The Role of Chatbots in Oral Health Promotion and Patient Education

Patients' and Dentists' Perspectives

Susana Raquel Marto Antunes

Supervisor:

Professor João Carlos Ferreira, Assistant Professor with Habilitation, ISCTE-IUL

Date:

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To my father, whose memory, though deeply missed, continues to inspire me to be more and to do better.

To my children, thank you for your smiles, hugs, and affection. You give me strength every single day.

And finally, to the person who supported me the most throughout all of this, my husband. Without you, I truly could not have done this. Thank you for everything.

Abstract

Chatbots are increasingly present in healthcare communication and patient information environments. In oral health, however, limited research has examined how these tools are perceived by key stakeholders and under what conditions they may effectively support health promotion and patient education.

This study aims to explore patients' and dentists' perspectives on the role of chatbots in oral health promotion, focusing on perceived benefits, risks, trust dynamics, and conditions for responsible integration into clinical practice.

A qualitative research design was employed, based on semi-structured interviews with nine patients and ten dentists. Participants were recruited through purposive and snowball sampling. Interviews were conducted online, transcribed verbatim, and analyzed using thematic analysis. A cumulative analytical approach was adopted to identify recurring themes and subthemes within and across stakeholder groups.

Both groups perceived chatbots as complementary tools rather than substitutes for professional care. Patients highlighted immediacy, accessibility, and convenience, particularly for clarifying minor doubts and reinforcing preventive guidance. Dentists acknowledged potential benefits in supporting hygiene education and reducing repetitive explanations but expressed concerns regarding misinformation, overreliance, lack of contextualization, and potential challenges to professional authority. Across participants, scientific credibility, clearly defined scope of use, and professional oversight emerged as central conditions for effective implementation.

Findings suggest that chatbots may contribute to oral health promotion when positioned within clearly defined boundaries and integrated under professional guidance. Their effectiveness depends not only on informational quality but also on trust, role clarity, and alignment with existing clinical relationships.

Keywords: Chatbots; Oral Health Promotion; Patient Education; Preventive Dentistry; Digital Health

JEL Codes: I12; O33

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Glossary

AI	Artificial Intelligence
LLM	Large Language Model
OH	Oral Health
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RQ	Research Question
SLR	Systematic Literature Review
WHO	World Health Organization

Introduction

Oral health (OH) is an essential component of overall health and well-being, yet oral diseases remain a global challenge. The World Health Organization (WHO) estimates that nearly 3.7 billion people live with some form of oral disease, with untreated dental caries in permanent teeth being the most common health condition worldwide, according to the Global Burden of Disease 2021 (WHO, 2025). Despite being mostly preventable, these illnesses disproportionately impact underprivileged groups, underscoring ongoing disparities in patient education and access to preventative care.

At the same time, the digital transformation of health systems is advancing rapidly. The WHO's Global Strategy on Digital Health 2020–2025 calls for people-centered, digitally enabled health services to expand access, strengthen prevention, and improve health communication (WHO, 2021), objectives that are closely linked to promoting OH literacy and supporting behavior change. In this context, the growing digitalization of healthcare has also transformed the way individuals seek and access health information. An increasing number of individuals, particularly patients, are seeking health-related information through various online channels, including both formal and informal websites, social media platforms, as well as through more engaging and interactive communications with conversational agents such as chatbots (Sun & Zhou, 2023). Artificial intelligence (AI)-driven chatbots are software tools that use natural language to mimic human interaction through text, voice, and/or visual communication (Laranjo et al., 2018), and are increasingly recognized as an effective, low-cost approach to scalable health communication, providing tailored information, reminders, and continuous support outside conventional healthcare settings (Aggarwal et al., 2023; Sun & Zhou, 2023).

Despite growing evidence of the potential of AI-powered chatbots to provide useful information to patients across multiple specialties in healthcare (Ayers et al., 2023; Laymouna et al., 2024), their use in OH remains underexplored (Helvacioglu-Yigit et al., 2025). In recent years, some studies have shown that chatbots can deliver accurate (Arpaci et al., 2025), empathetic (Maruska et al., 2025), and accessible information (Agrawal et al., 2025) on OH topics which may enhance patient education and engagement, promote healthy habits such as regular brushing and flossing, and help overcome common barriers related to time constraints, language, and information retention (Thorat et al., 2024). However, despite these promising findings, there is still limited understanding of how such tools are used in everyday contexts by patients and accepted by dentists as educational complements. Moreover, existing research

rarely compares or integrates the perspectives of these two key stakeholder groups, whose involvement is crucial for the successful and ethical implementation of digital tools in healthcare.

Objectives and Research Questions

Given this context, there is a clear need to explore the role of chatbots in OH promotion. Therefore, this study aims to examine patients' and dentists' perspectives on how chatbots are perceived, accepted, and used as tools to support OH literacy and patient education.

More specifically, the study seeks to explore patients' perceptions and experiences regarding the use of chatbots for OH education, examine dentists' perspectives on their potential role in patient education and engagement, and identify the factors that may influence their effective contribution to OH promotion.

To achieve these objectives, the study is guided by the following research questions (RQs):

- RQ1: How do patients perceive and experience the use of chatbots for OH education?
- RQ2: How do dentists perceive chatbots as tools for patient education and engagement in oral care?
- RQ3: What factors could influence the effective contribution of chatbots to OH promotion?

The expected contributions of this study are twofold. From a theoretical perspective, it seeks to clarify the factors influencing chatbot acceptance and the mechanisms through which conversational technologies may affect engagement, health literacy, and behavior change in OH. From a practical perspective, it aims to generate guidance for the design and implementation of chatbot-based educational interventions to inform clinicians, developers, and policymakers.

Research Methodology

To address the RQs, this study adopts a qualitative research design based on semi-structured interviews with patients and dentists. This approach enables an in-depth exploration of how chatbots are perceived, used, and positioned as tools for OH education, while also allowing participants to express their experiences, expectations, concerns, and conditions for acceptance in their own words. Thematic analysis of the interview data enables the identification of recurring themes and subthemes within each participant group and their subsequent comparison across patients and dentists.

The expected contributions are twofold: theoretical, by clarifying acceptance factors and the mechanisms through which conversational technologies may influence engagement, health literacy, and behavior change in OH; and practical, by generating actionable guidance for the design and implementation of chatbot-based educational interventions to inform clinicians, developers, and policymakers.

In this study, ChatGPT (version 5.2) was used solely as a writing support tool for translation, linguistic revision, syntax and grammar correction, and enhancement of textual clarity.

Structure of the Document

This document is organized into an introduction, four main chapters, and a conclusion. Following this introduction, the state of the art chapter presents the theoretical background and a systematic literature review (SLR) of the existing evidence, describing the methodology and synthesis of studies regarding chatbot use in OH promotion. The methodology chapter outlines the design of the qualitative study, data collection procedures, and analytic approach. The results chapter presents the findings emerging from the interviews, organized according to the three research questions. The discussion chapter interprets the findings in relation to the existing literature, highlighting the main theoretical and practical implications. The conclusion summarizes the main contributions, limitations, and recommendations for future research and practice in digital OH promotion. Finally, a references section compiles all sources cited throughout the document.

Chapter 1 - State of the Art

1.1. Theoretical Background

The rapid digitalization of healthcare has reframed how preventive care and patient education can be delivered. According to the WHO (2021), digital tools act as key enablers of access, prevention, and people-centered communication. Moreover, the WHO (2022) also emphasizes the importance of shifting from treatment-oriented models to prevention and promotion across communities. Consequently, OH messages should not end at the clinic door; they should be available, comprehensible, and timely in people's everyday lives. This is precisely the space where conversational technologies can operate.

Within this landscape, AI-driven chatbots have gained traction as scalable channels for health information and behavior support. These conversational agents are computer programs designed to simulate human-like interactions using natural language through text, voice, or visual interfaces (Laranjo et al., 2018). Chatbots have been adopted across various industries because they can deliver information efficiently and operate continuously at low cost. In health contexts, they support functions such as symptom checking, triage, disease management, and health-behavior coaching (Aggarwal et al., 2023; Tudor Car et al., 2020). Their appeal lies in improving access to reliable information, reducing providers' workload, and promoting patient self-management. For OH, this potential translates into delivering explanations about hygiene practices, dispelling myths, providing preventive guidance, addressing questions and reinforcing routines between appointments.

Whether these interactions actually help patients depends first on health literacy, which is the ability to access, understand, appraise, and use health information (Nutbeam, 2008), and on electronic health literacy, which extends these skills to digital contexts (Norman & Skinner, 2006). Chatbots can lower comprehension barriers by using plain language, stepwise instructions, and immediate clarification when users show uncertainty. On the other hand, limited literacy or digital confidence can reduce the impact of any message, however accurate it is. In this study, literacy therefore functions as both a precondition for understanding chatbot output and a moderator of perceived usefulness and trust.

1.2. Systematic Literature Review

The growing integration of AI into healthcare has accelerated the adoption of chatbots as tools for patient communication, education, and behavioral support. Chatbots have already been applied across several medical fields, including mental health, chronic disease management,

and lifestyle modification, where they have shown potential to enhance user engagement and promote behavior change (Aggarwal et al., 2023; Tudor Car et al., 2020).

Despite this growing body of evidence, the application of chatbots in OH promotion remains limited and fragmented. Existing studies are often exploratory, small-scale, or focused on technical feasibility rather than educational or behavioral outcomes. No comprehensive systematic review has yet synthesized findings specific to OH contexts, and recent evidence on user perceptions and professional acceptance remains scarce. Given the global burden of oral diseases and the emphasis on preventive, patient-centered digital health outlined in the WHO, there is a pressing need to consolidate current knowledge and identify opportunities and gaps in this emerging field.

As part of this study, an SLR was conducted to map how chatbots are currently being used in OH education and promotion, and to identify key trends shaping this evolving research area. In addition, this review aims to provide a comprehensive and up-to-date overview of the reported benefits and limitations of chatbot-based interventions, as well as the factors influencing their effectiveness and acceptance among both patients and dental professionals. Gaining a clearer understanding of these aspects is essential to inform the responsible, evidence-based design and implementation of conversational technologies within oral healthcare.

1.2.1. Methods

This SLR was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines (Page et al., 2021), to ensure a transparent, rigorous, and reproducible process. The methods applied in this review include the definition of eligibility criteria, identification of information sources, development of a structured search strategy, application of a multi-stage study selection process, and systematic extraction and synthesis of data from the included studies. The detailed methodological procedures are presented in the subsections below.

1.2.1.1. Eligibility Criteria

To ensure methodological rigor and consistency throughout the selection process, explicit inclusion and exclusion criteria were established. Table 1.1 summarizes these criteria.

Table 1.1. Eligibility Criteria for Study Selection

Inclusion Criteria	Exclusion Criteria
Focused on chatbots or conversational agents as the primary tool or intervention	Focused on tools other than chatbots or conversational agents (e.g., robotic systems, virtual reality, or other non-conversational AI tools)
Examined chatbots or conversational agents applied in OH contexts	Examined chatbots or conversational agents applied outside OH contexts
Target population consisted of patients or their caregivers, either as direct users or recipients of chatbot-based interventions	Targeted populations other than patients or patients' caregivers
Addressed patient education and/or OH promotion	Did not address education, prevention, or OH promotion
Published from 2020 onwards	Published before 2020
Full text available	Inaccessible full text
Published in English	Non-English publication

These criteria were designed to ensure that only studies directly relevant to the use of chatbots in OH education and promotion were considered, while excluding those outside the defined scope.

1.2.1.2. Information Sources

A comprehensive search strategy was applied across seven electronic databases to ensure broad coverage of relevant studies: PubMed, Scopus, Web of Science, IEEE Xplore, ACM Digital Library, ScienceDirect, and EBSCOhost. All database searches were performed on 16 September 2025.

