The Use of Teledentistry in Improving Access to Oral Healthcare in Saudi Arabia: A narrative review

Abstract

Aim In Saudi Arabia, despite free healthcare access, incidence of dental diseases is increasing. The reasons include access difficulty, low trust on free facilities, policies regarding foreigners, and lengthy waiting times. This review, through a thorough analysis of studies published from 2012 to 2024, aims to explore teledentistry as a potential tool in transforming oral health access to align with Saudi's Vision 2030.

Materials and Methods The article explores the applications of teledentistry, in diagnosis and treatment planning, and barriers in its implementation, like digital illiteracy, inefficient infrastructure, and privacy issues. Moreover, the review draws a thorough comparison between teledentistry knowledge, perception, and attitude among dentists across the globe and in Saudi Arabia.

Results Saudi Arabia, through its Vision 2030 aims to transform the country into a modern and facilitative state. Adopting teledentistry aligns well with its 2030 goals of improving the health sector and healthcare access. However, there is notably low knowledge about teledentistry among dentists in country. Moreover, like the rest of the world, numerous challenges halt its progress.

Conclusions Thus, there is a dire need for policy-level measurements and training professionals to fully utilize teledentistry potential.

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Keywords

Teledentistry, Oral Health, Digital Health, Vision 2030, Saudi Arabia, Healthcare Access, Remote Consultation, Telemedicine.

BACKGROUND

Dental health plays a substantial role in overall physical and mental health, appearance and social interactions of a person. Recent literature suggests that dental conditions, like periodontal disease also serve as a risk factor for multiple systemic illnesses, including diabetes, cardiovascular and lung disease (1) emphasizing the need for dental health maintenance across all age groups. However, the burden of dental diseases continues to increase, specifically in Saudi Arabia where despite the availability of free dental care, dental caries has risen from 68-96% in children and older adults and 70% in adults, in past decade (2). Similarly, prevalence of periodontal disease among Saudis as recently reported is 46.2% (3). Numerous factors, including lengthy wait times, low trust levels on government provided care, strict policies for foreigners, and accessibility to dental care, have been linked to delays in obtaining dental treatment (4). These challenges highlight the urgent need for innovative, scalable strategies that can complement conventional dental services and address persistent gaps in access, especially for underserved communities.

Objective

The main objective of this review is to critically evaluate the potential of teledentistry in transforming oral healthcare system in Saudi Arabia to align with Vision 2030. The article aims to synthesize existing evidence regarding knowledge, perception, and practice of teledentistry among Saudi dentist, compare the findings with global research, and identify challenges and opportunities. Through this the review intends to serve as a ground for policy recommendations and future direction.

Methodology

This narrative review was conducted to explore the role of teledentistry in improving access to oral healthcare in Saudi Arabia, with an emphasis on current practices, global comparisons, and future prospects. A systematic search of peer-reviewed literature was conducted across databases including PubMed, Scopus, Google Scholar, and Web of Science. The search strategy employed a combination of keywords such as *"teledentistry," "oral health," "Saudi Arabia," "digital health," "dental care access,"* and *"Vision 2030."*

Articles published between 2012-2024 whether qualitative or quantitative were included if they were in English. The topics of focus were teledentistry applications, access to dental care, and Saudi healthcare reforms. Non-peer-reviewed articles, those published in language other than English, and studies with no relevance to access or healthcare systems were excluded. The selection process was guided by narrative review principles, and relevant data were extracted to synthesize themes, benefits, challenges, and policy implications. Though not a systematic review, this work follows key principles of the PRISMA-ScR (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews) to ensure transparency in evidence selection and synthesis.

Origin of Teledentistry

The American Army first introduced the idea of teledentistry in 1994 as part of the Total Dental Access Project with the primary objective of enhancing the effectiveness of dental care provided to soldiers (5). Over the past several years, the scope of teledentistry has broadened to multiple dental specialties, including dental health research, education, and public awareness.

Teledentistry has become a significant way to enable remote dental operations that might improve access to dental care (6). However, while its theoretical benefits are well documented, there remains an ongoing debate regarding its practical integration into existing healthcare systems, particularly in contexts like Saudi Arabia where infrastructure, digital literacy, and practitioner readiness vary widely.

