Original Article

Beyond Teledentistry: From Video Consultation to a Digital Oral Health Ecosystem

Arnun Jukisalapong



Arnun Jukisalapong

Dental Department, Bangkok Hospital Chiang Mai, Chiang Mai, Thailand.

*Address Correspondence to author:
Arnun Jukisalapong
Bangkok Hospital Chiang Mai
88/8-9 Moo 6 Nong Pa Khrang,
Mueang Chiang Mai,
Chiang Mai 50000, Thailand.
email: chopinconcerto@gmail.com

Received: September 16, 2025
Revision received: November 20, 2025
Accepted after revision: January 3, 2026
BKK Med J 2026;22(1): 11-15.
DOI: 10.31524/bkkmedj.2026.11.003
www.bangkokmedjournal.com

Abstract

OBJECTIVES: This review aims to synthesize the current evidence on the clinical, economic, and service quality outcomes of teledentistry and to explore emerging technological trends that are expected to drive future development, including interoperability, artificial intelligence (AI), the Internet of Dental Things (IoDT), and value-based oral health care models.

MATERIALS AND METHODS: A narrative review was conducted by searching PubMed, Scopus, and Web of Science for studies published between 2015 and 2025 using the keywords "teledentistry," "digital health," "AI in dentistry," "remote monitoring," and "interoperability." Eligible studies included clinical trials, systematic and narrative reviews, and relevant professional guidelines. Data were synthesized narratively and grouped thematically.

RESULTS: Current evidence supports that teledentistry improves access to care, reduces costs, and yields clinical outcomes comparable to or better than conventional care in several contexts. The integration of AI and IoDT shows promise for enhancing diagnostic accuracy and longitudinal monitoring, while the adoption of interoperability standards such as fast healthcare interoperability resources (FHIR) and digital imaging and communications in medicine (DICOM) facilitates secure and efficient clinical data exchange. Most available studies are concentrated in high-income countries, highlighting the need for further research in low- and middle-income settings to guide policy and implementation strategies.

CONCLUSION: This review highlights the importance of moving beyond conventional teledentistry toward a digitally integrated ecosystem that incorporates AI, IoDT, and standardized data exchange. Ethical frameworks, data protection regulations, and sustainable reimbursement policies will be critical to achieving equitable and scalable teledentistry services worldwide.

Keywords: teledentistry, digital oral health, artificial intelligence

Equitable access to quality dental services remains a major challenge in many countries, particularly in rural and underserved communities. These populations often face multiple barriers, including workforce shortages, geographic distance, and travel-related costs, which limit early disease detection and continuity of care. In this context, teledentistry has emerged as a key strategy to enhance access, reduce waiting times, and mitigate oral health disparities. [1-3]

Multiple studies have reported that teledentistry is effective for screening, specialist consultation, and postoperative follow-up, while simultaneously reducing costs at both the patient and health system levels. This role became especially critical during the COVID-19 pandemic, when teledentistry provided a means to maintain continuity of care despite restrictions on in-person visits. Nevertheless, most current applications remain focused on video consultations or the asynchronous transfer of images, meaning that the full potential of digital technologies—such as AI-driven decision support and real-time interoperability—has not yet been realized at scale.[2,4-6]

Emerging trends highlight that the future of digital oral health should move toward the creation of an integrated ecosystem. This includes adopting interoperability standards such as health level seven (HL7) FHIR and DICOM to enable secure data exchange, deploying AI for diagnosis and treatment planning, and leveraging the IoDT for continuous behavioral and outcome monitoring.[7-10] Furthermore, value-based care models and patient-centred approaches are gaining traction as frameworks that not only expand access but also improve long-term health outcomes and cost-effectiveness.[11-14]

Accordingly, this narrative review aims to synthesize current evidence on the clinical outcomes, economic impact, patient experience, and service quality of teledentistry. It also explores the technological innovations with the potential to transform oral health care delivery and discusses policy, legal, and ethical considerations required for scaling teledentistry beyond its conventional form toward a comprehensive, sustainable digital oral health ecosystem.[3,9]

Materials and Methods

This study is a narrative literature review conducted by a single investigator, aiming to synthesize current evidence regarding teledentistry, including its clinical outcomes, economic impact, and technological advances.