In addition to database searches, citation searching (backward snowballing) (Wohlin, 2014) was performed on the reference lists of included studies to identify supplementary articles not captured through the primary search.

1.2.1.3. Search Strategy

A single, replicable Boolean query was developed to be applied across all databases. The query was structured around three conceptual blocks reflecting the core elements of this review: (1) terms related to chatbot technologies; (2) terms describing the OH context; and (3) terms associated with health education and promotion. The final query was: ("chatbot*" OR "conversational agent*" OR "virtual assistant*" OR "AI assistant*" OR "intelligent agent*") AND ("OH" OR "dental health" OR "oral hygiene" OR "oral care" OR "dentistry") AND ("health promotion" OR "prevention" OR "education" OR "patient engagement" OR "patient education" OR "health behavior*").

Searches were restricted to Article Title, Abstract, and Keywords fields to improve relevance and reduce the retrieval of unrelated records, whenever the database allowed this level of filtering. Only in ScienceDirect was this not possible, since it does not allow a search

only in these fields. Also, due to the limitations of ScienceDirect's search engine (maximum 8 Boolean operators and no truncation), a simplified version of the main query was used, preserving one representative term per concept block (chatbots, OH, and health promotion). The final terms chosen were (chatbot OR "virtual assistant" OR "AI assistant") AND ("OH" OR "oral care" OR dentistry) AND ("health promotion" OR "patient education" OR "health behavior"). "Review articles" and "research articles" filters were applied.

1.2.1.4. Selection Process

The selection process followed the PRISMA 2020 recommendations and comprised three stages: identification, screening and inclusion.

Identification

In the identification phase, 194 records were retrieved from the selected databases (Table 1.2), and 6 additional records were identified through citation searching (backward snowballing).

Table 1.2. Number of records retrieved from electronic databases

Electronic Database	Number of Records Retrieved
PubMed	30
Scopus	35
Web of Science	32
IEEE Xplore	9
ACM Digital Library	0
ScienceDirect	77
EBSCOhost	11
Total	194

In this initial phase, all records retrieved from the databases were exported in RIS format and imported into Mendeley Reference Manager, which was used to identify and remove duplicates and to manage the bibliographic data. A total of 68 duplicate records and 1 ineligible record (which could not be imported into Mendeley nor retrieved manually) were removed, resulting in 125 unique records for screening. The 6 records identified through citation searching proceeded directly to full-text assessment in the eligibility step of the screening phase.

Screening

According to PRISMA 2020 recommendations, the screening phase is conducted in two sequential steps: (1) the screening of titles and abstracts to remove clearly irrelevant records, and (2) the assessment of full-text reports to determine final eligibility.

In the first step, all 125 records obtained from database searching were screened by title and abstract based on the predefined inclusion and exclusion criteria. A total of 105 records were excluded at this stage for not meeting the criteria. Most exclusions were due to studies targeting populations other than patients or their caregivers or not addressing education or OH promotion.

In the second step, 20 reports from the database search and the 6 additional reports identified through citation searching were retrieved for full-text assessment. One report was not retrieved because the full-text version was unavailable, and four were excluded after full-text evaluation—two for targeting non-patient populations and two for not focusing on conversational AI tools.

Inclusion

Following these stages, 15 studies identified through database searching and 6 studies identified through citation searching (backward snowballing) met all inclusion criteria and were included in the SLR. Consequently, a total of 21 studies were incorporated into the final synthesis.

Each step of the process (identification, screening, and inclusion) is illustrated in the PRISMA flow diagram in Figure 1.1.

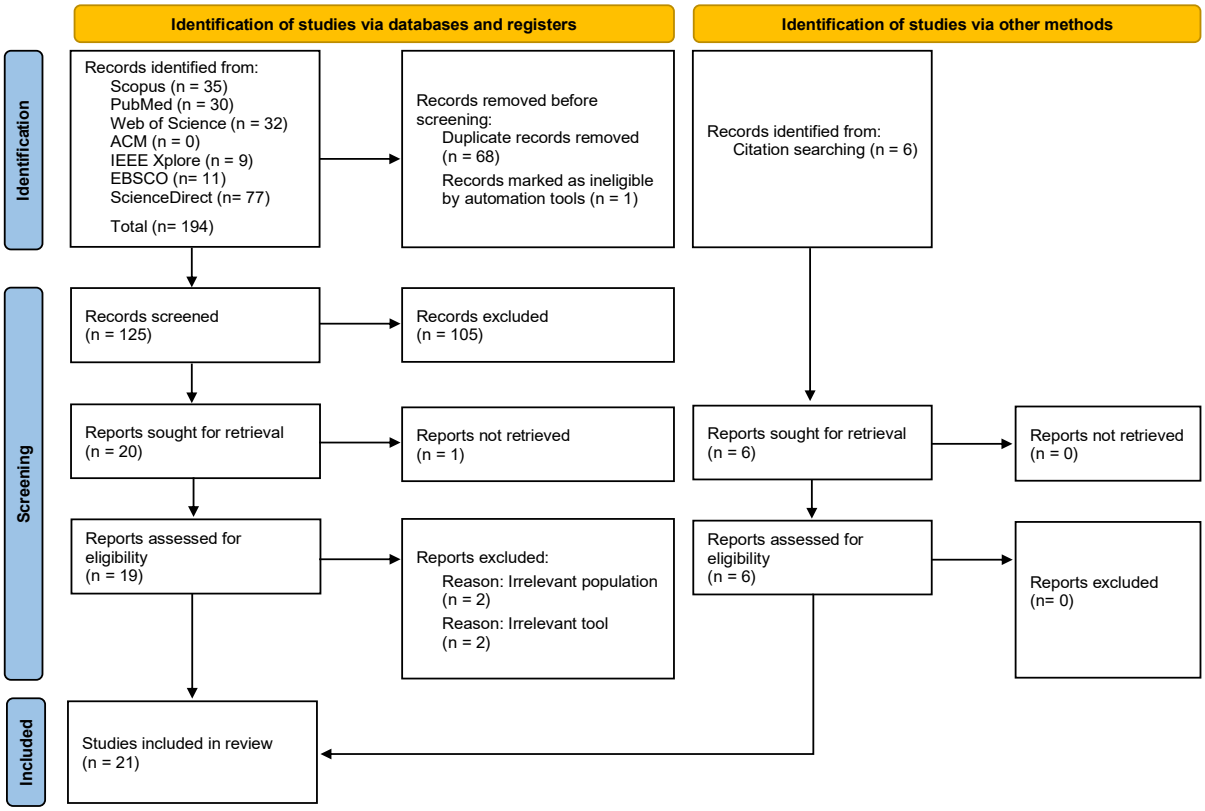


Figure 1.1. PRISMA 2020 Flow Diagram of Study Selection. Adapted from Page et al. (2021)

This systematic procedure ensured transparency, reproducibility, and minimization of bias throughout the study selection process.

1.2.1.5. Data Collection Process

The data collection process was conducted manually by a single reviewer, following a structured and systematic procedure to ensure the accuracy and consistency of the extracted information. After the final set of studies was determined, the reviewer read each full-text article in detail and extracted all relevant information.

The data items to be extracted were previously defined to ensure consistency and alignment with the objectives of this SLR. Table 1.3 summarizes the data extracted from each included study.

Table 1.3. Data items extracted from each study

Category	Description
General Study Characteristics	Authors, year, country, study aim, study design, sample size, participant characteristics.
Chatbot Characteristics	Type of chatbot (LLM / rule-based), platform/modality, purpose and functional scope.
OH Topic and Context	Dental domain (e.g., pediatric dentistry, periodontology), educational or behavioral focus.
Evaluation Measures and Outcomes	Primary outcomes (knowledge, accuracy, usability, behavior change), secondary outcomes (empathy, satisfaction, feasibility), instruments used.
Authors' Reported Limitations	Methodological constraints, sample issues, generalizability limitations.

The extracted variables covered study characteristics, methodological aspects, chatbot specifications, target populations, and outcome domains relevant to OH education and promotion.

1.2.2. Results of the SLR

The results of this SLR are presented in accordance with the PRISMA 2020 guidelines. The following subsections provide an overview of the characteristics of the included studies and a synthesis of their main findings, enabling a clearer understanding of how chatbots have been employed in OH education and promotion, and what outcomes have been reported across the literature.

1.2.2.1. Characteristics of Included Studies

Although the search was restricted to studies published from 2020 onwards, no eligible reports published in 2020 or 2021 were identified. Consequently, all 21 included reports were published between 2022 and 2025, underscoring the novelty and growing academic interest in this

research area. As illustrated in Figure 1.2, the earliest publications appeared in 2022 and 2023, with one study each year, indicating the initial exploration of chatbot applications in OH promotion. The number of studies then increased from three in 2024 to sixteen in 2025, reflecting a sharp acceleration in research output. This growth demonstrates the increasing relevance attributed to conversational technologies within the fields of digital health and dentistry.

As the search was completed in mid-September 2025, the number of publications from 2025 is likely to be higher, reinforcing that the integration of chatbots into OH education and preventive care is an emerging and rapidly expanding area of inquiry.

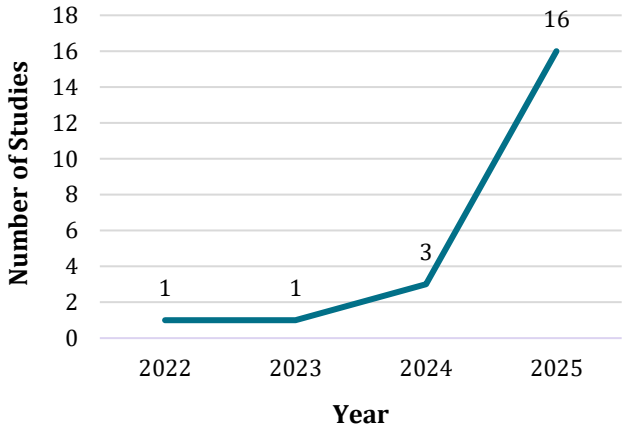


Figure 1.2. Annual distribution of included studies. Author's own work (2026)

Regarding study design, the vast majority adopted a quantitative approach (n = 20), reflecting a predominant focus on measurable outcomes such as user satisfaction, knowledge improvement, or chatbot performance metrics (Figure 1.3). Only one study employed a mixed-methods design, combining quantitative measures with qualitative insights to provide a more comprehensive understanding of chatbot effectiveness.

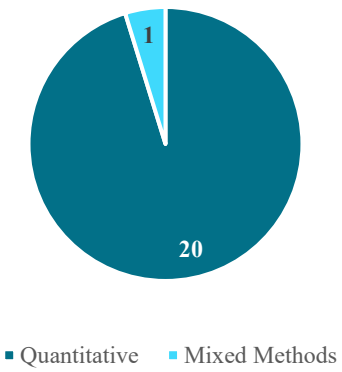


Figure 1.3. Study design distribution among included studies. Author's own work (2026)

This distribution suggests that research on chatbots in OH education and promotion remains largely exploratory and oriented toward quantitative evaluation of feasibility and acceptance. However, the absence of qualitative approaches, along with the limited use of mixed-method designs, highlights the need for more in-depth exploration of contextual, behavioral, and emotional dimensions, particularly from both patients' and dentists' perspectives.

1.2.2.2. General Synthesis of Findings

Among the 21 studies included in this SLR, sixteen examined general-purpose large language model (LLM) chatbots, while five focused on dedicated custom-built OH chatbots (Figure 1.4).

