

How Has Teledentistry Been Applied in Public Dental Health Services? An Integrative Review

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Abstract

Background: There are inequities in the provision of oral health care, and a large proportion of the population face challenges in accessing public dental health care options.

Introduction: Teledentistry (TD), a new branch of telemedicine dedicated to dentistry, is a potential approach that can be used to overcome these challenges. Therefore, the purpose of this integrative review was to collect information regarding the inclusion of the application of TD tools in the public dental health services.

Methods: Five electronic databases (PubMed/Medline, Virtual Health Library, CINAHL, Scopus, and Web of Science) were searched for relevant articles if they reported on original data related to the use of TD in public dental health services.

Results/Discussion: Twenty-four studies met the inclusion criteria and were, consequently, included in the review. Our key findings indicated that TD can be used for training and continuing education of professionals, for remote patient care, to exchange information among health professionals, and orientation. It increases the access to dental care and enables general practitioners to interact with specialties. The benefits include cost-effective health equity services, improve dental knowledge, and reduce consultation waiting time. However, despite the advances made with the use of this technology, there are still some obstacles to overcome, such as limited infrastructure, low levels of motivation and the lack of compliance, professional resistance, and legal and security issues.

Conclusion: TD may be very a useful tool for dental public health increasing the quality of the care by improving access, professional education, and patient satisfaction.

Keywords: public health dentistry, dental health services, teledentistry, e-health, telemedicine

Introduction

Oral health is an essential component of good health, which is a fundamental human right.¹ However, the inequities in the provision² of oral health care and difficulties in accessing oral health services still are major public health challenges.^{3,4} Some of these problems are related to the following concerns that are usually observed around the world, especially in developing countries and in those that have hard-to-access remote areas,⁵⁻⁸ the lack of access to oral health care, high or unaffordable costs of dental treatments, growing and aging populations, workforce migration, long distances from specialists, and shortage of dental professionals.

In circumstances such as these, every effort made to improve the access to oral health services is welcome. This is the case with the new information and communication technologies (ICTs), such as teledentistry (TD) that are being developed to help decrease the inequities observed in the provision of oral health services and to improve their quality.⁶⁻⁸

TD is a new branch of telemedicine that is dedicated to dentistry. It makes use of ICTs, especially of the internet, to exchange clinical information and associated images^{9,10} to provide consultation services among professionals and health care providers¹¹ over long distances.

To the extent of our knowledge, no integrative literature review articles have been published regarding the inclusion of the use of TD in dental public health services that have demonstrated its various applications and benefits. In this case, the authors considered “public health” as defined by MeSH Terms, as those programs or actions enacted at a community, state, or federal level. Therefore, the purpose of this integrative review was to collect the available information on the methods through which TD is implemented in this context.

Methods

This review followed the five-stage integrative review process that involves the following steps: (1) problem identification, (2) literature search, (3) data evaluation, (4) data analysis, and (5) presentation and interpretation of the results.¹²

LITERATURE SEARCH PROCESS

Searches were conducted on five electronic databases (PubMed/Medline, Virtual Health Library, CINAHL, Scopus, and Web of Science) using both medical subject headings (MeSH terms) and keywords. The following terms were used for the literature search: “Public Health Dentistry” OR “Community Dentistry” OR “Dental Health Services” OR “Oral Health Services” OR “Dental Care” OR “Dental Public Health” combined with “Teledentistry” OR “Telemedicine” OR “Mobile Health” OR “E-health” (Table 1).

INCLUSION CRITERIA

The inclusion criteria were studies reporting on original data related to the inclusion of TD applications in dental public health services, including dental health programs or dental health-related actions taken at a community, state, or federal level. Studies that were published in English, Spanish, and Portuguese from 2007 to June 2019 were included. Three researchers (C.B.C., F.S.P., and A.L.S.F.M.) independently screened titles and abstracts to identify articles that potentially met the inclusion criteria. The full-text articles that were potentially relevant to the subject of the review were retrieved and reviewed independently by the same three authors (C.B.C., F.S.P., and A.L.S.F.M.), and articles were selected for the final review based on a consensus. Additionally, the reference lists of these studies were used to identify further articles.

