Original paper

Assessment of knowledge, practices and attitudes of dentists toward coronavirus disease while performing aerosol-generating procedures in dentistry: A cross-sectional survey from India

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Abstract

Background. Dental procedures that generate aerosols, if not performed with precautions, are the source of infection during the coronavirus disease 2019 (COVID-19) pandemic.

Objectives. The aim of the present study was to analyze dentists' awareness, knowledge and practice regarding the spread of coronavirus in India, to fill the knowledge gaps and to limit the spread of the virus while performing aerosol-generating procedures (AGPs).

Material and methods. A cross-sectional survey containing 23 close-ended questions was conducted using the Google Forms platform. The questionnaire was knowledge, practice and attitude-based (KPA). It was completed by Indian dentists stratified according to gender, designation, years of experience, and residence type. Data was analyzed with the χ^2 test, and summarized using frequency and percentage. The independent samples t test and the one-way analysis of variance (ANOVA) were used to analyze intergroup differences.

Results. With regard to knowledge, females, specialists with 10 years of experience and those living in metro cities scored higher. For practice-based questions, males, the teaching staff, dentists with less than 5 years of experience, and those living in suburban areas provided more correct answers. For attitude-based questions, females, general practitioners (GPs), dentists with less than 5 years of experience, and those residing in suburban areas provided more correct answers.

Conclusions. Dentists in India demonstrated a high level of understanding with regard to COVID-19. However, they showed a limited understanding of the extra preventative procedures to safeguard against the disease. The study findings have significant implications for the measures aimed at increasing dentists' level of KPA toward coronavirus.

Keywords: knowledge, practice, attitude, coronavirus, aerosol-generating procedure

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Introduction

The fast-spreading coronavirus has been affecting global society, economics, health, and lifestyle since December 2019.[1] Since the first reported case in Wuhan, China, coronavirus has gradually encompassed the entire globe via close human-to-human contact.[2,3] Irrespective of age, gender or nationality, the deadly virus can infect everyone, causing multiple respiratory disorders, with symptoms ranging from a mild cough to life-threatening pneumonia, acute respiratory distress syndrome (ARDS), and multi-organ dysfunction leading to organ failure and subsequent death.[2] Inhalation and contact with contaminated droplets are the 2 ways of disease transmission, and the incubation period ranges from 2 to 14 days.[3] However, symptoms usually occur after 2–4 days of the incubation period. They include fever, cough, a sore throat, dyspnea, exhaustion, and malaise.[2] In most people, the infection is minor or asymptomatic, but in the elderly and those with comorbidities, it may be lethal.[2] The relative death rate is expected to be 2–3%.[2]

The virus can be detected in respiratory secretions with the use of specific molecular assays. An increased white blood cell (WBC) count and a high C-reactive protein (CRP) level are the initial laboratory test results that can help detect the disease.[4] Until July 2022, 546 million confirmed cases and 6.3 million deaths were recorded worldwide.[5] India reported 43.4 million confirmed cases and 0.5 million deaths.[6] Maharashtra, Kerala, Karnataka, Tamil Nadu, and Andhra Pradesh are the top 5 states affected, accounting for 56% of all cases.[7] Throughout this worldwide health disaster, dental professionals are at high risk of infection, as they are in direct contact with their patients.[3] In addition, devices such as ultrasonic scalers, air-water syringes and air turbine handpieces, commonly used in routine dental treatment, can be contaminated with the patient's saliva and blood, resulting in the production of infectious aerosols.[8]

Throughout the coronavirus disease 2019 (COVID-19) pandemic, the participation of dental professionals was critical in raising coronavirus awareness among themselves and the community.[9,10] As such, dental workers must have a high degree of coronavirus understanding, and a proper attitude toward infection control measures and disease significance. With this in mind, a survey was created to evaluate dentists' knowledge, practices and attitudes regarding coronavirus and its impact on dentistry.[11] The purpose of the present study was to analyze dentists' awareness and knowledge of coronavirus and infection control strategies in the dental context in India, to fill the knowledge gaps, and to limit the spread of the virus while performing aerosol-generating procedures (AGPs) in dentistry.

