

IMPACT OF TELEDENTISTRY DURING THE COVID-19 PANDEMIC ON SAUDI PATIENTS' SATISFACTION AND TREATMENT OUTCOMES

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<https://doi.org/10.51847/X7LSvA0AV2>

ABSTRACT

Using Teledentistry for consultations, diagnoses, treatment planning, coordination, and continuity of care will offer some decision assistance and make it easier for dentists to share the patient's contextual knowledge. Teledentistry will also provide dental students and practitioners with new possibilities while enhancing traditional teaching methods in dental education through video conferencing technology. This cross-sectional study was conducted among Riyadh's general public and dental professionals using an online survey. This study used 380 participants from the general public over 18 and 300 dental professionals. A total of 300 dentists participated in this study, of which 19 (82.6%) were female and 4 (17.4%) male participants. There were 21.7% interns, 39.1% BDS, and 39.1% specialists. 60.9% of participants had a clinical experience of fewer than five years. The majority of the participants (73.9%) were in public practice. Teledentistry became an essential part of the dental practice during COVID, with the majority of the participants being in its favor and advocating its benefits when it comes to long-distance patient management.

Key words: Teledentistry, COVID-19, Patients satisfaction, Cross-sectional.

Introduction

COVID-19

The World Health Organization (WHO) declared the Coronavirus Disease 2019 (COVID-19) a worldwide pandemic in March 2020. Following the WHO declaration, countries worldwide, including the Kingdom of Saudi Arabia (KSA), implemented various measures to contain the virus, including suspending all flights, shutting down universities and schools, and imposing a nationwide curfew [1]. The COVID-19 pandemic has impacted the general population in numerous ways; patients have had difficulty accessing dental care since all non-emergency medical and oral healthcare procedures were temporarily suspended due to the imposed lockdown and social distancing measures [2]. In addition, the nature of the dental profession presents a significant risk for dentists physically interacting with their patients [3]. Therefore, innovative information technology methods such as Teledentistry were required to address healthcare access issues while limiting direct patient-dentist contact [2].

Teledentistry

Teledentistry is the practice of providing dental healthcare across a great distance using telecommunications technologies. Teledentistry was initiated in 1989 by the Westinghouse Electronics Systems Group in Baltimore.

However, the first use of Teledentistry was in 1994 by the United States military [4]. The main aim of Teledentistry is to facilitate access to dental care, improve the quality of patient care, and decrease oral health care costs. Using Teledentistry for consultations, diagnoses, treatment planning, coordination, and continuity of care will offer some decision assistance and make it easier for dentists to share the patient's contextual knowledge. Teledentistry will also provide dental students and practitioners with new possibilities while enhancing traditional teaching methods in dental education through video conferencing technology [5]. Only diagnostic and preventative treatments benefit from Teledentistry. Patients must attend the clinic if they need treatment for procedures, including restorations, endodontic treatments, and extractions. Clinical photography is the basis for the diagnosis, which may alter based on in-person interaction. The proper representation of intraoral photos or videos could not match what is truly there. It cannot use other diagnostic tools like percussion and palpation [6].

Use of teledentistry during COVID-19

The emergence of COVID-19 has inflicted collateral impacts on the population and healthcare systems worldwide. Due to the high susceptibility of infection in dental settings, access to dental care services had to be limited or wholly suspended to safeguard the well-being of

both patients and clinicians. In response, healthcare services introduced Teledentistry as an innovative tool to resume dental care provisions while mitigating the risk of transmission through social distancing. During the pandemic, Teledentistry was utilized through various modalities. Teleconsultation is the most common application of Teledentistry. It permitted dentists to communicate and advise patients via video conferencing during self-isolation/quarantine or national lockdown. Additionally, Triage, in conjunction with telemonitoring, helped prioritize emergency patients and postpone non-urgent cases. This meant reducing unnecessary contact and lowering the burden on an already overwhelmed healthcare system [7, 8].

Furthermore, telediagnosis replaced a typical clinical examination with dental photography, software programs, and phone applications linked with specialists for detecting and diagnosing dental caries and oral lesions, including screenings for oral cancers [7]. A randomized control trial corroborated that referral decisions based on clinical photographs were comparable with those of face-to-face appointments. This removed the need for risky face-to-face appointments, eliminated travel for patients in rural communities, and eased access to specialists [9]. Although Teledentistry is steadily gaining acceptance with widespread use and education, several challenges must be overcome. Dentists expressed uncertainty regarding the accuracy of Teledentistry due to misleading image quality and the inability to complete all elements of diagnostic procedures, such as palpitations [6].