EXCLUSION CRITERIA

Studies that did not fulfill the eligibility criteria were not considered for the review. Specifically, studies that were not related to TD and its applications in dental public health services and studies that were focused on associated legal issues, available technologies, and the history of TD were excluded. Additionally, editorials, letters, comments, summaries of annals, essays, dossiers, official documents of national and international programs, reports of experiences, theses, dissertations, literature reviews, course articles, epidemiological bulletins, management reports, and books were also excluded.

Table 1. Search Terms and Their Structure

1. "Public Health Dentistry" OR "Community Dentistry" OR "Dental Health Services" OR "Oral Health Services" OR "Dental Care" OR "Dental Public Health"
2. "Teledentistry" OR "Telemedicine" OR "Mobile Health" OR "E-health"
3. 1 AND 2
4. Limit 3 to English, Spanish, and Portuguese languages
5. Limit 4 to 2007–June 2019

DATA ITEMS AND DATA COLLECTION PROCESS

One of the author's (C.B.C.) collected the relevant data from the selected studies. The information was then crosschecked by the second and third reviewers (F.S.P. and A.L.S.F.M.). The data collected consisted of the names of the authors, year of publication, country, study design, context, and key findings (Table 2).

QUALITY ASSESSMENT OF INCLUDED STUDIES AND DATA ANALYSIS

Due to the variety of research methods employed in the included studies, the Mixed Methods Appraisal Tool (MMAT)¹³ was used to assess their quality (Table 2). The score for each article was calculated by dividing the number of met criteria by four. The calculated scores ranged from 25% (one criterion met) to 100% (four criteria met).¹³

A constant comparison method was used to classify the extracted data into groups and subgroups based on themes. Undertaking this approach to perform the data analysis for an integrative review is compatible with researches that involve the use of a variety of data items and diverse methodologies not only in the case of qualitative studies but also of quantitative or mixed-method studies; this is because the approach allows for interactive comparisons across primary data sources.¹⁴

To facilitate the analysis, data were extracted from the studies and organized into an evidence table (Microsoft Excel[®]). Following this, data were compared item by item, and similar data were grouped and categorized based on themes to answer the research question: How can TD be used in dental public health services? Additionally, relevant quotes from the articles' authors were selected to elucidate each category's content.

Results and Discussion

The initial search yielded 1,269 articles. After excluding the 298 duplicates, the titles and abstracts of the 971 remaining articles were screened. Most of the publications (832) were excluded because they were not related to TD and were presented in the formats of editorials, letters, comments, summaries of annals, essays, dossiers, official documents of national and international programs, theses, dissertations, course articles, epidemiological bulletins, management reports, and books. From the 139 articles whose full texts were assessed for eligibility, 115 articles were excluded because they were not related to public health, only described the history of TD and associated legal issues, or focused on available technologies. After the full-text review, 24 studies were included in the final review (Fig. 1).¹⁵

Table 2. Results By Author, Year, Country, Study Design, Context, Key Findings, and Mixed Methods Appraisal Tool Score