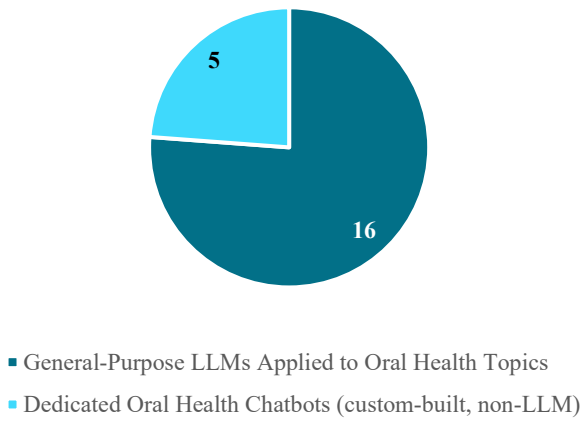


Figure 1.4. Type of chatbot distribution among included studies. Author's own work (2026)

The LLM-focused studies covered a wide range of dental topics (Table 1.4), including periodontal disease, effects of smoking, endodontics, orthodontics, oral cancer, prosthodontics, implantology, radiology, restorative dentistry, temporomandibular disorders, pediatric dentistry, and general OH information. A diverse set of models was assessed, although ChatGPT-based systems predominated within the literature.

Table 1.4. OH topics addressed in included studies

Topic	Number of Studies
Endodontics	2
General OH Information	2
Implantology	2
Oral Cancer	2
Effects of Smoking in OH	1
Oral Radiology	1
Orthodontics	1
Pediatric Dentistry	1
Periodontal Disease	1
Prosthodontics	1
Restorative Dentistry	1
Temporomandibular Disorders	1

Within these LLM-focused studies, a diverse range of models was assessed and compared as shown in Figure 1.5. This distribution highlights the predominance of ChatGPT-based systems in dental literature.

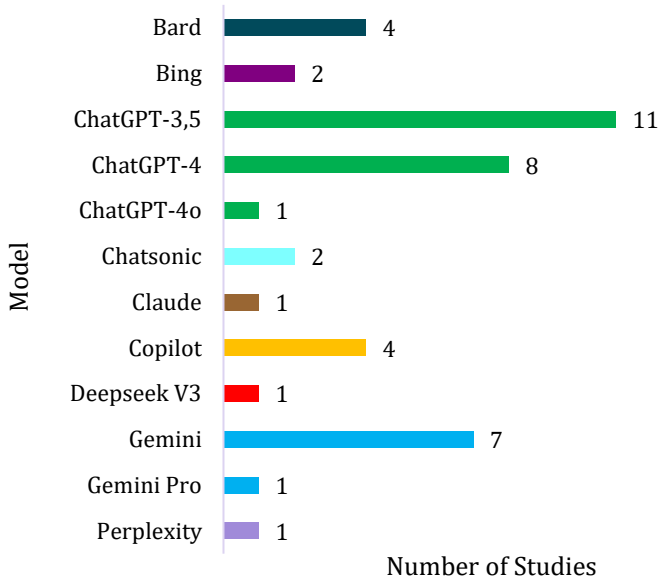


Figure 1.5. AI models evaluated across included studies. Author's own work (2026)

Unlike general-purpose LLM-based chatbots, the chatbots developed specifically for OH education are task-oriented, domain-specific systems that rely on predefined rules and structured content rather than LLMs. Five studies employed educational chatbots specifically developed for OH education and promotion, targeting either patients or caregivers. These studies implemented interactive systems to improve oral hygiene behaviors, health literacy, and patient adherence. Their target population is distributed as shown in Table 1.5.

Table 1.5. Target populations of included studies

Target Population of Studies	**Number of Studies**
Parents and Caregivers of Young Children	3
Adults Living in Rural Areas	1
Adult Orthodontic Patients	1

This distinction between purpose-built educational chatbots and general-purpose generative AI tools highlights an emerging dual trajectory in conversational AI research within dentistry: one emphasizing behavioral education and health promotion, and another centered on evaluating informational and communicative performance.

1.2.3. SLR Findings

At this point of the SLR, the findings from the selected studies are presented and summarized to provide a clear overview of the current research landscape on the use of chatbots in OH education and promotion and identify existing gaps. This synthesis is structured into two main components: (1) dedicated OH chatbots, and (2) general-purpose LLMs applied to dental topics.

1.2.3.1. Dedicated OH Chatbots

Studies involving dedicated OH chatbots have demonstrated that these tailored tools can effectively improve OH knowledge (Agrawal et al., 2025; Hunsrisakhun et al., 2025; Pithpornchaiyakul et al., 2022), enhance hygiene practice (Hunsrisakhun et al., 2025; Pithpornchaiyakul et al., 2022; Santonocito et al., 2025) and support long-term behavioral change among patients and caregivers (Pupong et al., 2025).

Although limited in number, these studies confirm the potential of conversational agents as facilitators of OH education, demonstrating that they can achieve better outcomes than traditional population-based educational methods such as pamphlets and brochures (Agrawal et al., 2025) and have even reported results comparable to those obtained through professional instruction, including the teaching of correct brushing and flossing techniques (Hunsrisakhun et al., 2025; Pithpornchaiyakul et al., 2022). These findings are particularly relevant in contexts where contact with healthcare professionals or access to reliable information is limited, such as rural or remote areas, underserved populations, socioeconomically disadvantaged groups, and exceptional circumstances like the COVID-19 pandemic.

Paradoxically, some of the contexts that could benefit the most from chatbots also present characteristics that may hinder their use. Limited digital literacy and restricted access to smartphones or stable internet were key barriers to consistent use, particularly in rural and low-resource settings (Agrawal et al., 2025). Besides this, sustained engagement also proved difficult, as long intervention durations and message overload reduced user adherence over time, leading to progressive fatigue and drop-off in participation (Pupong et al., 2025). Additionally, users frequently expressed concerns regarding the impersonality of automated guidance and the need for culturally tailored content, which affected trust and acceptance of the tool in everyday routines (Agrawal et al., 2025).

In the context of tailored chatbots, the limitation relates to the restricted number of studies (n = 5); the fact that three of them were conducted in the same geographical area; only one study focused on a specific dental specialty (orthodontics); and that all the research targeting

caregivers of young children is based on variations of the same chatbot model (21-Day FunDee / 21-Day FunDee Plus / 30-Day FunDee).

Overall, dedicated chatbots demonstrate meaningful educational and behavioral potential, though their effectiveness is constrained by contextual and user-related factors.

1.2.3.2. General-Purpose LLMs Applied to OH Topics

Regarding general-purpose LLMs applied to OH topics, positive educational outcomes have also been reported. The studies assessed a wide range of evaluation parameters, some focusing on a single model, while others compare multiple chatbot models. As shown in Figure 1.6, readability, reliability, and quality of the answers provided by LLM-based chatbots, were particularly explored in these studies.

Readability emerged as a consistent limitation, with multiple studies showing that chatbot-generated OH information generally requires reading skills well above recommended levels for patient education. Across different dental domains, including smoking cessation (Alnsour et al., 2025), endodontics (Büker & Mercan, 2025), early childhood caries (Elkarmi et al., 2025), oral cancer (Halboub et al., 2025; Rokhshad et al., 2025), radiology (Helvacioglu-Yigit et al., 2025), restorative dentistry (Ozdemir & Yapici, 2025), and temporomandibular disorders (Pagotto et al., 2025), the outputs produced by LLMs typically required secondary-school or higher literacy levels. Even the best-performing models routinely exceeded the sixth- to eighth-grade readability thresholds recommended for patient-facing materials, indicating that current chatbots do not yet generate content that is easily accessible to the general public, limiting their accessibility as standalone patient-education tools.



Figure 1.6. Evaluation metrics assessed in included studies. Author's own work (2026)

In the reviewed literature, LLM chatbots consistently demonstrated acceptable to high reliability in generating OH information (Alnsour et al., 2025; Binaljadm et al., 2025; Elkarmi et al., 2025; Mohammad-Rahimi et al., 2024; Ozdemir & Yapici, 2025; Pagotto et al., 2025; Taymour et al., 2025). Some studies reported that ChatGPT models produced content considered credible and aligned with established evidence (Alnsour et al., 2025; Elkarmi et al., 2025). Other comparative analyses also showed strong reliability performance for Gemini and GPT-based systems, with some studies identifying Gemini as the most reliable model within their datasets (Binaljadm et al., 2025; Taymour et al., 2025). Importantly, one study examined the entire set of bibliographic references generated by each chatbot, revealing substantial variation in citation authenticity, with DeepSeek producing the lowest number of fabricated references, highlighting a unique dimension of reliability related to source verification (Pagotto et al., 2025).

Across the included studies, chatbot performance in terms of quality of OH information was consistently rated as moderate to good, regardless of the specific dental topic addressed (Alan & Alan, 2023; Alnsour et al., 2025; Arpaci et al., 2025; Büker & Mercan, 2025; Elkarmi et al., 2025; Halboub et al., 2025; Rokhshad et al., 2025). Most investigations reported that LLMs, in particular ChatGPT-4, produced responses of superior quality compared to other systems (Arpaci et al., 2025; Halboub et al., 2025; Rokhshad et al., 2025), often approaching or matching the quality of trusted professional sources. Gemini also demonstrated strong quality scores in comparative analyses (Büker & Mercan, 2025), though generally slightly below ChatGPT-4. The evidence indicates that contemporary LLMs are capable of generating clinically acceptable, good-quality OH information, with variation mainly between models rather than across topics.

The studies suggest that LLM-based chatbots are capable of generating clinically accurate OH information, although their performance varies across models and dental domains. Studies report that LLM responses frequently achieve high or very high accuracy scores when assessed against expert consensus (Büker & Mercan, 2025; Daraqel et al., 2024; Ozdemir & Yapici, 2025; Pagotto et al., 2025) or authoritative reference materials, such as the World Dental Federation website (Arpaci et al., 2025). Overall, the models tended to generate clinically aligned and correct information, with only modest variation between them and the complexity of the domain.

Understandability was generally rated at moderate levels, indicating that chatbot-generated OH information is broadly comprehensible but often not sufficiently clear for typical patient audiences (Alnsour et al., 2025; Elkarmi et al., 2025; Halboub et al., 2025; Helvacioglu-Yigit

et al., 2025). Across the studies, assessments showed that explanations were usually coherent and logically structured, yet still required simplification to ensure full lay understanding. Although LLMs demonstrated the ability to convey key concepts, their outputs frequently lacked the degree of explicitness and ease of interpretation expected in patient-education materials, reinforcing the need for professional review to ensure adequate patient comprehension.

Validity assessments, across the studies analyzed, indicate that chatbot-generated dental information achieves moderate validity, meaning that responses are often generally correct but frequently lack the completeness or precision expected for high-quality patient education (Binaljadm et al., 2025; Gheisarifar et al., 2025; Mohammad-Rahimi et al., 2024). Although LLMs commonly provide information that aligns with clinical concepts, their answers regularly contain omissions, oversimplifications or occasional inaccuracies, especially when higher scoring thresholds are applied, affirming the role of professionals in ensuring informational integrity.

Across the selected studies, multiple secondary performance dimensions were considered, but each was investigated only minimally, in one or two studies. Usefulness was assessed, with chatbots being perceived as helpful in conveying practical OH information (Alnsour et al., 2025; Taymour et al., 2025). Completeness was also evaluated, as many responses captured the essential elements of the requested content, although occasional information gaps reinforced the need for professional supplementation (Daraqel et al., 2024; Gugnani et al., 2024). In terms of actionability, it was reported as moderate, revealing that while chatbots often provided understandable explanations, concrete guidance for patient action was less consistently delivered (Alnsour et al., 2025; Elkarmi et al., 2025). Consistency represented another dimension, with most models producing stable responses across repeated prompts, although variability persisted across platforms and question types (Gheisarifar et al., 2025; Ozdemir & Yapici, 2025). Affective and contextual aspects were also explored. Empathy emerged as a weak aspect of chatbot performance. Overall, most chatbot responses were rated as only slightly empathetic or not empathetic at all, with very few achieving genuinely empathetic tone (Pagotto et al., 2025; Rokhshad et al., 2025). Appropriateness was rated as acceptable, though opportunities for refinement remain (Büker & Mercan, 2025; Helvacioglu-Yigit et al., 2025). Finally, clarity, evaluated in a single study, indicated that while many responses were conceptually correct, the clarity of expression was inconsistent and sometimes insufficient for lay audiences (Gugnani et al., 2024).

