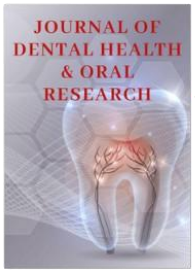

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Review Article

Community-Based Preventive Strategies to Reduce Oral Health Disparities: A Narrative Review

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Abstract

Oral diseases affect roughly half the world population and fall disproportionately on low-income, minoritized, rural and pediatric groups. These inequities arise from social determinants and structural barriers that individual clinical care cannot address. This narrative review synthesizes evidence on community-based preventive strategies for underserved populations, covering their reach, effectiveness and implementation. We reviewed literature from PubMed, Embase and Web of Science, prioritizing the last five years. Population-level measures, particularly water fluoridation, achieved the broadest reach and the greatest potential to narrow caries disparities. School-based programs improved knowledge, behavior and clinical outcomes when education was combined with clinical prevention. Community health workers, mobile units, teledentistry and primary-care integration extended access, though long-term equity effects remain heterogeneous. Interventions requiring transport, technology or literacy sometimes favored better-resourced groups. No single strategy eliminates disparities; the most equitable approach combines universal policy with targeted, culturally responsive delivery proportionate to need within publicly financed health systems.

Keywords: Oral Health Disparities; Health Equity; Community-Based Prevention; Underserved Populations; Preventive Dentistry

Introduction

Oral diseases rank among the most common chronic conditions worldwide and the burden falls hardest on populations already facing other forms of disadvantage. A recent systematic review and meta-analysis estimated a pooled global prevalence of early childhood caries of 49%, ranging from 34% in Central and South America to 72% in the Middle East, with the highest rates concentrated in lower-income countries [1]. Beyond childhood caries, oral conditions affect an estimated 3.5 billion people overall, again concentrated in low- and middle-income settings [2]. Global burden analyses place oral conditions among the leading causes of years lived with disability, a position that has remained largely unchanged over three decades [3]. That persistence prompted sustained international attention to oral health as a component of universal health coverage rather than a discretionary add-on to it [4]. These aggregate figures obscure how unevenly the burden falls within countries, where national surveys repeatedly show steep gradients by geography and income.

These gradients are not random; identifiable social conditions produce them. Income, education, insurance status and housing shape both exposure to risk and access to care, frequently from early childhood onward [5]. In Colombia, periodontitis among pregnant women was associated with subsidized insurance coverage, rural residence and intermittent water supply, factors that

proved more consequential than individual hygiene habits [6]. In Brazil, adolescents in municipalities with lower Human Development Index values showed higher odds of anterior open bite, a pattern compounded by the concentration of dental specialists in wealthier regions [7]. Even in Spain, where a universal health system operates, unmet dental needs cluster among the poor, with material deprivation rather than age or sex explaining most of that inequality [8]. Despite their different settings, these studies converge on a single point: oral health inequities take root where structural disadvantage meets a fragmented, cost-exposed dental care system and they persist across the life course.

This convergence explains why individual clinical care alone cannot close the gap. Dental services tend to cluster where people can pay for them, reproducing what has been described as the inverse care law, in which provision is thinnest where need is greatest [2,7,8]. Expanding insurance coverage helps but may fall short when poverty and competing survival needs prevent people from seeking care at all [9]. Recent evidence goes further, cautioning that policies built around individual behavioral education have limited power to reduce inequality, since the drivers are material and structural rather than a deficit of knowledge [8]. Reducing oral health disparities therefore requires shifting prevention upstream, toward population- and community-level interventions that reach people irrespective of their ability to pay or to navigate the clinical system.

This review takes up that shift. This narrative review synthesizes current evidence on the effectiveness and implementation of community-based preventive strategies to reduce oral health disparities among underserved populations and identifies the resulting implications for practice and policy. We defined the scope using the Population, Concept, Context structure. The Population comprises underserved and disadvantaged groups, including low-income, racial and ethnic minority, rural and pediatric populations. The Concept comprises community water fluoridation, school-based sealant and fluoride varnish programs, oral health education and promotion, community health worker models, mobile dental units and teledentistry. The Context comprises public health and community settings across varied geographic and socioeconomic environments, with evidence from both high-income and low- and middle-income countries.