FIRST AUTHOR (YEAR)	COUNTRY	STUDY DESIGN	CONTEXT	KEY FINDINGS	STUDY LIMITATIONS MMAT SCORE
Teoh (2018) ²³	Australia	Economic evaluation	Assessment and economic evaluation of TD for rural and regional cleft lip and palate patients.	TD is likely to be a cost-effective alternative compared with the standard practice of face-to-face consultation.	MMAT score 100%. No limitations.
Carrard (2018) ²⁴	Brazil	Exploratory descriptive study	Health providers from primary care submitted requests about oral lesions by means of a cloud-based platform to specialized oral medicine teleconsultants.	Telediagnosis for oral lesions is feasible and improves the quality of primary health care by supporting decision making, increasing access to specialists in remote areas, and reducing the number of face-to-face evaluations needed.	MMAT score 100%. No limitations.
Estai (2018) ²⁵	Australia	Cost-minimization analysis	Cost comparison (reallocation model) between TD and visual dental screening approaches in school children from different regions.	TD screening for low-risk children has the potential to save money, when compared with visual screening. In a context of scarce resources for dental services, TD screening can help to reduce inequalities, and shift available resources toward high-risk children.	MMAT score 100%. No limitations.
Tynan (2018) ²⁶	Australia	Mixed methods comparative study	An integrated oral health program utilizing TD and OHT in RACFs in a rural setting.	This program can improve oral health outcomes and benefit RACF residents, especially those with dementia and other significant cognitive and physical disabilities. RACFs benefit from the increased support and training opportunities for staff.	MMAT score 100%. No limitations.
Pacheco (2018) ²⁷	Brazil	Action research	Developing of a virtual environment platform for oral health providers of primary health care.	The platform can provide information, knowledge exchange, and shared experiences, improving the work process for oral health providers.	MMAT score 100%. No limitations.
Petcu (2017) ²⁸	France	Descriptive study based on behavioral observation	Asynchronous teleconsultation for dependent elders, disabled people, and prisoners by a geographically remote dentist.	Initial results are promising, despite the complications caused using an intraoral camera. Evaluate the acceptance of the patients is required to improve its experience and adherence.	MMAT score 100%. No limitations.
McLaren (2017) ²⁹	United States	Descriptive, retrospective study	Assessment of the accuracy of predicting dental treatment modalities using live-video TD in pediatric dentistry.	Live-video TD consultations are relatively precise when proposing dental treatment modalities for rural children. For those who have extensive dental needs and are of a young age, a TD consultation serves as an excellent platform to facilitate the completion of needed treatment.	MMAT score 100%. No limitations.
Friedman (2017) ¹⁶	United States	Case report	Development, implementation, and assessment of a VDH Demonstration project.	VDH is not considered a viable strategy to improve access to care for vulnerable and underserved populations. VDH offers minimal benefit compared with existing public health screening and prevention programs conducted by dental hygienists.	–
Giraudeau (2017) ¹⁷	France	Accuracy study	Oral teleconsultation performed by a nurse and a dentist, to diagnosis dental emergencies among incarcerated patients.	Although a video consultation is not equivalent to conventional oral examinations in terms of accuracy, it is sufficient for providing a rapid and relevant oral diagnosis. However, 63% of the diagnoses were incorrect.	–

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Table 2. Results By Author, Year, Country, Study Design, Context, Key Findings, and Mixed Methods Appraisal Tool Score *continued*

FIRST AUTHOR (YEAR)	COUNTRY	STUDY DESIGN	CONTEXT	KEY FINDINGS	STUDY LIMITATIONS MMAT SCORE
McFarland (2017) ³⁰	United States	Quantitative descriptive study	Formative evaluation of a TD training program in a rural area.	TD training and TD services can improve outcomes, education, and access to oral health care.	MMAT score 100%. No limitations.
Estai (2017) ⁶	Australia	Cost-minimization analysis	Costs comparison between TD and traditional dental screening approaches in school children.	The costs of TD is substantially lower than conventional face-to-face dental screening, in both remote and urban areas. The reduction of costs was due to the low salaries for dental therapists, and the lack of travel and accommodation costs.	MMAT score 100%. No limitations.
Jordi (2016) ³¹	Latin American countries	Descriptive, cross-sectional	Survey on the degree of computerization in dentistry, investigating the use of ICT by students, in training, and by professionals.	ICT is a tool for learning and teaching, representing an opportunity as well as a challenge.	MMAT score 50%. Response rate is unclear, compromising the identification of the representativeness of the sample.
Kruger (2016) ⁷	Australia	Descriptive cross-sectional study	Australian dental practitioners.	Dental practitioners generally reported on optimism associated with TD and have supported the concept of TD and its integration into current dental practices.	MMAT score 100%. No limitations.
Roxo-Gonçalves (2016) ³²	Brazil	Assessment study	Primary health care professionals (dentists and nondentists) took an e-learning course on oral lesions and had their skills evaluated.	Good capacity for discriminating the nature of oral lesions. Distance learning courses may improve the knowledge required for better oral cancer detection. There are obstacles that remain to be overcome.	MMAT score 50%. There are limitations on sampling procedures. The response rate is under 60%.
Avula (2015) ¹⁸	India	Descriptive study	Potential of teleperiodontics to provide access to a specialist, thereby, enhancing the effective delivery of therapy and information to rural and underprivileged areas.	Potential in patient management over geographic boundaries. Opportunities for dental education.	–
Boringi (2015) ³³	India	Cross-sectional study	Dental professionals' knowledge and acceptance in relation to TD.	Most of the respondents lacked adequate knowledge and awareness on TD.	MMAT score 75%. It is unclear if the sample is representative of the population under study.
Correia (2015) ¹⁹	Brazil	Experience report	TD experience from Telehealth Brazil Networks Program.	Consolidated data representing dentistry teleconsulting and tele-education actions, revealing TD as a powerful tool to support oral health as part of primary health care.	–
Gambino (2014) ²⁰	Italy	Experience report	TD system aimed to facilitate the "second opinion" task.	Low-cost system allowing remote medical examinations when an oral medicine expert is not present in a medical structure or territory.	–
Blomstrand (2012) ⁸	Sweden	Cross-sectional study	Telemedicine consultations with specialists offered to dentists in the public dental health services.	The most effective health care level or the right type of patient diagnosis provided in the right place as part of the health service is a cost-effective way to organize health care.	MMAT score 75%. It is unclear if the sample is representative of the population under study.
Skelton-Macedo (2012) ²¹	Brazil	Descriptive study	Tele-education and teleassistance applications adding value to professional actions and improving the quality of oral health care.	Care needs to be taken to protect the confidentiality of information relating to patients. Creative ways to incorporate ICT in day-to-day dental practice.	–