On the other hand, patients were concerned about the inability to communicate their needs to the dentist sufficiently. Lastly, as a novel tool, there remains ambiguity regarding the security and confidentiality of records, raising medicolegal issues for the dentist and the patient [6]. Although Teledentistry demonstrates numerous benefits and limitations, it can complement dentistry and improve dental care during and beyond the COVID-19 pandemic [7].

Literature review

DAA Khan *et al.* (2021) assessed the knowledge and practice of Teledentistry during COVID-19 in southern Arabia. They concluded that most healthcare practitioners are well aware of Teledentistry and have demonstrated a positive attitude regarding the technology; however, dentists need to improve the use of Teledentistry through the pandemic. In the article, the authors focused on the practitioner's point of view on teledentistry technology. However, they didn't include the patient's perspective; instead, they assessed the knowledge and attitude of the practitioner. Literature that has addressed patient satisfaction and treatment outcomes toward Teledentistry in Saudi Arabia is limited; therefore, there is a gap in the literature.

Plaza-Ruiz *et al.* (2021) evaluated the impact of the COVID-19 pandemic on dentists' knowledge, practices, and expectations toward Teledentistry and its association with sociodemographic variables [10]. A cross-sectional survey was distributed online to a sample of general or specialist dentists working in Colombia's private or public clinics. It concluded that the COVID-19 pandemic had a good impact on Teledentistry. However, barriers such as insufficient financial reimbursement, low technical skills in older dentists, and inequalities in remote regions must be overcome.

Rahman *et al.* (2020) evaluated the patients' experience using Teledentistry during the coronavirus (COVID-19) pandemic [11]. Most survey participants expressed positive views towards Teledentistry in all five domains: patient satisfaction, ease of use, effectiveness, increasing access to clinical services, reliability of the teledentistry system, and usefulness for patients. However, the article had some limitations in the sample size. They had a small sample size, which made the results unreliable. Also, it only includes the patient experience when utilizing Teledentistry during the coronavirus (COVID-19) pandemic without the dentist's experience.

Materials and Methods

Study design

This cross-sectional study was conducted among Riyadh's general public and dental professionals using an online survey.

Study sample

This study used 380 participants from the general public over 18 and 300 dental professionals.

Study instrument

An online questionnaire comprised questions about personal, professional, and demographic data followed by questions linked to Teledentistry and its impact, satisfaction level, and experiences.

Instrument validity and reliability

A pilot study was conducted by sending the survey to 20 participants. The data were inserted in SPSS version 22 to determine the reliability using Chronbach's coefficient alpha. The validity of the questionnaire was tested by sending it to experienced researchers in REU, and changes were made according to their feedback and comments.

Statistical analysis

Collected data was analyzed using SPSS version 22, where descriptive and inferential statistics will be conducted. Comparisons between groups were made with the value of significance kept under 0.05. A test for normality was conducted, and the statistical test selection was decided upon, depending on the normality.

Results and Discussion

Dentists' responses to teledentistry

A total of 300 dentists participated in this study, of which 19 (82.6%) were female and 4 (17.4%) male participants. There were 21.7% interns, 39.1% BDS, and 39.1% specialists. 60.9% of participants had a clinical experience of fewer than five years. The majority of the participants (73.9%) were in public practice. The demographic characteristics of the respondents are shown in **Table 1**.

Table 1. Demographics of the study participants

Variables		%
Gender:	Male	17.4%
	Female	82.6%
	Total	100.0%
Qualification:	Intern	21.7%
	BDS	39.1%
	Specialist	39.1%
	Total	100.0%
Experience:	<5 years	60.9%
	>5 years	39.1%
	Total	100.0%
Current Practice:	Private	26.1%
	Public	73.9%
	Total	100.0%

Among 23 dentists, most were familiar with Teledentistry, while only 30% practiced TD at their current workplace. Of the dentists, 73% agree that TD can reduce patient flow during pandemics. All the dentists (100%) who participated in the study agree that TD is a good tool for giving oral hygiene instructions to patients. 95% of dentists believe that TD could add to regular dental care. 100% of dentists agree that TD provides accessibility to oral healthcare services to the rural population, as shown in **Table 2**. 60.9% of dentists had never practiced TD(**Figure 1**).

Table 2. Knowledge and practice of teledentistry among the study participants.