Types of Teledentistry

Following three are the methods to employ teledentistry.

Synchronous consultations

In synchronous consultations, dentist examine the patients through live video conference. This helps dental professionals evaluate the patient in real time, receive immediate feedback from patient, and provide clarifications to patients if needed (7).

Asynchronous consultations

Patients send their medical records (radio and photographs) to dentists through secure computer systems for offline consultation and treatment planning. Asynchronous consultation is not live, so it does not require the availability of dentist and patient at same time. It also helps dentists to share patient information with other dental professionals (8).

Mobile Health

Mobile communication devices, including smartphones, smartwatches, tablets, and personal digital assistants (PDAs) are essential to teledentistry and mobile health (mHealth).

Mobile health free the user of the need of a dentist. These applications can monitor the course of persistent dental issue, including gingivitis or cavities. They can help patients take medicines on time through reminders (9) (Tab. 1, Fig. 1).

Feature	Synchronous	Asynchronous	mHealth
Real-time	☑	☒	☒
Needs dentist involvement	☑	☑	☒ / ☑
Schedule Dependent	☑	☒	☒
Device used	PC/Phone	Phone	Mobile/Wearables

Tab. 1 Common Applications of Teledentistry in Oral Healthcare

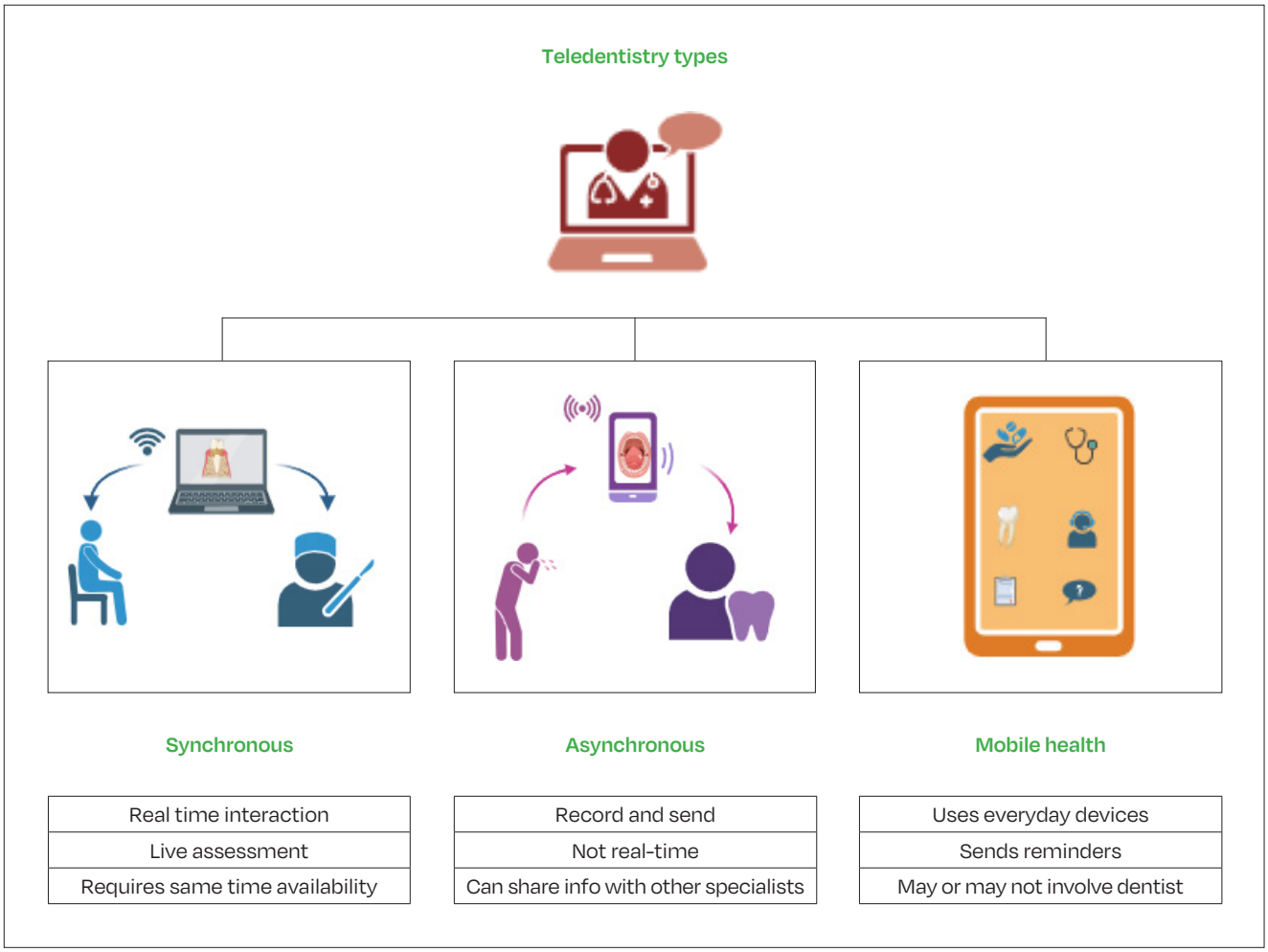

Fig. 1 Methods of Teledentistry and Key Characteristics

APPLICATIONS OF TELEDENTISTRY

Technology makes it easier, faster, safer, and more efficient to provide and exchange information. This is extremely useful in dental care as access to a good dental professional is the key issue in dental care. Teledentistry can resolve this issue and help improve the quality of oral health services.

The use of teledentistry as a tool to make dental care more accessible changed during the COVID-19 pandemic and the subsequent closure of dental clinics.

During that time, teledentistry was thought to be especially useful in enabling quicker oral health consultations, diagnosis, and potentially treatment planning (10).

Diagnosis and clinical evaluations

Teledentistry is considered feasible and highly accurate method for assessment of most dental diseases. Majority of temporomandibular joints disorders (TMJD) are correctly diagnosed and appropriately treated using teledentistry. According to Duka et al. (11), teledentistry exhibited complete diagnostic agreement with real-time clinical evaluations of impacted or semi-impacted third molars, suggesting high reliability for diagnosing surgical cases.

