



Original Article

The Influence of Teledentistry on Patient Satisfaction and Treatment Results in Saudi Arabia during the Covid-19 Pandemic

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ABSTRACT

Teledentistry (TD) plays a crucial role in consultations, treatment planning, diagnoses, coordination, and maintaining continuity of care, offering valuable decision support and simplifying the process of sharing patient information. It also opens new opportunities for dental students and professionals, enhancing traditional educational methods through video teleconferencing technology. The present study aimed to investigate the impact of TD on patient satisfaction and treatment outcomes in Saudi Arabia during the COVID-19 pandemic. This cross-sectional research surveyed both the general public and dental professionals in Riyadh via an online questionnaire. The sample consisted of 380 participants from the public, aged 18 and above, and 300 dental professionals. Among the 300 participating dentists, 19 (82.6%) were female and 4 (17.4%) male. The participants included 21.7% interns, 39.1% holding a BDS degree, and 39.1% specialists. 60.9% of the respondents had less than five years of clinical experience, with the majority (73.9%) working in public practice. During the COVID-19 pandemic, TD became an integral part of the dental practice, with most participants supporting its use and recognizing its advantages for managing patients remotely.

Keywords: Cross-sectional, COVID-19, Teledentistry, Patient satisfaction

Introduction

COVID-19

In March 2020, the World Health Organization (WHO) officially declared COVID-19 a global pandemic. In response, countries across the globe, including the Kingdom of Saudi Arabia, enforced various strategies to control the spread of the virus, such as halting international flights, closing educational institutions, and implementing a nationwide curfew [1]. The COVID-19 crisis has had widespread effects on the population, with many patients struggling to access dental care due to the suspension of all non-urgent medical and dental treatments during the lockdown and social distancing measures [2]. Furthermore, the nature of dental procedures poses a high risk of transmission for healthcare providers due to close patient interaction [3]. Consequently, alternative technological solutions, like teledentistry (TD), were introduced to maintain healthcare services while minimizing physical contact between patients and dental professionals [2].

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TD

TD refers to the delivery of dental care over long distances using telecommunication technologies. This practice was first introduced in 1989 by the Westinghouse Electronics Systems Group in Baltimore, though its initial use occurred in 1994 by the United States military [4]. The primary objective of TD is to enhance access to dental services, improve patient care quality, and reduce overall dental care expenses. It supports consultations, diagnoses, treatment planning, care coordination, and continuity by aiding decision-making and allowing dentists to exchange comprehensive patient information. Additionally, TD opens new opportunities for dental students and professionals, improving traditional educational methods through video conferencing technology [5]. However, TD is mainly beneficial for diagnostic and preventive care. For more complex procedures like restorations, endodontic treatments, or extractions, patients must visit the clinic in person. Diagnosis relies on clinical images, which may not fully represent the condition, as they lack the accuracy of hands-on examinations. Moreover, diagnostic tools like palpation or percussion cannot be employed remotely [6].

Use of TD during COVID-19

The onset of the COVID-19 pandemic has had widespread effects on both the population and healthcare systems globally. Given the high risk of infection in dental environments, access to dental care was significantly restricted or completely halted to protect both patients and practitioners. In response, TD emerged as an innovative solution, allowing dental services to resume while minimizing the risk of transmission through social distancing. Throughout the pandemic, various forms of TD were employed, with teleconsultation being the most common. This approach enabled dentists to provide consultations and guidance to patients via video calls during quarantine or lockdown periods. Additionally, Telerriage, coupled with telemonitoring, allowed for the prioritization of emergency cases and the postponement of non-urgent ones, thereby reducing unnecessary exposure and easing the strain on the already overwhelmed healthcare system [7, 8].

Moreover, telediagnosis replaced traditional clinical exams by utilizing dental photography, software, and mobile apps to assist specialists in detecting conditions such as dental caries, oral lesions, and even oral cancers [7]. A randomized controlled trial confirmed that decisions based on clinical images were comparable to those made during in-person visits. This not only reduced the need for potentially risky face-to-face consultations but also eliminated the need for patients in rural areas to travel and made specialist access more convenient [9]. Despite TD's growing acceptance and integration into dental practice, several challenges remain. Dentists have expressed concerns about the accuracy of diagnoses due to poor image quality and the inability to perform all diagnostic steps, such as palpation [6].