Databases and Search Period

A comprehensive literature search was performed in PubMed/MEDLINE, Scopus, and Web of Science, with additional exploration of Google Scholar to identify grey literature and reports from professional organizations such as the American Dental Association (ADA) and the World Health Organization (WHO). The search covered studies published between January 2015 and September 2025 to ensure the inclusion of recent evidence, particularly post–COVID-19 pandemic literature.

Search Strategy

Search terms were adapted for each database and combined using Boolean operators. The primary keywords included: “teledentistry” OR “tele-dentistry”, “digital oral health” OR “remote dental care”, “AI in dentistry” OR “artificial intelligence”, “remote monitoring” OR “Internet of Dental Things”, “FHIR” OR “DICOM” AND “oral health”. This strategy was designed to capture both clinical and technological aspects relevant to teledentistry.

Eligibility Criteria

Inclusion criteria: Systematic reviews, Umbrella reviews, Meta-analyses, and Narrative reviews on teledentistry, Experimental studies (RCTs, prospective cohort studies) and Observational studies reporting quantitative outcomes, Articles addressing AI, Data interoperability (FHIR/DICOM), IoDT applications, or Policy implications.

Exclusion criteria: Single case reports that could not be generalized, Non–peer-reviewed articles, Publications unrelated to teledentistry or digital oral health.

Study Selection and Data Synthesis

Titles and abstracts were screened manually by the investigator, followed by full-text review of eligible studies. Relevant data—including author(s), year of publication, study type, sample size, main findings, and limitations—were extracted and summarized in a structured table. A narrative synthesis approach was then applied, grouping findings into five thematic categories:

1. Clinical outcomes and quality of care
2. Economic outcomes and cost-effectiveness
3. Patient and provider experience
4. Technological innovations
5. Policy, legal, and ethical frameworks

Results

The literature search identified five major categories of relevant evidence: an umbrella review, a systematic review on caries detection, a prospective AI-assisted diagnostic study, a narrative review of hybrid models, and a real-world data report. The key findings are summarized below.

Clinical Outcomes and Quality of Care

The umbrella review by Scheerman et al.[15] synthesized 10 systematic reviews and reported that teledentistry improves access to dental care and is associated with positive oral health outcomes, including reduced caries incidence and better periodontal control in several studies. However, the overall quality of evidence was rated as low to critically low according to AMSTAR-2, and there remains a lack of high-quality, long-term randomized controlled trials (RCTs).[15]

Regarding diagnostic accuracy, the systematic review by Kargozar&Jadidfard[16], which included 19 in vivo studies, demonstrated that extra-oral photographs captured with smartphones or DSLR cameras yielded sensitivity ranging from 48% to 98.3% and specificity ranging from 83% to 100%, supporting the use of teledentistry as an effective screening tool, especially in settings where in-person examinations are not immediately available.[16]

In addition, Zhang et al.[17] (evaluated an AI-assisted caries detection model in 191 patients (4,361 teeth) and reported an overall accuracy of 93.4%, with sensitivity of 81.3% and specificity of 95.7% when compared with gold-standard clinical diagnosis by expert dentists. These findings indicate that AI can serve as a reliable decision-support tool when integrated into teledentistry platforms.[17]

Economic Outcomes

The CareQuest Institute18 real-world data report found that patients who initiated care through teledentistry

ISSN 2287-0237 (online)/ 2228-9674 (print)

experienced approximately 11% lower average episode-of-care costs and were more likely to complete an in-person dental visit within one week compared with those who did not use remote services. These data suggest that teledentistry enhances resource efficiency and can reduce the economic burden on both patients and the health care system.[18]

Patient and Provider Experience

Multiple studies have reported high levels of patient satisfaction with teledentistry, citing convenience, timeliness, and improved communication with the dental team as key benefits. Providers have also expressed positive perceptions, particularly in using teledentistry for screening and triage, which enables better case prioritization, advance treatment planning, and more efficient chairside time allocation.