Salazar-Fernandez et al. (12) reported that dental diseases treatment onset time was reduced from 78.6 to 2.3 days and working hours lost/ patient from 32 to 16 in teledentistry. Moreover, only 10% of teleconsulted patients required surgical referral, suggesting that teledentistry helped in effective

management of patients at primary care. However, the study was mainly focused on Wilkes Stages I–III internal derangements and excluded advanced TMJ disease, limiting its generalizability to more complex cases.

Exposto et al. (13) reported substantial to near perfect RSE (Reference Standard Examination) agreement scores of 0.86-1.00 and 0.74-0.87 for myalgia and arthralgia, respectively. However, diagnosis of disk displacement gave poor agreement score (0.30-0.58) with RSE, highlighting teledentistry's limitation in accurate diagnosis of intra-articular joint disorders.

Moreover, early childhood caries detection through teledentistry or conventional in-clinic evaluations had similar results. Teledentistry system was also able to transmit a clear picture of teeth with dental caries to a doctor for the purpose of caries assessment (14). Teledentistry also helped detect oral cancer at early stages (15) which implies that diagnosis of advanced diseases can be made much earlier employing teledentistry and chances of worsening can be prevented.

Accessibility

Teledentistry examinations are helpful specifically in remote locations where individuals lack access to dental professionals or services. Multiple studies (16-18) have reported positive outcomes by sharing dental photographs for distant evaluations. Most oral lesions, including dental caries were diagnosed with extremely high sensitivity and specificity. Apart from evaluations, teledentistry can improve access to dental expert consultations and follow-up. Employing teledentistry can cut down on travel expenses, time required, discomfort, and distance. According to Berndt et al. (19), underprivileged children with limited access to dental specialists can benefit from interceptive orthodontic treatments administered by qualified general dentists under the supervision of orthodontists via teledentistry. assessed the cost-effectiveness of teledentistry through a 12-month experiment carried out in general dental clinics. The study gathered information on the costs of lodging, lost productivity time, and clinic visits. Results indicated that when patients visit distant dental clinics, they may miss 2-12 hours of production. The study also reported that, teledentistry might save patients in rural regions almost 900 euros (20).