We identified literature through PubMed/MEDLINE, Embase and Web of Science. We prioritized articles published within the preceding five years, retaining earlier seminal work where it remained conceptually necessary. We considered studies addressing population- and community-level preventive interventions and their associated oral health equity outcomes. We excluded work confined to individual clinical treatment of established disease. We screened the reference lists of retrieved articles by hand. Given the narrative design, we did not conduct formal quality scoring or quantitative synthesis. The following section sets out the conceptual and equity frameworks that structure the strategies reviewed thereafter.

Conceptual Framework and Determinants of Oral Health Disparities

Oral health disparities describe measurable differences in oral health status, disease burden, access to care and treatment outcomes across population groups. Oral health inequities refer more specifically to those disparities that are avoidable and that arise from unfair social, economic, political or environmental circumstances. The distinction is more than semantic. Disparities identify differences in outcomes; inequities point to the structural conditions that create and sustain those differences. An equity-oriented approach therefore seeks not only to identify populations at greater risk but to understand the mechanisms through which unequal opportunity translates into poorer oral health [10,11].

Although most oral diseases are largely preventable, they continue to affect billions of people [3,10,12]. This persistence cannot be explained by biological susceptibility or individual behavior alone. Oral health is strongly shaped by the conditions in which people are born, live, work and age. Income, educational attainment, employment, housing, access to healthcare and broader social policy influence both exposure to risk factors and access to preventive resources. Oral diseases are consequently better understood as conditions embedded in the social environment than as isolated clinical problems [5,10].

Current conceptual models hold that oral health inequities develop through interaction among structural determinants, healthcare systems, communities and individual-level factors. Structural determinants such as economic policy, social inequality, discrimination and educational opportunity shape intermediary conditions including neighborhood environment, oral health literacy, dietary pattern, tobacco use, psychosocial stress and access to preventive dental services. Individual behavior therefore occurs within social contexts that either enable or constrain healthy choices [11,13-15]. Figure 1 summarizes these pathways.

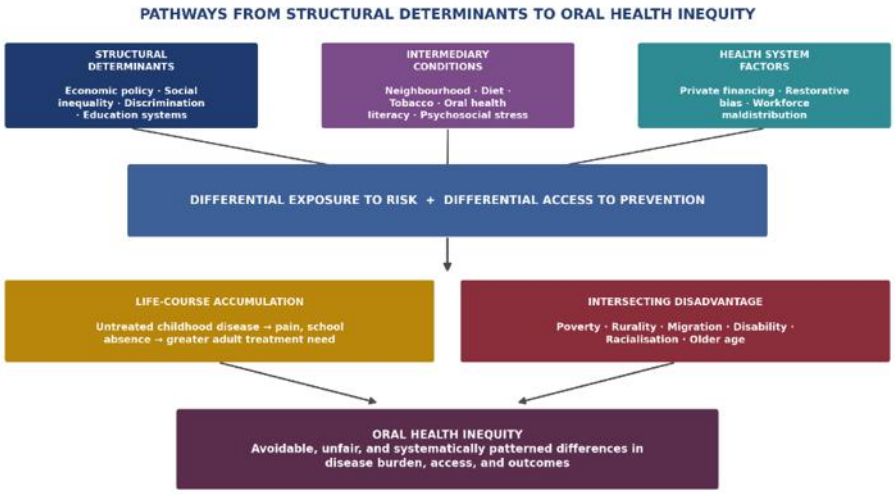

Figure 1: Pathways from structural determinants to oral health inequity REF [11,13-15,17].

A life course perspective illustrates how disadvantage accumulates over time. Limited access to preventive services during childhood may lead to untreated disease, pain, school absenteeism and greater treatment need in later life. In adulthood, inadequate insurance coverage, high out-of-pocket costs, unstable employment, transport difficulty and uneven distribution of oral health professionals may further compromise continuity of care. As these disadvantages accumulate across generations, they contribute to persistent oral health inequalities [13-15,17].