Material and methods

The present online cross-sectional survey was developed in February 2022. It included 23 questions regarding AGPs in dentistry (Table 1). The respondents were encouraged to fill in the questionnaire over the Google Forms platform. It made the data collection process simpler, quicker and safer with regard to the COVID-19 pandemic, as the Indian government had advised the public to avoid face-to-face interaction and isolate at home. Individuals were sent a link to Google Forms that explained the study background and purpose, the voluntary nature of participation, and contained the declarations of confidentiality and privacy, and instructions for completing the questionnaire. The study was open to all Indian dentists working in private clinics, teaching faculties, medical facilities, or hospitals. The Dental Council of India (DCI) website lists all dentists currently registered in India. From the website, we randomly searched 3,500 dentists who were available on social media, such as Facebook, Instagram, Twitter, and WhatsApp, and requested them to participate in the survey. However, only 2,367 dentists agreed to take part. The 2,367 registered dentists who expressed interest in the survey were provided with an online link via the same relevant social media platform. Of the 2,367 respondents, only 1,279 met the eligibility criteria (Table 2). To create a balance of gender-based replies and prevent any bias in the demographic data, another 279 respondents from male dentists were randomly excluded.

The questionnaire was developed after reviewing the published literature and the most recent COVID-19 information available from the Centers for Disease Control and Prevention (CDC) dental setting guidelines,[11–15] and was also assessed for validity by 5 experienced reviewers. The survey consisted of 23 questions regarding AGPs (safety majors, the hygiene protocol and risk perceptions) in the clinic and broadly divided into 3 categories: attitude-based (question numbers 1–6); practice-based (question numbers 7–15); and knowledge-based (question numbers 16–23). The survey was designed as a multiple-choice questionnaire with 1 correct option for each question. The number of responses to all options was recorded for each question. The answers were analyzed according to gender (male or female), designation (a general practitioner (GPs) – BDS (Bachelor of Dental Surgery), a specialist – MDS (Master of Dental Surgery) or the teaching staff, i.e., BDS/MDS), years of experience (5, 5–10 or >10) and residence type (a metro city, a suburban area or a rural area). Ethical approval for the study was granted by the ethics committee at the Teerthanker Mahaveer Dental College and Research Centre, Moradabad, India (No. TMDCRC/IEC/SS/21-22/PRO 01).

Table 1. Participants' responses to attitude-, practice- and knowledge-based questions

Section	Questions	Answers	Percentage [%]
Attitudes	1. Do you feel safe while performing AGPs?	maybe	28.4
		no	33.9
		yes	37.7
	2. Do you strictly follow the WHO hand hygiene protocol before treating a new patient?	maybe	6.2
		no	3.6
		yes	90.2
	3. Which of the following is important before treating a patient?	negative RT-PCR	5.0
		proper history taking	10.3
		none	0.8
		both	**83.9**
	4. On a scale from 1 to 10, with 10 being the highest score, rate the following: Do you consider the usage of a PPE kit in an asymptomatic patient while performing AGPs to be important?	**10**	**88.0**
	5. What measures have you taken to minimize the amount of produced aerosol?	replacing an air rotor with a micro-motor	14.6
		switching to non-contact laser procedures	6.3
		none	25.0
		both	**54.1**
	6. Do you use AC while performing AGPs?	always	8.2
		sometimes	46.3
		never	**45.5**
Practices	7. In which of the following clinical procedures, do you take maximum precautions?	AGPs	23.2
		history taking and clinical examination	9.0
		taking radiographs	1.3
		all	**66.5**
	8. What type of mask do you use while performing AGPs?	any	7.6
		double masking with a surgical mask	27.7
		a hand-sewn cloth mask	1.1
		a NIOSH-approved N95 mask	**63.6**
	9. Does your clinic have a separate triage area for onitoring vitals, like temperature, oxygen saturation and sanitization?	no	19.1
		planning to add in the future	21.0
		yes	**59.9**
	10. What extra safety measures do you take while screening patients?	checking their status with the Aarogya Setu application	3.8
		history taking over the phone before scheduling an appointment	23.0
		none	13.6
		both	**59.6**
	11. Which method do you use to sanitize metal objects in the clinic, like dental chairs, instruments, and other?	70% alcohol	58.3
		detergent wash	3.9
		diluted (5%) bleaching solution	**9.6**
		fumigation	23.8
		none	4.4
	12. What do you wear for personal protection while performing AGPs?	**a disposable PPE kit with a face shield, a mask and gloves**	**63.3**
		a surgical gown with a face shield, a mask and gloves	21.0
		a face shield, a mask and gloves	12.1
		a mask and gloves	2.9
		none	0.7
	13. Do you have a separate setup for donning and doffing the PPE kit?	no	30.7
		yes	**69.3**
	14. Do you change your PPE kit for consecutive patients when performing AGPs?	no	25.5
		yes	**74.5**
	15. Do you provide PPE kits to your patients and your assistant?	maybe in the future	16.7
		no	14.9
		only to the assistant	28.6
		only to patients	3.8
		yes	**36.0**

