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HEALTH INFORMATICS IN DENTAL CARE: A SYSTEMATIC REVIEW OF CLINICAL, OPERATIONAL, AND PATIENT REPORTED OUTCOMES

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Abstract

Digital health tools are increasingly embedded in dental care to enhance prevention, treatment efficiency, and access. This systematic review synthesized original studies evaluating health informatics interventions in dentistry across clinical, operational, and patient reported outcomes. We included nine original studies: randomized trials and quasi experimental designs assessing smartphone tooth brushing applications, AI enabled remote monitoring during orthodontics, tele dentistry service models, SMS appointment reminders, web assisted e referrals for smoking cessation, and AI chatbot education. Across orthodontic settings, smartphone or chatbot interventions generally improved plaque and gingival indices or patient knowledge, while an AI remote monitoring platform reduced plaque, lesion progression in short term follows up; one clear aligner study found no meaningful difference between remote and conventional monitoring in malocclusion improvement. SMS reminders and tele dentistry pathways supported attendance and service reach, and e referrals increased engagement with cessation support. Patient reported outcomes favored digital modalities for satisfaction, perceived convenience, and acceptability. Heterogeneity in outcomes, follow up length, and fidelity limited meta-analysis; consistent signals suggest that well designed informatics tools can improve oral hygiene behaviors and streamline care. Future research should standardize outcome sets, extend follow up, and evaluate equity, costs, and implementation fidelity.

Keywords: Teledentistry; Mhealth; Orthodontics; AI Chatbot; Remote Monitoring; Appointment Reminders; Oral Hygiene.

INTRODUCTION

Digital transformation has accelerated in oral health, enabling remote triage, asynchronous consultation, decision support, and behavior change tools integrated with routine care (Daniel et al. 2013).

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Teledentistry leverages synchronous and store and forward models to deliver assessment, counseling, and follow up beyond clinic walls, with particular relevance for underserved populations and workforce shortages (Daniel et al. 2013).

During and beyond the COVID 19 era, telehealth platforms demonstrated comparable outcomes to in person care for selected indications, while reducing exposure risks and preserving capacity (Daniel et al. 2013).

Recent umbrellas and overviews converge on the potential of teledentistry to improve access, diagnostic performance, satisfaction, and selected clinical outcomes, while emphasizing gaps in standardization, cost evidence, and implementation guidance (Scheerman et al. 2024; Kengne Talla et al. 2025).

Within behavior change, mHealth interventions, SMS, smartphone applications, and AI conversational agents, have demonstrated improvements in oral hygiene indices, adherence, and knowledge in various populations (Toniazzo et al. 2019).

National and regional syntheses also document expanding utilization and feasibility in real world systems (Lee et al. 2024, Australia), mapping program types from screening and triage to specialist consultations and preventive counseling.

Against this backdrop, the present review, restricted strictly to nine original studies, examines health informatics interventions in dental settings across clinical (plaque, gingival status, lesions), operational (attendance, workflow), and patient reported outcomes (knowledge, satisfaction).

The included studies span orthodontic care with smartphone apps, AI enabled remote monitoring, AI chatbots for patient education, pediatric attendance reminders via SMS, web assisted cessation e referrals delivered in dental practice networks, and cluster randomized tele dentistry service models.

By aligning findings with contemporary evidence syntheses and implementation insights, we aim to clarify where informatics tools add value, where effects appear equivalent to standard care, and where methodological or reporting limitations constrain inference.

METHODS

Study Design

This was a systematic review of original intervention studies evaluating health-informatics applications in dental care, reported in line with PRISMA 2020 guidance. Eligibility was prespecified using a PICOS framework (patients receiving dental care; informatics-based interventions; usual/standard care comparators; clinical, operational, and patient-reported outcomes; randomized or quasi-experimental designs).

Eligibility Criteria

Population: Patients receiving dental care in any setting (orthodontic clinics, pediatric dentistry, general practice).

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Intervention: Health informatics, digital modalities (teledentistry, remote monitoring, smartphone apps, SMS, AI chatbots, web assisted e referrals).

Comparator: Usual care, conventional monitoring, leaflets, standard education, or parallel digital alternatives.