Visual Precision

Diagnosis using teledentistry mostly rely on photographs taken through intraoral cameras. These photographs are of high-quality which can be magnified on computer enhancing picture details and leading to better diagnostic outcomes (21). Several studies have even concluded that photographic analysis was better than visual clinical assessment, whereas other reported that the two approaches were similar (22).

While the applications of teledentistry are diverse and promising, there are challenges associated with complete adoption of teledentistry.

TELEDENTISTRY CHALLENGES

Camera Quality

Mostly teledentistry employs intraoral camera to record dental details. While intraoral cameras are not available everywhere a smartphone camera can capture pictures (23). This presents certain limitations. Encryption is necessary when sending patient data over the Internet. Furthermore, dentist or staff aren't allowed to use personal camera phones to access patient data. Above all, the validity of teledentistry adoption and implementation depends on the quality of the photographic picture. Compared to photos of intraoral camera, mobile photographs were mostly of lesser quality which make it difficult for the dentist to accurately determine the need for treatment (24).

Lack of Clinical Information

One of the primary restrictions that can compromise the validity of teledentistry is access to patient data. In-person examinations offer the chance to speak with patients and gather information to help with diagnosis. Lack of patient history may make a dentist less confident in diagnosing a patient using a teledentistry system alone, which would lower the teledentistry's validity score. Videoconferencing can be used in real time or following the assessment of oral pictures for accurate diagnosis (8).

Experience of dentist

Furthermore, the ability to diagnose utilizing teledentistry is significantly influenced by the dentists' expertise. More accurate diagnoses were made remotely by experienced dentist than by less experienced ones (25).

CURRENT ORAL HEALTHCARE SYSTEM IN SAUDI ARABIA AND NEED FOR TELEDENTISTRY

Saudi Arabia has a diverse demographical landscape with an exponential growth of population in past decades due to high economic growth and an immigrants' population of 41%. Additionally, the holy city of Makkah welcomes over 6 million Muslim pilgrims from all over the world each year for Hajj and Umrah. This number is expected to reach 30 million in the coming decade. Although, the country provides free dental care access, it seems insufficient as only 12% of people above 15 routinely see a dentist (26). This underscores the need for an updated oral health program that can cater to the needs of such diverse

array of population.
Moreover, Saudi Arabia is set on a road to transformation into an ambitious country, a place of opportunity, and a strong economic power under its Vision 2030 plan. A total of 96 goals encompasses the laid out 2030 vision assigned to different categories. Among those goals, 2.1 (improving healthcare services), 5.2.4 (e-government development), and 5.2.5 (improving service quality for patients) align with the incorporation of technology in overall and dental healthcare (27). Digital innovation plays a pivotal role in addressing systemic gaps in access, cost, and quality. Among these innovations, teledentistry emerges as a particularly relevant and transformative solution (26).
Studies suggest that, 64.4% of Saudi dental schools have already incorporated education on digital dental tech. Saudi Arabia is also adopting technologies, like EHRs, telemedicine, mHealth, and AI at an increasing rate. For instance, a general tertiary hospital in Riyadh, established a database system for storing, organizing, and recovering patients' dental data, which enhanced treatment results (28).
Saudi Arabia has also undertaken to privatize the healthcare system as a solution to oral healthcare access as most population prefer private health facilities (29). Some studies, however, suggested that privatization might not be enough to solve the issue on its own. Furthermore, there is a lack and unequal distribution of dental professionals throughout Saudi Arabia's provinces (30). Also, challenges like opposition from professionals, inadequate technical knowledge, and usability concerns hinder technology adoption in Saudi Arabia (31).