continued →

Table 2. Results By Author, Year, Country, Study Design, Context, Key Findings, and Mixed Methods Appraisal Tool Score *continued*

FIRST AUTHOR (YEAR)	COUNTRY	STUDY DESIGN	CONTEXT	KEY FINDINGS	STUDY LIMITATIONS MMAT SCORE
Bradley (2010) ³⁴	Northern Ireland	Descriptive study	Feasibility study of the use of TD for triage referrals to specialist services and its potential as a tool to support locally based treatment centers as part of a community dental service.	TD systems can be useful in the management of patients with oral mucosal disease, and it is especially suitable for the management of referrals of older dependent adults who have oral mucosal disease.	MMAT score 50%. There are unclear issues about the sample and measurements.
Berndt (2008) ³⁵	United States	Case-control series study	The outcomes of a general dentist practitioner providing interceptive orthodontic services to disadvantaged children with real-time supervision by an orthodontist using TD were compared with those of orthodontist residents supervised by specialists on-site.	Positive outcomes from interceptive orthodontic treatment can be achieved by a general dentist practitioner with real-time supervision from an orthodontist using TD.	MMAT score 75%. It is unclear whether all the outcome data have been provided.
Bradley (2007) ³⁶	England	Assessment study	To know the profiles and opinions of general dental practitioners, working in primary centers regarding an online orthodontic referral service.	The service enables saving time and achieving a quicker opinion on a practitioner's treatment plan.	MMAT score 100%. No limitations.
Chen (2007) ²²	United States	Case report	Specialized dental care program offered using the TD university program.	<p>Increase access to dental specialty care for underserved populations in remote communities.</p> <p>Providers are confident about the assessments, diagnoses, and recommended treatment plans, which were complete and like a regular dental clinic visit. A good working relationship among team members at both sites is needed to establish a reliable TD network.</p> <p>Providers reported that 61% of visits were about as time consuming as a regular in-office visit.</p>	–

ICT, information and communications technology; MMAT, Mixed Methods Appraisal Tool; OHT, oral health therapists; RACFs, residential aged care facilities; TD, teledentistry; VDH, virtual dental home.

Among the 24 studies that met the eligibility criteria, 7 studies^{16–22} could not be assessed using MMAT because they did not have enough information regarding the methods and criteria that were employed; however, the remaining 17 studies^{6–8,23–36} were assessed by MMAT. Most of them (14 studies) had good-quality scores, meeting 3 or more of the 4 criteria. Furthermore, 3 studies were considered to have moderate-quality scores, meeting only 2 of the 4 criteria (*Table 2*).

The main findings outlined by the studies were arranged in terms of the issues faced in relation to the use of TD, its advantages, and the obstacles encountered in the

application of TD (*Table 3*). Each of these is elaborated as follows:

APPLICATION

In dental public health services, TD is utilized in the field of education (tele-education) and to provide diagnoses and recommend treatments over long distances (tele-assistance).

