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Preventive Oral-Health Navigation Through Community Digital Platforms

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Abstract

Preventive oral healthcare depends not only on the availability of dental services but also on whether individuals can recognize preventive needs, understand where appropriate care is available, determine when professional assessment is warranted, arrange appointments, and successfully complete referral pathways. These steps can be especially difficult in communities affected by geographic distance, limited oral-health literacy, fragmented services, cost uncertainty, language differences, or weak connections between community settings and dental providers. Digital technologies offer a potential mechanism for reducing some of these navigation barriers. Mobile messaging, community applications, teledentistry, digital educational resources, appointment-routing systems, and community health-worker interfaces can provide oral-health information while also connecting users with appropriate preventive services. WHO and the International Telecommunication Union's 2021 mOralHealth guidance explicitly positioned mobile technologies as tools for complementing existing oral-health programmes through health promotion, health-worker training, detection support, data collection, and monitoring.

The present study develops a simulation-based framework for preventive oral-health navigation through community digital platforms. Navigation is defined as the process through which users progress from recognizing an oral-health need to obtaining reliable preventive information, identifying an appropriate service, arranging a preventive appointment, and completing that visit. Because no original community participant dataset was provided, 600 synthetic cases were modeled across three conditions: information-only digital access, a guided community digital platform, and a community digital platform supported by a human navigator. All numerical results are hypothetical and are intended to demonstrate an analytical framework rather than estimate clinical effectiveness.

The simulated analysis indicates that preventive visit completion rises from 12% under information-only access to 25% with guided digital navigation and 39% when digital navigation is combined with community-navigator support. Conversely, the modeled proportion taking no further action falls from 42% to 14%. This pattern is theoretically consistent with evidence that mobile oral-health interventions can improve knowledge and oral-hygiene behaviors and that teledentistry can support referral, screening, and access pathways. A 2021 systematic review and meta-analysis concluded that teledentistry—particularly messaging and mobile applications—was promising for oral-health promotion and prevention, while earlier systematic reviews found growing but still methodologically heterogeneous evidence for teledentistry.

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The study argues that community digital platforms should not be designed as substitutes for dental examination or as automated diagnostic authorities. Their principal preventive value may lie in reducing informational and navigational friction: making reliable information understandable, identifying the next appropriate action, connecting users with services, preserving referral continuity, and supporting individuals who have difficulty progressing independently from awareness to care. Effective implementation therefore requires attention to digital accessibility, privacy, health literacy, language, community trust, provider availability, and the capacity of local oral-health systems to absorb increased demand.

Keywords: preventive oral health; digital health; community digital platforms; teledentistry; mHealth; oral-health navigation; dental access; oral-health promotion

1. Introduction

Oral diseases are largely preventable, yet preventive oral healthcare frequently occurs later than would be desirable. Individuals may seek dental services only after pain, infection, visible damage, or functional difficulty develops rather than using routine preventive assessment, professionally recommended hygiene support, fluoride-related prevention, periodontal monitoring, or risk-based follow-up. This pattern cannot be explained solely by individual motivation. Access to preventive oral healthcare depends on interacting informational, geographical, financial, cultural, and service-related conditions. Digital oral-health strategies have therefore attracted increasing attention because they may extend preventive information and initial service connections beyond conventional dental clinics. WHO's 2021 implementation guidance specifically recognizes mobile technologies as a means of complementing oral-health programmes, including health promotion, workforce support, detection, data collection, and monitoring.

The distinction between oral-health information and oral-health navigation is particularly important. Information informs an individual that twice-daily brushing, fluoride exposure, dietary moderation, or preventive dental visits may be beneficial. Navigation addresses what happens next: where care can be obtained, whether a preventive visit is appropriate, how to arrange it, what documents or information are required, whether a referral has been received, and what to do if the first service is inaccessible. Mobile interventions have shown potential for improving oral-hygiene knowledge and behavior. Toniazzo and colleagues' systematic review and meta-analysis concluded that mHealth could serve as an adjunct for managing gingivitis, increasing oral-health knowledge, and improving oral hygiene. The preventive potential of digital systems may therefore become greater when behavioral support is connected with an actionable pathway into care.