Despite their promise as educational tools, LLM-based chatbots present inherent limitations that restrict their role in patient support. Across studies, they are consistently described as insufficient substitutes for professional guidance, particularly when treatment decisions or clinical interpretation are involved (Alan & Alan, 2023; Alnsour et al., 2025; Binaljadm et al., 2025; Elkarmi et al., 2025). Their capacity to deliver personalized or context-specific recommendations remains limited, which constrains their potential to promote behavioral change or tailored self-care actions (Alnsour et al., 2025). Moreover, existing evaluations focus predominantly on informational accuracy rather than interactive, user-centered engagement, meaning that current evidence captures how LLMs perform in controlled assessments rather than in authentic patient experiences. Taken together, these constraints indicate that, while LLM chatbots can complement educational efforts, they must operate under professional oversight and cannot replace clinician-led communication, positioning LLM chatbots as complementary tools rather than standalone solutions for OH education.

The body of research examining general-purpose LLMs in OH contexts reveals several methodological gaps that limit the strength and generalizability of current evidence. Most evaluation studies rely on heterogeneous designs, inconsistent assessment tools, and varying reference standards, which hampers direct comparison between results. In addition, the majority of investigations analyze isolated, static outputs rather than real-time or longitudinal interactions, reducing ecological validity. Consequently, these studies contribute more to understanding the informational performance of AI chatbots than to assessing its actual educational or behavioral impact on users. The small number of studies assessing each performance dimension, combined with limited representation of specific dental specialties and uneven geographical distribution, further constrains the robustness of the existing findings. These methodological limitations emphasize the need for more rigorous, real-world, and patient-centered evaluations in future research.

Chapter 2 - Methodology

2.1. Study Design

This study adopts a qualitative research design based on semi-structured interviews with two distinct participant groups: patients and dentists. Qualitative interviewing is well suited to exploring individual experiences, beliefs, and perceptions related to healthcare practices and digital health tools, enabling participants to express their perspectives in their own words while allowing the interviewer to probe and clarify meanings (Gill et al., 2008). In the context of chatbot use for OH education, this approach provides rich insights into how patients and dentists perceive, evaluate, and position these technologies in their everyday experiences and professional practice.

2.2. Participants and Sampling Strategy

Participants from both groups were recruited via personal contacts, professional networks within dental clinics, and snowball sampling procedures, whereby participants were invited to recommend others who might be interested and eligible to participate. Semi-structured interviews were used because they enable participants to elaborate on their own perspectives while allowing the interviewer to follow up with clarifying questions, which is particularly valuable in healthcare-related qualitative research (Gill et al., 2008).

To ensure a coherent and methodologically rigorous sample, clear inclusion and exclusion criteria were established for both participant groups. These criteria were defined to guarantee that all participants had relevant experience with dental care and basic digital literacy and were able to meaningfully engage in an online semi-structured interview. Table 2.1 summarizes the inclusion and exclusion criteria applied to patients and dentists.

No predetermined sample size was established. Instead, recruitment continued until data saturation was reached. Saturation is an established guiding principle for determining sample adequacy in qualitative research and typically occurs within a relatively small number of interviews, depending on the level of homogeneity in the data (Guest et al., 2006; Saunders et al., 2018). Data saturation becomes evident when additional data collection no longer produces new themes and the same responses recur across participants, meaning that no new relevant themes emerged from the interviews.

Interviews were transcribed and emerging concepts were compared across participants using a cumulative approach. When additional interviews no longer generated substantively

new thematic categories and instead reinforced previously identified patterns, saturation was considered achieved.

Table 2.1. Inclusion and exclusion criteria for study participants

	Inclusion Criteria	**Exclusion Criteria**
Patients	- being 18 years of age or older; - having used dental healthcare services in the previous 12 months, either as a patient or caregiver; - having access to and basic literacy in digital technologies, such as a smartphone, tablet, or computer; - being able to participate in an online interview using Microsoft Teams.	- being unable to use videoconferencing tools such as Microsoft Teams; - having cognitive or communication limitations that prevent participation in an interview format; - being under 18 years of age; - being unable to communicate in Portuguese.
Dentists	- holding a degree in Dentistry; - having at least one year of clinical experience; - being able to participate in an online interview via Microsoft Teams.	- not being in clinical practice for at least one year; - being unable to use Microsoft Teams; - being unable to communicate in Portuguese.

This process was applied separately to patients and dentists. As seen in Figure 2.1, for patients, most subthemes emerged within the first four interviews. Although no new subthemes appeared in P5, small increments were still observed in P6, P7, and P8. The final interview (P9) introduced no new subthemes, confirming stabilization at a total of 45 subthemes.

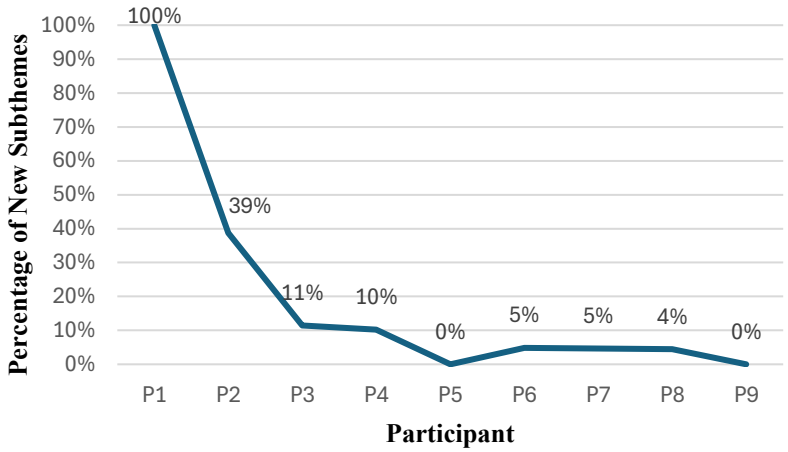


Figure 2.1. Thematic saturation curve across patient interviews. Author's own work (2026)

A similar pattern was observed among dentists (Figure 2.2). The first four interviews, along with D6, contributed the majority of new subthemes. Subsequent interviews yielded only minimal additional insights, and the final interview introduced no new subthemes, confirming stabilization at 52 subthemes.

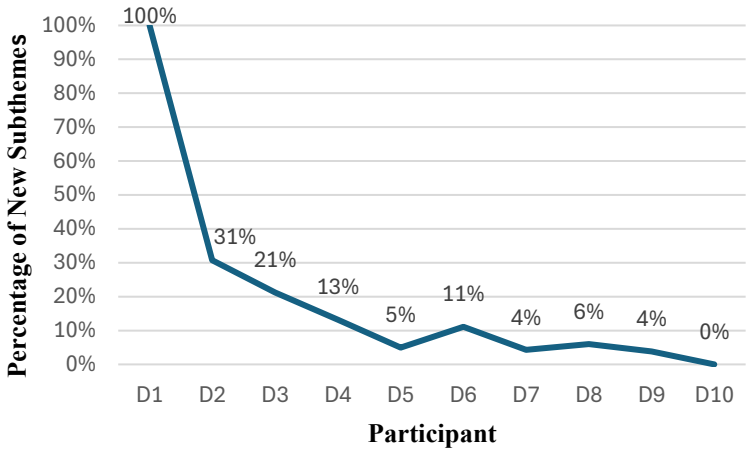


Figure 2.2. Thematic saturation curve across dentist interviews. Author's own work (2026)

In both groups, thematic stabilization was observed before the final interviews were conducted, indicating that the sample size was sufficient to address the RQs and ensure methodological adequacy and analytical depth. Comprehensive tables outlining the concepts addressed by each participant, with explicit indication of when each concept was first introduced, can be found in Appendix A for patients and Appendix B for dentists.

2.3. Interview Guide Development

The interview guides were developed following a rigorous process to ensure alignment with the research aims and methodological standards for qualitative interviewing. Their design was grounded in the main themes identified in the literature, including technology use in healthcare, experiences with chatbots, patient education, OH promotion, and factors influencing digital tool adoption. These themes were directly linked to the study's RQs.

Given the study's dual focus on patients and dentists, two parallel interview guides were created. While both guides address the same overarching thematic areas, they were adapted to the specific characteristics of each population. This approach allows for methodological consistency across interviews while ensuring relevance, clarity, and contextual appropriateness for each participant group.

Prior to the interview questions, basic sociodemographic information was collected from all participants. In addition to the section addressing the RQs, each interview guide then began with a set of descriptive questions intended to characterize participants' contextual profiles. Although not directly linked to the RQs, these items were included to provide background information on participants' professional experiences and their familiarity with digital

technologies and chatbots. This information supported contextual interpretation of the findings but was not included in the thematic saturation analysis.

The full version of the interview guide for the patient group is provided in Appendix C, and the version for dental professionals is available in Appendix D.

2.4. Data Collection Procedures

Prior to participation, all individuals received an information sheet detailing the purpose of the study, the voluntary nature of participation, data handling procedures, and confidentiality safeguards. Written informed consent was obtained from all participants before the interviews.

All interviews were conducted on Microsoft Teams and audio-recorded through the platform's built-in recording function, with all cameras disabled to protect participant privacy. In addition to audio recording, the built-in Microsoft Teams transcription feature was used to automatically generate real-time verbatim transcripts from the interview audio. The transcripts were then downloaded in text format and manually reviewed, corrected, and anonymized to ensure accuracy and completeness before analysis. The final anonymized transcripts were used as the basis for the thematic analysis, whose results are presented in Chapter 3.

Interviews with patients lasted between 12 and 26 minutes, with a mean duration of 16 minutes, whereas interviews with dentists ranged from 9 to 27 minutes, with a mean duration of 15 minutes.

2.5. Data Analysis

The interviews were analyzed using a thematic analysis approach. Following transcription and manual revision of the interview transcripts, the material was carefully read and re-read to ensure familiarization with the data and to identify meaningful segments related to participants' perceptions, experiences, and evaluative judgments concerning chatbot use in OH contexts.

Themes were identified inductively from the data rather than defined a priori. Through iterative comparison across interviews, recurring patterns of meaning were progressively refined and organized into coherent thematic structures comprising overarching themes and related subthemes. Attention was given to both convergence and divergence in participants' accounts, ensuring that themes captured shared perspectives as well as nuanced differences.

The analysis was conducted separately for patients and dentists before comparing the two groups to identify convergences, divergences, and key factors shaping perceptions of chatbots in oral healthcare.

Chapter 3 - Results

3.1. Participants' Characteristics

The study sample consisted of nineteen participants, divided into two groups: patients and dentists. Of these, nine participants belonged to the patient group and ten to the dentist group.

3.1.1. Patient Group

A summary of the characteristics of the patient group is presented in Table 3.1, while the complete data are provided in Appendix E.

Table 3.1. Sociodemographic and digital characteristics of patient participants

Variable	Summary
Mean age	37.4 years (range 31–41)
Gender distribution	7 Female (78%); 2 Male (22%)
Region of residence	100% Portugal (Lisbon)
Dental care pattern	Predominantly preventive and hygiene-focused; majority attend at least annually
Caregiver role	Majority reported being caregivers of children
Digital comfort	Generally moderate to high
Use of health-related digital tools	Frequent for appointment booking and accessing medical reports
Chatbot use	Moderate; primarily ChatGPT
Chatbot use for OH	None reported

Participants were aged between 31 and 41 years. The sample included seven female participants and two male participants. All participants were residing in Lisbon.