Outcomes: Clinical indices (plaque index, gingival index, white spot lesions, PAR); operational metrics (attendance, no show, referrals, engagement); patient reported knowledge, satisfaction, or acceptability.

Study design: Randomized or quasi experimental original research.

Information Sources and Search Strategy

We search electronic bibliographic databases using combinations of controlled vocabulary and free-text terms related to dental health informatics (teledentistry, mobile health, remote monitoring, chatbots, electronic reminders) and clinical, operational outcomes.

After duplicate removal, titles, abstracts and then full texts were screened against prespecified picos criteria, with reasons for exclusion recorded.

Data Items and Extraction

From each study we extracted setting, sample size, population, intervention components, comparator, follow up, primary outcomes, and key results (favoring prespecified outcomes). When numerical details were not clearly available on initial pages, qualitative outcome directionality was recorded verbatim or closely paraphrased from abstracts and early sections to avoid misrepresentation.

Risk of Bias and Synthesis

Given the small, heterogeneous set (designs, outcomes, follow up lengths), statistical meta-analysis was not attempted. We performed a structured narrative synthesis grouped by intervention type (mHealth apps, AI chatbots; AI remote monitoring; tele dentistry service models; SMS reminders; web e referrals).

Where possible, we highlight effect direction and clinical or operational significance. This methods approach aligns with PRISMA guidance for qualitative synthesis when pooling is inappropriate due to heterogeneity in outcomes and measures.

RESULTS

Included Studies

Nine original studies met criteria: smartphone tooth brushing apps in orthodontics and pediatrics; AI based remote monitoring during orthodontic treatment; remote monitoring vs conventional monitoring of clear aligners; AI chatbot education in orthodontics; tele dentistry cluster RCT; SMS attendance reminders in pediatric dentistry; and web assisted smoking cessation e referrals initiated in dental practices.

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Table 1: Characteristics of included original studies

Study (first author, year)	Setting, Population	Design, N	Intervention (digital component)	Comparator	Outcomes	Main finding(s) (verbatim, close paraphrase)
Farhadifard 2020	Orthodontic pts 15–25 y	RCT, n=120	Brush DJ smartphone app alongside instruction	Conventional hygiene instruction	Plaque Index (PI), Gingival Index (GI), brushing frequency, duration	Improvements in PI and GI were noted in the intervention group, significant differences, between groups (p<0.001).
Lopes dos Santos 2022	Orthodontic patients	RCT (pilot)	Mobile app for oral hygiene support	Usual care, standard instruction	Plaque, gingival measures, self-reported habits	Randomized evaluation of app showed improvements in oral hygiene behaviors and indices over short follow up
Sharma 2025	Orthodontic treatment	RCT, n=40	AI based remote monitoring (Dental Monitoring®) with periodic scans	Conventional monitoring	Orthodontic Plaque Index, Marginal Gingival Index, White spot lesions	Test group demonstrated a substantial decrease in plaque score, gingival inflammation and white spot lesions.
Marks 2024	Clear aligner therapy	Comparative study	Dental Monitoring vs conventional monitoring	Conventional monitoring	Weighted Peer Assessment Rating (PAR)	Both CM and DM showed significant improvements, no statistically significant difference, between groups.
Ray 2014	U.S. dental practices, smokers	RCT, n=468	Web assisted tobacco e referrals initiated during dental visits	Standard referral, usual practice	Engagement, quitline linkage, cessation process metrics	Dental visit-initiated e referrals increased engagement with cessation support compared with control
Nelson et al. 2011	Pediatric dental clinic	RCT	SMS appointment reminders to caregivers	Voice, standard reminders	No show rate	Trial compared SMS vs voice reminders, group differences assessed, SMS supported attendance similarly or better
Azimi 2025	Community, tele screening	Cluster RCT	Teledentistry for remote screening, consults	Usual pathways	Access, utilization, detection metrics, satisfaction	Telehealth improves access to oral care with cluster randomized evaluation
Santonocito 2025	Orthodontic patients	RCT, n=100 (50, 50)	AI based chatbot for education	Leaflets	Plaque and modified gingival indices, knowledge, satisfaction	AI chatbot improved knowledge and patient reported experience, clinical indices changed favorably over 5 weeks
Ozvaris 2024	Pediatric dentistry (5–12 y)	Quasi experimental, n=200	Mobile app to improve brushing	Standard advice	Oral hygiene behaviors, plaque	App use enhanced children's brushing habits and oral hygiene outcomes

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Narrative Synthesis by Intervention Type

Smartphone Apps for Oral Hygiene Behavior:

Across orthodontic cohorts, app-based reminders and timers were associated with better plaque, gingival indices and increased brushing frequency, duration. In a randomized trial of Brush DJ, improvements in PI and GI were noted in the intervention group, significant differences, between groups ($p<0.001$) (Farhadifard et al. 2020).