Tele-education and teleassistance can improve the knowledge of professionals to facilitate the early detection of oral diseases, such as caries, cancer, and periodontal disease. By providing remote diagnoses to perform the initial evaluation

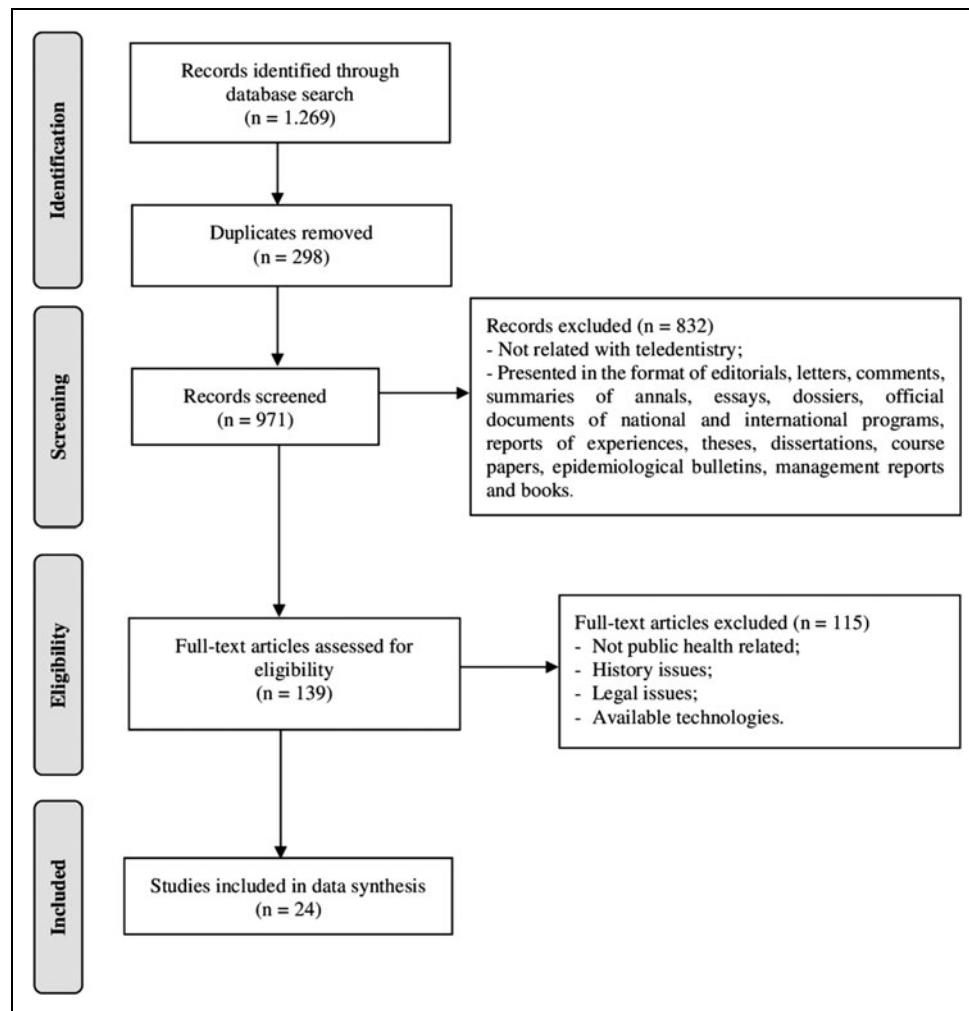


Fig. 1. Flowchart adapted from PRISMA.¹⁵

of a dental condition and to recommend a treatment plan, TD has the potential to help reduce morbidity and mortality through promoting preventive and health promotion practices. It also gives patients the ability to follow up with their dentists online.^{6,8,17,18,22,24–26,29,32,34,37–39}

Latin American countries, such as Brazil, Colombia, and Uruguay, are developing ICT projects as part of dental public health services to improve the continuing education and collaborative research efforts between national and foreign institutions.³¹ In Brazil, TD is also used to exchange information among universities and primary health care dentists, thereby adding value to innovative actions taken by professionals and improving the quality of oral health care in this country.^{21,24,27}