Teledentistry research provides further support for this pathway perspective. Estai and colleagues' systematic review found emerging evidence for benefits associated with teledentistry, while emphasizing that the evidence available at the time was insufficient for broad conclusions concerning long-term effectiveness and cost-effectiveness. Alabdullah and Daniel's systematic review also examined the validity of teledentistry for oral examination and diagnostic purposes, demonstrating that remote oral-health assessment had developed beyond a purely theoretical concept. Community-oriented teledentistry models have additionally been used to improve access among populations who might

otherwise experience difficulty obtaining conventional dental assessment. Kopycka-Kedzierawski, McLaren, and Billings described a long-running teledentistry programme intended to expand oral-health access, including among underserved children.

Preventive digital navigation nevertheless raises important limitations. A mobile application can identify a nearby dental service only if an appropriate service exists, appointment capacity is available, the patient can afford or otherwise access care, and the information supplied by the platform is accurate. A reminder system cannot overcome all transportation, disability, language, cultural, or financial barriers. Mobile applications also vary considerably in quality. Chen and colleagues systematically evaluated applications intended for dental-caries prevention and highlighted the need to consider quality and evidence when recommending oral-health apps. Consequently, the digital layer should be understood as one component of an oral-health system rather than an independent solution.

2. Objectives of the Study

2.1 To Examine Digital Platforms as Preventive Oral-Health Navigation Tools

The first objective is to examine how community digital platforms could move beyond general oral-health education toward structured preventive navigation. The proposed platform combines evidence-informed preventive messages, service information, appointment-routing support, reminders, and referral follow-up. This broader approach is compatible with WHO and ITU guidance, which presents mobile oral-health technologies as complements to established oral-health systems rather than isolated applications.

The objective is not to develop an automated diagnostic system. The platform is conceptualized as helping users understand preventive priorities and identify an appropriate next step. Where clinical assessment is required, the expected destination of the digital pathway is professional oral-health care rather than continued self-management.

2.2 To Compare Information-Only, Guided Digital, and Navigator-Supported Pathways

The second objective is to compare three levels of digital support. The information-only pathway provides preventive material and service listings. The guided digital pathway adds structured navigation, reminders, appointment support, and referral-status visibility. The navigator-supported pathway combines these functions with a trained community worker or oral-health navigator who can assist users experiencing difficulties.

The distinction is theoretically important because access barriers are not purely informational. Evidence from rural and underserved teledentistry programmes demonstrates that successful digital oral-health delivery commonly depends on integration among technology, oral-health professionals, community settings, and referral systems. Digital guidance may therefore be sufficient for some people, whereas others may benefit from human assistance that translates platform information into action.

2.3 To Evaluate Preventive Engagement Rather Than Digital Usage Alone

The third objective is to distinguish platform engagement from preventive-health engagement. Opening an application, reading a message, or viewing a service directory should not automatically be treated as a

successful oral-health outcome. The primary modeled endpoint is completion of an appropriate preventive dental visit.

This distinction responds to the wider mHealth literature, where improved knowledge or app engagement does not necessarily demonstrate clinical benefit. Toniazzo and colleagues found promising evidence for oral-hygiene outcomes, while Fernández and colleagues' later systematic review and meta-analysis described teledentistry and mHealth as promising preventive and promotional tools but also emphasized the continuing need for broader and stronger evidence.

3. Review of Literature

3.1 Mobile Oral-Health Promotion and Preventive Behavior

Mobile technologies can deliver preventive oral-health content through text messaging, applications, reminders, images, videos, and interactive interfaces. Their potential advantage is frequency: preventive guidance can be delivered between dental visits rather than being restricted to occasional clinical encounters.

Toniazzo, Nodari, Muniz, and Weidlich systematically evaluated mHealth interventions and concluded that they could be used as an adjunct for improving oral hygiene, acquiring oral-health knowledge, and managing gingivitis-related outcomes. Their findings support digital reinforcement as an adjunct rather than a replacement for professional dental care. The distinction matters because behavior change may reduce risk while existing disease still requires clinical assessment.