TELEDENTISTRY KNOWLEDGE AND PRACTICE: INSIGHTS FROM SAUDI ARABIA AND GLOBAL STUDIES

Perception of dentists regarding teledentistry

Global evidence indicates generally positive perception of dentists towards teledentistry. In Rwanda and Turkey, for instance, a study found that the majority of participants (79% and 83%, respectively) believe that teledentistry will save time and reduce number of patient visits (32). Similarly, survey conducted in Ankara city demonstrated that majority (80%) of the participants supported teledentistry integration into the current dental practice (33). In South Africa, majority of participants (77.5%) think that teledentistry would increase peer-to-peer connection, (78.4%) improve recommendations and guidance, and (77.5%) make patient referrals more efficient (34). Similar results were obtained by Chaudhary et al. (35) for Pakistani and Saudi dentists with majority agreeing that teledentistry would enhance guidelines and advice (74.2%), improve peer-to-peer interaction (79.5%), and make patient's referrals more efficient (75.8%). Teledentistry is also considered more economical for the patients (61.1%); because consultations can be done online avoiding unnecessary travel (76.8%) which will significantly benefit patients in remote areas (74.7%).
In India, however, there exist skepticism regarding teledentistry benefits. According to Ramesh et al. (36), only 33% think that teledentistry saves time and a meager 21% believe that it reduces the cost of dental practices. This suggests that despite recognized theoretical benefits, practical trust in teledentistry is limited specifically in underdeveloped world.
In KSA, knowledge regarding teledentistry appears to be low as Aboalshamat et al. (37), reported that only 17% of practitioners had heard of teledentistry before. This figure is comparable to teledentistry awareness of dental students in Saudi Arabia (17.2%). On the other hand, a marginally high percentage (28.4-33%) was reported in another KSA research, including dental practitioners (38).
Due to limited knowledge, Saudi dental practitioners have mixed opinions about teledentistry. Al-Khalifa & AlSheikh, (22) reported that majority of dental professionals (60%) believed that patients, particularly rural and remote area residents, would benefit from teledentistry by reducing needless trips to the dental clinics. Over 55% agreed that teledentistry will minimize the waiting list and will improve the efficacy of advice and recommendations
Contrary to that, there are concerns regarding diagnostic capabilities of teledentistry as Alshammari and Almaktoom (40) reported that 50% dentists questioned whether teledentistry could offer sufficient diagnostic information, and 58% thought that multiple photographic sessions would be necessary. Only 38% believed that installing a teledentistry system would not be too costly, reflecting financial uncertainty, while the remainder were undecided or pessimistic.
Concerns regarding data confidentiality and patient privacy were reported globally. Among them, the most common (80%) was privacy breach while sharing data online (39). there were apprehensions regarding digital forgeries (76%), hardware incompatibility (78%), and equipment dependability (75%) (40). In KSA, however, less (22.6%) participants think that teledentistry violates the patient's privacy (22.6%) or is difficult to use (14.7%) or have distrust towards the teledentistry equipment (24.2%) (35).

Technology Utilization

The knowledge, attitude and daily internet access are significantly positively correlated with practice of teledentistry. However, the practice of teledentistry being done by dental practitioners is still at low level. Murererehe et al. (33) reported that despite perceiving teledentistry useful, only a few (6.8%, 12.6%, and 7.8%) practitioners in Rwanda and Turkey

were using videoconferencing, digital x-ray and digital photographs. Similarly, in South Africa, 62.2% dental practitioners do not currently utilize teledentistry. Even among those with internet access at work, less than half (42.6%) actually used it; the figure dropped further to 12.5% among those with access only at home (33). Differences in digital engagement are also apparent regionally. More Pakistani dental professionals still preferred in-person communication and half of the participants (50%) use less than one hour of internet daily for practice-related use. By contrast, in Turkey, (frequent computer users) 81% were satisfied monitoring the patients' conditions using teledentistry (43). Yet in India skepticism again persisted as approximately 56% of dental professionals believed that patients can't be effectively monitored