Technological Innovations

The narrative review by Drafta et al.[19] highlighted the role of hybrid models that integrate teledentistry, AI, and virtual dental homes in expanding access and preventive care uptake among vulnerable populations. Such models streamline clinical workflows and enhance early detection. Future directions include the wider adoption of interoperability standards such as FHIR and DICOM, which enable secure and seamless exchange of radiographic images and electronic health records across care settings.[19]

Policy, Legal, and Ethical Considerations

The review also emphasized the need for robust policy and regulatory frameworks to support sustainable teledentistry implementation. Critical areas include data privacy protection, obtaining informed consent, cross-jurisdictional licensure, and the development of reimbursement mechanisms that incentivize remote care without compromising quality or equity.[20]

The current body of evidence supports teledentistry as an effective approach to increasing access to care, reducing costs, and achieving clinical outcomes comparable to conventional, in-person dental services. These benefits are particularly pronounced when teledentistry is integrated with AI and interoperable digital health systems. Nevertheless, high-quality evidence—such as large-scale randomized controlled trials and cost-utility analyses—remains limited. Future research should focus on long-term evaluations, implementation studies, and health economic assessments, particularly in low- and middle-income settings, to inform policy decisions and assess population-level impact.[1,7,13] (Table 1).

Discussion

The findings of this review reaffirm that teledentistry is a crucial tool for improving access to dental care, reducing costs, and achieving clinical outcomes that are comparable to, or in some cases better than, conventional face-to-face care. The umbrella review by Scheerman et al.[15] demonstrated consistent positive effects of teledentistry on oral health outcomes and cost-effectiveness. However, the overall quality of evidence was rated as low to critically low, highlighting the need for more rigorous study designs, particularly adequately powered randomized controlled trials (RCTs) with long-term follow-up to assess sustainability of outcomes.

Table 1: Summary of Current Evidence on Teledentistry.

Author/Year	Study Design	Sample / Scope	Main Findings	Limitations
Scheerman et al.[15] (2024)	Umbrella review (systematic reviews)	• 10 systematic reviews selected from 749 articles.	• Teledentistry improves oral health outcomes and is cost-saving in several settings; however, the overall quality of evidence was rated low to critically low.	Most included studies were: • Observational. • Lack of long-term RCTs. • High methodological heterogeneity.
Kargozar&Jadidfard[16] (2024)	Systematic review (diagnostic accuracy)	• 19 in vivo studies using extra-oral photography compared with clinical examination.	• Reported sensitivity ranged from 48–98.3% and specificity from 83–100% for caries detection, supporting its use as a screening tool.	• High heterogeneity. • No meta-analysis performed. • Variation in imaging protocols. • Lesion types.
Zhang et al.[17] (2024)	Prospective clinical evaluation Narrative review + case studies	• 4,361 teeth from 191 patients assessed with intraoral camera + AI. (MobileNet-V3 + U-net)	• Overall accuracy 93.4%, sensitivity 81.3%, specificity 95.7% compared with expert clinical gold standard.	• Not yet validated across multiple settings. • Sensitivity lower for interproximal caries.
Drafta S, et al.[19] (2025)	Real-world data report	• Literature from 2013–2024 focusing on vulnerable populations. • Patients across multiple U.S. states.	• Hybrid models integrating teledentistry and AI enhanced access, improved preventive care uptake, and streamlined clinical workflow.	• Predominantly case studies. • Limited quantitative data. • Generalizability remains low.
CareQuest Institute[18] (2023)			• Average cost per episode reduced by ~11%; higher likelihood of in-person follow-up within 1 week after tele-triage.	

Regarding diagnostic accuracy, the integration of digital technologies and AI shows substantial potential. Zhang et al.[17] reported that AI-assisted caries detection achieved an overall accuracy of 93.4%, with sensitivity of 81.3% and specificity of 95.7% when compared with expert clinical diagnosis, supporting its role as a decision-support tool for screening and treatment planning. Nonetheless, sensitivity was lower for interproximal caries, indicating the need for further refinement and validation of these systems across diverse populations and resource-constrained settings.

Economic outcomes reported by the CareQuest Institute[18] align with the hypothesis that teledentistry reduces costs for both patients and health systems, particularly when used for triage to minimize unnecessary in-person visits. Nonetheless, most cost analyses rely on assumptions regarding travel costs, opportunity costs, and resource allocation that may vary by health system context. Comprehensive cost-utility analyses incorporating both direct (consultation fees, treatment costs) and indirect costs (travel time, lost productivity) are needed to generate robust policy-relevant evidence.

Patient and provider experiences were generally positive, with high levels of satisfaction related to convenience, timeliness, and communication quality. Common challenges, however, include variability in internet connectivity, suboptimal image quality, and limited digital literacy among patients and providers. Addressing these barriers will require user-friendly platforms, standardized imaging protocols, and targeted training programs.