Chen and colleagues examined mobile applications specifically related to dental-caries prevention. Their systematic search and quality evaluation demonstrated that numerous applications were available but that quality assessment remained necessary before apps could be considered reliable preventive resources. This evidence has direct implications for community platforms. The presence of large quantities of digital oral-health information does not guarantee that users receive evidence-informed, understandable, or appropriately prioritized advice.

Fernández and colleagues subsequently synthesized evidence from teledentistry and mHealth interventions for oral-health promotion and prevention. Their 2021 systematic review and meta-analysis characterized digital approaches, particularly messaging and applications, as promising tools for preventive oral health while emphasizing the need for broader population evidence and improved implementation knowledge. This provides the immediate evidence base for shifting the research question from whether oral-health messages can be delivered digitally to how digital systems can be connected with preventive service access.

3.2 Teledentistry, Referral, and Access to Care

Teledentistry extends digital oral health from communication into remote professional interaction. Depending on the model, it can involve remote screening, image transmission, professional consultation, referral prioritization, treatment planning, and follow-up. Alabdullah and Daniel's review examined evidence concerning the validity of teledentistry for oral examination and diagnostic purposes, indicating that remote assessment could achieve clinically meaningful validity in selected applications.

Estai, Kanagasingam, Tennant, and Bunt reviewed the broader benefits of teledentistry and concluded that evidence was emerging for effectiveness while remaining insufficient for definitive long-

term policy conclusions. The cautious conclusion remains relevant to community navigation. Digital connection should not be promoted on the assumption that every remote pathway is automatically equivalent to conventional dental care. The technology must be evaluated according to the specific task it performs.

Examples from underserved and geographically dispersed populations demonstrate why navigation may nevertheless be valuable. Kopycka-Kedzierawski, McLaren, and Billings described extensive teledentistry experience at the Eastman Institute for Oral Health, including programmes that improved access for underserved children. Tynan, Deeth, and McKenzie evaluated an integrated oral-health programme for rural residential aged-care facilities that incorporated oral-health professionals and teledentistry, demonstrating the feasibility of combining community-based support with remote dental expertise.

Estai and colleagues also developed a school-based teledentistry pathway designed to identify high-risk children and create a faster route to appropriate dental treatment while avoiding unnecessary referral. Their 2020 randomized-trial protocol illustrates an important principle for preventive navigation: the digital system becomes valuable when it changes what happens after screening, not simply when it produces a remote image or record.

3.3 Community Digital Platforms, Equity, and Implementation

Community digital platforms occupy a middle position between population health promotion and individualized clinical care. They can deliver common preventive messages to large populations while also providing location-specific service information and referral assistance. WHO and ITU's 2021 implementation guide explicitly provides a framework for national or large-scale mOralHealth programmes and emphasizes integration with existing oral-health systems.

Digital delivery, however, can reproduce existing inequalities when systems require smartphones, reliable connectivity, high literacy, a dominant language, or familiarity with online appointment processes. Community implementation therefore needs low-bandwidth options, accessible language, culturally appropriate content, and alternative offline pathways. Riza and colleagues' 2021 work on an IT-based health-promotion algorithm in temporary settlements illustrates the broader possibility of using digital approaches for preventive service navigation among populations experiencing complex access barriers, including questions relating to dental care.

Human support can provide an equity layer when automated navigation becomes difficult. Community health workers, trained volunteers, primary-care workers, or oral-health navigators can help interpret platform information, explain preventive recommendations, verify service availability, and assist with appointment completion. The present framework treats this support not as evidence that the digital platform has failed but as part of a hybrid model appropriate for users with differing navigation needs.

4. Research Methodology

4.1 Research Design and Simulation Framework

The study adopts a simulation-based explanatory quantitative design. No community participants were recruited, no dental records were accessed, and no platform was deployed in a real population.

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Simulation was selected because no primary dataset was supplied and because fictional utilization data should not be represented as completed empirical research.