Patients also voiced frustrations about their inability to effectively communicate their dental concerns remotely. Furthermore, as a relatively new practice, concerns regarding the confidentiality and security of patient data persist, presenting potential medicolegal risks for both practitioners and patients [6]. Despite these challenges, TD offers significant potential to complement traditional dental practices and enhance care both during and after the COVID-19 pandemic [7].

Literature review

Khan *et al.* examined the awareness and implementation of TD in southern Arabia during the COVID-19 pandemic. Their findings indicated that while most healthcare professionals are knowledgeable about TD and have a positive outlook on its use, there is a need for dentists to further enhance their application of this technology throughout the pandemic. The study primarily focused on the perspectives of practitioners regarding TD but did not address the patients' viewpoints. Consequently, there is a gap in the existing literature regarding patient satisfaction and treatment outcomes related to TD in Saudi Arabia.

Plaza-Ruiz *et al.* [10] conducted a study on the impact of the COVID-19 pandemic on dentists' awareness, practices, and expectations regarding TD, while also considering sociodemographic factors. An online cross-sectional survey was distributed to general and specialist dentists working in private or public clinics in Colombia. The study found that the pandemic positively influenced the adoption of TD. However, it also highlighted challenges such as inadequate financial reimbursement, limited technical expertise among older practitioners, and disparities in remote areas that need to be addressed.

Rahman *et al.* [11] focused on evaluating patient experiences with TD during the COVID-19 pandemic. The majority of participants reported positive feedback on several aspects, including patient satisfaction, effectiveness, ease of use, accessibility of clinical services, reliability of the system, and overall usefulness. However, the study

had a significant limitation in its small sample size that affected the reliability of the results. Additionally, it only explored patient experiences with TD during the pandemic, without including the perspectives of the dentists involved in the care process.

The present study aimed to investigate the impact of TD on patient satisfaction and treatment outcomes in Saudi Arabia during the COVID-19 pandemic.

Materials and Methods

Study design

This research utilized a cross-sectional approach and involved both the general public and dental professionals in Riyadh through an online survey.

Study sample

The sample consisted of 380 individuals from the general public aged 18 and older, along with 300 dental professionals.

Study instrument

The study employed an online questionnaire that included sections on personal, demographic, and professional information, followed by items relating to TD, its impact, satisfaction levels, and experiences.

Instrument reliability and validity

A pilot test was conducted by distributing the survey to twenty participants. Data collected from this pilot were analyzed using SPSS version 22, and Cronbach's alpha coefficient was used to assess reliability. The questionnaire's validity was evaluated by experienced researchers at REU, and revisions were made based on their suggestions.

Statistical analysis

Data analysis was performed using SPSS version 22, where both inferential and descriptive statistics were applied. Group comparisons were carried out with a significance level set at 0.05. A normality test was carried out, and the appropriate statistical test was chosen based on the distribution of the data.

Results and Discussion

Dentists' responses to TD

A total of 300 dentists took part in this study, with nineteen (82.6%) being female and four (17.4%) male. Among the participants, 21.7% were interns, 39.1% held a BDS degree, and 39.1% were specialists. Additionally, 60.9% of the dentists had less than five years of clinical experience. The majority (73.9%) were practicing in public institutions. The demographic details of the participants are provided 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%

Out of 23 dentists, the majority were knowledgeable about TD, although only 30% were currently utilizing it in their practice. 73% of these dentists agreed that TD could help manage patient flow during pandemics. All participating dentists (100%) recognized TD as an effective tool for delivering oral hygiene education to patients. Additionally, 95% believed that TD could complement traditional dental care. Every dentist (100%) agreed that TD improves access to dental services for rural populations, as detailed in **Table 2**. Interestingly, 60.9% of the dentists had not yet implemented TD in their practice, as shown in **Figure 1**.

Table 2. Understanding and implementation of TD by the study participants.

