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Teledentistry For Rural Populations: Improving Access To Care

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Abstract

Background: Access to oral healthcare remains a significant challenge for rural populations due to geographical barriers, a shortage of dental professionals, and limited resources. Teledentistry offers a promising digital solution to extend dental care and improve service delivery in underserved areas. However, evidence regarding its practical application in enhancing access to care within routine rural primary healthcare workflows remains limited.

Methods: This quantitative observational study employed a cross-sectional design to evaluate the role of teledentistry in a rural primary healthcare setting. Data were collected from 240 adult patient cases assessed via teledentistry and 38 healthcare providers. The intervention involved store-and-forward and synchronous consultations for preliminary assessment, triage, and referral guidance. Outcome measures included the effectiveness of remote management, referral decision accuracy, timeliness of care, and provider experiences.

Results: Nearly half (43.3%) of patient cases were managed remotely without requiring an in-person referral. Dental pain was the most common presenting complaint (38.3%). Teledentistry demonstrated high referral accuracy, with 80.8% of referrals confirmed as appropriate by specialists. Only 6.7% of cases required immediate emergency referral. The majority of healthcare providers reported improved confidence in oral assessment (76.3%), faster referral decisions (81.6%), and a reduction in unnecessary referrals (71.1%).

Conclusion: Teledentistry significantly improved access to oral healthcare for rural populations by enabling effective early assessment, accurate triage, and efficient referral coordination. It supported the remote management of a substantial proportion of cases and enhanced clinical decision-making. These findings advocate for the integration of teledentistry as a complementary component of rural primary healthcare services to reduce oral health disparities.

Introduction

Access to oral healthcare continues to represent a major public health concern for rural populations, where geographical distance, limited availability of dental professionals, and logistical constraints frequently hinder timely access to dental services. In many rural regions, individuals rely primarily on primary healthcare centers that often lack on-site dental facilities, resulting in delayed diagnosis, unmanaged oral conditions, and increased dependence on emergency or referral-based care. Such disparities contribute not only to the progression of preventable oral diseases but also to inefficiencies within the broader healthcare system (Beltrán et al., 2025).

In recent years, teledentistry has gained increasing attention as a digital health innovation capable of addressing gaps in oral healthcare delivery. By enabling the remote exchange of clinical data, images, and real-time consultations, teledentistry offers a mechanism to extend dental expertise beyond traditional clinical settings (Kengne Talla et al., 2024). Its potential is particularly relevant for rural communities, where travel to specialized dental services may require significant time, cost, and effort. Rather than functioning solely as a substitute for in-person care, teledentistry can be viewed as a complementary approach that supports early assessment and informed clinical decision-making (Beltrán et al., 2025).

The integration of teledentistry within rural primary healthcare settings presents an opportunity to improve access to care through more structured and timely evaluation of oral health conditions. When appropriately implemented, teledentistry may assist healthcare providers in identifying urgent cases, guiding interim management, and determining the necessity and priority of referrals to dental specialists (Mathivanan et al., 2020). In this context, its value may be greatest as a triage and referral support tool that enhances coordination between primary care services and dental providers, thereby optimizing patient pathways and resource utilization (García et al., 2023).

Although the feasibility and general acceptance of teledentistry have been explored in previous studies, evidence regarding its practical role in improving access to dental care for rural populations remains limited. Much of the existing literature focuses on patient satisfaction or technical viability, while fewer studies examine how teledentistry can be systematically embedded into routine primary care workflows to reduce unnecessary referrals and improve the timeliness of care (Ward et al., 2022). Furthermore, factors such as technological readiness, workforce training, and organizational support may influence the effectiveness of teledentistry in real-world rural settings and warrant further investigation (Alabass et al., 2025).

Within this context, evaluating the application of teledentistry in rural primary healthcare environments becomes particularly relevant. This study examines the role of teledentistry in improving access to oral healthcare for rural populations, with a specific focus on its contribution to early assessment and efficient referral processes. By addressing this gap, the research aims to generate evidence that can inform service planning, policy development, and the sustainable integration of teledentistry into existing healthcare systems to promote more equitable delivery of dental care (Falah et al., 2025).