Looking forward, a critical priority is the integration of interoperability standards such as HL7 FHIR and DICOM into electronic health record systems to enable secure, seamless data exchange between care settings. Combining this with AI-driven decision support and the IoDT for remote monitoring and personalized prevention would align with the concept of P4 Dentistry (Predictive, Preventive, Personalized, Participatory), thereby transforming teledentistry from a consultation tool into a comprehensive digital health ecosystem.

From a policy perspective, critical challenges include the establishment of clear data protection regulations (e.g., personal data protection act (PDPA) compliance), reimbursement codes for remote services, and professional licensure frameworks that support cross-jurisdictional practice and ethical AI deployment. Building these structural elements will be essential for scaling teledentistry sustainably and reducing oral health inequities worldwide.

Policy, Legal, and Ethical Considerations

To ensure that teledentistry can be scaled sustainably, comprehensive policy frameworks must be established. Key priorities include:

1. Data protection and privacy: Compliance with regulations such as general data protection regulation (GDPR)–Europe (GDPR), Health insurance portability and accountability act (HIPAA)–United States, and PDPA (Thailand) is essential to safeguard patient information. Clear guidelines on consent management and secure data storage should be developed.
2. Licensure and scope of practice: Cross-jurisdictional licensure agreements and recognition of telehealth credentials are required to allow providers to deliver care across regions, particularly for underserved rural populations.
3. Reimbursement and financial models: Payers should adopt reimbursement codes and value-based payment models that incentivize remote care while maintaining quality and equity.
4. Ethical AI deployment: Standards for algorithm transparency, bias mitigation, and explainability should be established to build trust among patients and clinicians.
5. Infrastructure investment: Governments and health systems should prioritize investment in broadband connectivity, interoperable electronic health record (HER) systems (HL7 FHIR, DICOM), and user training to address digital literacy gaps.
6. Embedding these policies into national oral health strategies will create a robust environment that supports equitable access, protects patient rights, and encourages innovation in digital oral health delivery.

Future Research Directions

Based on the findings of this review, several key areas for future research are recommended:

1. Large-Scale Randomized Controlled Trials (RCTs): Well-powered, long-term RCTs are needed to evaluate the sustained impact of teledentistry on clinical outcomes and health care costs.
2. Comprehensive Cost-Utility Analyses: Studies should incorporate both direct and indirect costs and assess outcomes using quality-adjusted life years (QALYs) to inform value-based care models.
3. Implementation Research: Investigations into effective strategies for scaling teledentistry within real-world health systems, including workforce integration and reimbursement models, are critical.
4. Ethical and AI Acceptance Studies: Research should explore explainability, transparency, and user trust in AI-assisted teledentistry to ensure responsible and equitable adoption.
5. Studies in Low- and Middle-Income Countries: Context-specific research is required to evaluate infrastructure needs, technology feasibility, and sustainable financing models in resource-limited settings.

Conclusion

This review demonstrates that teledentistry plays a pivotal role in improving access to care, reducing costs, and supporting favorable clinical outcomes across a range of settings—particularly when used for screening, consultation, and postoperative follow-up. The evidence also highlights the

transformative potential of integrating AI, the IoDT, and interoperability standards such as FHIR and DICOM to elevate teledentistry into a comprehensive and sustainable digital oral health ecosystem. However, much of the current evidence remains of low-to-moderate quality, with a paucity of well-designed, long-term RCTs, limiting the ability to draw definitive causal inferences. Significant challenges also remain, including digital infrastructure gaps, user adoption barriers, data privacy concerns, and the absence of robust reimbursement mechanisms. Future development should prioritize: Building value-based, patient-centred care models, establishing interoperable data standards to enable secure information exchange, Incorporating AI and remote monitoring under strong governance frameworks and Conducting rigorous cost-effectiveness and implementation research to support health system integration. If addressed comprehensively, these steps will allow teledentistry to transcend its traditional role as a teleconsultation tool and become a key driver in reducing oral health disparities and strengthening population-level oral health outcomes.