In the developed countries that have been using this technology for a longer time, responses to tele-education projects¹⁹ reveal that this powerful approach was ac-

cepted by 80% of students and professors⁴⁰ despite some technical problems that may occur during transmission.^{19,40}

Distance and online courses can improve the knowledge of professionals that is required for the detection of diseases, such as oral cancer, dental caries, and periodontal disease, thereby helping to reduce the occurrence of these diseases by recommending preventive practices and promoting good health in association with the remote diagnosis and its initial investigation.^{27,32,39–43}

The applicability of TD has been demonstrated in a wide range of dental patient groups, including pediatric,^{25,29} orthodontic,³⁵ and elderly^{26,28} patients, as well as prisoners.¹⁷ It also has potential utility in complex forms of treatment (e.g., long-term management of cleft lip and palate) involving multidisciplinary teams.

BENEFITS

TD is an instrument of democratization, equity, and development, which enables the dynamic dissemination of knowledge in the

dental public health field through using its applications such as tele-education and teleassistance.^{19,24,25,27,32} The main advantages are related to reducing waiting time,³⁶ and treatment costs.^{6,8,20,23,25}

Teleassistance is an innovative method of delivering health services that has the potential to facilitate the timely distribution of information to locally based practitioners to enable better decision making, to provide consulting services in case a second opinion is required, to effectively triage patients who require referrals, and to support locally based treatment centers.^{6,41} Most dental practitioners and patients have reported on experiencing optimism and satisfaction regarding TD and its integration into the current dental practices due to the resulting possibilities of saving time and of gaining quicker access to medical case and a recommended treatment plan.^{7,22,24}

TD systems may be useful in the management of patients with conditions, such as oral mucosal disease (stomatology

Table 3. Examples of "Quotes" for Data Analysis

THEMES	"QUOTES"
Applications	<p>"...the teleconsultants prepared a report including: a) one or more diagnostic hypothesis, b) recommendations for the management/treatment of the lesion, c) need to refer the patient for specialized care or suggestion to treat at the PHC level."²⁴</p> <p>"...management of Clef Lip and Palate. The dental management of CL&P patients can involve multiple consultations to determine coordinated timing for orthodontic and surgical treatment in addition to the standard dental care and annual follow-ups."²³</p> <p>"...integrated oral health program utilizing tele-dentistry and OHT in RACFs in a rural setting within Australia."²⁶</p> <p>"A virtual environment was provided for teleconsulting services, tele education and a virtual library to the oral health teams of a Brazilian state."²⁷</p> <p>"Asynchronous teleconsultation to improve access to dental care for the dependent elderly, disabled people, and prisoners, some of whom may be cognitively impaired."²¹</p> <p>"Oral teleconsultation could improve the quality of oral care in prisons... to give patients a score, according to how urgently their dental issue needed to be treated."²⁸</p> <p>"The use of TD by non-dental providers for consultation, referral and disease management..., particularly for rural and underserved populations."³⁰</p> <p>"...(TD) can help direct specific dental care or preventive services towards a population that needs it more and allows for the optimal distribution of scarce resources, thus contributing to reducing inequalities in oral health."⁶</p> <p>"Distance learning courses may improve the knowledge required for better oral cancer detection..."²⁴</p> <p>"Tele monitoring may stand as a good platform for monitoring the patients after various procedures like periodontal surgeries. Supportive periodontal therapy can be delivered to patients across geographic distances."¹⁸</p> <p>"...from attached to the system, provided support to the differential diagnosis of sarcoidosis and neoplasia in upper lip, with proper routing in the network."¹⁹</p> <p>"...medical problem was sorted out, and the general dental practitioners were able to provide treatment without need for referral."⁸</p> <p>"...using teledentistry in the management of patients with oral mucosal disease can work successfully."³⁴</p> <p>"In spite of some unavoidable limitations in comparability between the groups, interceptive orthodontic treatment supervised remotely through teledentistry was shown to be a promising approach to reducing the severity of malocclusions in disadvantaged children when referral to an orthodontist was not feasible."³⁵</p> <p>"Interceptive orthodontic treatments provided by sufficiently prepared general dentists and supervised remotely by orthodontic specialists through teledentistry are a viable approach to reducing the severity of malocclusions..."³⁵</p> <p>"Orofacial disorders and pain, oral medicine and oral pathology conditions."²²</p>
Benefits	<p>"Telediagnosis for oral lesions is feasible and has potential to improve the quality primary health care by bridging the gap between primary and specialized healthcare...after ...use, the intention to refer the patients to face-to-face consultation reduced..., the high level of satisfaction...and the reduction in the number of patients referred for specialist assessment among the cases evaluated indicate that is a promising strategy."²⁴</p> <p>"...the potential to reduce care expenditure and achieve equity in the distribution of care resources."²⁵</p> <p>"...a cost saving ...per appointment...days of clinic time may be freed up at the RCH to treat other patients and expand capacity."²³</p> <p>"The integrated oral health program incorporating OHTs and TD shows potential to improve the oral health outcomes of residents of RACFs."²⁶</p> <p>"...teleconsulting, web conferences, distance courses and the virtual library itself are able to provide educational knowledge..."²⁷</p> <p>"... could aid in complying with the legal obligations and health recommendations; recording dental data; prioritizing care; increasing efficiency in the dental surgery; and modifying the nurse's implication in dental care."¹⁷</p> <p>"... children requiring OR care did not waste time and resources going to see a general dentist...the effectiveness of TD in identifying dental needs in underserved areas... positive change in all trainees' attitudes following the training sessions, with the majority of trainees acknowledging a positive impact on their knowledge and competency."³⁰</p> <p>"It is a low-cost system allowing remote medical examinations..."²⁰</p> <p>"The cost savings with respect to time are...around 10,000SEK...or 1,000SEK...per patient."⁸</p> <p>"The environmental benefits of telemedicine should not be underestimated."⁸</p> <p>"In over 90% of visits, specialists were satisfied with the teledentistry consult and said the trip to their office was saved."²²</p>

