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ASSESSMENT OF CLINICIAN ACCEPTABILITY FOR THE MODERN TOOL OF TELEDENTISTRY

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ABSTRACT

Background: Teledentistry refers to providing dental care remotely using technology instead of direct patient contact, saving time and travel costs for patients. However, it may face challenges such as internet or phone connectivity issues, outdated software, and limitations in assessing certain cases. Improvements could include raising awareness in remote areas and enhancing internet infrastructure.

Objective: This study aims to evaluate the perceptions of clinicians on the use of teledentistry, assessing its effectiveness in various dental care settings, particularly in improving access to oral healthcare, reducing operational costs, and providing remote consultations during and after the COVID-19 pandemic.

Methods: A survey was conducted among 188 dental clinicians, evaluating their attitudes towards teledentistry across 12 key questions, such as its role in consultations, education, cost reduction, and future adoption. The study was conducted at Institute of dentistry, CMH Lahore Medical College from January 2024 to June 2024. The participants were grouped by age, educational background, and prior experience with teledentistry. Data were analyzed based on the responses to Likert-scale questions, ranging from "Strongly Agree" to "Strongly Disagree."

Results: The majority of respondents (63.8%) had previous experience with teledentistry. Key findings showed that 77.6% of clinicians agreed that teledentistry facilitates consultation with experts regarding specific patient problems. Similarly, 77.6% believed it is effective in dental education. However, only 43.6% felt that teledentistry examinations were as accurate as traditional in-office settings. Cost and time efficiency were highlighted, with 65.9% agreeing teledentistry reduces operational costs and 71.3% agreeing that it saves time for dentists. Importantly, 75.5% of

respondents indicated a willingness to adopt teledentistry in the future, despite concerns about diagnostic accuracy.
Conclusion: Teledentistry is broadly accepted among clinicians for its ability to improve access to care, streamline operations, and reduce costs. However, skepticism remains regarding the diagnostic precision compared to traditional dental settings. The findings are consistent with global trends in teledentistry adoption, which emphasize the need for enhanced technological infrastructure, training, and integration into routine dental practice to optimize its benefits. The results suggest that with improved accuracy and supportive frameworks, teledentistry could play a crucial role in the future of dental care delivery, especially in underserved regions.

Keywords: Teledentistry, access to care, cost reduction, remote consultation, clinician perceptions, dental education

INTRODUCTION

Telemedicine introduced in 1970, means “healing from a distance”, tt involves healthcare professionals using technology to exchange information for diagnosing, treating, and preventing illnesses, as well as for research and education, with the goal of improving individuals' and communities' health.[1] Tele dentistry, emerging in 1994 from a military project, enables dental professionals to communicate over long distances and facilitates ongoing dental training. It utilizes electronic platforms for dental specialists to interact remotely and share patient information.[2] Tele dentistry is a growing area of dentistry with various applications. It's beneficial not only in urban areas where patients need immediate dental care but also in rural areas where distance and financial constraints make accessing dental treatment difficult. By accessing a website, patients can receive prompt dental assistance, overcoming barriers like distance and cost. Tele dentistry has the potential to address issues related to accessibility, affordability, expertise, and quality of dental care. This article aims to spotlight these emerging aspects of tele dentistry.[3]

The internet is crucial for teledentistry systems as it allows for fast transmission of various types of data. Changes in data transfer speed and methods over the past decade have made teledentistry more important in healthcare. Internet-based communication and information technologies are now integral in education, allowing students to learn at their own pace and convenience. In professional dental education, modern internet systems enable online video conferencing, broadcasting of lessons and treatments, and online courses. There are two types of telemedicine modalities: store-and-forward, which provides good results at low costs for most dental applications, and real-time consultation.[4] Email is commonly used for store-and-forward communication, but it has limited data security. Video conferencing is a standard method for real-time consultation, but it requires expensive equipment and simultaneous online presence. Cloud storage offers another store-and-forward approach, allowing secure data storage and retrieval. While email and video conferencing are becoming more popular in dentistry, the adoption of cloud computing is still limited.[5] The rapid advancement of smartphone technology has led to increased use of smartphones for capturing and transmitting dental images for cavity screening. Smartphone cameras' zoom and flash features make it easier to capture both external and internal dental images. The accessibility and portability of smartphones provide an efficient way to capture images quickly.[5]
The primary workflow of teledentistry includes taking pictures with mobile phones, sending these images directly to a secure system using an app, retrieving data using user IDs and passwords, and allowing remote inspection of dental images by oral health specialists.[5] Key advantages of teledentistry include providing cost-effective alternatives to in-person care, enabling two-way communication between dentists and patients.[6] It helps dentists and other healthcare providers, such as midlevel professionals and dental hygienists, enhance diagnosis, treatment, and patient management.[6] Teledentistry reduces the time patients spend in the dental chair by allowing consultations without the need for physical presence, thereby increasing the number of patients dentists can see per day.[7] It also provides easy access to dental healthcare in remote areas, regions