Items	%
Are you familiar with the concept of TD?	Yes 95.7%
	No 4.3%
Do you believe that TD can be used across all areas of dentistry?	Yes 43.5%
	No 56.5%
Are you currently implementing TD in your practice?	Yes 30.4%
	No 69.6%
Do you plan to incorporate TD into your practice in the future?	Yes 73.9%
	No 26.1%
TD can help manage patient flow during pandemics by delaying non-urgent dental appointments.	Yes 91.3%
	No 8.7%
Online video consultations and intraoral cameras can provide the same level of effectiveness as traditional in-office dental exams.	Yes 30.4%
	No 69.6%
TD is an effective method for providing patients with oral hygiene guidance.	Yes 100.0%
	No 0.0%
TD can complement the standard care offered by dentists.	Yes 95.7%
	No 4.3%
TD helps dentists save time.	Yes 73.9%
	No 26.1%
TD enhances access to dental care, especially in remote locations and during health crises.	Yes 100.0%
	No 0.0%
TD is expected to play a significant role in clinical practice moving forward.	Yes 82.6%
	No 17.4%
A government-led initiative for a TD program is essential, allowing patients to receive treatment advice from a central hub.	Yes 95.7%
	No 4.3%

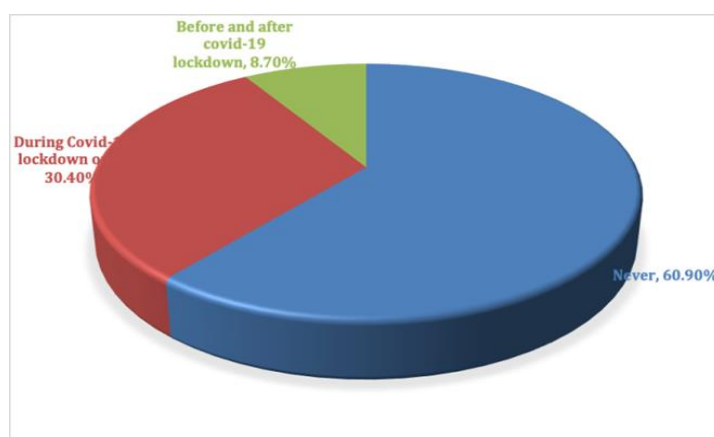


Figure 1. Initiation of TD practice among dental professionals (n = 23).

General public's responses to TD

A total of 102 individuals took part in this study. According to the demographic information, the majority of participants were female, with 91 (89.2%) females and 11 (10.8%) males. The sample included 41 (40.7%) professionals, 20 (19.6%) homemakers, 20 (19.6%) retirees, 15 (14.7%) students, 3 (2.9%) caregivers, and 3 (2.9%) unemployed individuals, as presented 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%

Over half of the participants expressed willingness to consider virtual clinic consultations in the future. The majority of respondents highlighted the advantages of TD, including its ease of access, time-saving nature, availability, and effectiveness. However, only 37.3% felt that the virtual clinic adequately addressed their needs. Meanwhile, 47.1% indicated that they would be willing to use the virtual clinic again, as shown in **Table 4**.

Table 4. Overview of the general public's attitudes and experiences with TD (n = 102).

Items	SA	A	N	D	SD
I would be open to having consultations through a virtual clinic in the future.	11.8%	40.2%	29.4%	14.7%	3.9%
The virtual clinic helped me save time.	18.6%	36.3%	27.5%	11.8%	5.9%
I was able to use the virtual clinic.	12.7%	33.3%	31.4%	12.7%	9.8%
I could communicate with the clinician just as effectively as if we were meeting face-to-face.	9.8%	43.1%	22.5%	19.6%	4.9%
I was able to communicate my thoughts.	8.8%	41.2%	28.4%	16.7%	4.9%
I had no difficulty hearing or speaking with the clinician.	9.8%	48.0%	28.4%	7.8%	5.9%
The system was user-friendly.	7.8%	45.1%	30.4%	11.8%	4.9%
The virtual clinic fulfilled my requirements.	3.9%	33.3%	40.2%	17.6%	4.9%
I would consider using the virtual clinic once more.	10.8%	36.3%	28.4%	16.7%	7.8%

Patient

TD is an innovative healthcare approach that facilitates dental patient triage by enabling communication and follow-up. It also allows for discussing results and providing clinical advice. The initial phase of this study focused on evaluating patient satisfaction and treatment outcomes related to TD. The findings reveal that the majority of patients expressed agreement or neutrality regarding their experience. In this study, 46% of respondents found accessing the virtual clinic easy, while 31.4% were neutral, a much lower percentage compared to Rahman *et al.* study [11], where 82% reported ease of access. Additionally, while 52% of participants in this study expressed interest in using the virtual clinic in the future, this is significantly lower than the 95% reported by Rahman *et al.* [11]. Furthermore, 54.9% of respondents agreed that TD could save time and travel, which is also a lower value compared to the 91% agreement in Rahman *et al.* study. However, despite these lower percentages, the data still indicate that most patients were satisfied with the key aspects of TD, including its practicality, effectiveness, and overall patient satisfaction.