Participants represented diverse professional backgrounds, including nursing, early childhood education, university teaching, dental assistance, civil engineering, data analysis, social work and personal training.

In terms of dental care experience, most participants reported regular engagement with dental services, primarily for preventive care such as routine hygiene appointments. Several participants described past experiences involving caries treatment, restorations, root canal treatment, extractions, implants or orthodontic care. Three participants described ongoing caregiver roles for children undergoing orthodontic treatment or monitoring for specific dental or systemic conditions.

Regarding digital literacy, most participants described feeling comfortable using digital technologies in their daily lives. Two participants explicitly described very high levels of confidence in using digital tools, while others characterized themselves as comfortable but not expert users. No participant reported significant barriers to everyday digital technology use.

All participants reported prior use of digital health tools, primarily for booking appointments, accessing medical reports, or consulting health-related information online. Several participants used national health service applications or private hospital platforms. Five participants reported prior experience using general AI chatbots mainly for non-health-related purposes. Importantly, none of the participants reported having used a chatbot specifically for OH questions prior to the interview. Even those who were frequent users of general AI tools indicated that they had not applied them to OH concerns.

3.1.2. Dentist Group

A summary of the dentists' characteristics is provided in Table 3.2, while additional details are available in Appendix F.

Table 3.2. Sociodemographic, professional and digital characteristics of dentist participants

Variable	Summary
Mean age	36.4 years (range 30–41)
Gender distribution	80% Female (n=8); 20% Male (n=2)
Geographic location of practice	90% Portugal (Lisbon); 10% France
Mean interview duration	15 minutes 06 seconds
Years of experience	6–14 years
Main areas of practice	General dentistry (5); Orthodontics (4); Endodontics (2); Rehabilitation/Implantology (2)
Patient profile	Predominantly adults; most also treat children
Predominant educational strategy	Verbal explanation supported by visual aids (online images/videos)
Use of digital tools for patient communication/education	Limited
Professional chatbot use	Minimal
Personal chatbot use	Moderate to frequent

In the dentist group, the participants were aged between 30 and 41 years. The sample included eight female dentists and two male dentists. Nine participants were practicing in Lisbon, Portugal, and one was practicing in Grenoble, France.

Professional experience ranged from 6 to approximately 14 years of clinical practice. Regarding areas of clinical practice, three participants reported practicing primarily general dentistry. The remaining participants described focused areas of intervention, including orthodontics and functional orthopedics, endodontics, implantology, prosthetic rehabilitation, pediatric dentistry and restorative dentistry. Several dentists combined general practice with a specific area of greater clinical focus.

In terms of patient population, most participants reported treating predominantly adult patients. Two dentists reported a primary focus on pediatric dentistry, working mainly with children and their families. One participant treated both adults and children in a relatively balanced proportion, while others reported seeing children less frequently, often in specific contexts such as orthodontic treatment or urgent care.

All participants reported using verbal explanation as their main strategy for patient education during consultations. Most complemented verbal communication with visual resources, including digital images (e.g., Google Images), online videos (e.g., YouTube), schematic drawings, PowerPoint presentations or physical demonstration models. Visual demonstrations were frequently described as part of routine clinical communication.

The use of digital tools for patient education varied. Some participants reported minimal or no structured use of digital applications in clinical practice. Others reported using social media platforms, online videos, aligner-related applications, or digital images to support patient communication. One participant reported the use of AI tools in the clinic for structuring written reports, and two participants described occasional professional use of chatbots to clarify clinical doubts or structure written responses.

Experience with chatbots in a professional context was limited. Most participants reported no regular professional use. In contrast, several participants reported personal use of chatbots for information search, content summarization, email drafting, travel planning, or idea generation.

3.2. RQ1 – How do patients perceive and experience the use of chatbots for OH education?

Patients' perceptions of chatbots in OH education were varied and reflected differing levels of familiarity with digital technologies. Although none had previously used a chatbot specifically for OH, participants were able to identify potential roles, benefits, and limitations associated with such tools.

3.2.1. Perceived Contribution to OH Education

When invited to reflect on how a chatbot might contribute to OH information or education, participants predominantly positioned it as a supportive informational resource operating within defined and limited boundaries. Table 3.3 presents the distribution of identified subthemes across participants, illustrating how each theme was represented within the interview data.

Table 3.3. Thematic matrix of patients' perceived contribution to OH education

Subthemes	P1	P2	P3	P4	P5	P6	P7	P8	P9	n
Clarification and Doubt Resolution	x		x				x	x	x	5
Low-Complexity Use Contexts		x		x			x	x		4
Preliminary Triage	x	x		x						3
Visual Support	x	x				x				3
Conditional Use	x	x						x		3
Preventive and Routine Guidance				x	x					2
Reinforcement of Prior Professional Advice								x		1
Perceived System-Level Benefits		x								1

The most significant function described was the clarification of doubts and the provision of additional explanations about OH concerns. Participants frequently referred to everyday uncertainties arising at home, particularly in caregiving contexts, and conceptualized the chatbot as a tool for resolving specific questions or providing guidance in moments of hesitation. Participants also highlighted its potential to adapt explanations to different levels of understanding, noting that it could explain a concept "as if to a 10-year-old child" (P3), thereby facilitating comprehension when prior clinical explanations had not been fully understood.

Beyond clarification, chatbots were also described as mechanisms for preliminary triage in situations of uncertainty. Participants suggested that such tools might help them determine whether symptoms required urgent professional attention or whether it would be reasonable to wait or manage the issue at home. One participant referred explicitly to the idea of "triage of the urgency or not of an observation" (P1). In this sense, the chatbot was not framed as a diagnostic authority, but rather as a preliminary orienting mechanism.

Preventive and routine guidance also emerged as a relevant domain of use. Participants mentioned the potential usefulness of chatbots for supporting everyday oral hygiene decisions, such as choosing appropriate toothbrushes or toothpaste, or obtaining concise information about preventive practices. These uses were typically framed as appropriate precisely because they did not require direct clinical examination. In caregiving contexts, particularly in relation to orthodontic appliances or children's oral hygiene, chatbots were perceived as capable of reinforcing instructions previously given by dental professionals, allowing users to revisit and clarify guidance in a timely manner.

Some participants additionally emphasized the value of visual or graphical explanations. There was recognition that certain anatomical or clinical processes are difficult to conceptualize through verbal description alone. One participant noted the importance of "a kind of graphic or

image that could help us understand what is happening" (P6). These reflections indicate an expectation that explanatory support might extend beyond text-based responses.

Importantly, participants consistently delineated the contextual boundaries within which chatbots were considered appropriate. Their use was primarily associated with minor, non-urgent, or routine situations, contexts characterized by lower complexity and absence of immediate clinical risk. Reliance on chatbots was also described as conditional and situational, often linked to practical constraints such as the unavailability of a professional at a given moment. As one participant noted, it could be helpful "when at that moment it was not possible to contact the doctor" (P8). Thus, chatbot use was not positioned as a primary source of care, but rather as a contingent resource activated in specific circumstances.

Finally, one participant extended the reflection beyond the individual level, suggesting that chatbots might help reduce unnecessary consultations and alleviate pressure on healthcare services by filtering minor concerns before professional engagement. This perspective introduced a broader, system-level dimension to the perceived contribution of such tools.

3.2.2. Perceived Benefits

Participants identified several practical and experiential advantages associated with the use of chatbots for OH information. Table 3.4 provides an overview of how the identified subthemes were distributed across participants.

Table 3.4. Thematic matrix of patients' perceived benefits

Subthemes	P1	P2	P3	P4	P5	P6	P7	P8	P9	n
Immediacy and Rapid Access	x			x	x		x		x	5
Convenience and Practicality	x			x	x			x	x	5
Clarification and Doubt Resolution		x	x		x			x		4
Preventive and Caregiving Support		x								1
Informational Consolidation				x						1
Conceptual Clarity						x				1
Emotional Reassurance							x			1

The most prominent benefit concerned immediacy and rapid access to information. Chatbots were described as tools that allow users to obtain responses quickly, without waiting for appointments or relying on direct professional availability. As one participant stated, the main advantage is "being a super practical, super fast tool. You are only a few words away from getting an answer" (P9). Similarly, another emphasized the importance of speed and

accessibility. These accounts highlight the perceived value of instant access and reduced temporal barriers.

Closely related to immediacy, convenience and practicality were also frequently emphasized. Participants referred to the ease of obtaining information without depending on external resources. The possibility of accessing guidance at any moment, particularly when direct contact with a dentist was not feasible, was perceived as a significant advantage.

Another commonly articulated advantage involved clarification and doubt resolution. Participants described chatbots as useful for addressing specific questions that arise in daily life, both in personal and caregiving contexts. The ability to quickly clarify uncertainties was valued as a way to resolve minor doubts without delay. In some cases, this extended to preventive and caregiving support, particularly in relation to children's oral hygiene, product selection, and age-appropriate guidance.

A smaller number of participants described chatbots as capable of integrating dispersed knowledge, referring to "the consolidation of the learning and knowledge of thousands and thousands of brains" (P4), suggesting that the aggregation of information into a single response was seen as advantageous. Others pointed to the potential for conceptual clarity, particularly when explanations are presented clearly or supported by visual elements, facilitating understanding of technical or anatomical aspects.

Finally, emotional reassurance was mentioned in more isolated instances. For some, obtaining immediate orientation in situations of uncertainty, such as minor symptoms, could help prevent unnecessary anxiety. Additionally, chatbots were perceived as streamlining the information-seeking process by reducing the number of steps required to obtain relevant guidance, thereby making the overall experience more efficient.

3.2.3. Concerns and Perceived Limitations

When discussing potential concerns or limitations associated with the use of chatbots in OH contexts, participants expressed heterogeneous but clearly articulated reservations. The most salient concerns related to the origin, reliability, and transparency of the information provided. Table 3.5 summarizes the occurrence of the identified concern-related subthemes across participants.

Table 3.5. Thematic matrix of patients' concerns and perceived limitations

Subthemes	P1	P2	P3	P4	P5	P6	P7	P8	P9	n
Transparency Concerns	x			x	x				x	4
Need for Critical Filtering			x	x					x	3
Lack of Reliability			x						x	2
Human Oversight and Autonomy Preservation		x		x						2
Overgeneralization and Lack of Personalization		x			x					2
Risk of Professional Substitution		x								1
Input–Output Misalignment						x				1
Habituation and Familiarity as Moderating Factors								x		1

A recurrent issue involved uncertainty about the provenance of knowledge and the legitimacy of its sources. Several participants questioned where chatbot-generated information comes from and whether it is grounded in credible professional expertise. Similar concerns were raised regarding the difficulty of determining whether responses are based on reliable scientific sources or on less trustworthy online material. This reflects broader apprehension about source opacity and epistemic transparency.

Closely related to this, some participants expressed doubts about the absolute reliability of chatbot responses. One participant stated that the information provided may not be "100% true" (P3), emphasizing the need to verify or further investigate the content received. Another referred explicitly to the risk of "misinformation or bad information" (P9), reinforcing the perception that digital outputs require careful scrutiny. In this context, several participants highlighted the importance of critical evaluation and personal responsibility when using such tools. Rather than rejecting chatbots outright, they stressed that users must interpret and filter the information provided. As one participant noted, "we have to put into perspective the information that reaches us and then make a decision based on what we think is best" (P4). This reflects a consistent emphasis on maintaining human judgment and autonomy in decision-making processes.

Concerns were also raised about the generalized nature of chatbot responses. Some participants observed that answers may be overly broad and insufficiently tailored to individual clinical contexts, given that OH conditions vary across patients. One participant commented that responses tend to be "very programmed and very much directed to the general case" (P5), suggesting that generic guidance may not always correspond to specific needs.