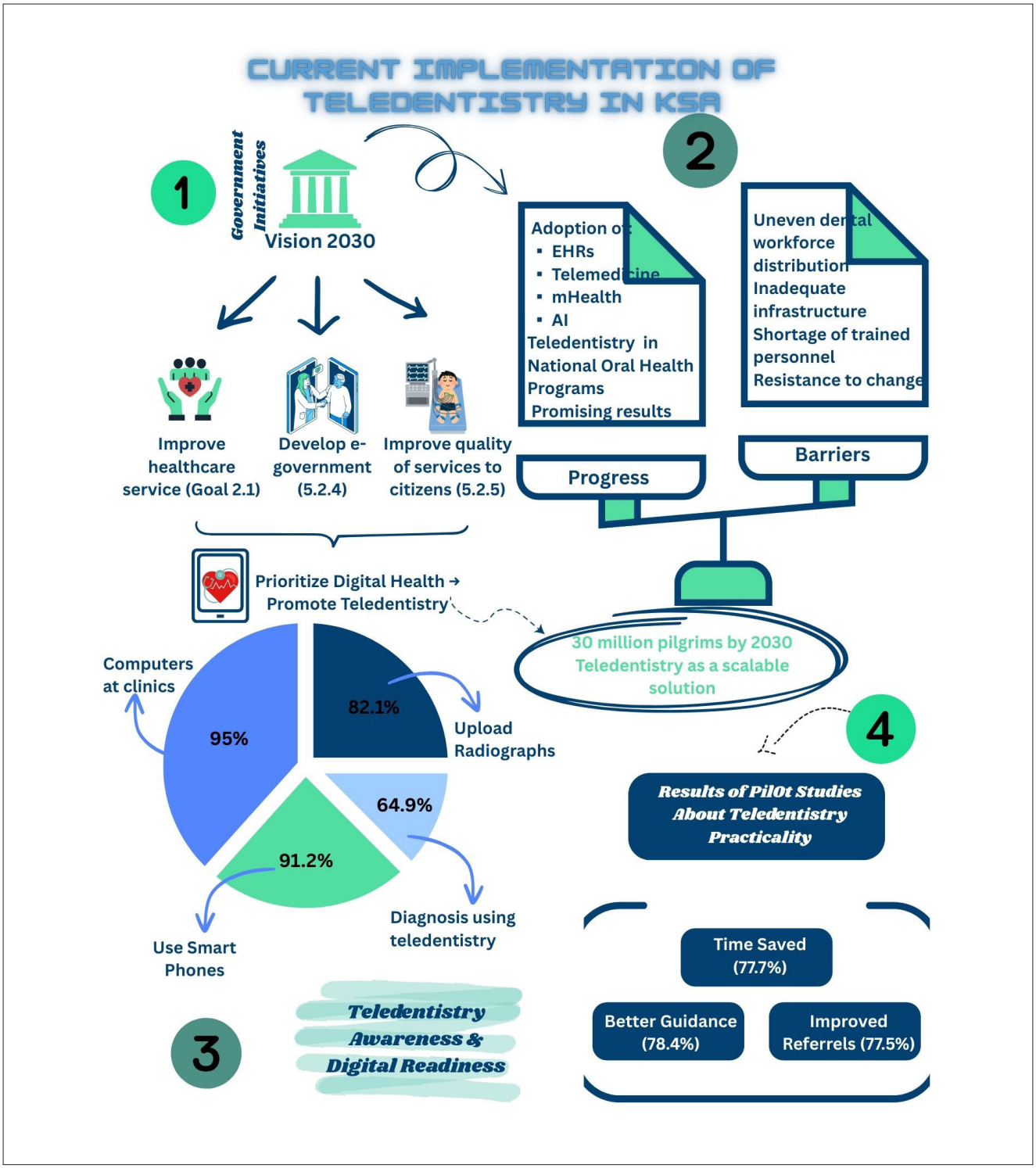

Fig. 2 Current implementation of teledentistry in KSA

Author	Objective	Findings
Aboalshamat (2020)	To assess students' awareness, beliefs, practices, and barriers regarding teledentistry and its relevance to Vision 2030 and COVID-19	Found limited awareness and practice among students; emphasized the need for training and integration into the curriculum
Agili (2012)	To review dental caries prevalence and severity among Saudi kids	Reported high prevalence of dental caries; highlighted the need for national preventive programs
Alabdullah and Daniel (2018)	To evaluate the diagnostic validity and reliability of teledentistry	Found teledentistry to be a valid and reliable tool, especially for screening and consultation
Alasiri and Mohammad (2022)	To provide an overview of healthcare transformation under Vision 2030	Highlighted major reforms and digital health integration, including teledentistry
Al-Buhaisi et al. (2024)	To summarize research on teledentistry's effect on oral health outcomes and care access	Demonstrated that teledentistry improves access and oral health outcomes, particularly in underserved areas
Aldhafeeri (2024)	To examine digital health integration in Saudi Arabia and its effects on healthcare sectors	Identified challenges (infrastructure, resistance to change) and opportunities (efficiency, access)
Alfallaj et al. (2022)	To assess implementation of digital dental technologies in Saudi dental schools	Found partial integration, with a need for wider adoption in curricula
Chaudhary et al. (2022)	To explore awareness, usefulness, and barriers associated with teledentistry in Pakistan and Saudi Arabia	Knowledge and perception of teledentistry among both Pakistani and Saudi dentists was positive. However, certain concerns like privacy breach were hindering widespread adoption.
Almazrooa et al. (2021)	To investigate the utilization of teledentistry in oral health care of Saudi patients	There is availability of technological infrastructure like internet and online data sharing platforms, still Saudi dentists lack teledentistry practice and even q good number of them is unaware of the term itself
Al-Hanawi et al. (2019)	To review healthcare workforce challenges in Saudi Arabia	Highlighted shortages, uneven distribution, and recommended investment in training and retention

