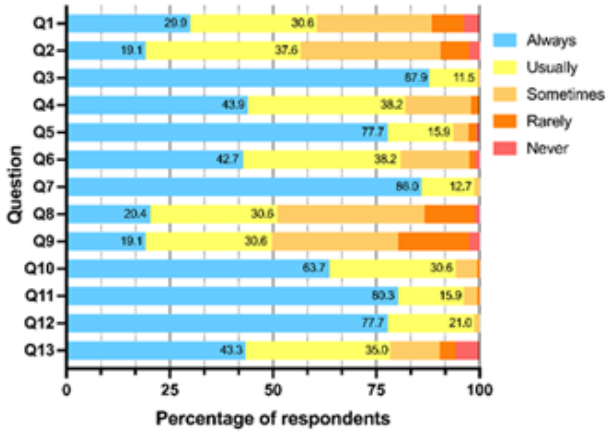

Figure 3 *Percentage of the respondents according to their frequencies of practices*

Additional needs

One hundred and fifty-two UGs responded to this question, 59.9% and 67.5% requested more supplies of alcohol gel and air purifiers, respectively. A laundry delivery room for their gowns near dental clinics and a changing room were requested by 56.7% and 43.3% respectively. For other additional needs, 26.1% suggested a more effective distribution of COVID-19 dental practice guidelines to dental staff. Interestingly, 17.8% requested relief measures for COVID-19-positive UGs who had to stop clinical practice due to quarantine. The data was shown in Figure 4.

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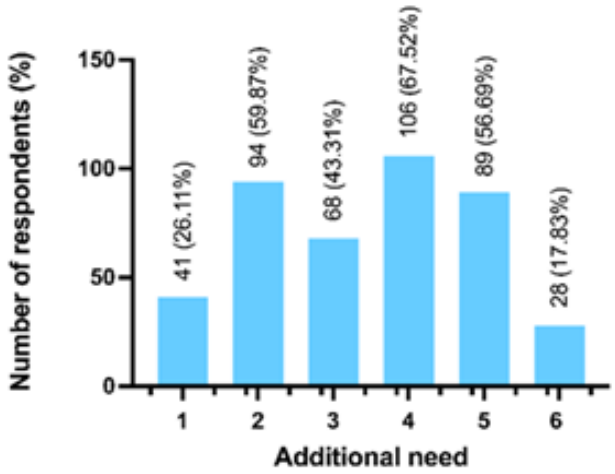

Figure 4 *The number of respondents who suggested additional needs regarding COVID-19 prevention,*

1. *More effective distribution of COVID-19 dental practice guidelines*
2. *More alcohol gel in various locations*
3. *Changing room to change the uniform before and after doing dental work*
4. *More air purifiers in various locations*
5. *Laundry delivery room for long sleeve gowns*
6. *Other additional needs*

Discussion

The current study highlights the paramount importance of prioritizing infection control measures within dental clinics, particularly given the elevated risk of exposure to infections among dental staff during procedures. While infection control has traditionally been a focal point since the preclinical phase, the emergence of the COVID-19 pandemic has accentuated the urgency of cross-infection prevention.[11,12] The evolving situation prompted a comprehensive update and heightened emphasis on infection control guidelines at the FDCU,[14] leading to a corresponding reorganization of clinical settings.

Despite the availability of updated guidelines, a notable number of respondents provided incorrect answers. This discrepancy might stem from challenges in accessing the guidelines or diverging interpretations among individuals. A particularly illustrative case is the issue of waste segregation, where guidelines prescribe incineration for certain plastics in the recycle plus bin.[14] However, mismanagement of this disposal process was evident, possibly arising from misconceptions around the potential contamination of patient fluids.

Interestingly, the 4th-year UGs scored higher on environmental contamination prevention knowledge than the 5th- and 6th-year UGs. The reasons for this finding are beyond the scope of this research. However, future study may pay attention to find the relevant explanations.

While positive attitudes towards infection control protocols were generally prevalent among most respondents, the enthusiasm appeared to wane when considering aspects of social distancing and the efficacy of the COVID-19 risk assessment questionnaire. This phenomenon could be rooted in perceptions of the limited effectiveness of social distancing measures, exacerbated by research suggesting SARS-CoV-2 transmission beyond the recommended 2 meters (6 feet) distance.[15,16] Compounded by the physical constraints of clinical settings that hinder optimal distancing, some respondents might be swayed by personal experiences of close interactions with COVID-19 patients without contracting the virus, fostering skepticism towards the necessity of social distancing. A parallel skepticism extended to the efficacy of the COVID-19 risk assessment questionnaire, potentially stemming from the challenges of accurately assessing patients' responses or the screeners' diligence. The absence of a statistically significant difference in attitude among the three years of UGs may be because they were in the same late pandemic clinical environment.

A noteworthy discrepancy surfaced between knowledge and behavior concerning the utilization of aerosol prevention equipment and the consistent use thereof. Despite sound knowledge regarding equipment like high-power suction and Easy prep®, only a fraction of respondents reported always utilizing these tools. A possible rationale lies in the lack of dental assistants in clinical practice, rendering the use of certain equipment less feasible without adequate support. Similarly, the constraints of employing a rubber dam for specific procedures, coupled with practicality concerns in others, led some respondents

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to forgo its consistent use. However, most of the respondents were aware of wearing PPE and disinfecting the potentially contaminated working surface before and after performing operative procedures.