References

1. Deshpande S, Patil D, Dhokar A, et al. Teledentistry: A boon amidst COVID-19 lockdown—a narrative review. *Int J Telemed Appl*. 2021;2021:8859746. doi:10.1155/2021/8859746.
2. Nuvvula S, Mallineni SK. Remote management of dental problems in children during and post the COVID-19 pandemic outbreak: A teledentistry approach. *Dent Med Probl.* 2021;58(2):237-41. doi:10.17219/dmp/133182.
3. Inquimbert C, Balacianu I, Huyghe N, et al. Applications of teledentistry in a French inmate population: A one-year observational study. *PLoS One.* 2021;16(4):e0247778. doi:10.1371/journal.pone.0247778
4. Chopra SS, Sahoo NK. Pandemic proofing dental education. *Med J Armed Forces India*. 2021;77(Suppl 1):S31-6. doi:10.1016/j.mjafi.2020.11.025.
5. Emodi-Perlman A, Eli I. One year into the COVID-19 pandemic—temporomandibular disorders and bruxism: What we have learned and what we can do to improve our manner of treatment. *Dent Med Probl*. 2021;58(2):215-8. doi:10.17219/dmp/132896.
6. Kohara EK, Abdala CG, Novaes TF, et al. Is it feasible to use smartphone images to perform telediagnosis of different stages of occlusal caries lesions? *PLoS One*. 2018;13(9):e0202116. doi:10.1371/journal.pone.0202116.
7. Kishimoto T, Goto T, Matsuda T, et al. Application of artificial intelligence in the dental field: A literature review. *J Prosthodont Res.* 2022;66(1):19-28. doi:10.2186/jpr.JPR_D_20_00139.
8. Khanagar SB, Al-Ehaideb A, Maganur PC, et al. Developments, application, and performance of artificial intelligence in dentistry—a systematic review. *J Dent Sci.* 2021;16(1):508-22. doi:10.1016/j.jds.2020.06.019.
9. Kamath P, Kamath P, Saldanha SJR, et al. A brief exploration of artificial intelligence in dental healthcare: a narrative review. *F1000Res*. 2024;13:37. doi:10.12688/f1000research.140481.2.
10. Alauddin MS, Baharuddin AS, Mohd Ghazali MI. The modern and digital transformation of oral health care: a mini review. *Healthcare (Basel)*. 2021;9(2):118. doi:10.3390/healthcare9020118.
11. Najafizada M, Rahman A, Oxford K. Analyzing models of patient-centered care in Canada through a scoping review and environmental scan. *Z Gesundh Wiss.* 2023;31(3):355-67. doi:10.1007/s10389-021-01528-8.
12. Vincent JL, Shehabi Y, Walsh TS, et al. Comfort and patient-centred care without excessive sedation: the eCASH concept. *Intensive Care Med.* 2016;42(6):962-71. doi:10.1007/s00134-016-4297-4.
13. Benjamins J, Haveman-Nies A, Gunnink M, et al. How the use of a patient-accessible health record contributes to patient-centered care: scoping review. *J Med Internet Res.* 2021;23(1):e17655. doi:10.2196/17655.
14. Santana MJ, Manalili K, Jolley RJ, et al. How to practice person-centred care: a conceptual framework. *Health Expect.* 2018;21(2):429-40. doi:10.1111/hex.12640.
15. Scheerman JFM, Qari AH, Varenne B, et al. A systematic umbrella review of the effects of teledentistry on costs and oral-health outcomes. *Int J Environ Res Public Health.* 2024;21(4):407. doi:10.3390/ijerph21040407.
16. Kargozar S, Jadidfard MP. Accuracy of teledentistry for caries detection: a systematic review of in-vivo studies using extra-oral photography methods. *BMC Oral Health.* 2024;24:364. doi:10.1186/s12903-024-04564-4.
17. Zhang W, et al. Diagnostic accuracy of artificial intelligence-assisted caries detection using intraoral images. *BMC Oral Health*. 2024;24:512. doi:10.1186/s12903-024-04847-w.
18. CareQuest Institute. Teledentistry is an effective tool to triage patients and save money. CareQuest Institute for Oral Health; 2023. Available from: https://www.carequest.org/resource-library/teledentistry-effective-tool-triage-patients-save-money
19. Drafta S, Macris R, Petre BA. Innovations on the horizon: teledentistry, artificial intelligence, and hybrid models to improve oral health for vulnerable communities. *Front Oral Health.* 2025;6:1649715. doi:10.3389/froh.2025.1649715.
20. Barbosa W, Zhou K, Waddell E, et al. Improving access to care: telemedicine across medical domains. *Annu Rev Public Health.* 2021;42:463-481. doi:10.1146/annurev-publhealth-090519-093711.