Tab. 2 Summary of Relevant Studies on Oral Health, Teledentistry, and Healthcare Transformation in Saudi Arabia

using teledentistry.

In Saudi Arabia, there is infrastructure readiness, still practice gap exists. According to the results of a national survey in KSA, 95% of respondents have at least one computer or laptop at the dentist's office, most frequently shared with colleagues. Radiographs (82.1%) and, to a lesser extent, photographs (58.2%) are uploaded or connected to the electronic health record system by 72.4% of participating dentists, who have been utilizing electronic medical records overall. The chance of using or applying teledentistry was significantly predicted by the fact that every participant reported having an active email address that they routinely visited from a desktop, laptop, or smartphone. The majority of participants (91.2%) had a smartphone, and those without one were less likely to have previously utilized teledentistry. Even after such resource availability, fewer (28.4%) of the participants knew what teledentistry meant and after reading the definition, and additional 30.2% claimed they had unknowingly used teledentistry before (44).

Perception regarding different dental disciplines

In Rahman & AlBorie (45) questionnaire about which dental specialty participants felt would mostly benefit from teledentistry usage, OM was mentioned first (53.4%), followed by Endodontics (47.3%) and Oral Medicine (45.3%). Periodontics gained the least advantage from teledentistry (25.7%). Most respondents (83.8%) were confident in the ability for teledentistry to improve the average dental practitioner's day-to-day clinical practice, and save time and money, while teledentistry was not as successful in improving peer-to-peer communication, assisting in diagnosis, and making recommendations for new patients.

Regarding the participants' prior teledentistry experience, 64.9% of all subjects had used it for diagnosis, and 73.0% had done so to get a second opinion from someone who had previously used it (46).

Compared to other specializations, Saudi Arabian dentists were generally more in favor of the use of teledentistry in the fields of oral radiography, endodontics, and oral medicine. Furthermore, teledentistry has been effectively incorporated into several dental specialties worldwide, with no apparent benefit to one over another (38).

Regarding dental patients in KSA, 97.1–80% had an excellent experience with teledentistry. However, 48.6% experienced issues with their internet connection, and 54.3% had trouble taking dental photos. Overall, the results demonstrated high accuracy of teledentistry in

determining the patient's oral hygiene state, number of missing teeth, number of filled teeth, and major complaint (47).

CONCLUSION

This review explores the potential of teledentistry which is emerging as a tool to improve access to oral healthcare in Saudi Arabia, specifically within the broader context of digital health transformation under Vision 2030. A comparative analysis of global and local studies suggested that the diagnostic accuracy and management efficacy of teledentistry is comparable to clinical evaluations. Regarding attitude, there is optimism in most parts of world including Turkey, Rwanda, Pakistan, and Saudi Arabia. However, the adoption of teledentistry faces skepticism owing to lack of infrastructure, digital illiteracy, privacy concerns, and diagnostic limitations of teledentistry for advanced diseases.

Overall, the studies imply that teledentistry has diagnostic accuracy and management efficiency comparable to clinical evaluations. However, certain limitations hinder generalizing the results of these studies, including small sample sizes (typically 100–250 participants) and restriction to early disease stages or less-advanced conditions. Further research with larger, more diverse samples and inclusion of advanced disease presentations is required to fully establish teledentistry's role in comprehensive oral healthcare. Moving forward, targeted training for dental professionals, clearer national protocols, and investment in secure digital infrastructure will be critical to bridge the gap between perceived benefits and routine practice, ensuring teledentistry's sustainable integration into Saudi Arabia's evolving healthcare landscape.

Conflict of Interest
None.

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