Section	Questions	Answers	Percentage [%]
Knowledge	16. What is the correct sequence of donning the PPE kit?	**gloves, a mask, a gown**	**18.9**
		a gown, a mask, gloves	59.2
		a mask, gloves, a gown	3.6
		a mask, a gown, gloves	18.3
	17. What is the correct sequence of doffing the PPE kit?	gloves, a mask, a gown	31.3
		a gown, a mask, gloves	20.2
		a mask, a gown, gloves	9.8
		gloves, a gown, a mask	**38.7**
	18. Which of the following procedures is least safe to practice?	**crown preparation**	**37.8**
		impression making	26.4
		laser-guided procedures	26.9
		none	8.9
	19. What is the incubation period of SARS-CoV-2?	1–7 days	22.8
		1–15 days	**57.9**
		1–21 days	18.3
		1–35 days	1.0
	20. What is the duration of hand washing with soap/liquid soap?	10 s	3.9
		20 s	**25.8**
		30 s	42.8
		60 s	27.5
	21. The disease cannot be spread from asymptomatic patients	**false**	**83.0**
		true	17.0
	22. Which of the following investigations do you advise patients?	all	62.4
		blood investigations	0.6
		chest X-ray	1.2
		RT-PCR	**35.8**
	23. When should AGPs be appointed?	first appointment of the day	21.8
		anytime	30.1
		last appointment of the day	**48.1**

AGP – aerosol-generating procedure; WHO – World Health Organization; PPE – personal protective equipment; RT-PCR – reverse-transcription polymerase chain reaction; AC – air conditioning; NIOSH – National Institute for Occupational Safety and Health; SARS-CoV-2 – severe acute respiratory syndrome coronavirus 2. Correct answers are marked in bold.

Table 2. Inclusion and exclusion criteria

No.	Inclusion criteria	Exclusion criteria
1.	dentist practicing in India	dentist who declined to accept the consent form
2.	dentist who performs aerosol-generating procedures in their clinic	dental auxiliary
3.	dentist who has practised during the COVID-19 pandemic	dental practice that is limited to dental schools only
4.	–	incomplete or casually filled in forms

COVID-19 – coronavirus disease 2019.

Sample size calculation

The sample size was calculated using open-source software (OpenEpi) designed by CDC for epidemiological studies. Assuming a base population of 10,000 and setting the expected frequency of response at 59% (with a significance level of 0.1%), a sample size of 949 was required to achieve internal validity.

Statistical analysis

Descriptive and inferential statistics were analyzed by IBM SPSS Statistics for Windows, v. 20.0 (IBM Corp., Armonk, USA). The data was analyzed using the χ^2 test, and summarized using frequency and percentage. The mean and standard deviation ($M \pm SD$) values were used to summarize clinical parameters (the knowledge,

practice and attitude scores between genders, designation types, experience categories, and residence types) for the groups. The independent samples *t* tests compared differences in knowledge, practices and attitudes between the gender groups. The one-way analysis of variance (ANOVA) assessed intergroup differences in knowledge, practices and attitudes between designation types, experience categories and residence types. Frequency and percentage were used to summarize qualitative data (individual responses to questionnaire items). Throughout the study, $p < 0.05$ was considered a statistically significant difference.

Results

Comparison between genders

To ensure an equal number of replies from each gender and prevent any bias in the gender-based data, 279 male responses out of 1,279 responses were randomly excluded from the research. Females scored higher on knowledge-based (42.03 ±17.07) and attitude-based questions (71.41 ±22.63), whereas males scored higher on practice-based questions (51.10 ±19.92) (Table 3).

Table 3. Assessment of knowledge-, practice- and attitude-based responses between genders

Section	Gender	*M* ±*SD*	*SEM*	*p*-value
Knowledge	males	37.53 ±17.71	0.90	0.001*
	females	42.03 ±17.07	0.69	
Practices	males	51.10 ±19.92	1.01	0.026*
	females	48.05 ±21.84	0.88	
Attitudes	males	63.69 ±26.63	1.35	0.001*
	females	71.41 ±22.63	0.91	

M – mean; *SD* – standard deviation; *SEM* – standard error of the mean; * statistically significant.