Some participants also were concerned that the absence from clinical practice during their quarantine might impact their operative skills or the shortage of time to make up requirements. Online case-based discussions and tutorials were suggested as potential alternative teaching methods that could be adopted during that period.[17] Moreover, the extension of study gave dental students more experiences and confidence in performing oral surgery.[18]

There were significant differences observed in the adherence of some clinical practices according to the guidelines among UGs of different clinical years. These differences were likely due to the varying levels of clinical experience and exposure to different dental procedures among UGs of different clinical years. However, the relevant reasons of non-adherence to the guidelines should be further investigated to establish good and safe clinical practice behaviour.

This study, while offering valuable insights, bears certain limitations. Some questionnaire statements may have engendered misunderstandings among respondents, as demonstrated by varying interpretations of the role of an assistant. This raises concerns about the clarity of certain survey items, particularly in assessing the frequency of PPE usage in the capacity of an assistant. Recognizing these limitations, future research could prioritize enhanced clarity in question design to mitigate potential ambiguities.

In conclusion, this research underscores the pivotal role of infection control within dental settings, particularly in the context of the COVID-19 pandemic. Despite prevailing positive attitudes towards infection control, disparities between knowledge, attitudes, and practices were apparent. These findings underscore the need for continual educational reinforcement, addressing misconceptions, and fostering a comprehensive understanding of infection control protocols among dental students. As dental education evolves, integrating pragmatic strategies for optimizing infection control adherence becomes imperative to ensure the well-being of dental professionals, patients, and the wider community.

Acknowledgement

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References

1. About COVID-19. Available from https://www.cdc.gov/coronavirus/2019-ncov/your-health/about-covid-19.html [cited 2022 Jan 10].

2. World Health Organization. 2019 novel coronavirus (2019-nCoV) strategic preparedness and response plan for the south-east Asia region. World Health organization regional office for south-east Asia, 2020.

3. Salian VS, Wright JA, Vedell PT, Nair S, Li C, Kandimalla M, *et al.* COVID-19 transmission, current treatment, and future therapeutic strategies. ***Mol Pharm*** 2021;18(3):754-71.

4. Sharma A, Ahmad Farouk I, Lal SK. COVID-19: A Review on the Novel Coronavirus Disease Evolution, Transmission, Detection, Control and Prevention. ***Viruses 2021*** Jan 29;13(2):202.

5. Osterrieder A, Cuman G, Pan-Ngum W, Cheah PK, Cheah PK, Peerawaranun P, *et al.* Economic and social impacts of COVID-19 and public health measures: results from an anonymous online survey in Thailand, Malaysia, the UK, Italy and Slovenia. ***BMJ Open*** 2021;11:e046863.

6. Mofijur M, Fattah IMR, Alam MA, Islam ABMS, Ong HC, Rahman SMA, ***et al.*** Impact of COVID-19 on the social, economic, environmental and energy domains: Lessons learnt from a global pandemic. ***Sustain Prod Consum*** 2021;26:343-359.

7. How to Protect Yourself and Others. Centers for Disease Control and Prevention. Available from https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html [cited 2022 Jan 10]

8. Veena H, Mahantesha S, Joseph PA, Patil SR, Patil SH. Dissemination of aerosol and splatter during ultrasonic scaling: a pilot study. ***J Infect Public Health*** 2015;8(3):260-5.

9. Spagnuolo G, De Vito D, Rengo S, Tatullo M. COVID-19 Outbreak: An Overview on Dentistry. ***Int J Environ Res Public Health*** 2020; 17:2094.

10. van Doremalen N, Bushmaker T, Morris DH, Holbrook MG, Gamble A, Williamson BN, et al. Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1. ***N Engl J Med*** 2020; 382:1564–7.

article in press

11. Amato A, Caggiano M, Amato M, Moccia G, Capunzo M, De Caro F. Infection Control in Dental Practice During the COVID-19 Pandemic. ***Int J Environ Res Public Health*** 2020;17(13):4769.

12. Caggiano M, Acerra A, Martina S, Galdi M, D'Ambrosio F. Infection Control in Dental Practice during the COVID-19 Pandemic: What Is Changed? ***Int J Environ Res Public Health*** 2023;20(5):3903.

13. Induri SNR, Chun YC, Chun JC, Fleisher KE, Glickman RS, Xu F, *et al.,* editors. Protective measures against COVID-19: Dental practice and infection control. ***Healthcare;*** 2021:9(6),art.no.679.

14. Guidelines for Infection and Transmission Controls in Dental Clinics (2021), Faculty of Dentistry, Chulalongkorn University. Available from http://www.dent.chula.ac.th/wp-content/uploads/2023/06/Guideline-IC_Dent_CU_2021.pdf

15. Setti L, Passarini F, De Gennaro G, Barbieri P, Perrone MG, Borelli M, *et al.* Airborne Transmission Route of COVID-19: Why 2 Meters/6 Feet of Inter-Personal Distance Could Not Be Enough. ***Int J Environ Res Public Health*** 2020;17(8):2932.

16. Sun C, Zhai Z. The efficacy of social distance and ventilation effectiveness in preventing COVID-19 transmission. ***Sustain Cities Soc*** 2020;62:102390.

17. Loch C, Kuan IB, Elsalem L, Schwass D, Brunton PA, Jum'ah A. COVID-19 and dental clinical practice: Students and clinical staff perceptions of health risks and educational impact. ***J Dent Educ*** 2021;85(1):44-52.

18. Macluskey M, Anderson AS, Shepherd SD. The Impact of a 1-Year COVID-19 Extension on Undergraduate Dentistry in Dundee: Final Year Students' Perspectives of Their Training in Oral Surgery. ***Dent J (Basel)*** 2022;10(12):230.

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