A synthetic analytical sample of 600 community users was created and divided equally among three digital-navigation conditions. Each condition contained 200 cases. The first condition represented information-only access, the second represented structured digital navigation, and the third combined structured digital navigation with community-navigator support.

The model assumes that all three pathways can improve preventive awareness but that they differ in their ability to reduce attrition between receiving information and completing preventive care.

4.2 Operationalization of Preventive Oral-Health Navigation

Preventive navigation is represented as a sequence rather than a single score. A user may receive information but take no action, obtain information without booking a visit, book an appointment but not attend, or complete the preventive visit.

Table 1: Operational Framework for the Proposed Digital Navigation Model

Construct	Proposed Operational Definition	Scale	Analytical Role
Digital Oral-Health Access	Exposure to reliable preventive information through a community digital platform	Yes/No	Entry condition
Navigation Guidance	Structured assistance identifying appropriate preventive services and next steps	0–100	Primary pathway variable
Oral-Health Navigation Literacy	Ability to understand preventive recommendations and use service information	0–100	Proposed mediator
Appointment Support	Digital reminders, booking assistance, location guidance, and referral-status information	0–100	Proposed mediator
Community-Navigator Support	Human assistance when digital navigation alone is insufficient	Yes/No	Enhanced pathway component
Preventive Appointment Booking	Successful scheduling of an appropriate preventive oral-health visit	Yes/No	Intermediate outcome
Preventive Visit Completion	Attendance at the scheduled preventive visit	Yes/No	Primary outcome
Navigation Attrition	Failure to progress between consecutive stages	Percentage	Implementation outcome

4.3 Analytical Procedure and Ethical Boundaries

Synthetic pathway outcomes were generated so that increasing support reduced navigation attrition while preserving realistic failure at every stage. The information-only condition places most responsibility on users. The guided digital platform adds personalized service information, reminders, and navigation prompts. The hybrid pathway additionally provides human assistance when users encounter barriers.

Descriptive percentages are emphasized because significance tests performed on deliberately generated data would not provide evidence concerning a real population. Future empirical evaluation could use randomized or quasi-experimental designs, logistic regression for appointment completion, survival analysis for time to preventive attendance, and multilevel models when participants are nested within neighborhoods or community organizations.

The proposed platform is deliberately restricted from autonomous diagnosis. It may provide general preventive education, identify the need for professional assessment according to an approved decision protocol, and facilitate referral, but it should not represent algorithmic output as a confirmed dental diagnosis. This boundary is consistent with WHO's framing of mOralHealth as a complement to existing oral-health programmes and with the continuing evidence limitations identified in teledentistry reviews.

5. Analysis

5.1 Simulated Preventive Navigation Outcomes

The modeled results show a progressive shift from passive digital exposure toward completed preventive care as navigation support increases.

Table 2: Simulated Preventive Oral-Health Outcomes Across Digital Pathways

Navigation Outcome	Information Only	Guided Digital Platform	Platform + Community Navigator
Simulated Cases	200	200	200
No Further Action	42%	25%	14%
Information Viewed Only	28%	23%	16%
Preventive Appointment Booked	18%	27%	31%
Preventive Visit Completed	12%	25%	39%