Additionally, one participant articulated concern regarding the potential substitution of professional care, noting the possibility that some individuals might rely exclusively on chatbot advice rather than seeking in-person consultation (P2). Another highlighted the potential

misalignment between user input and chatbot output, acknowledging that imprecise symptom descriptions could lead to inadequate or overly generic responses (P6).

Finally, while some participants articulated explicit concerns, others minimized perceived risks. One participant suggested that limitations may be more related to habit than to inherent technological flaws, stating that it is "a matter of habit" (P8). This indicates that familiarity and exposure may shape risk perception over time.

3.2.4. Dentist vs. Chatbot

Across interviews, participants overwhelmingly positioned the human dentist as the primary authority in OH contexts. Table 3.6 summarizes the occurrence of dentist–chatbot comparative subthemes across participants.

Table 3.6. Thematic matrix of dentist vs. chatbot comparisons

Subthemes	P1	P2	P3	P4	P5	P6	P7	P8	P9	n
Professional Authority and Clinical Legitimacy	x	x	x	x	x		x	x	x	8
Complementary Role		x		x	x	x	x	x	x	7
Situational Adequacy		x		x	x	x	x	x	x	7
Context-Sensitive Clinical Judgment		x	x	x	x		x			5
Necessity of Physical Examination	x	x	x				x		x	5
Anonymity		x	x	x			x			4
Relational and Human Dimension of Care	x					x				2
Relational Variability							x			1

The preference for professional information was strongly grounded in perceptions of formal expertise, legitimacy, and domain-specific competence. Several participants explicitly stated that they would "always trust more what the dentist says" (P9), emphasizing that OH falls within the dentist's area of expertise. Similarly, others expressed that having a person assess the situation would transmit greater confidence than relying on a virtual system (P7).

Beyond general authority, participants highlighted the importance of context-sensitive clinical judgment. Dentists were described as capable of integrating clinical history, individualized characteristics, and real-time assessment in ways that chatbots cannot replicate. One participant stressed that a professional "has the clinical history" (P2), while another explained that a chatbot "does not have the vision" required to determine the depth or severity of a condition (P3). This perception was closely linked to the belief that individualized cases require tailored evaluation rather than generalized guidance.

Closely related to this, the necessity of physical examination emerged as a central boundary. Several participants associated OH with the need for direct observation, imaging, or embodied clinical evaluation. For some, the idea of relying exclusively on text-based interaction was perceived as insufficient in contexts involving diagnosis or intervention.

At the same time, participants did not frame chatbots as inherently inappropriate. Instead, a strong pattern of complementarity emerged. Chatbots were described as useful for preliminary information, routine doubts, or low-risk situations, but not as substitutes for professional care. Participants consistently differentiated between complex or individualized scenarios, where professional involvement was considered essential, and simpler or routine contexts in which digital guidance might suffice. As one participant explained, for "more day-to-day information, without major issues," a chatbot could be sufficient (P5).

Situational adequacy was also emphasized. Chatbot use was framed as context-dependent, particularly in the absence of immediate professional access. Some participants indicated that they might accept chatbot guidance temporarily while awaiting professional confirmation, especially in non-urgent cases. However, this acceptance was consistently conditional and embedded within a broader framework of professional primacy.

The relational dimension of care appeared less uniformly emphasized but remained relevant. A few participants highlighted the importance of human interaction, empathy, and conversational reassurance. One referred to the "human aspect" that "does not seem accessible with a machine" (P6), underscoring the perceived relational depth of face-to-face care. Others acknowledged that comfort levels may vary depending on the individual professional, suggesting relational variability (P7).

Finally, regarding emotional comfort and perceived judgment, most participants reported no significant difference between interacting with a dentist and using a chatbot. However, a minority recognized that anonymity might reduce embarrassment in specific situations and digital interaction can provide psychological distance in potentially sensitive contexts.

3.3. RQ2 – How do dentists perceive chatbots as tools for patient education and engagement in oral care?

Dentists' perceptions of chatbots as tools for OH education were heterogeneous and ranged from cautious openness to skepticism. They were generally able to identify potential areas in which such tools could contribute to patient education and engagement.

3.3.1. Perceived Contribution to OH Education

Dentists generally conceptualize the educational contribution of chatbots as conditional and bounded rather than universally applicable. Table 3.7 summarizes the occurrence of the identified subthemes related to perceived contribution of chatbots to OH education.

Table 3.7. Thematic matrix of dentists' perceived contribution to OH education

Subthemes	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	n
Conditional Use		x	x	x		x	x	x	x	x	8
Preventive and Basic Hygiene Guidance	x			x	x			x		x	5
Complementary Role	x			x		x	x	x			5
Immediate Doubt Clarification Between Appointments	x	x						x			3
Rapid Access to Structured Information	x								x	x	2
Digital Engagement of Younger Generations					x	x					2
Translation of Technical Knowledge into Lay Language			x								1
Visual Support					x						1

The most consistently emphasized dimension was the conditional educational use of chatbots, contingent upon the reliability of the underlying information. Across interviews, contribution was framed as dependent on whether the content provided is accurate, evidence-based, and properly filtered. Several dentists stressed that usefulness depends on whether the system can distinguish credible sources from unreliable ones, highlighting uncertainty about how information is curated. As one participant reflected, "I still haven't understood to what extent it filters trustworthy sites from non-trustworthy ones" (D9). This conditional stance shaped the way educational potential was interpreted.

Within these boundaries, chatbots were primarily described as suitable for delivering general preventive and hygiene-related guidance. Dentists frequently referred to standardized content such as toothbrushing techniques, choice of toothbrush or toothpaste, fluoride use, and orthodontic hygiene instructions as appropriate areas for digital support. These were framed as informational domains where advice is relatively generalizable and does not require individualized clinical assessment. Basic preventive indications and routine hygiene recommendations were consistently positioned as the safest and most viable forms of educational contribution.

Another recurrent theme concerned the complementary but non-substitutive role of chatbots. Dentists emphasized that such tools cannot replace professional evaluation or contextualized clinical judgment. Rather, they may function as supportive resources that extend or reinforce information without displacing the dentist–patient relationship. Even when

recognizing potential benefits, participants repeatedly reaffirmed that "nothing replaces the professional," underlining the centrality of clinical authority and in-person assessment.

Some dentists also noted the potential of chatbots to provide rapid, organized access to information, simplifying the process of searching across multiple sources. In this sense, chatbots were described as tools capable of synthesizing dispersed knowledge into accessible responses. Closely related to this was the perception that they may help clarify doubts that arise between appointments, potentially reducing unnecessary contact with the clinic and enabling patients to obtain immediate orientation for minor questions.

A smaller number of participants highlighted the possibility that chatbots could facilitate the translation of technical concepts into more accessible language, acting as intermediaries between professional discourse and everyday understanding. Others emphasized their potential to engage younger generations who are accustomed to seeking information autonomously through digital platforms. In this context, visual elements, such as video demonstrations of brushing techniques, were mentioned as particularly promising educational formats.

3.3.2. Perceived Benefits for Patients

When discussing the potential benefits of chatbot use for patients, dentists most frequently emphasized the immediacy of access to information. The occurrence of subthemes identified is summarized in Table 3.8.

Table 3.8. Thematic matrix of dentists' perceived benefits for patients

Subthemes	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	n
Immediate Access to Information	x	x							x	x	4
Clarification of Doubts and Reinforcement of Knowledge		x	x				x				3
Preventive and Basic Hygiene Guidance				x	x		x				3
Complementary Role			x					x	x		3
Visual support			x		x						2
Emotional Reassurance			x						x		2
Support for Shy or Reluctant Patients						x					1

Rapid clarification of doubts and ease of access were consistently described as the primary advantages. Participants highlighted that patients often leave consultations with unanswered questions or recall information later at home. In this context, chatbots were perceived as tools that allow patients to obtain responses without waiting for a subsequent appointment or contacting the clinic directly. As one dentist noted, chatbots may help resolve doubts

"immediately, instead of calling the clinic or waiting until the next appointment" (D2). This immediacy was particularly associated with minor or non-urgent concerns.

Closely related to this, several dentists described chatbots as useful for clarifying doubts and reinforcing previously provided information. They were seen as resources that could help patients revisit hygiene instructions, better understand procedures, or consolidate knowledge discussed during consultations. Within this scope, preventive and basic hygiene guidance was also highlighted as an appropriate area of benefit, particularly regarding brushing techniques, flossing habits, and routine oral care recommendations.

A smaller group of participants pointed to emotional and psychological benefits. Chatbots were described as potentially contributing to reassurance of procedures by explaining treatments in an organized and calm manner that could help to reduce anxiety. In a similar vein, chatbots were perceived as potentially supporting individuals who feel hesitant or embarrassed to ask certain questions directly, lowering interpersonal barriers to information-seeking.

Some dentists also referred to the value of visual or multimedia reinforcement, particularly through video demonstrations that patients could watch and replicate at home, thereby extending chairside education beyond the clinical setting.

3.3.3. Perceived Benefits for Professionals

When reflecting on potential professional benefits associated with patients' use of chatbots, dentists identified some subthemes. Table 3.9 presents the distribution of these identified subthemes across dentists in the interview dataset.

Table 3.9. Thematic matrix of dentists' perceived benefits for professionals

Subthemes	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	n
Reduction of Repetitive Educational Burden	x	x		x	x						4
Enhancement of Treatment Outcomes				x		x				x	3
Improved Patient Baseline Knowledge				x					x	x	3
Complementary Role	x								x		2
Time Efficiency		x									1

The most frequently mentioned concept was the reduction of repetitive educational burden. Several participants acknowledged that a considerable portion of chairside communication involves reiterating standardized oral hygiene instructions and preventive recommendations. One dentist illustrated this dynamic by stating that "sometimes I even joke that I could record an audio, because I say the same thing from appointment to appointment" (D1), highlighting

the repetitive nature of educational explanations. In a similar vein, another participant described how digital support could make it “less tiring for us to always be repeating in every patient” (D5). Within this perspective, chatbots were viewed as potentially assisting in delivering general, standardized information outside the consultation setting, thereby alleviating communicative fatigue.

Another frequently identified benefit concerned improved patient baseline knowledge. Some dentists suggested that when patients arrive with prior exposure to general information, communication may become more efficient and fluid. As one participant explained, if patients already have “some general knowledge,” understanding during the appointment may be facilitated (D9). This shared informational starting point was described as potentially supporting clearer dialogue and enabling the dentist to focus more directly on individualized clinical reasoning.

A smaller number of participants referred to enhancement of treatment outcomes through greater patient awareness. In these accounts, better-informed patients were perceived as more likely to adopt improved hygiene practices and behavioral changes, contributing to longer-lasting clinical results. This benefit was framed not as a replacement of professional care, but as a reinforcement of preventive responsibility on the patient’s side.

Time efficiency and consultation streamlining were mentioned more cautiously and in a conditional manner. While one participant suggested that resolving minor doubts externally could reduce time spent during appointments, this potential benefit was presented as dependent on the accuracy and appropriateness of the information provided.

Finally, some dentists explicitly framed chatbot use as complementary rather than substitutive. One participant emphasized that such tools could function as “an excellent complement,” but not as a replacement for professional interaction (D1), reinforcing the idea that educational support may be extended digitally while clinical authority and relational care remain central to professional practice.

3.3.4. Perceived Risks and Limitations

Regarding the limitations and risks that dentists perceived in chatbot use, Table 3.10 outlines the distribution of these identified risk-related subthemes.

The most consistently identified concern across all interviews was the risk of misinformation and inaccurate content. Every participating dentist referred, directly or conditionally, to the possibility that chatbots may provide incorrect, incomplete, or misleading guidance. As one participant stated succinctly, the principal risk is “the information not being

correct" (D4). Others warned about the "divulgation of wrong information" (D5) and the amplification of unreliable online content. This concern was frequently linked to the absence of guaranteed filtering mechanisms capable of distinguishing scientifically credible sources from inaccurate or outdated material.

