

Innovative Service Delivery Models for Underserved Populations in Oral Health

Hadi Ghasemi

Associate Professor, Department of Community Oral Health, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

***Corresponding Author:** Hadi Ghasemi, Associate Professor, Department of Community Oral Health, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

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Abstract

Despite remarkable advances in dental science, profound oral health disparities persist among vulnerable populations globally. The elderly, people with disabilities, pregnant women, rural communities, and low-income groups continue to bear a uneven burden of oral disease—largely due to persistent barriers in access to care. Traditional, chairside-focused service delivery models, while clinically effective for those who can access them, have proven inadequate for reaching populations with the greatest needs. This article examines emerging innovations in oral health service delivery that are transforming access and equity: tele-dentistry and digital platforms, community health worker integration, satellite and mobile clinic models, and inter-professional collaborative care. Drawing on implementation science evidence and lessons from diverse global contexts, the paper explores how these models are overcoming geographic, financial, cultural, and systemic barriers. These innovations represent a paradigm shift from reactive, clinic-based care to proactive, community-centered oral health systems. Practical recommendations are offered for clinicians, policymakers, and educators committed to advancing oral health equity.

Key words: brain activation by meanings; consciousness; neural networks; integral memory; holographic semantic images

1. Introduction

Oral health is a fundamental component of overall health and well-being, yet it remains one of the most neglected areas of healthcare globally [1]. The World Health Organization has recognized that oral diseases affect nearly 3.5 billion people worldwide, with the burden falling unreasonably on vulnerable and marginalized populations [2]. In high-income countries, dental caries in children from low-income families is twice as common as in their more affluent peers; in low- and middle-income countries, the disparities are even more stark [3].

These inequities are not accidental. They are the predictable consequences of service delivery models that were designed for a different era. Traditional oral healthcare has been characterized by a focus on surgical-interventionist care delivered in fixed clinical settings by highly specialized professionals [4]. This model, while clinically effective, fails to address the fundamental barriers that prevent vulnerable populations from accessing care: geographic isolation, financial constraints, lack of transportation, disability, low health literacy, cultural and linguistic mismatches, and the fragmentation of health services.

The consequences of these access failures are severe. Untreated dental caries can lead to pain, infection, compromised nutrition, impaired speech development, reduced school attendance, and diminished quality of life [5]. For older adults, poor oral health is associated with systemic

conditions including cardiovascular disease, diabetes, and pneumonia [6]. For pregnant women, periodontal disease is linked to adverse pregnancy outcomes [7].

Recognizing these challenges, there has been a global movement toward innovative service delivery models that reimagine how, where, and by whom oral healthcare is provided. This article examines four promising innovations: tele-dentistry and digital health technologies, community health worker-led interventions, satellite and mobile clinic models, and inter-professional collaborative care. Drawing on evidence from implementation science and real-world programs, the paper explores how these approaches are beginning to bridge the gap between those who have access to care and those who do not.

2. The Innovation Landscape: Four Promising Models

2.1 Tele-Dentistry and Digital Health Platforms

The rapid expansion of digital health technologies has created unprecedented opportunities to extend oral health services to underserved populations. Tele-dentistry—the use of telecommunications technology to deliver oral health services remotely—has emerged as a particularly promising innovation [8].

Tele-dentistry encompasses several service modalities:

- Store-and-forward (asynchronous) tele-dentistry, where clinical images, radiographs, and patient histories are captured by a trained auxiliary provider and transmitted to a dentist for remote evaluation and treatment planning.

- Real-time (synchronous) tele-dentistry, where live video consultations enable dentists to interact directly with patients, often with the assistance of a tele-presenter at the patient's location.

- Remote patient monitoring, where digital tools enable ongoing monitoring of oral health conditions and patient adherence to preventive protocols.

- Mobile health (mHealth) applications, including smartphone apps for oral health education, risk assessment, self-care guidance, and appointment management.

Evidence for the effectiveness of tele-dentistry has grown substantially. A systematic review of tele-dentistry applications found that diagnostic accuracy using store-and-forward methods is comparable to clinical examination for many conditions, including caries detection and oral mucosal screening [9,10]. Tele-dentistry has been shown to increase access to specialist consultations in rural and remote areas, reduce unnecessary referrals, and improve patient satisfaction [11].

Work in this area has focused on developing digital tools for educational purposes. A mobile application was designed and implemented for teaching population oral health needs assessment to dental students, demonstrating the potential for digital platforms to enhance both clinical training and population health monitoring. In a non-randomized trial, students who used the mobile application showed significantly improved understanding of community health needs assessment compared to traditional teaching methods, suggesting that such tools could be equally valuable for community-based screening and surveillance programs [11].

2.2 Community Health Worker and Peer-Led Models

The integration of community health workers (CHWs) into oral health service delivery represents one of the most transformative innovations in recent years. CHWs—lay community members who receive targeted training to deliver health services in their communities—have been successfully deployed in numerous health domains, including maternal and child health, infectious disease control, and chronic disease management [12]. Their application to oral health is gaining momentum.