Items	Yes	%
Do you know what Teledentistry (TD) is?	Yes	95.7%
	No	4.3%
Do you think that TD is applicable in all branches of dentistry?	Yes	43.5%
	No	56.5%
Do you practice TD at your current workplace?	Yes	30.4%
	No	69.6%
In the future, will you practice TD?	Yes	73.9%

	No	26.1%
TD can reduce patient flow during pandemics by postponing 2n urgent dental visits.	Yes	91.3%
	No	8.7%
Dental examination via online video calls and intraoral cameras is as effective as in the traditional office setting.	Yes	30.4%
	No	69.6%
TD is a good tool for giving oral hygiene instructions to patients.	Yes	100.0%
	No	0.0%
TD can be an addition to the regular care that dentists provide.	Yes	95.7%
	No	4.3%
TD saves time for the dentist.	Yes	73.9%
	No	26.1%
TD can improve access to oral healthcare services, particularly in rural areas and during pandemics.	Yes	100.0%
	No	0.0%
TD will have a major role in future clinical practice.	Yes	82.6%
	No	17.4%
There is a clear need for a government initiative in the form of a TD program whereby patients could obtain advice on treatment needs from a central facility.	Yes	95.7%
	No	4.3%

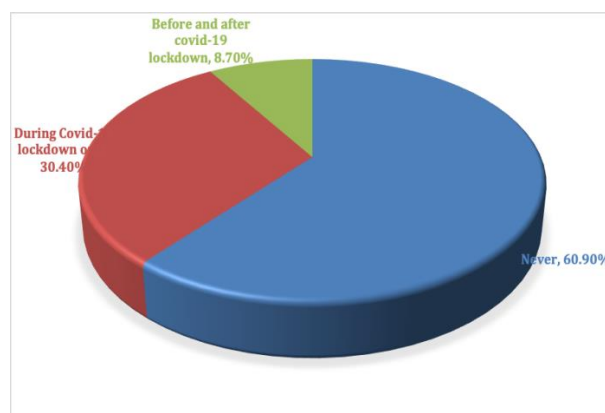


Figure 1. Start of practicing Teledentistry among dentists (N=23)

General public's responses to teledentistry

A total of 102 participants participated in this study. Demographic data showed that most respondents were female, 91(89.2%), and 11 (10.8%) male participants. There were 41 (40.7%) professionals, 20 (19.6%) homemakers, 20 (19.6%) retired, 15 (14.7%) students, 3 (2.9%) carers, and 3 (2.9%) unemployed, as is shown in **Table 3**.

Table 3. Descriptive analysis of the study participants.

Variables		%
Gender	Male	10.8%

	Female	89.2%
	Total	100.0%
"Occupation	Student	14.7%
	Professional	40.2%
	Carer	2.9%
	Homemaker	19.6%
	Retired	19.6%
	Unemployed	2.9%
	Total	100.0%

More than 50% of the participants agreed to consider future virtual clinic consultations. Most respondents agree that Teledentistry has positive aspects such as being easy to access, less time-consuming, readily available, and effective. Only 37.3% of the participants reported the virtual clinic met their needs. While 47.1 % of the participants reported using the virtual clinic again (Table 4).

Table 4. Distribution of responses to teledentistry attitude and experience among the general public (N=102)

Items	SA	A	N	D	SD
I would consider future consultations via a virtual clinic.	11.8%	40.2%	29.4%	14.7%	3.9%
The virtual clinic saved me time.	18.6%	36.3%	27.5%	11.8%	5.9%
I was able to access the virtual clinic	12.7%	33.3%	31.4%	12.7%	9.8%
I could talk to the clinician as well as if we met in person	9.8%	43.1%	22.5%	19.6%	4.9%
I was able to express myself effectively	8.8%	41.2%	28.4%	16.7%	4.9%
I could easily hear and talk to the clinician	9.8%	48.0%	28.4%	7.8%	5.9%
The system was easy to use	7.8%	45.1%	30.4%	11.8%	4.9%
The virtual clinic met my needs	3.9%	33.3%	40.2%	17.6%	4.9%
I would use the virtual clinic again.	10.8%	36.3%	28.4%	16.7%	7.8%