Table 3.10. Thematic matrix of dentists' perceived risks and limitations

Subthemes	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	n
Misinformation and Inaccurate Content	x	x	x	x	x	x	x	x	x	x	10
Conflict Between Digital and Professional Authority			x						x	x	3
Overreliance			x						x	x	3
Lack of Contextual and Individualized Assessment		x	x								2
Information Filtering and Source Credibility Concerns								x	x		2
Patient Misinterpretation							x				1
Information Overload						x					1
Potential Undermining of Therapeutic Adherence									x		1

Beyond factual inaccuracy, several dentists expressed concern about overreliance on digital information and the potential displacement of professional epistemic authority. Some participants described scenarios in which patients attribute excessive legitimacy to chatbot responses, treating them as definitive. One dentist illustrated this by describing patients who arrive already convinced: "I saw on ChatGPT that this pain is this and that, so it can only be this" (D3). Closely related to this was the theme of conflict between digital and professional authority, whereby patients may experience difficulty reconciling chatbot information with clinical evaluation, generating tension within consultations.

A smaller but relevant group of participants highlighted the lack of contextual and individualized assessment as a structural limitation. Dentists emphasized that oral healthcare decisions depend on medical history, behavioral factors, and clinical nuance that generalized responses may not adequately capture. In this sense, standardized outputs were viewed as potentially insufficient for case-specific decision-making.

Other risks were mentioned less frequently but remain conceptually significant. These included concerns about patient misinterpretation of technically correct information, information overload leading to confusion, and the potential undermining of therapeutic adherence when patients encounter conflicting digital narratives. In particular, one participant warned that without appropriate filtering, exposure to misleading online content could reduce trust in professional recommendations and weaken adherence to prescribed treatments.

3.3.5. Professional Authority

When reflecting on whether chatbot use could compromise or devalue the dental profession, most participants did not perceive a direct threat to clinical autonomy. The distribution of references to each subtheme is presented in Table 3.11.

Table 3.11. Thematic matrix of dentists' perspectives on professional authority

Subthemes	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	n
Preservation of Clinical Autonomy		x		x	x	x		x		x	6
Risk of Credibility Undermining	x		x								2
Perceived Devaluation of the Profession			x				x				2
Conditional Threat								x	x		2
Increased Professional Burden									x		1

The dominant position across interviews was that dentistry is inherently manual, procedural, and dependent on physical intervention. Several dentists emphasized that their work cannot be replaced by a conversational tool because clinical practice requires in-person examination and technical execution. In this sense, autonomy was largely viewed as resilient to technological substitution.

However, some participants expressed concerns regarding potential tensions at the level of credibility. These concerns centered on situations in which chatbot recommendations might contradict clinical advice, thereby creating uncertainty about whom patients should trust. One dentist illustrated this scenario by questioning what would happen "if I say you have to do A and the chatbot says you have to do B, who will the patient believe?" (D1). Such reflections suggest that the perceived threat lies not in procedural replacement, but in the destabilization of epistemic authority within the consultation setting.

A smaller number of dentists also described the possibility of professional devaluation through informational substitution. In these accounts, the concern was that patients might rely on chatbot-generated explanations to self-diagnose or delay seeking professional evaluation, potentially trivializing the need for clinical assessment. This risk was framed as a shift in how patients attribute legitimacy to health information.

Additionally, some participants indicated that professional authority could be compromised under specific conditions, particularly if chatbot systems operate without adequate filtering mechanisms or clinical oversight. In these cases, the risk was not attributed to the technology itself, but to the absence of quality control and supervision in its deployment. Only one participant explicitly highlighted the possibility that correcting chatbot-derived misconceptions

might require additional effort from the dentist, implying a need to reassert professional credibility in certain encounters.

3.3.6. Perceived Patient Trust

When discussing patients' trust in chatbot-generated information, dentists largely perceived a high level of reliance on these tools. The distribution of references to each subtheme is presented in Table 3.12.

Table 3.12. Thematic matrix of dentists' perceptions of patient trust in chatbots

Subthemes	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	n
Age-Related Differences in Trust	x	x	x	x	x	x			x	x	8
High Perceived Trust in Chatbot Information	x	x	x	x			x		x	x	7
Socioeconomic and Educational Influences	x	x	x	x							4
Polarized Trust Profiles		x				x					2
Context-Dependent Trust								x			1
Limited Critical Appraisal		x				x	x		x	x	5

Age-related differences were frequently highlighted. Several dentists described younger individuals as more inclined to both use and trust chatbots, given their familiarity with digital environments. According to one participant, younger users "use it and believe that everything written there is a fact" (D2). Conversely, some participants suggested that older patients may demonstrate greater skepticism due to lower digital literacy. However, one participant described older adults as particularly vulnerable to misinformation circulating online. These contrasting views suggest that generational influence on trust is perceived as complex rather than linear.

Many participants suggested that patients tend to accept chatbot responses as credible and authoritative, sometimes without substantial questioning. As one participant stated, patients may "trust it more than the professional" (D1), reflecting concern about a possible shift in epistemic hierarchy. This perception of strong digital trust emerged as one of the most recurrent findings across interviews.

Socioeconomic and educational factors were also mentioned as potential determinants of trust. Some dentists argued that individuals with lower educational backgrounds may find it more difficult to assess credibility, which could increase reliance on chatbot outputs. At the same time, a few participants indicated that trust may be shaped more by personality traits than by socioeconomic status alone, suggesting that individual cognitive disposition plays a mediating role.

A smaller number of dentists described trust as polarized. In these accounts, patients were characterized as either trusting everything they read or rejecting digital information entirely. This binary framing underscores the perception that trust in chatbots is highly individualized rather than uniformly distributed.

Concerns regarding limited critical appraisal skills also emerged. Several participants emphasized that patients may struggle to evaluate the reliability of information, particularly when responses are presented in a structured and persuasive format. One dentist noted that the difficulty lies in patients not knowing "how to evaluate whether that information is 100% reliable" (D7). This perceived lack of digital health literacy was framed as a central vulnerability.

3.4. RQ3 – What factors could influence the effective contribution of chatbots to OH promotion?

Participants identified a range of factors that could influence whether chatbots effectively contribute to OH promotion. Rather than evaluating them as inherently beneficial or problematic, both patients and dentists described specific conditions that would shape their practical usefulness and acceptability.

3.4.1. Factors shaping the effective contribution of chatbots to OH promotion

Participants identified several conditions influencing whether chatbots could effectively contribute to OH promotion. Among these, two factors emerged most prominently across both groups: the need for clear limits of use and the requirement for strong scientific credibility.

Table 3.13 presents the distribution of subthemes across patients and dentists, indicating the number of participants who referred to each factor.

Table 3.13. Thematic matrix of factors influencing the effective contribution of chatbots to OH promotion

Subthemes	Patients		Dentists		Total
	IDs	n	IDs	n	
Credibility and scientific grounding	P1, P4, P5, P6, P8, P9	6	D1, D2, D3, D4, D5, D6, D8, D9, D10	9	15
Defined scope and limits of use	P3, P4, P6, P7, P8	5	D1, D3, D4, D5, D6, D7, D8, D9, D10	9	14
Risk of misinterpretation	P4, P6, P7, P8	4	D1, D3, D6, D7, D8, D9	6	10
Integration within care pathways	P3, P4, P5, P6, P8	5	D2, D4, D6, D7, D9	5	10
Digital literacy	P1, P2, P6, P7, P8	5	D6, D8, D10	3	8

The most recurrent factor across interviews was the issue of credibility and scientific grounding. Both patients and dentists indicated that effectiveness would depend on the

perceived legitimacy of the information provided. Patients highlighted the importance of knowing who developed the tool and whether it was supported by clinical expertise. Dentists emphasized the need for evidence-based content, reliable sources, and, in several cases, some form of professional validation or oversight. References to scientific articles, expert panels, professional bodies, or filtered information sources were common. Trust in chatbot use was therefore described as conditional upon visible markers of professional and scientific legitimacy.

The definition of scope and boundaries was also repeatedly emphasized, particularly by dentists. Chatbots were consistently considered appropriate for preventive guidance, reinforcement of oral hygiene practices, and clarification of routine doubts, but not for diagnosis, individualized treatment planning, or clinical decision-making. Dentists frequently stressed that oral healthcare involves direct examination and contextual evaluation, which digital tools cannot replicate. Patients expressed similar distinctions, describing chatbots as supportive tools rather than primary sources of care. One participant clarified that it "would not be my main source" (P3), indicating a complementary rather than substitutive role.

Concerns regarding misinterpretation also shaped perceptions of effectiveness. Dentists noted that generalized information might be interpreted as personalized advice, potentially leading to misunderstanding or inappropriate self-management. Some patients similarly expressed uncertainty about fully trusting digital responses or about their own ability to correctly formulate questions and interpret answers. In this sense, the perceived effectiveness of chatbots was linked not only to the quality of information but also to how that information is understood and applied.

Integration within existing care pathways emerged as another relevant factor. Both groups described chatbots as potentially useful when aligned with professional advice and used to reinforce information provided during consultations. Effectiveness was framed as dependent on coherence between digital guidance and face-to-face clinical communication, rather than on autonomous digital decision-making.

Finally, digital literacy was identified as a contextual determinant. Variability in technological familiarity, language barriers, and personal comfort with digital tools were described as factors that could either facilitate or limit effective engagement. Contribution to OH promotion was therefore perceived as dependent not only on technological characteristics but also on users' capacity to navigate and critically interpret digital information.

3.4.2. Implementation Requirements

Participants from both groups identified several structural and design-related requirements that would condition the effective implementation of chatbots in OH promotion. Among these, the most recurrent requirement concerned the need for evidence-based content and reliable source validation.

The distribution of references to all subthemes across patients and dentists is presented in Table 3.14.

Table 3.14. Thematic matrix of implementation requirements for the effective use of chatbots in OH promotion

Subthemes	Patients		Dentists		Total
	IDs	n	IDs	n	
Evidence-based content and source validation	P1, P4, P5, P6, P9	5	D1, D2, D3, D4, D5, D8, D9, D10	8	13
Usability and intuitive design	P1, P2, P6, P8, P9	5	D6, D7, D8	3	8
Professional oversight	P4, P5, P9	3	D1, D3, D5, D8	4	7
Content structure and conciseness	P2, P3, P6	3	D4, D6, D7	3	6
Visual support	P1, P3, P4, P8	4	D7	1	5
Linguistic accessibility and adaptation	P1, P2, P3, P6	4	D6	1	5

Across interviews, both patients and dentists emphasized that the usefulness of a chatbot would depend on its scientific grounding. Dentists frequently referred to the necessity of basing responses on peer-reviewed articles, validated sources, and filtered databases. Several mentioned the importance of mechanisms that ensure information is drawn from credible scientific repositories rather than general internet content. Patients similarly highlighted the need to know the origin of the information and who was responsible for developing the tool. Effectiveness was therefore closely linked to transparent sourcing and demonstrable clinical legitimacy.

Usability and intuitive design emerged as the second most frequently mentioned implementation requirement. Patients consistently stressed that the tool should be easy to navigate, simple to operate, and free from unnecessary complexity. Difficult interfaces, bureaucratic steps, or repeated payment requirements were described as potential deterrents. Dentists also noted that simplicity in design would be essential to ensure practical usefulness.

Closely related to scientific grounding was the issue of professional oversight and institutional backing. Some participants indicated that visible association with recognized professionals, expert panels, or professional bodies would increase trust and acceptability. References to signatures, expert validation, or institutional endorsement were presented as

mechanisms capable of reinforcing credibility and distinguishing a health-focused chatbot from general AI tools.