CHW-led interventions in oral health typically involve:

- Delivery of preventive education and oral hygiene instruction
- Screening and risk assessment for common oral conditions
- Referral facilitation to dental services
- Navigation support for patients needing care
- Follow-up and adherence support
- Community-level health promotion and advocacy

A growing evidence base supports the effectiveness of CHW-led oral health interventions. A systematic review of community-based oral health programs in underserved populations found that CHW-led interventions were associated with improved oral health knowledge, increased preventive behaviors (including toothbrushing and dental attendance), and reduced caries incidence in children [13]. An intervention on oral health literacy and oral health behavior among slum area women demonstrated that community health volunteer-led programs significantly improved oral health knowledge, attitudes, and behaviors among participants [14].

Peer-led models, in which individuals from within a community serve as health educators and supporters, have also shown promise. Peer friendship groups for oral health promotion among students have been

effective in improving oral hygiene behaviors [15]. The underlying mechanism—trust, social support, and the power of relevant role models—operates in diverse cultural contexts and across age groups.

2.3 Satellite and Mobile Clinic Models

The geographic concentration of dental services in urban centers has long been a barrier to access for rural and remote populations. Satellite and mobile clinic models address this challenge by bringing services directly to underserved communities.

Satellite clinics are smaller, often part-time dental facilities located in rural or underserved urban areas, typically operated by a parent dental institution or health system. These clinics may be staffed by dental hygienists, therapists, or dentists who rotate from the parent facility. Mobile dental clinics—fully equipped dental practices housed in vans, buses, or trailers—can travel to schools, community centers, residential facilities, and workplaces to provide care.

These models offer several advantages:

- Geographic accessibility, as services reach populations that would otherwise travel long distances.
- Flexible scheduling, allowing clinics to align with community needs and school or work schedules.
- Reduced costs for patients, as transportation costs are eliminated.
- Continuity of care, as patients can be referred for more complex services when linked to a parent organization.

A case study of rural dental satellite clinics in Iran [16], India [17], and Chile [18], documented the feasibility and impact of this model in a low-resource setting. The satellite clinics were able to deliver preventive and basic restorative care to populations with no previous access to services, significantly improving oral health outcomes and quality of life indicators among children and adults.

2.4 Inter-professional and Collaborative Care Models

Perhaps the most fundamental innovation in service delivery is the integration of oral health into broader healthcare systems [19]. The traditional separation of oral health from general health has been a major contributor to disparities, as vulnerable populations often interact with primary care, maternity, and school-based health services without receiving oral health assessment or referral.

Inter-professional collaborative care models seek to embed oral health promotion and screening into:

- Antenatal and maternity care, including screening for periodontal disease, oral health education, and referral for treatment
- Primary care settings, with oral health assessment during routine medical visits
- School health programs, providing fluoride varnish, sealants, and preventive education
- Workplace health programs, integrating oral health promotion with other health initiatives
- Long-term care facilities, ensuring routine oral health assessment and care for older adults

Research on inter-professional collaboration has focused on several of these settings. A study of obstetricians' and midwives' knowledge, attitude, and practice regarding the effect of periodontal diseases on premature birth found significant knowledge gaps and barriers to collaboration, identifying opportunities for educational interventions [20]. The integration of oral health into disaster management has been explored [21], and barriers and facilitators of oral health screening among tobacco users in primary care settings have been investigated [22].

The evidence for inter-professional models is compelling. School-based oral health promotion programs have demonstrated reductions in caries incidence, improved oral hygiene, and enhanced quality of life [23]. A cluster randomized controlled trial of a school-based oral health promotion program in Iraq found significant improvements in oral health knowledge, behaviors, and clinical outcomes among participating children [24]. Workplace-based interventions have similarly shown promise; a study examining the association between toothbrushing frequency and work-related factors among Japanese workers highlighted the potential of occupational health settings for oral health promotion [25].

3. Evidence and Lessons Learned

3.1 What Works: Key Success Factors

A synthesis of implementation research on innovative service delivery models reveals several factors that contribute to successful outcomes:

Community engagement and co-design. Programs that actively involve community members in the design, implementation, and evaluation phases are more likely to be acceptable, culturally appropriate, and sustainable. Community members can identify priority needs, navigate cultural considerations, and build trust that enables effective service delivery.

Integration with existing systems. Embedding oral health services into established health, education, or social service infrastructure reduces costs, influences existing trust, and creates opportunities for referral and follow-up. This was a key lesson from an assessment of integrating oral health interventions into the health-promoting schools' program in Iran [26].

Training and support for frontline workers. Whether working with CHWs, hygienists, therapists, or those working in tele-dentistry programs, the quality of training and ongoing supervision is critical. Competency-based training that includes both technical skills and communication skills is essential for effective service delivery.