When it comes to ease of use, only 45.1% of patients found the system easy to navigate, and 48.0% felt they could effectively communicate with the clinician. In contrast, Menhadji *et al.* [12] found that around 70% of their participants were satisfied with their video consultations, with 66% expressing interest in more future appointments if applicable. Additionally, 78% did not face connection issues, and 97% reported that the consultation was easy to follow. Moreover, 97% of participants rated their virtual consultations highly, between 7 and 10, reflecting strong satisfaction with the service [12].

Dentist

TD (TD) transformed dental care during the COVID-19 pandemic by enabling remote patient triage, referrals, diagnoses, monitoring, and consultations through technological means [7, 8]. To the best of our knowledge, this is the first study in Saudi Arabia that simultaneously evaluates the experiences of both patients and clinicians with TD. The results highlight that TD adoption had positive effects overall. Dental professionals demonstrated a stronger positive outlook on treatment outcomes, while patients exhibited mixed satisfaction levels. A large majority of dentists (95.7%) were aware of TD, but only 69.6% implemented it in their practices. This indicates that while dental professionals are well-informed about TD, they have yet to fully integrate it into their patient care routines, a trend that aligns with findings from a systematic review and meta-analysis.

A contributing factor to the moderate adoption of TD could be the lack of training and the absence of a formal platform to incorporate this technology into the dental field [13]. Regarding its applicability, 56.5% of dentists didn't view TD as suitable for all areas of dentistry, a lower percentage compared to the 64.10% reported by Abbas *et al.* [14]. This was further supported by the fact that while 100% of dentists agreed that TD is useful for providing oral hygiene instructions, 69.6% found video calls and intraoral cameras inadequate for conducting dental exams compared to traditional methods. The inability to perform certain aspects of dental exams, such as palpation, may account for this view [6]. However, this finding contrasts with a randomized controlled trial that demonstrated the effectiveness of clinical photographs in comparison to in-person dental exams [9]. The dental specialties where TD is most beneficial were explored by Menhadji *et al.* [12], although this aspect was beyond the scope of our research.

Additionally, 100% of dentists acknowledged that TD enhances access to dental services in rural areas, which is a higher percentage than the 88.2% reported by Abbas *et al.* [14]. Likewise, 73.9% of dentists felt that TD saved time, although this is slightly lower than the 84.10% reported by Abbas *et al.* [14]. Despite these limitations, dental professionals showed strong support for TD, with 73.9% expecting to adopt it in the future, and 95.7% seeing it as a complementary tool to regular care. Furthermore, 82.6% of respondents believed that TD would play an important role in the future of clinical practice, and 95.7% called for the establishment of a government-backed TD program with a centralized facility. Such initiatives could stimulate the efficient and effective implementation of TD while addressing challenges related to medicolegal issues, technical hurdles, and infrastructure. Ultimately, these efforts could optimize the benefits of TD and facilitate its wider acceptance and use among both the general public and dental professionals.

TD is increasingly becoming a pivotal area in the field of dentistry, with the COVID-19 pandemic accelerating its adoption. Dentists now can monitor, consult, and triage patients remotely using TD. In the present study, it was found that while most participating dentists had information about TD, only 30% actively implemented it in their practices, though 73.9% expressed interest in using it in the future. Research by Tiwari *et al.* [15] reported that fewer than a quarter of the dentists surveyed had engaged with TD, and only 11% planned to incorporate it in the future. In our study, 100% of the dentists agreed that TD is an effective tool for providing oral hygiene instructions to patients, which aligns with findings from Nagarajappa *et al.* where nearly seventy % of dentists supported its role in promoting better oral hygiene practices [15].