Patient

Teledentistry is an innovative healthcare service that can aid the triaging of dental patients by contacting and following up with them. In addition, it enables the investigations of the results to be discussed and clinicians to give advice. This first part of the study evaluated the use of Teledentistry from a patient’s perspective on satisfaction and the treatment outcome. The results illustrate that most patients showed either agree or neutral responses. In the present study, most respondents found access to the virtual clinic easy (46%). However, 31.4% were neutral, which doesn’t fall in either category, a lower value than the study of Naomi Rahman *et al.*, who reported 82%. In this study, the majority of the respondents (52%) would use the virtual clinic in the future, which, in addition, reports a much lower value than what has been proposed by Naomi Rahman *et al.*, which was approximately 95%. Naomi Rahman *et al.* reported that 91% of respondents agreed that Teledentistry would save time and travel. In this study, 54.9% of the participants agreed with the statement, which also reported a much lower value. The data demonstrate that most patients were satisfied with using Teledentistry in the main categories: practicability, patient satisfaction, and service effectiveness. In line with the proposed hypothesis, the data analysis supports the positive impact and high satisfaction among the patients who used Teledentistry.

Regarding patient ease of use, only 45.1% of patients believed that the system was easy to navigate, with 48.0% reporting being able to communicate with the clinician effectively. By contrast, Menhadji *et al.* (2021) reported that approximately 70% of patients reported that their video consultations were satisfactory and proceeded smoothly [12]. 66% reported they would, if appropriate, like more appointments like this in the future. 78% did not have any connection issues. 97% found the consultation easy to follow. 97% rated their appointments 7–10, showing high satisfaction with the virtual consultations [12].

Dentist

Teledentistry (TD) modified dental service delivery amid the COVID-19 pandemic to permit patient triage, referral, diagnoses, monitoring, and consultation remotely via technology [7, 8]. To our knowledge, this is the first dual-prospective study that evaluates patients' and clinicians' experience of TD in Saudi Arabia. Our findings show that TD utilization resulted in favorable impacts. The dental professionals displayed a more substantial positive attitude towards treatment outcomes, whilst patients expressed overall positive but divided satisfaction levels. Most dentists demonstrated awareness of TD (95.7%) but moderate levels of practice in the clinic (69.6%). This suggests that dental professionals are highly aware of TD but are yet to incorporate it into their delivery of care, which is consistent with the findings of a systematic review and meta-analysis.

A possible explanation for the moderate uptake is the lack of training and formal platform to adopt this new

technology into the dental system [13]. Regarding applicability, 56.5% of dentists did not recognize TD as applicable in all branches of dentistry, lower than the 64.10% reported by Abbas *et al.* [14]. This was reflected in 100% of dentists finding TD as a good tool for oral hygiene instructions for patients but 69.6% finding video calls and intraoral cameras ineffective for dental examinations in place of traditional settings. This may be explained by the inability to complete all elements of dental examination procedures, such as palpitations [6]. However, this was inconsistent with a randomized control trial that found clinical photographs were comparable to face-to-face dental examination appointments [9]. The specific dental specialties where TD would be of merit were explored by Menhadji *et al.* but go beyond the scope of this study.

Furthermore, 100% of dentists agreed that TD improves access to services in rural areas more than the 88.2% reported by Abbas *et al.* And 73. % found that it saved the dentists time less than the 84.10% expressed by Abbas *et al.*[14]. Despite the limitations, dental professionals accredited the use of TD and its promising prospects since the future uptake of TD is expected to increase to 73.9%, with 95.7% including it in conjunction with regular care. In addition, 82.6% believe TD will have a significant role in future clinical practice, and 95.7% called for the need to establish a government initiative with a central facility for a TD program. Such programs may prompt TD implementation where it is more efficient and effective. It can also address the medicolegal, technical, and infrastructural concerns. This, in return, can optimize TD's benefits and potentially increase its adoption and acceptance among the general public and dental professionals.

Teledentistry is becoming an important field in dentistry. The COVID-19 pandemic helped to hasten the use of it. Dentists can consult, monitor, and triage patients using Teledentistry. In the current study, we discovered that most of the participant dentists were familiar with Teledentistry, while only (30%) practice Teledentistry, and (73.9%) will practice Teledentistry in the future. A study by Tiwari *et al.* (2022) found that less than a quarter of the dentists surveyed had used Teledentistry, while (11%) planned on using it in the future. In the current study (100%) of dentists agreed that Teledentistry is a good tool for giving oral hygiene Instructions to patients; this is following a study done by Nagarajappa *et al.*, where nearly (70%) agreed that it can help in training better oral hygiene practices [15].