Flexible and adaptive implementation. Programs that allow for adaptation to local circumstances while maintaining fidelity to core evidence-based principles are more likely to succeed. This may involve adjusting clinical protocols, appointment schedules, or educational materials based on community feedback.

Addressing financial barriers. Service delivery innovations may still fail to achieve impact if patients cannot afford care. Models that combine service delivery with financing mechanisms—such as subsidies, insurance coverage, or sliding-scale fees—are more effective. Research on parents' willingness to pay for preventive dental treatments in Iran provides insights into the financial considerations that shape oral health access [27].

3.2 Challenges and Barriers

Despite their promise, these innovative models face significant challenges:

Regulatory and policy barriers. Scope-of-practice restrictions, reimbursement policies, and licensing requirements may limit the ability of CHWs, hygienists, or therapists to deliver services, or may restrict telehealth practice across jurisdictional boundaries.

Reimbursement and sustainability. Innovative models often struggle to secure adequate and sustainable funding. Short-term grants may support pilot programs but fail to provide the stability needed for scale-up.

Interprofessional collaboration challenges. Differences in professional cultures, training, and priorities can impede collaboration between dentists, physicians, and other health professionals.

Technology and infrastructure limitations. Tele-dentistry and digital health tools require reliable internet connectivity, appropriate equipment, and technical support—all of which may be lacking in underserved communities.

Evaluation and evidence gaps. There is a need for more rigorous evaluation of these innovations, including randomized controlled trials, cost-effectiveness analyses, and implementation science studies that document the factors that influence success and failure.

4. Implications for Practice, Policy, and Education

4.1 For Clinicians

Dentists and dental team members can support innovative service delivery models in several ways:

Adopt a population health mindset. Consider how clinical practice can address the needs of underserved communities. This might involve participating in community outreach, accepting referrals from community health workers, or providing telehealth consultations.

Engage in interprofessional practice. Build relationships with physicians, midwives, social workers, and other health professionals to create pathways for integrated care. Research with obstetricians and midwives highlights both the need and the opportunity for collaborative practice [17].

Use digital tools to extend reach. Consider offering telehealth consultations for screening, triage, and follow-up. Use digital platforms for patient education and self-care support.

Support the development of the allied dental workforce. Advocate for the training and appropriate utilization of dental hygienists, therapists, and CHWs to expand the reach of dental services.

4.2 For Policymakers

Policymakers can create the enabling conditions for innovative service delivery models:

Reform regulatory frameworks. Update scope-of-practice laws, telehealth regulations, and licensing requirements to enable the full utilization of all oral health professionals and technologies.

Develop sustainable financing mechanisms. Create payment models that support prevention, community-based care, and innovative service delivery—not just surgical-interventionist care delivered in traditional settings. Consider value-based payment models that reward health outcomes rather than procedures.

Invest in workforce development. Support the training of CHWs, dental therapists, and other allied professionals. Incorporate interprofessional education and community-based training into dental education.

Support research and evaluation. Fund implementation science research to identify the factors that contribute to successful scaling of innovative models.

4.3 For Educators and Researchers

Dental educators can prepare the next generation of practitioners for these emerging models:

Integrate community-based education. Ensure that students have opportunities to work in underserved settings and with diverse populations. Research on dental students' attitudes toward underserved populations highlights the importance of such experiences in shaping professional identity and commitment to equity [25].

Teach interprofessional collaboration. Incorporate interprofessional education into the curriculum, providing students with the knowledge and skills to work effectively with other health professionals.

Teach health communication and literacy. Prepare students to communicate effectively with patients from diverse backgrounds and with varying levels of health literacy. Work on oral health literacy and behavior change interventions provides a foundation for this training [14,26].

Develop research capacity. Build research programs that evaluate innovative service delivery models, inform evidence-based policy, and contribute to the implementation science knowledge base.

5. Conclusion

The persistent oral health disparities affecting vulnerable populations demand a fundamental reimagining of how oral healthcare is delivered. Traditional models-focused on surgical intervention delivered in fixed clinical settings by highly specialized professionals-have failed to reach those with the greatest needs. The innovations described in this article-tele-dentistry, community health worker integration, satellite and mobile clinics, and interprofessional collaborative care-represent promising pathways toward more equitable oral health systems.

Evidence from implementation science, including research in diverse settings, suggests that these models can improve access, enhance health outcomes, and reduce disparities. However, their full potential will only be realized with supportive policies, sustainable financing, workforce development, and a commitment to community engagement and co-design.

The vision is an oral health system where:

- Services are available where people live, work, learn, and play
- Care is delivered by a well-trained, diverse team of professionals and community members
- Prevention is prioritized alongside treatment
- Integration with broader health systems ensures that oral health is not neglected
- Equity is an explicit and measurable goal.

Achieving this vision requires action from all stakeholders-clinicians, researchers, educators, policymakers, and communities. The innovations of excellence described here provide a roadmap. It is now the collective responsibility to build the systems that will make oral health equity a reality.

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