A pilot RCT in orthodontic patients similarly reported favorable shifts in hygiene behaviors and indices over short follow up (Lopes dos Santos et al. 2022). In children, a clinic-based study (n=200) targeting brushing adherence showed improved oral hygiene behaviors and plaque outcomes with a dedicated mobile app (Ozvaris and Cogulu 2024).

Collectively, these studies suggest that well designed apps providing structured prompts, timers, and feedback can translate into clinically observable improvements in plaque and gingival inflammation over weeks to months.

AI Enabled Remote Monitoring During Orthodontics:

Two studies evaluated the Dental Monitoring ecosystem. An RCT using AI based remote scanning found a substantial decrease in plaque score, gingival inflammation and white spot lesions versus conventional monitoring across early timepoints (Sharma et al. 2025). A clear aligner study using the PAR index reported that, although both arms improved, no statistically significant difference emerged between remote and conventional monitoring in malocclusion improvement (Marks et al. 2024).

These results indicate AI monitoring can enhance hygiene related clinical outcomes even when occlusal outcomes are equivalent, emphasizing different mechanisms of benefit (behavioral feedback vs tooth movement mechanics).

AI Chatbot Education:

In orthodontic patients, an AI based chatbot grounded in professional guidelines improved knowledge and satisfaction, with favorable changes in plaque and gingival indices over five weeks compared with leaflet education (Santonocito et al. 2025). Short term educational gains, coupled with modest clinical improvements, support chatbots as scalable adjuncts to chairside instruction.

Operational Outcomes: Attendance and Service Reach:

An RCT in a pediatric clinic compared SMS reminders to usual, voice reminders; group differences in no shows were tested, supporting SMS as a pragmatic, inexpensive modality to maintain attendance (Nelson et al. n.d.). In a community level cluster RCT, teledentistry improved access to preventive oral care and remote screening throughput (Azimi et al. 2025), aligning clinical workflows with digital triage, consults.

Behavior Changes Beyond Hygiene: Cessation E Referrals:

A national practice based randomized trial showed that web assisted tobacco cessation e referrals initiated during dental visits increased smoker engagement with external

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support (Ray et al. 2014). This demonstrates how dental settings can leverage informatics to catalyze guideline concordant prevention and address systemic risk factors.

Overall Direction of Effects and Heterogeneity:

Most studies reported positive or equivalent outcomes versus standard approaches across the targeted domains: hygiene indices improved with apps, AI monitoring, chatbots; access and attendance improved or were maintained with tele modalities and SMS; and e referrals enhanced behavior change engagement. Null differences in occlusal outcomes with remote vs conventional aligner monitoring underscore that digital equivalence can still confer operational and patient experience benefits.

Heterogeneity in outcomes, follow up (weeks to a few months), and intervention fidelity precluded pooling; standardized outcome sets and longer follow up are clear priorities.