The burden of oral disease is consequently concentrated among populations experiencing social and economic disadvantage, including low-income families, racial and ethnic minority groups, rural communities, migrants, Indigenous populations, people with disabilities and older adults. These vulnerabilities rarely occur in isolation. An intersectional perspective recognizes that poverty, discrimination, disability, migration status and geographic isolation frequently overlap, creating compounding barriers to prevention and treatment. Such structural disadvantage ultimately determines who reaches preventive services and who remains disproportionately affected by untreated disease [11,14].

Healthcare systems themselves either reduce or perpetuate inequity. Systems that rely heavily on private financing or prioritize restorative treatment over prevention create additional barriers for vulnerable populations. Integrating oral health into primary healthcare, expanding preventive services and allocating resources according to population need represent the principal system-level strategies for improving equity [13,15,17].

Population-Level Strategies: Community Water Fluoridation and Policy Measures

Population-level prevention is recognized as a cornerstone of public health because it addresses the environmental and social conditions that shape disease risk across whole communities. Unlike interventions delivered exclusively in clinical settings, these strategies act before disease develops and benefit broad population segments, including individuals with limited access to routine dental care. By reducing exposure to common risk factors and expanding access to preventive resources, population-based policy can improve oral health while reducing disparities [13,18].

Community Water Fluoridation (CWF) remains among the most extensively evaluated public health interventions for caries prevention. By maintaining optimal fluoride concentrations in public water systems, CWF promotes enamel remineralization and slows caries progression. Its principal strength is that the benefit does not depend on an individual's income, education or frequency of dental attendance. Contemporary systematic reviews suggest the magnitude of effect is smaller than in earlier decades, largely because fluoride toothpaste is now widely available, yet current evidence continues to support its role as an effective population-based measure [19,20].

Beyond reducing caries experience, CWF may narrow oral health inequalities. Because it reaches entire communities without requiring active participation or direct financial outlay, fluoridation can protect populations facing barriers to preventive

services; analysis of United States national data found the greatest caries advantage among children and adolescents from lower-income households [21]. Its effectiveness nevertheless depends on adequate water infrastructure, consistent monitoring and integration with other preventive initiatives, so fluoridation is best regarded as one component of a broader strategy rather than a standalone solution [20,21].

Other population-based policies also matter. Reducing free sugar consumption through taxation of sugar-sweetened beverages, nutrition labeling, restrictions on food marketing to children and healthier school food environments addresses a principal shared risk factor for caries and other chronic diseases [22]. Improving access to affordable fluoride toothpaste through public policy and community distribution strengthens preventive reach, particularly among underserved populations [18,23].

Population-based interventions are also economically attractive because they benefit large populations while reducing future treatment needs. Economic evaluation in the United States has demonstrated long-term cost savings associated with CWF, particularly in larger communities where implementation costs are distributed across more residents [24]. These findings reinforce the case for investing in prevention as a sustainable component of oral health systems.

Implementation challenges nonetheless persist. Public concern regarding fluoridation, differing political priorities, funding constraints and variation in water infrastructure contribute to uneven adoption. Current evidence supports the safety of fluoridation when implemented within recommended public health guidelines, while emphasizing continuous surveillance, transparent communication and ongoing program evaluation [19,25].

Setting-Based Programs: School and Community Prevention

Preventive programs delivered in schools and community settings are among the most effective strategies for reducing childhood caries and narrowing oral health inequalities [26,27]. Unlike models based on clinic attendance, these programs bring prevention to the places where children live and learn, reaching populations that face economic, geographic or social barriers to dental services [26,28]. Accumulated evidence indicates that the most effective programs combine evidence-based clinical interventions with oral health education, family involvement and intersectoral collaboration [26-28].