Methodology

Study Design

This study was conducted using a quantitative observational design to evaluate the role of teledentistry in improving access to oral healthcare services for rural populations. The research adopted a cross-sectional approach, allowing for the assessment of teledentistry use, referral processes, and clinical decision-making outcomes at a single point in time. This design was selected to capture real-world implementation characteristics of teledentistry within primary healthcare settings and to examine its effectiveness as a supportive tool for early assessment and referral management.

Study Population

The study population consisted of adult patients seeking care at primary healthcare facilities serving rural communities, as well as healthcare providers involved in the delivery of oral health services or initial patient assessment. Patients included in the study were individuals who presented with oral health complaints requiring evaluation, while providers included general healthcare practitioners and dental professionals

participating in teledentistry consultations. Participants were selected to reflect routine clinical practice and to ensure representation of cases commonly encountered in rural primary care settings.

Inclusion and Exclusion Criteria

Patients were included in the study if they required an oral health assessment and were evaluated using teledentistry as part of their care pathway. Only individuals who provided informed consent and had complete clinical and consultation records were considered eligible. Patients were excluded if they required immediate emergency intervention that precluded teledentistry assessment or if their records were incomplete. Healthcare providers were included if they had received basic training in the use of teledentistry systems and were actively involved in patient evaluation or referral decisions during the study period.

Teledentistry Intervention

Teledentistry was implemented as a store-and-forward and synchronous consultation system, allowing primary healthcare providers to transmit clinical information, intraoral images, and patient histories to dental professionals for remote evaluation. Real-time consultations were conducted when required to clarify clinical findings or support decision-making. The teledentistry platform was used primarily for preliminary assessment, triage, and referral guidance rather than definitive treatment. All consultations followed standardized clinical protocols to ensure consistency and reliability of assessments.

Data Collection Procedures

Data were collected using structured data collection forms designed specifically for the study. Information obtained included patient demographic characteristics, presenting oral health complaints, clinical findings documented by primary healthcare providers, teledentistry consultation outcomes, and referral decisions. For healthcare providers, data included professional role, experience with teledentistry, and consultation response time. All data were recorded prospectively during routine clinical encounters and were anonymized prior to analysis to protect participant confidentiality.

Outcome Measures

The primary outcome measure was the effectiveness of teledentistry in supporting early oral health assessment and appropriate referral decisions. Secondary outcomes included the proportion of cases managed without in-person referral, timeliness of referral decisions, identification of urgent cases, and alignment between initial assessments and specialist recommendations. These outcomes were selected to reflect access to care, efficiency of service delivery, and optimization of patient management pathways.

Sample Size and Sampling Technique

A convenience sampling technique was used to recruit eligible participants over the study period. The sample size was determined based on the number of patients who met the inclusion criteria and utilized teledentistry services during routine care. This approach was considered appropriate given the exploratory nature of the study and the aim to evaluate real-world implementation rather than population-level prevalence.

Data Analysis

Collected data were entered into a statistical software package for analysis. Descriptive statistics were used to summarize patient characteristics, consultation outcomes, and referral patterns. Categorical variables were presented as frequencies and percentages, while continuous variables were expressed as means and standard deviations. Where applicable, comparative analyses were performed to examine associations between teledentistry use and referral outcomes. Statistical significance was determined using appropriate tests, with a predefined threshold applied for analytical consistency.

Ethical Considerations

Ethical approval for the study was obtained from the appropriate institutional review body prior to data collection. All participants were informed about the purpose of the study, the voluntary nature of participation, and the confidentiality of their information. Written informed consent was obtained from all participants before inclusion in the study. Data were stored securely and accessed only by the research team to ensure privacy and ethical compliance throughout the research process.

Results

A total of 240 patient cases assessed through teledentistry services were included in the final analysis, along with data from 38 healthcare providers involved in the consultation and referral process. The results describe patient characteristics, presenting oral conditions, teledentistry consultation outcomes, referral decisions, and the role of teledentistry in early assessment and care coordination for rural populations.