with restrictions on female mobility, and areas with fewer experts and specialists. During the COVID-19 pandemic, e-dentistry offered quick relief for acute dental issues through phone consultations, especially when mobility was limited due to lockdowns.[8,9] Tele dentistry has various applications in oral medicine, prosthodontics, paediatrics, preventive dentistry, endodontics, orthodontics, and oral and maxillofacial surgery. With advancements in dental technology, tele dentistry connects patients and dentists through virtual dental clinics. In the future, remote robotic surgeries may be enhanced by tele dentistry, allowing dentists to control and oversee procedures from afar using mechanical consoles. Tele dentistry is an exciting and progressive field with limitless potential.[10]

Teledentistry has emerged as a valuable tool in dental practice, enabling remote consultations, diagnostics, and patient management, especially in underserved areas. Despite its benefits, the adoption of teledentistry by clinicians varies, often influenced by factors such as technology comfort, perceived effectiveness, and patient outcomes. Understanding clinician acceptability is crucial to address barriers and enhance the integration of this modern tool in routine practice. This study aims to assess clinicians' perspectives on teledentistry, focusing on its usability, efficiency, and impact on patient care. The findings will provide insights into optimizing teledentistry's adoption and addressing concerns that may hinder its broader implementation.

METHODOLOGY:

This cross-sectional study was conducted among clinicians, including dentists, dental hygienists, and other oral health professionals, to assess their acceptability of teledentistry as a modern tool. The study was conducted at Institute of dentistry, CMH Lahore Medical College from January 2024 to June 2024. An online survey was used to collect data, allowing a broader reach and convenience for participants. Clinicians who were actively engaged in dental practice, had experience using teledentistry tools, or were familiar with digital healthcare systems were included in the study. The inclusion criteria were licensed dental professionals, including dentists, dental hygienists, and specialists who were willing to participate and provide informed consent, with at least six months of experience in clinical practice. Clinicians without access to digital devices or those unwilling to use teledentistry and participants with less than six months of clinical experience were excluded.

The sample size was calculated based on previous findings on the acceptability of telehealth tools among clinicians, with a 95% confidence interval and a margin of error of 5%. A minimum of 200 participants was targeted to ensure adequate power for statistical analysis. A structured questionnaire was developed to assess clinicians' acceptability of teledentistry. The survey included sections on demographic information (age, gender, years of practice, and specialty), experience with teledentistry (frequency of use, types of applications, and perceived ease of use), perceived benefits and barriers (effectiveness, cost-efficiency, accessibility), and acceptability measures, where clinicians rated their satisfaction, perceived usefulness, and willingness to continue using teledentistry on a Likert scale. The questionnaire was distributed electronically via email and professional social media platforms, with reminders sent to increase response rates. Data collection was completed over two months.

Ethical approval was obtained from the Institutional Review Board (IRB) of the participating institutions. Informed consent was sought from all participants before data collection, ensuring confidentiality and the right to withdraw from the study at any stage. Data were analyzed using SPSS software (version 25.0). Descriptive statistics summarized the demographic data, and chi-square tests compared acceptability levels across different clinician subgroups. Logistic regression analysis was performed to identify factors associated with higher acceptability of teledentistry, with statistical significance set at $p < 0.05$.

RESULTS:

Table 1 presents the demographics of the included respondents. The age distribution of the respondents was as follows: 12 respondents (6.4%) were less than 21 years old, 72 respondents (38.3%) were between 21 and 30 years, 68 respondents (36.2%) were between 31 and 40 years, and

36 respondents (19.1%) were 41 years or older. In terms of education level, 28 respondents (14.9%) had undergraduate education, 76 respondents (40.4%) were graduates, 46 respondents (24.5%) held postgraduate degrees, 24 respondents (12.8%) had a Master's degree, 10 respondents (5.3%) had a PhD, and 4 respondents (2.1%) specified other educational backgrounds. Experience with teledentistry was reported by 120 respondents (63.8%), while 68 respondents (36.2%) had no experience.