Among interventions with the strongest evidence are pit-and-fissure sealants and fluoride varnish. A Cochrane review demonstrated that sealants significantly reduce caries incidence on occlusal surfaces of permanent teeth, particularly when applied shortly after eruption and maintained through periodic review [29]. Recent systematic evidence similarly shows that periodic fluoride varnish application in school settings reduces new lesions in both primary and permanent dentition [30]. A meta-analysis further found that combining sealants with fluoride varnish offers superior protection compared with either intervention alone, supporting comprehensive rather than isolated preventive programs [31].

A Community Guide systematic review reinforces this evidence, concluding that school fluoride delivery programs consistently reduce caries experience and represent a cost-effective intervention, particularly in communities with high socioeconomic vulnerability. The same review notes that the magnitude of benefit depends on program coverage, application frequency and continuity, underscoring the importance of sustained, adequately financed delivery [26].

Oral health education forms another essential component, though the evidence indicates that education alone has limited effect on clinical outcomes. A global scoping review found that purely educational interventions improve knowledge and certain hygiene behaviors but produce only modest reductions in caries incidence when not accompanied by clinical prevention [27]. Programs integrating education, fluoride application, sealants and promotion of healthy habits show more consistent and durable results [27,30,31]. Peer interaction-based approaches offer a promising way to strengthen the educational component in school settings [32]. Taken together, these findings support a multifaceted model in which education complements clinical intervention rather than substituting for it.

The literature also emphasizes directing resources toward children and families at higher risk. Schools in low-income communities offer a distinctive opportunity to reduce inequalities, since they serve populations with high caries prevalence and low dental service utilization. The BASICS protocol proposes an adaptive prevention model in which intervention intensity is adjusted according to each student's individual risk. Results remain under evaluation, but the approach represents a shift toward

programs that are both more personalized and potentially more efficient in resource use [33].

Success also depends on integration with other community services. Community organizations play a fundamental role in early identification of children with special healthcare needs and in reducing access barriers for vulnerable families [28]. Complementarily, including social workers within oral health teams has emerged as a promising strategy for addressing social determinants, facilitating system navigation and strengthening coordination among schools, families and health services [34].
Despite robust evidence of effectiveness, implementation continues to face significant obstacles. Principal barriers include insufficient funding, a shortage of trained personnel, difficulty obtaining parental consent, logistical constraints within the school day and a lack of longitudinal follow-up to ensure continuity. Conversely, programmes characterised by institutional support, collaboration between education and health sectors, standardized protocols and active family participation achieve greater coverage, sustainability and impact [26,27,34]. Table 1 compares the principal strategies families reviewed across this and the preceding section.

Strategy	Population reach	Strength of evidence	Equity considerations	Reference
Community water fluoridation	Whole community; no individual action required	Extensive; effect size smaller than historical estimates	Strongest equity potential where coverage is universal; requires water infrastructure	[19-21]
Sugar-sweetened beverage taxation	Whole population	Moderate; evidence stronger for intake than for caries endpoints	Addresses a shared risk factor; regressive effects debated	[22]
Fluoride toothpaste access policy	Broad, but depends on distribution	Moderate	Directly targets affordability barrier	[18,23]
School sealant programs	Enrolled children; misses non-attenders	Strong (Cochrane-level)	High reach in low-income schools; consent and staffing constrain coverage	[26,29,31]
School fluoride varnish	Enrolled children	Strong	Cost-effective in vulnerable communities; benefit depends on frequency	[26,30,31]
Oral health education alone	Broad within setting	Weak for clinical outcomes	Improves knowledge without closing outcome gaps; may favour higher-literacy groups	[27,32]
Risk-adaptive school models	Enrolled children, intensity by risk	Emerging; under evaluation	Explicitly proportionate to need	[33]

Table 1: Principal community-based preventive strategies: Population reach, strength of evidence and equity considerations [18-33].

Workforce and Access Models: Community Health Workers, Mobile Care and Teledentistry

Community-based prevention has evolved from a model centered exclusively on the dentist toward multidisciplinary approaches incorporating community health workers, mobile dental units, teledentistry and integration with primary care. These models aim to expand preventive coverage, reduce inequality and bring services closer to populations traditionally excluded from the dental care system. Recent evidence indicates that no single model is sufficient to eliminate access barriers; the best results follow from integrated interventions combining education, clinical prevention and interprofessional coordination [35-38]. Fig. 2 situates these models within a framework of proportionate universalism and Fig. 3 summarises how each extends preventive reach.