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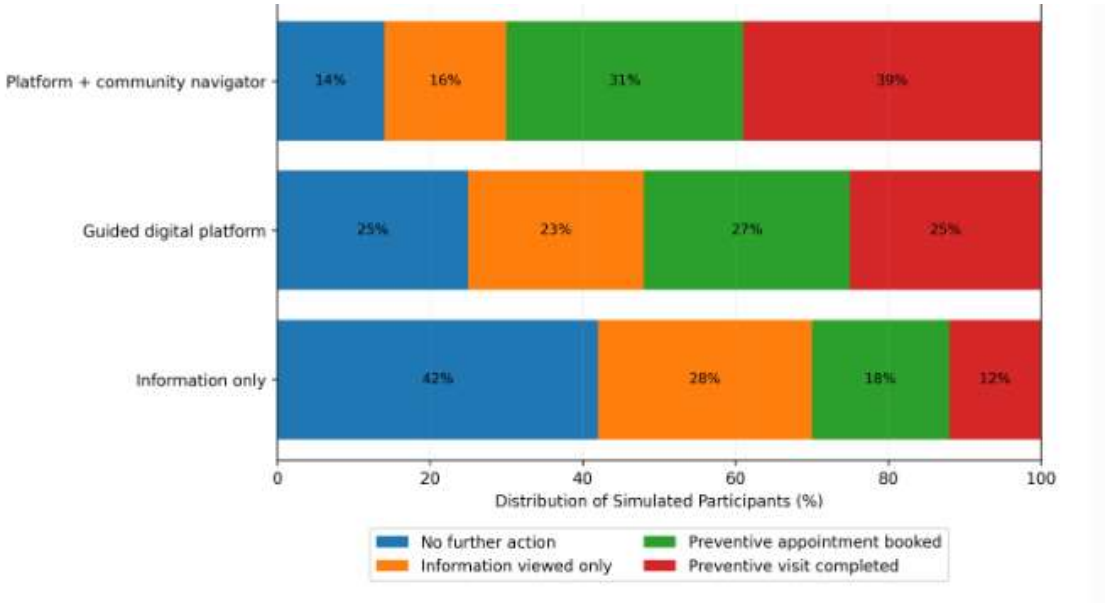
Under the information-only condition, 70% of simulated users fail to progress beyond information exposure: 42% take no further action and another 28% view information without arranging care. Preventive visit completion reaches only 12%.

The guided platform reduces total nonprogression to 48% and increases completed preventive visits to 25%. The hybrid navigator-supported pathway produces the strongest simulated outcome, with 39% completing a preventive visit and only 14% taking no further action.

5.2 Distribution of Navigation Outcomes

Graph 1: Simulated Preventive Oral-Health Navigation Outcomes by Digital Support Pathway



The 100% stacked bar graph demonstrates how the composition of outcomes changes as support intensifies. Under information-only access, the largest segment consists of users taking no further action. With guided digital navigation, appointment booking and visit completion occupy a greater proportion of the pathway. Under navigator-supported digital care, completed preventive attendance becomes the largest single outcome category.

The important finding is therefore not simply increased application engagement. The modeled intervention changes the endpoint toward actual preventive-service completion.

5.3 Navigation Attrition as the Central Analytical Problem

The simulation identifies navigation attrition as a potentially useful performance measure. Digital oral-health programmes commonly measure message reach, clicks, log-ins, downloads, or knowledge. These metrics describe platform activity but do not establish whether individuals obtain appropriate preventive care.

The modeled pathway demonstrates several points at which users can be lost: after information delivery, during service selection, during appointment booking, and between booking and attendance. Different interventions are likely to be required at each stage.

For example, improved health literacy may reduce attrition after information delivery, whereas reminder systems may address appointment nonattendance. Community navigators may be most useful when barriers concern language, technology, transport, uncertainty, or service-system complexity. The framework therefore supports stage-specific evaluation rather than treating all unsuccessful navigation as one undifferentiated outcome.

6. Discussion

6.1 From Digital Oral-Health Education to Actionable Navigation

Digital oral-health programmes have a credible preventive foundation. Systematic evidence available through 2021 indicates that mHealth interventions can improve oral-health knowledge and hygiene-related outcomes and that teledentistry may support preventive and promotional oral healthcare. However, educational success and healthcare access are conceptually different. A person can understand the importance of preventive dentistry while remaining uncertain about where to go, how much care may cost, whether a referral is necessary, or how to arrange an appointment.

The present model therefore proposes actionability as the key extension of oral-health education. A useful community platform should convert preventive guidance into specific next steps. Users who require only education can receive concise evidence-informed material, while those requiring professional assessment should be directed toward appropriate services. Appointment links, location information, opening hours, eligibility information, and referral status should be integrated where health-system infrastructure permits.

This approach aligns with WHO–ITU guidance that mobile oral-health programmes should complement wider oral-health systems. A digital platform should consequently be judged partly by whether it strengthens the connection between communities and existing preventive services rather than by the number of messages transmitted.