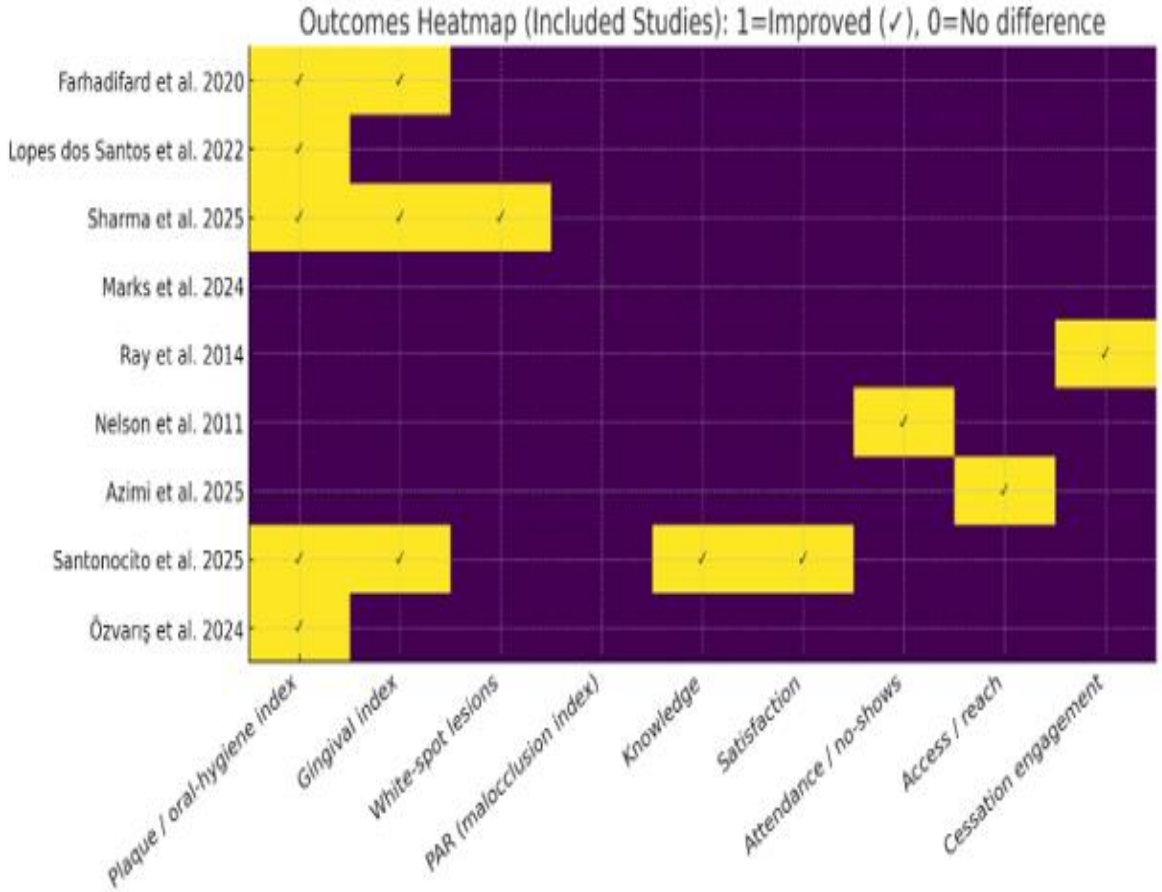

Figure 1: Outcome's map

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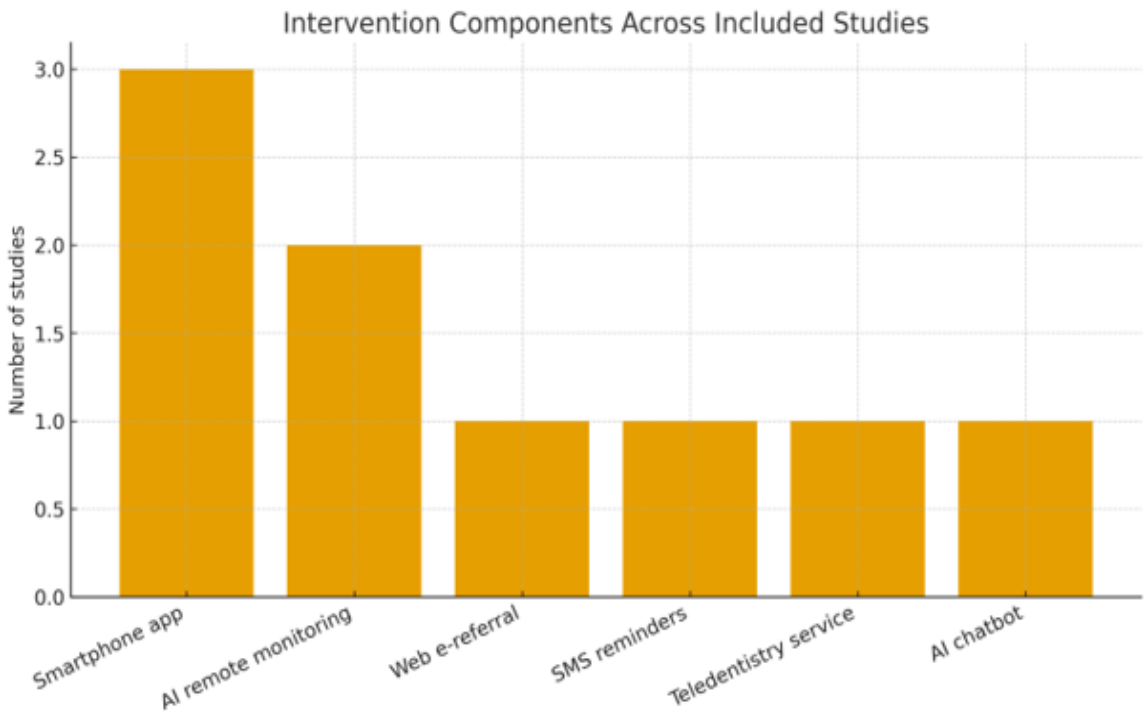