A study by Nassani *et al.* (2021) found that (77.4%) of dentists believe that Teledentistry can reduce patient flow during pandemics by postponing urgent visits [16]. In comparison, in this study (91.3%) believe that. Also, according to Nassani *et al.*, (31.3%) of participant dentists believe that dental examination via online video calls and intraoral cameras is as adequate as in the traditional office

setting, almost the same in the current study (30.4%). In the current study, we found that (100%) of participant dentists believe that Teledentistry can improve access to oral healthcare services in rural areas. In Nassani *et al.*, only 75.9% of the study believe that. (73.9%) Dentists believe that Teledentistry saves time for the dentist, while in Nassani *et al.*, only (68.7%) believe that. Also, in the current study (95.7%), participant dentists believe that there is a clear need for government initiative in the form of a teledentistry program whereby patients could obtain advice on treatment needs from a central facility, while in Nassani *et al.*, study (67.6%) believe that. Teledentistry will have a significant role in future clinical practice according to 82.6% of participant dentists, while only 65.9% of participant dentists believe in that in Nassani *et al.*'s study. Practicing Teledentistry requires adequate infrastructure, such as networking, appropriate hardware, intraoral cameras, and digital images. We need more future research for Teledentistry.

Dentist combined

Teledentistry (TD) is gaining significance in the field of dentistry. It modified dental service delivery amid the COVID-19 pandemic to permit the triage, referral, diagnosis, monitoring, and consultation of patients remotely via technology [7, 8]. To our knowledge, this is the first dual-prospective study that evaluates patients' and clinicians' experience of TD in Saudi Arabia. Our findings show that TD utilization resulted in favorable impacts. The dental professionals displayed a more robust positive attitude towards treatment outcomes, while patients expressed an overall positive but divided satisfaction level. Most dentists demonstrated awareness of TD (95.7%) but moderate levels of practice in the clinic (69.6%).

Similarly, a Tiwari *et al.* study found that less than a quarter of the dentists surveyed had used TD before. This suggests that dental professionals are highly aware of TD but have yet to incorporate it into their care delivery, consistent with the findings of a systematic review and meta-analysis. A possible explanation for the moderate uptake is the lack of training or a formal platform to adopt this new technology into the dental system [13].

56.5% of dentists did not recognize TD as applicable in all branches of dentistry, lower than the 64.10% reported by Abbas *et al.*[14]. This was reflected by 100% of dentists finding TD as a good tool for patient oral hygiene instructions. Still, only 30.4% find video calls and intraoral cameras effective for dental examinations in place of traditional settings. This may be explained by the inability to complete all elements of dental examination procedures, such as palpitations[6]. These findings are almost identical to Nassani *et al.*, where 31.3% of dentists believe that dental examination via online video calls and intraoral cameras is as adequate as the traditional setting. However, this was inconsistent with a randomized control trial that found clinical photographs were comparable to face-to-face

dental examination appointments [9]. The specific dental specialties where TD would be of merit were explored by Menhadji *et al.*, but go beyond the scope of this study.

Furthermore, 100% of dentists agreed that TD improves access to services in rural areas more than 88.2% reported by Abbas *et al.*, and 75.9% reported by Nassani *et al.*. Also, 73.9% believe TD saved the dentist's time more than the 68.7% found by Nassani *et al.*, but less than the 84.10% expressed by Abbas *et al.* Also, Nassani *et al.*, demonstrated that 77.4% of dentists found TD reduced patient flow during pandemics by postponing urgent visits, lower than that reported in this study (91.3%). Despite the limitations, dental professionals accredited the use of TD and its promising prospects since the future uptake of TD is expected to increase to 73.9%, with 95.7% including it in conjunction with regular care. In addition, 82.6% believe TD will have a significant role in future clinical practice, and 95.7% called for the need to establish a government initiative with a central facility for a TD program, higher than (65.9%) and (67.6%) reported by Nassani *et al.*, respectively. Such programs may prompt TD implementation where it is more efficient and effective. It can also address the medicolegal, technical, and infrastructural concerns. This, in return, can optimize TD's benefits and potentially increase its adoption and acceptance among the general public and dental professionals. The future of TD requires adequate resources and more significant research on its implications.

Conclusion

Teledentistry became an essential part of the dental practice during COVID, with the majority of the participants being in its favor and advocating its benefits when it comes to long-distance patient management.

Acknowledgments: None

Conflict of interest: None

Financial support: None

Ethics statement: This study has received ethical approval from the REU research center.

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