Table 1: Demographics of included respondents

Demographic Variable	**Category**	**Number of Respondents**	**Percentage (%)**
Age Distribution	Less than 21 years	12	6.4%
	21 – 30 years	72	38.3%
	31 – 40 years	68	36.2%
	41 years and above	36	19.1%
Education Level	Undergraduate	28	14.9%
	Graduate	76	40.4%
	Postgraduate	46	24.5%
	Master's	24	12.8%
	PhD	10	5.3%
	Other (please specify)	4	2.1%
Experience with Teledentistry	Yes	120	63.8%
	No	68	36.2%

Table 2 summarizes the clinician responses to survey questions on teledentistry. For the question "Does teledentistry help consult with an expert about specific patient problems?", 60 clinicians (31.9%) strongly agreed, 86 clinicians (45.7%) agreed, 30 clinicians (15.9%) were neutral, 10 clinicians (5.3%) disagreed, and 2 clinicians (1.1%) strongly disagreed. Regarding "Is teledentistry good for dental education over the Internet?", 64 clinicians (34.0%) strongly agreed, 82 clinicians (43.6%) agreed, 30 clinicians (15.9%) were neutral, 10 clinicians (5.3%) disagreed, and 2 clinicians (1.1%) strongly disagreed. For the question "Is teledentistry useful in improving access to oral healthcare?", 58 clinicians (30.8%) strongly agreed, 78 clinicians (41.5%) agreed, 36 clinicians (19.1%) were neutral, 12 clinicians (6.4%) disagreed, and 4 clinicians (2.1%) strongly disagreed.

Concerning "Are dental examinations via computers or mobiles as accurate as in traditional office settings?", 32 clinicians (17.0%) strongly agreed, 50 clinicians (26.6%) agreed, 54 clinicians (28.7%) were neutral, 42 clinicians (22.3%) disagreed, and 10 clinicians (5.3%) strongly disagreed. For the question "Does teledentistry help in reducing costs for dental practices?", 48 clinicians (25.5%) strongly agreed, 76 clinicians (40.4%) agreed, 46 clinicians (24.5%) were neutral, 14 clinicians (7.4%) disagreed, and 4 clinicians (2.1%) strongly disagreed. Regarding "Does teledentistry save time for the dentist?, 52 clinicians (27.7%) strongly agreed, 82 clinicians (43.6%) agreed, 38 clinicians (20.2%) were neutral, 12 clinicians (6.4%) disagreed, and 4 clinicians (2.1%) strongly disagreed. For the question "Does teledentistry help monitor the patient's oral health?", 50 clinicians (26.6%) strongly agreed, 74 clinicians (39.4%) agreed, 46 clinicians (24.5%) were neutral, 14 clinicians (7.4%) disagreed, and 4 clinicians (2.1%) strongly disagreed.

Concerning "Can teledentistry be applied as a regular protocol?", 40 clinicians (21.3%) strongly agreed, 64 clinicians (34.0%) agreed, 54 clinicians (28.7%) were neutral, 22 clinicians (11.7%) disagreed, and 8 clinicians (4.3%) strongly disagreed. For the question "Is teledentistry a convenient form of oral healthcare delivery that makes dental examinations easier?", 56 clinicians (29.8%) strongly agreed, 76 clinicians (40.4%) agreed, 38 clinicians (20.2%) were neutral, 14 clinicians (7.4%) disagreed, and 4 clinicians (2.1%) strongly disagreed.

Regarding "Can teledentistry increase accessibility of specialists to rural communities for dental needs?", 62 clinicians (33.0%) strongly agreed, 74 clinicians (39.4%) agreed, 36 clinicians (19.1%)

were neutral, 12 clinicians (6.4%) disagreed, and 4 clinicians (2.1%) strongly disagreed. For the question "Can the teledentistry system reduce unnecessary hospital appointments?", 48 clinicians (25.5%) strongly agreed, 72 clinicians (38.3%) agreed, 50 clinicians (26.6%) were neutral, 12 clinicians (6.4%) disagreed, and 6 clinicians (3.2%) strongly disagreed. Finally, for the question "In the future, will you practice teledentistry?