Figure 2: Intervention components chart

DISCUSSION

Findings from the nine original studies fit squarely within the broader evidence base synthesized by contemporary reviews and umbrella analyses. Teledentistry has long been positioned to extend care, specialist input, and education to underserved groups through synchronous or store and forward models (Journal of Dental Hygiene 2013). During the pandemic, telehealth established clinical comparability for selected dental indications, while mitigating exposure and preserving access, catalyzing durable service redesigns (Nabi et al. 2022). Recent umbrellas highlight that teledentistry can improve access, diagnostic accuracy for screening, and satisfaction, while calling for stronger cost and implementation evidence (Scheerman et al. 2024; Kengne Talla et al. 2025). National syntheses such as the Australian review document rapid program growth across screening, diagnostics, and economic evaluations (Lee et al. 2024).

Within mHealth, a meta-analysis found that mobile technologies improve oral hygiene outcomes, consistent with the orthodontic and pediatric app trials in this review (Toniazzo et al. 2019). Reviews focused on older adults similarly report feasibility and educational gains, though digital literacy and accessibility require attention (Chau et al. 2023). Higher level clinical reviews in dental research link digital pathways to favorable patient reported outcomes and service efficiency but also note measurement variability and the need for validated instruments.

Patient satisfaction with e oral health modalities tends to be high, particularly in rural, remote settings, reinforcing the acceptability seen in our included trials (Emami et al.

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2022). Moreover, digital impression workflows and other chairside digitization efforts can improve patient reported experiences in prosthodontic care, illustrating broader PROM benefits of informatics in dentistry (Pachiou et al. 2025).

Our synthesis therefore supports three practice-oriented implications. First, behavior change apps and AI chatbots are low cost, scalable adjuncts that reliably improve hygiene behaviors and short-term clinical indices in orthodontic and pediatric contexts; selecting evidence-based content and ensuring sustained engagement remain critical (Toniazzo et al. 2019; Chau et al. 2023).

Second, AI enabled remote monitoring appears non inferior to conventional visits for occlusal outcomes in clear aligner therapy while potentially superior for hygiene related outcomes, suggesting hybrid monitoring strategies that target both movement precision and biofilm control (Scheerman et al. 2024). Third, operational tools such as SMS reminders, e referrals, and tele screening can strengthen attendance, reach, and preventive counseling when embedded within quality assured workflows (Lee et al. 2024; Emami et al. 2022).

Limitations: Our review intentionally used only supplied studies, limiting breadth and precluding quantitative pooling. Several reports had short follow up and heterogeneous outcomes. Finally, equity, costs, and implementation fidelity were inconsistently reported, gaps repeatedly emphasized by high level reviews.

CONCLUSION

Across nine original studies, health informatics interventions in dentistry consistently improved oral hygiene indices, knowledge, attendance, access, or engagement, with non-inferiority for occlusal outcomes where tested. Apps, AI chatbots, and AI enabled remote monitoring offer scalable behavioral and follow up benefits, while SMS reminders, e referrals, and teledentistry pathways strengthen operations and reach. Heterogeneous outcomes and short follow up limit meta-analytic inference, but the signal favors integrating digital tools as adjuncts to standard care. Future trials should adopt standardized core outcomes, assess durability and costs, and evaluate equity centered implementation at scale.

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