continued →

Table 3. Examples of "Quotes" for Data Analysis *continued*

THEMES	"QUOTES"
Obstacles	"...internet access of poor quality as well as lack of familiarity with the internet use could be mentioned...the adoption of telemedicine depends on many stages as acquaintance, persuasion, decision, initial adoption and diffusion" ²⁴
	"The quality of photographs was defined based on the ability to clearly identify mucosal lesions. Images were considered 'inappropriate' if 1) out of focus, 2) overexposed, 3) underexposed, or 4) inconsistent with clinical data." ²⁴
	"... dental care is excluded from Medicare because dental care is considered a low priority by health policymakers." ²⁵
	"... not enough time for dedicated oral health staff within the aged care facilities to focus on management of the program; ...some facilities may not be equipped to take on telehealth technology; access to telehealth technology not in a well-planned and accessible space for residents." ²⁶
	"...some professionals find it difficult to deal with ICT...the lack of good technology infrastructure and connectivity also affect its success." ²⁷
	"...the acceptance of technology by the elderly identifies technology anxiety and dispositional resistance to change as key features of this group." ²⁸
	"The VDH does not allow a qualified dental hygienist to diagnose a carious lesion, determine when an ITR is appropriate therapy, or when to refer an individual to a dentist for treatment." ¹⁶
	"Oral teleconsultations are made asynchronously in prisons. The patient does not directly interact with the dentist. In this way, the first encounter would take place during the treatment phase. This practice thus significantly changes the patient/doctor interaction." ¹⁷
	"...to include new equipment, software and training tools." ³⁰
	"The biggest challenge...is the feeble infrastructure to meet all the technological requirements...; Poverty and illiteracy; Licensure of teledentistry practice...; There exists a possibility that patient information will be intercepted, despite maximum efforts to maintain security there by violating patient confidentiality." ¹⁸
	"It has limited application on dental emergencies" ³⁴
	"Although teledentistry is the way to provide remote interceptive orthodontic treatment to underserved populations, training of the general dentists, hardware and software problems, and patient compliance can be challenging but not insurmountable." ³⁵
"...collaboration between hub and remote sites. The dental teams have to collaborate constantly..." ²²	

A\$, Australian dollar; CEA, cost-effectiveness analysis; CL&P, cleft lip and palate; OR, operating room; RCH, Royal Children's Hospital; SEK, Swedish krona.