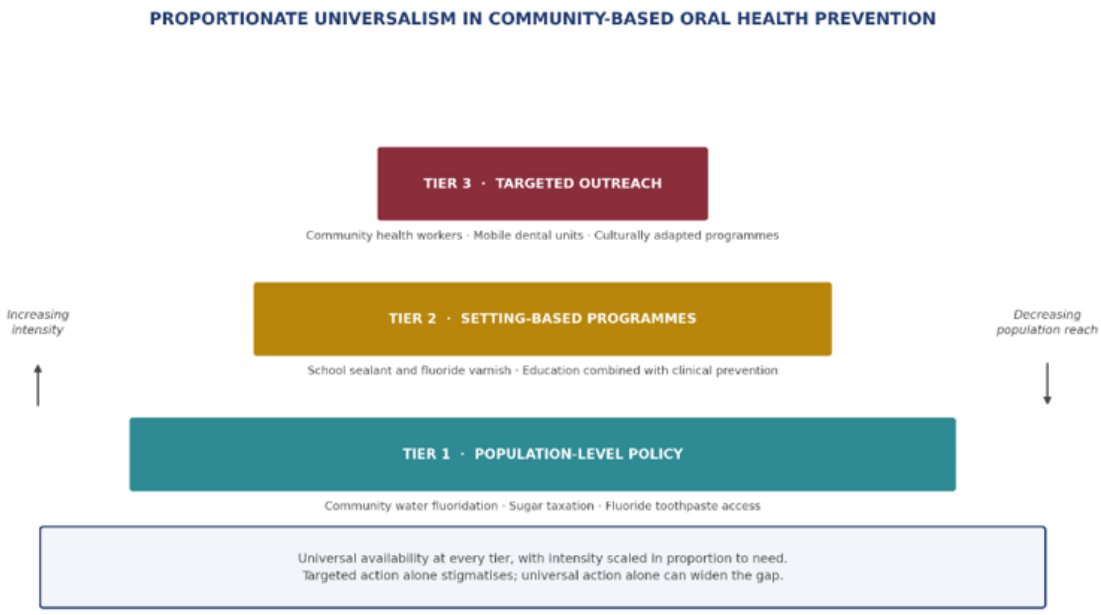

Figure 2: Proportionate universalism in community-based oral health prevention: population-level policy, setting-based programs and targeted outreach [16,18,39].

Community health workers represent one of the models with the greatest potential to improve access to preventive care in vulnerable communities. A scoping review found that these workers actively participate in school-based programs by delivering oral hygiene education, basic caries risk assessment and health habit promotion and by facilitating referrals and coordinating with dental services. Their principal strength lies in cultural and social proximity to the communities they serve, which eases communication with families, improves acceptance of interventions and supports continuity. The same review identifies significant limitations, including variability in training, a lack of standardized protocols and a scarcity of studies evaluating long-term clinical outcomes [35].

The family component has been documented separately. Qualitative work within an Early Head Start program showed that oral hygiene practices in young children are influenced by factors beyond individual knowledge, including family routine, socioeconomic position, social support and cultural belief [40]. These findings suggest that preventive programs work best when community health workers engage directly with parents and caregivers and address the social barriers that impede adoption of healthy habits. Reviews among populations with intellectual disabilities and among refugee children point in the same way, showing that culturally adapted, community-based programs targeting vulnerable groups improve utilization of preventive services and reduce inequity [41,42].

Mobile dental units and services linked to schools or community centers constitute a second widely used strategy. These models deliver preventive care directly to populations with limited access to dental clinics, reducing barriers of transport, cost and professional availability. Available evidence indicates improvements in sealant coverage, fluoride application and preventive assessment, though sustainability depends heavily on financing, logistical coordination and integration with established referral and follow-up systems. Mobile units perform best when embedded within well-established school or community programs rather than operating as isolated interventions [36,42].