Table 2: Summary of Clinician Responses to Survey Questions on Teledentistry

Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Q1. Does teledentistry help consult with an expert about specific patient problems?	60 (31.9%)	86 (45.7%)	30 (15.9%)	10 (5.3%)	2 (1.1%)
Q2. Is teledentistry good for dental education over the Internet?	64 (34.0%)	82 (43.6%)	30 (15.9%)	10 (5.3%)	2 (1.1%)
Q3. Is teledentistry useful in improving access to oral healthcare?	58 (30.8%)	78 (41.5%)	36 (19.1%)	12 (6.4%)	4 (2.1%)
Q4. Are dental examinations via computers or mobiles as accurate as in traditional office settings?	32 (17.0%)	50 (26.6%)	54 (28.7%)	42 (22.3%)	10 (5.3%)
Q5. Does teledentistry help in reducing costs for dental practices?	48 (25.5%)	76 (40.4%)	46 (24.5%)	14 (7.4%)	4 (2.1%)
Q6. Does teledentistry save time for the dentist?	52 (27.7%)	82 (43.6%)	38 (20.2%)	12 (6.4%)	4 (2.1%)
Q7. Does teledentistry help monitor the patient’s oral health?	50 (26.6%)	74 (39.4%)	46 (24.5%)	14 (7.4%)	4 (2.1%)
Q8. Can teledentistry be applied as a regular protocol?	40 (21.3%)	64 (34.0%)	54 (28.7%)	22 (11.7%)	8 (4.3%)
Q9. Is teledentistry a convenient form of oral healthcare delivery that makes dental examinations easier?	56 (29.8%)	76 (40.4%)	38 (20.2%)	14 (7.4%)	4 (2.1%)
Q10. Can teledentistry increase accessibility of specialists to rural communities for dental needs?	62 (33.0%)	74 (39.4%)	36 (19.1%)	12 (6.4%)	4 (2.1%)
Q11. Can the teledentistry system reduce unnecessary hospital appointments?	48 (25.5%)	72 (38.3%)	50 (26.6%)	12 (6.4%)	6 (3.2%)
Q12. In the future, will you practice teledentistry?	66 (35.1%)	76 (40.4%)	36 (19.1%)	8 (4.3%)	2 (1.1%)