Table 1. Demographic Characteristics of Patients (n = 240)

Variable	Frequency (n)	Percentage (%)
Age Group		
18–30 years	62	25.8
31–45 years	88	36.7
46–60 years	59	24.6
>60 years	31	12.9
Sex		
Male	131	54.6
Female	109	45.4

The largest proportion of patients belonged to the 31–45 years age group (36.7%), followed by those aged 18–30 years (25.8%). Patients above 60 years constituted the smallest group (12.9%). Males represented a slightly higher proportion of cases (54.6%) compared to females (45.4%), indicating relatively balanced gender representation among teledentistry users.

Table 2. Presenting Oral Health Complaints Assessed via Teledentistry (n = 240)

Presenting Complaint	Frequency (n)	Percentage (%)
Dental pain	92	38.3
Gingival or periodontal problems	61	25.4
Caries-related issues	47	19.6
Oral lesions or swelling	26	10.8
Trauma-related complaints	14	5.9

Dental pain was the most common presenting complaint, accounting for 38.3% of cases, followed by gingival and periodontal problems (25.4%). Caries-related conditions represented 19.6% of consultations, while oral lesions and swelling comprised 10.8%. Trauma-related complaints were least frequent (5.9%), suggesting that teledentistry was primarily utilized for non-emergency but clinically significant oral conditions.

Table 3. Teledentistry Consultation Outcomes (n = 240)

Consultation Outcome	Frequency (n)	Percentage (%)
Managed remotely without referral	104	43.3
Referred for routine dental care	78	32.5
Referred for urgent dental care	42	17.5
Required immediate emergency referral	16	6.7

Nearly half of the cases (43.3%) were successfully managed remotely without the need for in-person

referral, highlighting the effectiveness of teledentistry in supporting early assessment and interim management. Routine referrals accounted for 32.5%, while 17.5% of cases were identified as requiring urgent dental care. Only 6.7% of cases necessitated immediate emergency referral, demonstrating the value of teledentistry in distinguishing between urgent and non-urgent conditions.

Table 4. Referral Decision Accuracy Following Teledentistry Assessment (n = 120 referred cases)

Referral Outcome	Frequency (n)	Percentage (%)
Referral confirmed as appropriate	97	80.8
Referral upgraded in urgency	15	12.5
Referral downgraded or avoided	8	6.7

Among referred cases, 80.8% of referrals were confirmed as appropriate following specialist evaluation. In 12.5% of cases, the urgency of referral was upgraded, indicating early detection of potentially serious conditions. Only 6.7% of referrals were downgraded or deemed unnecessary, suggesting a high level of accuracy in teledentistry-supported referral decision-making.

Table 5. Healthcare Provider Experience with Teledentistry (n = 38)

Provider Response	Frequency (n)	Percentage (%)
Improved confidence in oral assessment	29	76.3
Faster referral decision-making	31	81.6
Reduced unnecessary referrals	27	71.1
Reported workflow challenges	9	23.7

A majority of healthcare providers reported improved confidence in oral health assessment (76.3%) and faster referral decision-making (81.6%). Additionally, 71.1% indicated a reduction in unnecessary referrals following the integration of teledentistry. However, 23.7% of providers reported workflow-related challenges, highlighting areas for improvement in system integration and training.

Discussion

The present study examined the role of teledentistry in improving access to oral healthcare for rural populations, with particular emphasis on early assessment, triage, and referral efficiency. The findings demonstrated that teledentistry supported timely clinical decision-making, reduced unnecessary referrals, and enabled a substantial proportion of cases to be managed remotely. These results reinforce the growing body of evidence suggesting that teledentistry is an effective adjunct to conventional dental care delivery in underserved rural settings (Kengne Talla et al., 2024).

A key finding of this study was that 43.3% of patients were managed remotely without requiring in-person referral. This highlights the capacity of teledentistry to address non-urgent oral health conditions efficiently, thereby reducing patient travel burden and pressure on specialist services. Similar outcomes have been reported in rural and remote care models, where teledentistry facilitated early intervention and prevented escalation of manageable conditions (Mathivanan et al., 2020; Ward et al., 2022).

Dental pain emerged as the most common presenting complaint, accounting for more than one-third of consultations. This aligns with previous studies indicating that pain-related conditions often prompt care-seeking behavior in rural populations due to delayed access to routine dental services (García et al., 2023). The ability of teledentistry to rapidly assess pain-related complaints and determine urgency underscores its value as a first-line screening and triage tool.