Teledentistry has substantially extended the reach of preventive strategies, particularly in rural areas and underserved communities. A systematic review concluded that teledentistry demonstrates high diagnostic validity for screening caries and other oral pathology, with agreement comparable to in-person examination when high-quality images and standardized protocols are used [43]. More recent work describes current applications including remote screening, asynchronous consultation, patient monitoring, health education and interdisciplinary communication, establishing teledentistry as a complementary tool rather than a substitute for in-person care [36].

Clinical evidence on access is also emerging. A cluster randomized controlled trial showed that incorporating teledentistry increased timely access to preventive care and facilitated early identification of treatment need in populations with limited access [44]. Two teledentistry models implemented in rural schools similarly demonstrated that remote screening and virtual consultation optimized referral and reduced unnecessary travel [45]. Implementation nevertheless continues to face challenges of digital infrastructure, information system interoperability, regulation and professional training. A cross-sectional survey found that although acceptance among dentists is growing, notable knowledge gaps persist regarding clinical and legal application [46].

The literature further emphasizes integrating oral health into primary care and safety-net systems. Federally Qualified Health Centers in the United States play an essential role in improving access for low-income populations by offering integrated preventive services and coordinating medical, dental and social work professionals. Comparative work found that these centers possess greater capacity to ensure access and quality than other primary care models [37] and appointment availability for vulnerable patients has been shown to be correspondingly greater [47]. Interdisciplinary teams that include social workers strengthen system navigation, improve service coordination and address the social determinants influencing oral health [38].

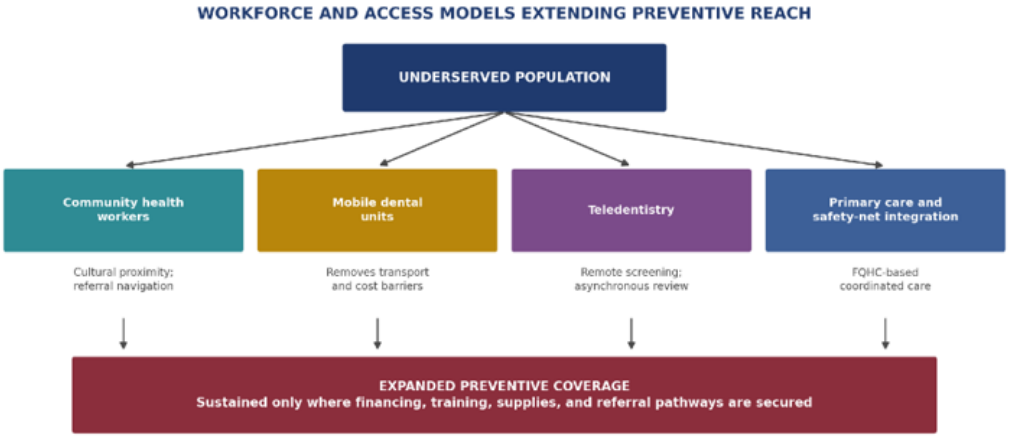

Figure 3: Workforce and access models extending preventive reach: community health workers, mobile dental units, teledentistry and primary care and safety-net integration [35-38,47].

The evidence indicates that expanding preventive access requires considerably more than increasing the supply of dental services. The most promising models combine community health workers, mobile care, digital technology and primary care integration, allowing interventions to be tailored to vulnerable populations' needs. Sustainability, however, depends on continuing investment in training, infrastructure, financing and outcome evaluation and on public policy that fosters interprofessional collaboration and reduces inequity [35-38,47].