Comparison according to designation

General practitioners performed better on attitude-based questions (71.71 ±23.43), specialist dentists performed better on knowledge-based questions (43.17 ±19.96) and the teaching staff performed better on practice-based questions (54.39 ±20.67) (Table 4).

Comparison according to experience

The highest knowledge scores (51.14 ±13.75) were found among participants with more than 10 years of experience. The highest attitude scores (70.73 ±23.28) occurred among participants with less than 5 years of experience (Table 5).

Comparison according to the demographic area

Participants residing in metro cities had the highest knowledge scores (43.45 ±18.06), while suburban participants had the highest practice (52.25 ±20.80) and attitude scores (72.61 ±23.69) (Table 6).

Table 4. Assessment of knowledge-, practice- and attitude-based responses according to designation

Section	Designation	*M* ±*SD*	*SEM*	*p*-value
Knowledge	GPs	39.17 ±16.42	0.68	0.003*
	specialists	43.17 ±19.96	1.15	
	teaching staff	38.48 ±14.54	1.36	
Practices	GPs	49.23 ±21.85	0.90	0.009*
	specialists	47.26 ±19.64	1.13	
	teaching staff	54.39 ±20.67	1.93	
Attitudes	GPs	71.71 ±23.43	0.97	0.001*
	specialists	63.50 ±24.98	1.44	
	teaching staff	64.56 ±26.28	2.45	

GP – general practitioner; * statistically significant.

Table 5. Assessment of knowledge-, practice- and attitude-based responses according to experience

Section	Experience [years]	*M* ±*SD*	*SEM*	*p*-value
Knowledge	<5	39.59 ±17.18	0.57	0.001*
	5–10	44.42 ±20.49	2.54	
	>10	51.14 ±13.75	2.39	
Practices	<5	50.09 ±21.07	0.70	0.001*
	5–10	42.73 ±19.95	2.47	
	>10	38.38 ±21.17	3.68	
Attitudes	<5	70.73 ±23.28	0.77	0.001*
	5–10	51.54 ±28.25	3.50	
	>10	38.64 ±16.64	2.89	

* statistically significant.

Table 6. Assessment of knowledge-, practice- and attitude-based responses according to the demographic area

Section	Demographic area	*M* ±*SD*	*SEM*	*p*-value
Knowledge	metro city	43.45 ±18.06	1.15	0.001*
	suburban	39.67 ±17.15	0.68	
	rural	37.09 ±16.93	1.53	
Practices	metro city	44.49 ±20.21	1.28	0.001*
	suburban	52.25 ±20.80	0.83	
	rural	43.36 ±22.01	1.98	
Attitudes	metro city	60.28 ±23.70	1.50	0.001*
	suburban	72.61 ±23.69	0.94	
	rural	63.41 ±25.46	2.29	

* statistically significant.

Attitude-based questions

When performing AGPs, 66.1% of the participants felt safe, to some degree. The WHO hand hygiene protocol was followed by 90.2%, and 83.9% recognized that proper history taking and a negative reverse-transcription polymerase chain reaction (RT-PCR) test was vital before treating patients. Only 54.1% took all measures necessary to minimize the amount of produced aerosol, and air conditioning (AC) was never used by 45.5%; only 8.2% used it all the time (Table 1).

Practice-based questions

During clinical procedures, 66.5% preferred taking maximum precautions. The National Institute for Occupational Safety and Health-(NIOSH) approved N95 mask was used by 63.6%, and a separate triage setup was used by 59.9%. While screening patients, 59.6% took all extra safety measures. The most common method used for sanitizing metal objects was 70% alcohol, used by 58.3%. A disposable personal protective equipment (PPE) kit was used by 63.3%, and 69.3% had a separate setup for donning and doffing such kits, while a similar proportion changed the kit between patients. A total of 36.0% of dentists provided their patients and assistants with PPE kits (Table 1).

Knowledge-based questions

The correct sequence of donning the PPE kit was followed by 18.9%, whereas 38.7% chose the correct doffing sequence. Crown preparation was regarded as the least safe practice by 38.7%. The majority of the participants (57.9%) knew that the incubation period of the virus was 1–15 days. Regarding the hand washing procedures, 42.8% erroneously believed that 30 s with soap/liquid soap was safer than doing it for 20 s. Most participants (83.0%) knew that the virus can be spread from asymptomatic patients. Only 35.8% of the participants believed RT-PCR was a diagnostic coronavirus test. Meanwhile, less than half of the participants (48.1%) were aware that AGPs should be delayed until the last appointment of the day (Table 1).