Nassani *et al.* [16] understood that 77.4% of dentists believed TD could help reduce patient flow during pandemics by delaying urgent visits. Our study showed that 91.3% of dentists shared this view. Regarding the effectiveness of dental examinations via intraoral cameras and online video calls, Nassani *et al.* [16] reported that 31.3% of dentists considered it as adequate as traditional office examinations. Our study found nearly the same proportion (30.4%) of dentists agreeing with this. Furthermore, 100% of the dentists in our study believed TD could enhance access to oral healthcare in rural areas, a significantly higher percentage than the 75.9% reported by Nassani *et al.* [16]. Additionally, 73.9% of our respondents felt that TD saved time for dentists, compared to 68.7% in Nassani *et al.* research [16]. A notable 95.7% of dentists in our study emphasized the need for a government initiative to

establish a centralized TD program for patients to receive treatment advice, whereas only 67.6% of participants in the Nassani *et al.* study agreed with this.

Regarding the future role of TD, 82.6% of dentists in our study believed it would play a significant part in clinical practice, surpassing the 65.9% reported in Nassani *et al.* research [16]. However, the effective implementation of TD requires robust infrastructure, including adequate networking, intraoral cameras, suitable hardware, and digital imaging systems. Given these requirements, there is a strong need for further research into the potential and development of TD.

Dentist combined

TD is becoming increasingly important within the dental field, particularly in response to the COVID-19 pandemic, which facilitated the remote triage, referral, diagnosis, monitoring, and consultation of patients through technology [7, 8]. To the best of our knowledge, this is the first dual-prospective research assessing both patient and clinician experiences with TD in Saudi Arabia. Our findings indicate that the use of TD has led to positive outcomes, with dental professionals showing a more favorable attitude towards treatment results, while patients reported generally positive yet mixed levels of satisfaction. While a significant number of dentists (95.7%) were aware of TD, only 69.6% were actively implementing it in their practices.

This is in line with the findings of Tiwari *et al.* [15], where fewer than 25% of surveyed dentists had previously used TD. The results suggest that although dental professionals are generally aware of TD, its integration into clinical practice remains limited, a trend also reflected in a systematic review and meta-analysis. One potential reason for the moderate adoption of TD is the absence of proper training and a standardized platform to incorporate this emerging technology into routine dental care [15].

In this study, 56.5% of dentists didn't consider TD applicable across all areas of dentistry, a lower figure compared to the 64.1% reported by Abbas *et al.* [14]. However, 100% of the dentists agreed that TD is an effective tool for providing oral hygiene instructions to patients. Yet, only 30.4% found intraoral cameras and video calls to be suitable alternatives for dental examinations in place of traditional methods. This can be attributed to the limitations in performing certain dental examination procedures, such as palpations [6]. These results align closely with those of Nassani *et al.* [16], where 31.3% of dentists felt that dental examinations through intraoral cameras and video calls could match the effectiveness of traditional in-person evaluations. Nonetheless, these findings contradict a randomized control trial that concluded clinical photographs could serve as an effective substitute for in-person dental exams [16].

The potential value of TD in specific dental specialties was explored by Menhadji *et al.* [12] but is beyond the scope of this research. Moreover, 100% of the dentists in our study agreed that TD improves access to dental services in rural areas, which is higher than the 88.2% reported by Abbas *et al.* [14] and the 75.9% found in the Nassani *et al.* study. Additionally, 73.9% of dentists felt that TD helped save time, a higher percentage than the 68.7% reported by Nassani *et al.* but lower than the 84.1% reported by Abbas *et al.* [14]. Furthermore, 91.3% of dentists in this study agreed that TD could reduce patient flow by postponing urgent visits during pandemics, which is higher than the 77.4% found by Nassani *et al.* [16].

Despite some limitations, dental professionals acknowledged the benefits of TD and its promising future. It is expected that TD adoption will rise to 73.9% in the future, with 95.7% planning to integrate it alongside regular care. Furthermore, 82.6% of participants believed that TD will play an important role in the future of clinical practice, and 95.7% advocated for the establishment of a government initiative with a central facility dedicated to TD, which is a higher proportion than the 65.9% and 67.6% reported by Nassani *et al.* [16], respectively. Such initiatives could drive more efficient and effective implementation of TD, addressing challenges related to medicolegal, infrastructural, and technical concerns. This, in turn, could enhance the benefits of TD and facilitate its wider acceptance among both the public and dental professionals. For TD's future success, adequate resources and further research into its implications are essential.

Conclusion

TD emerged as a crucial component of dental care during the COVID-19 pandemic, with most participants expressing support for its use and highlighting its advantages in managing patients remotely.

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