6.2 Why Human Navigation May Remain Necessary

The simulated hybrid pathway produces the highest preventive visit completion because it recognizes that barriers differ among users. Some people are capable of moving from a digital reminder directly to booking and attendance. Others may experience difficulty understanding health information, navigating digital forms, locating an affordable provider, communicating in the dominant language, or deciding whether a service is appropriate.

Teledentistry programmes for underserved children, rural populations, and aged-care settings have repeatedly depended on relationships among community sites, oral-health professionals, and referral systems rather than technology operating independently. This suggests that hybrid delivery should not be interpreted as a temporary stage before complete automation. In some populations, the human component may remain an essential part of equitable digital care.

A community navigator can also identify when digital guidance has become inappropriate. A user experiencing escalating pain, swelling, bleeding, trauma, or another clinically significant concern should not remain within a preventive self-management pathway merely because a digital programme was originally designed for prevention. The navigator's role is not to diagnose but to help ensure that the person reaches an appropriate professional service.

6.3 Implementation, Quality, Privacy, and Equity

Digital oral-health expansion should be accompanied by quality control. Chen and colleagues' evaluation of dental-caries prevention applications demonstrates why app availability cannot be treated as equivalent to clinical quality. Community platforms should therefore use evidence-informed content, transparent authorship, scheduled clinical review, and clear boundaries concerning what the platform can and cannot determine.

Privacy is equally important. Dental images, health histories, appointment details, contact information, and community referral data can be sensitive. Any community platform collecting such information should apply appropriate consent, data-minimization, security, retention, and access-control principles. The practical value of navigation does not justify unnecessary collection of personal health information.

Equity should also be measured rather than assumed. A system that improves preventive attendance among digitally confident users while excluding people without smartphones, data plans, literacy, accessible interfaces, or preferred-language content could widen disparities. WHO's mOralHealth implementation framework is valuable precisely because it situates mobile technology within broader programme design rather than treating technology adoption as an end in itself.

Future implementations should therefore retain non-digital alternatives. Telephone navigation, community health workers, paper-based information, school or workplace oral-health programmes, and direct primary-care referrals can operate alongside digital services. The aim is not to maximize the percentage of oral healthcare delivered digitally; it is to reduce preventable barriers to timely and appropriate oral-health care.

7. Conclusion

Preventive oral-health navigation through community digital platforms offers a plausible strategy for narrowing the gap between knowing that preventive dental care matters and successfully obtaining that care. Mobile oral-health evidence published through 2021 supports the usefulness of digital interventions for oral-health education, hygiene behavior, preventive promotion, and selected teledentistry functions. The strongest contribution of a community platform, however, may arise when these functions are connected to a reliable pathway into professional services.

The simulation developed in this study illustrates this distinction. Preventive visit completion increases from 12% under information-only access to 25% with guided digital navigation and 39% when digital guidance is combined with community-navigator support. At the same time, the modeled proportion taking no further action falls from 42% to 14%. These values are entirely synthetic and should not be reported as real intervention effects.

The central conceptual contribution is the identification of navigation attrition as a meaningful oral-health system outcome. A community member can be lost between awareness and service identification, between service identification and booking, or between booking and attendance. Digital systems should be designed to identify these breakpoints and provide appropriate support rather than measuring success solely through downloads, clicks, or message delivery.

A hybrid model appears especially worthy of future investigation. Automated digital functions can deliver consistent information, reminders, and service directories at scale, while trained human

navigators can respond to barriers that cannot be solved through interface design alone. Such an approach is consistent with existing examples of teledentistry in rural, underserved, school, and aged-care populations where professional and community components operate together.

Future empirical studies should compare information-only, guided digital, and hybrid community-navigation models using real preventive outcomes. Appropriate endpoints include preventive appointment booking, visit completion, time to care, oral-health literacy, referral appropriateness, patient-reported navigation difficulty, cost, provider workload, and equity across socioeconomic and digital-access groups. The objective should remain clear: digital technology is valuable when it makes preventive oral healthcare easier to understand and realistically easier to reach, not simply when more oral-health activity occurs on a screen.

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