Discussion

Coronavirus disease 2019 is currently a global issue, notably among healthcare professionals and patients. Dentists are particularly vulnerable to nosocomial infections and may be coronavirus carriers.[12,13] The goal of this study was to investigate the knowledge, practices and attitudes of dentists in India regarding coronavirus. A questionnaire was developed to fill the knowledge gaps and reduce the viral spread while performing AGPs in dentistry through proper precautions.

Dentists' knowledge level was generally excellent. However, the findings indicate that the participants had considerable gaps in their coronavirus understanding, since only 57.9% knew the approximate incubation period of the infection. The incubation period is believed to be up to 15 days; however, it can be longer in rare situations.[14–16] For dental professionals, this asymptomatic phase might be problematic as the disease can spread before any symptoms appear.[17]

Female dentists showed better knowledge and attitudes toward coronavirus than male dentists. Similar research was conducted by Sezgin and Çapan, who also found that females had better coronavirus knowledge.[18] However, Olum et al. reported contrary findings, showing that males had significantly more knowledge than females.[19] The different designations of dentists play a major role in determining how the overall practice was performed during the COVID-19 pandemic. While the teaching staff provided better practice-based responses and GPs provided more accurate answers to attitude-based questions, the specialized dentists gave more accurate knowledge-based responses.

Dentists with more than 10 years of experience had more knowledge than those with less than 5 years of experience, who in turn chose correct answers for practice and attitude-based questions. Our results are similar to those of Nour et al., who reported higher knowledge among healthcare workers who had practiced for more than 10 years.[20] However, their survey mostly included participants from Saudi Arabia and Pakistan, which differ from the Indian population.[20]

A thorough understanding of any disease helps in its early detection, diagnosis, treatment, and prevention, especially during a pandemic. There was a significant number of appropriate practices among the responders. This is in line with the observations made by Zhang et al.,[21] Saqlain et al.[22] and Huynh et al.,[23] who found ethical behavior among medical personnel throughout the COVID-19 epidemic. A high correlation between knowledge and practice suggests that all health professionals' understanding has to be improved to increase the adoption of preventative measures.[24]

In our study, dentists living in metro cities were more knowledgeable than suburban dentists. However, suburban dentists were better in practice management during the COVID-19 pandemic and had better attitudes toward safety. There is no previous demographic data available regarding practice.

For dental practitioners working in triage areas, all prevention measures are necessary, from social distancing and hand washing to protective equipment, such as face shields, masks, gowns, and gloves.[25,26] Manzar et al. concluded that all dental operations, whether they generate an aerosol or not, can disseminate the virus.[27] As a result, all safety precautions must be used equally. Most participants knew who to report

to in the event of unprotected contact with a known or suspected coronavirus-positive patient, and what to do if they developed symptoms. A similar result was observed in a study by Kamate et al., in which dentists were considered to have high grades in both knowledge and practice.[28] This demonstrates Indian dentists' understanding and their role in raising public awareness about infection control and prevention techniques. Furthermore, the study might generate curiosity among the participating dentists regarding the virus infection and its prevention, especially those who did not provide correct answers.

Despite the positive results of the study, there were a few limitations. Since it was a cross-sectional study, only associations, not cause-and-effect relationships, could be reported. In addition, it is important to consider the degree of ambiguity around the self-reporting component of the survey and the participants' memory.

Conclusions

In the case of the dental personnel, there is a substantial risk of spreading infectious illnesses. The occurrence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has presented dentists with new challenges and duties.[28,29] Dentists in India demonstrated a high level of understanding with regard to COVID-19. On the other hand, dentists showed a limited understanding of the extra preventative procedures to safeguard dental workers and patients against the virus. Our findings have significant implications for the measures aimed at increasing dentists' level of practice and strengthening preventative programs. Special precautions should be taken to prevent the illness spread among patients; they can also be used to manage other respiratory diseases in the future.

Ethics approval and consent to participate

Ethical approval for the study was granted by the ethics committee at the Teerthanker Mahaveer Dental College and Research Centre, Moradabad, India (No. TMDCRC/IEC/SS/21-22/PRO 01). All participants provided written informed consent.

Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Consent for publication

Not applicable.

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