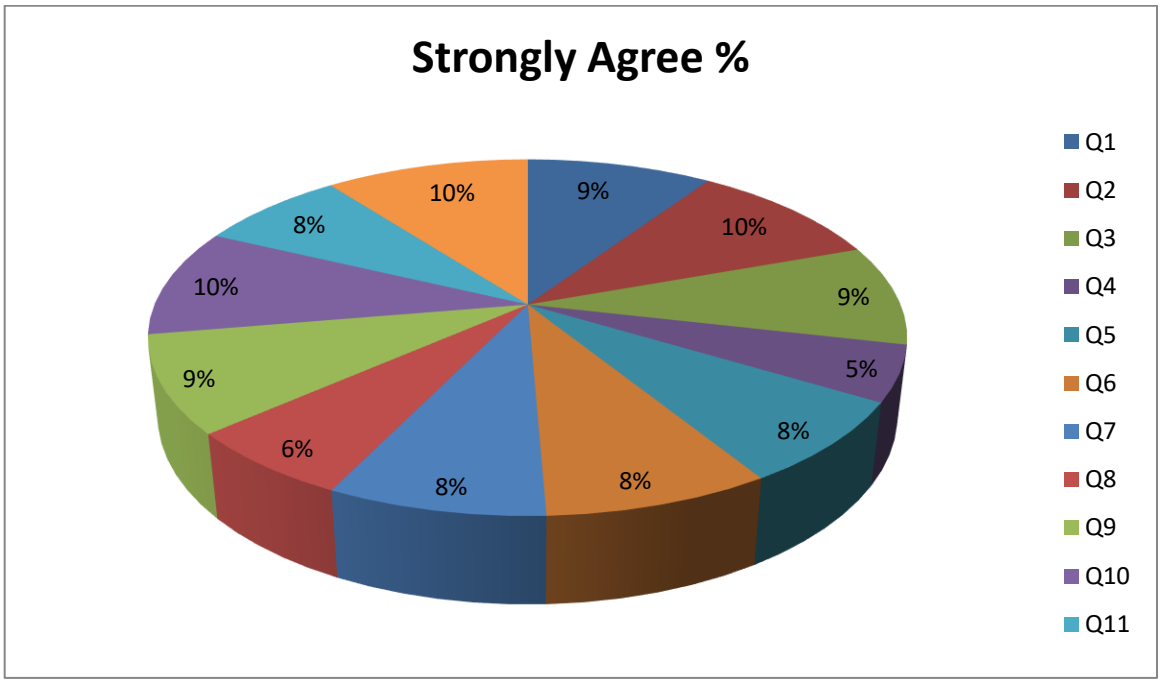

Figure 1: Percentage of strongly agree among asked questions

DISCUSSION

Teledentistry, a subset of telemedicine, has emerged as a pivotal tool in addressing challenges related to access to dental care, especially in underserved or rural populations. The present study aimed to evaluate clinician attitudes towards teledentistry and compare these findings with similar studies published on this subject. This discussion analyzes our results in light of other published data and highlights trends and disparities in clinician perceptions of teledentistry. In our study, 77.6% of clinicians agreed or strongly agreed that teledentistry facilitates consultation with an expert regarding specific patient problems. These findings are consistent with the work of Estai et al. (2020), where 83% of clinicians agreed that teledentistry helps in consulting specialists remotely.[13] Another study by Irving et al. (2020) emphasized that expert consultation through teledentistry is a valuable tool in providing care to patients in rural areas.[14]

The widespread consensus across studies suggests that teledentistry bridges geographic barriers and enables the sharing of expertise, which is especially beneficial for complex cases requiring specialized care. Our findings show that 77.6% of respondents believed teledentistry to be effective in dental education over the Internet, which mirrors the results from a study by AlShaya et al. (2021), where 75% of clinicians supported teledentistry as an educational tool.[15] Studies, such as by Rahman et al. (2021), have documented the growing integration of teledentistry in continuing education programs, especially during the COVID-19 pandemic.[16]

However, a minority of clinicians in our study (6.4%) expressed disagreement or strong disagreement with its efficacy in education, possibly reflecting concerns about the limitations of practical training over digital platforms. In our study, 72.3% of clinicians agreed that teledentistry improved access to oral healthcare. A similar sentiment was reflected in a study by Rocca et al. (2018), where 80% of clinicians indicated teledentistry expanded access to oral healthcare.[17] Research has consistently emphasized teledentistry's role in enhancing care access, particularly for rural and underserved populations, where specialist care is often sparse.[18]

The role of teledentistry in rural communities is particularly relevant in light of the study by Duka et al. (2021), which found that rural patients were more likely to have limited access to dental care but benefited significantly from remote consultations and follow-ups enabled by teledentistry. Our results revealed that only 43.6% of clinicians believed that dental examinations via computers or mobiles are as accurate as those in traditional office settings, with 27.6% either disagreeing or strongly disagreeing. This skepticism is reflected in the findings of Alabdullah et al. (2021), where

48% of clinicians questioned the diagnostic accuracy of teledentistry compared to in-office exams.[19] While teledentistry has demonstrated utility for consultations and follow-ups, limitations in tactile examination and certain imaging techniques may contribute to clinicians' reservations regarding diagnostic accuracy.

Our study found that 65.9% of clinicians agreed or strongly agreed that teledentistry helps reduce costs for dental practices, which aligns with findings by Mandall et al. (2020), who noted that the implementation of teledentistry could reduce operational costs by 25-30%.[20] Teledentistry enables practices to minimize patient no-shows, streamline consultation processes, and reduce the need for in-person follow-ups, all contributing to cost efficiency.

Moreover, 71.3% of our respondents agreed that teledentistry saves time for dentists, supporting findings by Rocha et al. (2018), where clinicians observed a 20% improvement in time management due to virtual consultations. Notably, 75.5% of respondents in our study indicated that they would consider practicing teledentistry in the future. This is consistent with AlShaya et al. (2021), where 78% of clinicians expressed openness to integrating teledentistry into their regular practice.[20] Despite some initial hesitations around diagnostic accuracy and practical limitations, there is a growing recognition of the potential benefits of teledentistry, especially in post-pandemic healthcare models where hybrid approaches to care delivery are becoming the norm.

Conclusion

Overall, our study's findings align with broader trends in teledentistry research, indicating widespread support for the technology's ability to improve access to care, consultation efficiency, and cost management. However, concerns regarding diagnostic accuracy persist, particularly in comparison to traditional office settings. Moving forward, integrating teledentistry with in-office visits and addressing technological limitations will be critical in realizing its full potential. As more clinicians gain experience with the system, teledentistry is poised to become a regular component of dental care delivery, especially in underserved communities.

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