and oral medicine),^{8,22,24,34} periodontitis,⁸ malocclusions, orthodontics disorders,^{35,36} temporomandibular disorders, and oral pain.²² It is a low-cost system that enables remote dental examinations when an oral medicine ward is not available,^{20,24} especially to assist primary care professionals.^{24,27} It allows for an easy access to efficient consultations. Furthermore, it enables the underserved population to seek treatment earlier, which in turn minimizes the burdens faced by the patients who would have to travel long distances to receive a consultation.^{6,24,26,28,29}

The results of experiments carried out in countries that employed this technique, demonstrated a reduction in costs by ~30% when compared with those of conventional treatments. The estimated savings were owing to the low salaries received by dental therapists and the travel and accommodation costs avoided by both patients and professionals.^{6,8} Time and financial resources saved by TD applications can be redirected to patient populations at higher risks of oral disease. In a context in which limited resources for dental services exist, TD can be a major contributory factor toward the

reduction of oral health inequalities²⁵ by reorienting public health services.

OBSTACLES

In the field of teleassistance, low levels of motivation and the lack of compliance are important obstacles that need to be overcome.³² Most postgraduates believe that TD has limited application in the case of dental emergencies.³³ Moreover, professionals who are not well versed in the resources of technology may be more resistant when it comes to adopting their use. A substantial number of professionals felt insecure about their information technology skills.³⁶ Adequate levels of knowledge and awareness regarding TD and a good working relationship among the professionals at both the transmitting and receiving sites is required to establish a reliable network of TD application.^{22,33}

According to each country's legislation, there are some limitations and legal issues to take into consideration, including licensure, jurisdiction, malpractice, and information security-related issues.¹⁸ Furthermore, a good infrastructure is

necessary to meet all the technological requirements needed to provide adequate services and to ensure security in relation to the exchange of patient data.^{18,22,35}

Some authors have criticized the use of TD as a strategy to increase access to health services, and have suggested that it would offer little benefit when compared with conventional screening and prevention programs performed by dental hygienists in the public service.¹⁶ A significant challenge is the ability of nonoral health professionals (e.g., nursing personnel) to accurately perform evaluations of oral disease. Indeed, a recent study carried out among prisoners to determine the need for emergency dental treatment reported that 63% of diagnoses made by nursing personnel were incorrect.¹⁷

Despite these issues, the interest in TD in the past 2 years has grown substantially, as is evident from the increased number of published articles from 2017 to 2019 (Table 2). The literature search conducted in this study documented only 14 published articles relating to the use of TD in public health services over a period of 10 years (2007–2017), compared with 10 studies in the last 2 years.

Conclusions

In conclusion, TD may be a very useful tool for dental public health professionals, caregivers, and patients. Although it has been in use only since recent times, it presents a great potential for further development.

TD can be used for training and continuing education of professionals, for remote patient care, to exchange information among health professionals, and to provide them with orientations. It results in benefits such as the reduction of waiting time in the case of both general and specialized dental care, avoiding expenses related to displacements, and saving financial resources. In this way, it increases the access to dental care for people who live in remote areas or who do not have specialists in their location. It enables general practitioners to interact with colleagues from different dental specialties, thereby increasing the quality of the care provided and improving patient satisfaction.

TD is a relatively new modality for the delivery of dental health services and has a tremendous potential for continued growth and expansion in the context of public health systems. To achieve this goal, significant governmental support is required, and strategic action plans are needed, which not only increase the technological resources available, but also the acceptance of ICT among the general patient population, caregivers, and health professionals. Additionally, increased training and continuing professional development for ICT use is required for general dental surgeons, specialists, dental auxiliaries, nurses, and other health professionals who deal

with oral health issues. Moreover, to facilitate the adoption of TD in public dental services, these strategic actions must form an integral part of the public health policy agenda, which advocates TD as an evidence-based and cost-effective method for improving oral health.

Limitations in this integrative review relate to the search strategy, which only targeted TD applications used in public dental health services in a community context, over a restrictive time period. In addition, only articles published in one of the three languages were included in the review. Furthermore, limited evidence was available for formulating definitive conclusions with regard to the superiority of one type of TD application versus another for fulfilling public health needs. Additional studies, preferably clinical trials, are required to inform stakeholder decisions in the selection of the best evidence-based TD applications for dental public health.

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