Periodontal and gingival conditions represented a significant proportion of consultations, reflecting the high prevalence of chronic oral diseases in rural communities. Teledentistry enabled early identification of these conditions and guided interim management, which is consistent with findings from systematic reviews emphasizing its role in preventive and monitoring strategies (Kengne Talla et al., 2024; Beltrán et al., 2025a).

Importantly, only 6.7% of cases required immediate emergency referral, indicating that teledentistry was effective in differentiating true emergencies from conditions suitable for deferred or routine care. This selective referral process mirrors findings from school-based and community-based teledentistry programs that reported improved prioritization of urgent cases (Ward et al., 2022).

The high referral accuracy observed in this study, with 80.8% of referrals confirmed as appropriate, further supports the reliability of teledentistry-assisted decision-making. Comparable levels of diagnostic agreement and referral appropriateness have been reported in pediatric and older adult populations, reinforcing the clinical validity of remote oral health assessments (Beltrán et al., 2025a; Beltrán et al., 2025b).

Notably, 12.5% of referrals were upgraded in urgency following specialist review, suggesting that teledentistry facilitated early detection of potentially serious conditions that may have otherwise been underestimated. This finding highlights the safety-enhancing role of teledentistry, particularly in settings where delayed diagnosis is common due to limited specialist availability (Mathivanan et al., 2020).

Healthcare provider responses further emphasized the benefits of teledentistry integration. More than three-quarters of providers reported improved confidence in oral health assessment, indicating that teledentistry functioned as an educational and decision-support mechanism. Similar improvements in provider confidence and perceived competence have been reported among dentists and primary care practitioners in low-access settings (Falah et al., 2025; Alabass et al., 2025).

The majority of providers also reported faster referral decision-making, which is consistent with prior studies demonstrating that real-time and asynchronous consultations reduce delays associated with traditional referral pathways (Ward et al., 2022). This efficiency is particularly relevant in rural contexts, where prolonged referral timelines can exacerbate disease progression.

Despite these benefits, nearly one-quarter of providers reported workflow challenges, underscoring the importance of organizational readiness and system integration. Previous research has identified similar barriers, including technical limitations, training gaps, and increased administrative workload during early implementation phases (Alabass et al., 2025; Falah et al., 2025).

Patient acceptability, although not directly measured in this study, can be inferred from the high utilization rates and successful remote management outcomes. These findings are consistent with studies reporting favorable patient attitudes toward teledentistry in rural and culturally diverse populations, particularly when services reduce travel and waiting times (García et al., 2023).

The study's findings also align with evidence from pediatric teledentistry interventions, where remote assessment improved early detection and referral efficiency in underserved areas (Beltrán et al., 2025b). This suggests that the benefits observed in adult populations may be transferable across age groups.

Furthermore, the results support broader conceptual frameworks that position teledentistry as a complementary, rather than replacement, model of care. By enhancing coordination between primary care and dental specialists, teledentistry contributes to more integrated and equitable healthcare delivery systems (Kengne Talla et al., 2024).

From a health systems perspective, reducing unnecessary referrals and optimizing resource utilization has important implications for cost containment and service sustainability. Similar system-level benefits have been reported in rural teledentistry models employing structured triage protocols (Ward et al., 2022; Mathivanan et al., 2020).

Overall, the findings of this study extend existing evidence by demonstrating the practical value of teledentistry within routine rural primary healthcare workflows. Unlike prior studies focusing primarily on feasibility or satisfaction, this research highlights concrete improvements in referral accuracy, efficiency, and early assessment, addressing key gaps identified in the literature (Kengne Talla et al., 2024).

Conclusion

This study demonstrated that teledentistry significantly improved access to oral healthcare for rural populations by supporting early assessment, accurate triage, and efficient referral decision-making. A substantial proportion of cases were managed remotely, unnecessary referrals were reduced, and urgent conditions were identified in a timely manner. These findings support the integration of teledentistry as a

complementary component of rural primary healthcare services and provide evidence to inform policy development, service planning, and sustainable implementation strategies aimed at reducing oral health disparities.

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