Challenges, Equity Considerations and Future Directions

Although oral diseases are largely preventable, community-based strategies will reduce disparities only where effective interventions are implemented equitably and sustained over time [10,13,16]. Major barriers include fragmented or short-term financing, workforce shortage and maldistribution, insufficient training and supervision, weak referral pathways and limited surveillance. In low-income countries, oral health is inconsistently incorporated into national policy and benefit packages, while data on expenditure, service utilization and workforce capacity remain scarce [48]. Global workforce analysis demonstrates pronounced geographic inequity and limited use of task-sharing [49]. Comparable implementation constraints, including inadequate funding, limited skills-based education, weak screening and absent policy support, have been documented in school programs in Uganda [50]. Without recurrent financing, local ownership, reliable supply and integration with primary care, promising initiatives risk remaining small pilots rather than becoming sustainable programs.

Scale-up does not automatically produce equity. Preventive interventions dependent on transport, digital access, health literacy,

school attendance or individual participation may reach better-resourced groups more readily. A scoping review of caries prevention programs found that some interventions reduced inequalities while others widened them or produced no measurable equity effect [39]. Programs should therefore combine universal availability with needs-based intensity, additional outreach and active removal of access barriers for the most disadvantaged populations.

Equity assessment must extend beyond average improvement. Evaluations should measure reach, uptake, fidelity, cost, maintenance, clinical outcomes and unintended effects, with results disaggregated by socioeconomic position, geography, race or ethnicity, migration status, age, sex or gender and disability. Both absolute and relative differences require reporting, because population-wide improvement can coexist with a widening gap. Current evidence remains limited: few upstream interventions explicitly assess oral health inequalities [18], school-based studies are heterogeneous and commonly lack long-term follow-up and data gaps are particularly substantial in low- and middle-income countries [18,48,51,52]. Table 2 sets out the domains that equity-oriented evaluation should address.

Evaluation domain	What to measure	Why it matters for equity	Reference
Reach	Proportion of eligible population contacted, by subgroup	Uniform delivery can still miss the most disadvantaged	[18,39]
Uptake and fidelity	Participation and adherence to protocol, by subgroup	Differential uptake converts equal provision into unequal benefit	[39,51]
Clinical outcome	Caries increment and untreated disease, disaggregated	Average gains may conceal a widening gap	[39,51]
Absolute and relative difference	Both gap measures reported together	Relative improvement can mask persistent absolute inequality	[14,39]
Cost and economic outcome	Cost per averted lesion; distributional cost analysis	Determines whether programmed survive beyond grant funding	[24,48]
Maintenance and sustainability	Continuation beyond initial funding period	Pilots that end leave inequities unchanged	[48,50]
Unintended effects	Stigma, opportunity cost, displacement of other services	Targeted delivery can stigmatize if poorly designed	[11,18]

Table 2: Domains for equity-oriented evaluation of community-based preventive programs [11,14,18,24,39,48,50,51].

Future studies should employ pragmatic effectiveness-implementation designs, standardized outcomes, economic evaluation, longer follow-up and community co-design. Policy priorities include protected public financing, incorporating essential preventive oral health services into universal health coverage, integrating with primary care and payment mechanisms that reward prevention and outreach [4,13,48]. Competency-based task-sharing and development of community-based personnel could improve workforce distribution [49]. Multisectoral policy addressing social and commercial determinants must complement service-delivery interventions and sustainability should be secured through routine budgets, governance and local capacity rather than time-limited grants [16,18,52].

Conclusion

Returning to the aim of this review, population-level measures, school-based prevention, community outreach, mobile and digital delivery and primary care integration all improve preventive reach and oral health outcomes among underserved populations. Direct evidence that these approaches consistently narrow inequities nevertheless remains insufficient. No single strategy is adequate on its own. The most equitable configuration unites universal population-level policy with targeted, culturally responsive interventions delivered in proportion to need and embedded within publicly financed primary care systems. Sustainable financing, task-sharing, local ownership and routine equity monitoring are prerequisites rather than refinements. For public health practice, the operative test is not whether average oral health improves, but whether those with the greatest need achieve the greatest gain.

Conflict of Interest
The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Data Availability Statement
The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethical Statement
The project did not meet the definition of human subject research under the preview of the IRB according to federal regulations and therefore was exempt.

Informed Consent Statement
Not applicable.

Authors' Contributions
All authors contributed equally to this paper.

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