Content structure and clarity were additional implementation considerations. Participants indicated that responses should be concise, well-organized, and coherent. Dentists, in particular, suggested that information should be structured in a clear and direct manner, avoiding excessive verbosity or alarmist tone. Patients similarly valued explanations that are easy to understand and adapted to different levels of comprehension.

Visual support was another feature associated with effective implementation, particularly in the context of oral hygiene education. Several patients referred to the usefulness of images or videos to demonstrate brushing techniques or appliance care. This indicates that procedural health information may benefit from visual reinforcement rather than relying exclusively on text-based responses.

Finally, linguistic accessibility and adaptation were identified as relevant. Participants mentioned the importance of providing information in accessible languages and avoiding overly technical terminology. Clear and adapted language was described as facilitating comprehension and supporting broader accessibility across different user profiles.

3.4.3. Future Use and Recommendation Intentions

Participants' intentions regarding future use and recommendation of chatbots in OH promotion were predominantly conditional and closely tied to credibility, safeguards, and contextual appropriateness. Table 3.15 details the frequency and distribution of subthemes across participants.

Table 3.15. Thematic matrix of future use and recommendation intentions regarding chatbots in OH promotion

Subthemes	Patients		Dentists		Total
	IDs	n	IDs	n	
Credibility and scientific grounding	P1, P4, P5, P6, P9	5	D1, D2, D3, D4, D5, D6, D7, D8, D9, D10	10	15
Non-recommendation at present	—	—	D1, D2, D3, D4, D5, D6, D8, D9, D10	9	9
Conditional willingness to use	P1, P2, P3, P4, P5, P6, P8, P9	8	—	—	8
Preference for specialized OH chatbot	P2, P3, P4, P5, P6, P	6	—	—	6

The most recurrent pattern across interviews concerned openness contingent upon demonstrable scientific reliability and professional validation. Both patients and dentists indicated that willingness to use or recommend chatbots would depend on confidence in the

accuracy of the information provided, visible evidence-based grounding, and the existence of appropriate filtering or validation mechanisms. In the absence of such assurances, hesitation prevailed.

Among dentists, a prominent pattern was non-recommendation at present. Most explicitly stated that they would not currently recommend chatbot use to their patients. This reluctance was not framed as categorical opposition to digital tools, but rather as a position linked to uncertainty about content accuracy, lack of familiarity with specific platforms, and concerns regarding misinformation. Some indicated that recommendation might become possible if tools were specifically developed for OH and aligned with professional standards.

From the patients' perspective, conditional willingness to use chatbots emerged as the dominant position. Use was described as situational and complementary, depending on the presence of specific doubts, minor recurring issues, or the need for clarification outside consultation hours. Chatbots were not framed as substitutes for professional care, but as supportive tools that could provide preliminary information or reinforce existing guidance. Several participants emphasized that more serious or complex situations would still require direct professional evaluation.

A further recurring pattern among patients was a preference for specialized chatbots dedicated exclusively to OH. Domain-specific tools were described as potentially more trustworthy and appropriate for health-related queries than general-purpose AI platforms. However, some participants reported no significant distinction between general and specialized systems, indicating variability in perceived differentiation.

Chapter 4 – Discussion

The findings of this study indicate that both patients and dentists approach the use of chatbots in OH education with cautious pragmatism rather than uncritical enthusiasm or categorical rejection.

Across groups, chatbots were not framed as substitutes for professional care, but as tools whose legitimacy depends on clearly defined boundaries, contextual appropriateness, and professional anchoring. Rather than centering exclusively on technological capability, participants consistently situated chatbot use within relational, epistemic, and professional structures that shape its acceptable scope.

4.1. Convergences and Divergences Between Patients and Dentists

A central convergence between patients and dentists concerns the delineation of functional boundaries for chatbot use. Across interviews, both groups consistently distinguished between informational support and individualized clinical judgment. Chatbots were broadly accepted as appropriate for preventive guidance, clarification of routine doubts, and reinforcement of previously delivered instructions, particularly outside consultation hours. However, when situations involved diagnostic uncertainty, symptom progression, or case-specific complexity, both patients and dentists reaffirmed the indispensability of professional evaluation.

Another area of convergence relates to the conditions of legitimacy. Both groups emphasized that chatbot usefulness depends on credibility, scientific grounding, and alignment with professional standards. Patients framed legitimacy primarily in terms of transparency and perceived expertise, wanting to know who developed the tool and whether it was professionally validated. Dentists, in turn, emphasized evidence-based content, source reliability, and the preservation of professional authority. Although articulated from different standpoints, both perspectives converge in positioning chatbot acceptance as contingent upon professional anchoring rather than technological autonomy.

At the same time, divergences emerged in how each group evaluated risks and practical implications. Patients tended to frame chatbot use through the lens of experiential utility, highlighting accessibility, convenience, reassurance, and situational support. Dentists, in contrast, approached chatbot integration through a framework of professional responsibility, focusing more explicitly on misinformation, misinterpretation, epistemic displacement, and the potential impact on consultation dynamics.

Differences were also visible in thresholds of conditional openness. Patients frequently expressed willingness to use chatbots in routine contexts, even when accompanied by reservations. Dentists, although not categorically opposed, articulated more explicit safeguards before endorsing or recommending such tools. Professional recommendation was framed as dependent on higher levels of reliability, control, and validation than individual use.

4.2. Positioning the Findings Within Existing Literature

The growing number of publications identified in the SLR confirms the increasing academic and clinical interest in the use of AI and chatbots within OH contexts. In recent years, a substantial body of research has emerged evaluating LLMs and dedicated chatbot systems across multiple dental specialties, including endodontics, implantology, restorative dentistry, oral oncology, and temporomandibular disorders (Alnsour et al., 2025; Arpaci et al., 2025; Büker & Mercan, 2025; Daraqel et al., 2024; Pagotto et al., 2025; Taymour et al., 2025).

Despite the increasing volume of research, no study within the reviewed examined simultaneously the perspectives of both patients and dental professionals regarding the acceptability, legitimacy, and conditional integration of chatbots in OH education. Existing studies tend to focus either on technical performance, assessing accuracy, reliability, readability, and validity of AI-generated responses (Alnsour et al., 2025; Halboub et al., 2025; Ozdemir & Yapici, 2025), or on intervention-based evaluations of structured, purpose-built chatbot systems measuring knowledge gains or behavioral outcomes (Agrawal et al., 2025; Hunsrisakhun et al., 2025; Pithpornchaiyakul et al., 2022; Pupong et al., 2025; Santonocito et al., 2025). As such, the present study addresses a methodological and conceptual gap by examining how both user groups negotiate the role of chatbots within the relational and professional ecosystem of oral healthcare.

The present findings align with prior evaluations demonstrating that LLMs can provide generally accurate and clinically relevant information across dental domains (Arpaci et al., 2025; Daraqel et al., 2024; Pagotto et al., 2025). Participants in this study similarly acknowledged the informational potential of chatbots, particularly for preventive advice and clarification of routine doubts, suggesting that users intuitively recognize the informational capabilities documented in performance-based research.

However, a critical distinction emerges when moving from technical adequacy to socio-professional integration. While the literature frequently assumes that accuracy and reliability are primary indicators of usefulness (Elkarmi et al., 2025; Mohammad-Rahimi et al., 2024;

Ozdemir & Yapici, 2025), the present findings indicate that these characteristics are necessary but insufficient conditions for acceptance. Participants framed chatbot contribution as contingent upon clearly defined boundaries, professional validation, and contextual appropriateness. In other words, technical performance does not automatically translate into legitimacy within clinical practice.

Studies included in the SLR consistently report limitations related to readability, lack of nuance, and insufficient personalization (Alnsour et al., 2025; Elkarmi et al., 2025; Halboub et al., 2025). In prior research, these are primarily treated as technical shortcomings. In contrast, participants in this study interpreted such limitations as markers of clear knowledge boundaries. The absence of individualized assessment and contextual interpretation was not simply viewed as a functional gap, but as evidence that clinical judgment remains fundamentally human. This reframing highlights a conceptual distinction between informational automation and diagnostic authority, reinforcing a model of complementarity rather than substitution.

The distinction between general-purpose LLMs and dedicated OH chatbots, also highlighted in the SLR, is further supported by the present findings. Intervention studies involving specialized chatbots report measurable improvements in knowledge acquisition and hygiene behaviors (Agrawal et al., 2025; Hunsrisakhun et al., 2025; Pithpornchaiyakul et al., 2022; Pupong et al., 2025). Participants in this study likewise expressed greater openness when chatbots were described as evidence-based, professionally validated, and aligned with clinical practice. This convergence suggests that domain specificity and institutional anchoring enhance perceived legitimacy.

Trust, as reflected in the current findings, also extends beyond general confidence in technology. Participants emphasized the importance of understanding where information originates and whether it is aligned with professional expertise. This concern aligns indirectly with prior evaluations of reliability but highlights a deeper issue concerning transparency in how information is developed and justified. Whereas studies assess factual correctness, users appear to seek clarity regarding authorship, source credibility, and professional endorsement. Effective integration therefore depends not only on accurate outputs but also on visible connections to recognized clinical authority.

At the same time, the present study introduces dimensions that remain comparatively underexplored in performance-focused research. Concerns regarding professional autonomy, role negotiation, conditional recommendation, and socio-professional legitimacy were important to dentists' reflections but are largely absent from quantitative studies. Similarly, patients' framing of chatbot use as situational, complementary, and bounded reveals a

negotiated model of integration rather than a simple acceptance of technological capability. These findings suggest that technical accuracy alone may not be sufficient to ensure successful implementation.

The current evidence base demonstrates that chatbots can deliver accurate and, in some cases, behaviorally impactful OH information. However, the present study suggests that effective integration depends on more than performance metrics.

4.3. Practical Implications for Chatbot Design and Clinical Integration

The findings of this study have several practical implications for the design, implementation, and integration of chatbots in OH promotion. Rather than recommending unrestricted deployment, the results point to a structured and professionally anchored model of integration, consistent with broader research on conversational agents in healthcare settings (Laranjo et al., 2018).

Chatbots intended for OH education should be domain-specific and grounded in evidence-based clinical guidelines. Participants consistently associated credibility with professional validation and scientific reliability. Therefore, such systems should be developed in collaboration with dental professionals and clearly communicate their alignment with recognized standards of care. Visible indications of authorship, professional endorsement, or institutional affiliation may enhance legitimacy and trust, aligning with research showing that confidence in automated systems depends not only on performance but also on transparency and perceived institutional legitimacy (Glikson & Woolley, 2020).

Clarity of language and accessibility also emerged as central requirements. Chatbots should provide information that is understandable to users with varying levels of health literacy, avoiding overly technical terminology while maintaining clinical accuracy. Structured conversational flows and logically sequenced prompts can improve usability and reduce misunderstanding (Montenegro et al., 2019). Where appropriate, visual aids, short explanatory videos, or interactive demonstrations of oral hygiene techniques could further enhance usability and reinforce preventive behaviors.

Although some degree of personalization was perceived as desirable, it should remain within clearly defined limits. Chatbots may tailor responses based on general user characteristics, but they should avoid positioning themselves as substitutes for individualized clinical diagnosis or treatment planning. Overstepping these boundaries risks both misinterpretation and erosion of professional trust.

The findings further underscore the importance of explicit safeguards. Chatbots should clearly communicate their scope and limitations, explicitly distinguishing between informational support and clinical decision-making. Statements clarifying that the tool does not replace professional consultation may help reduce unrealistic expectations and mitigate misuse. In addition, mechanisms encouraging referral to a dentist in cases of uncertainty, persistent symptoms, or potential emergencies should be embedded within the system. This triage-oriented function reinforces complementarity rather than substitution.

Ongoing content moderation and periodic review by qualified professionals are equally critical. Given the evolving nature of clinical evidence and digital health technologies, sustained oversight is necessary to maintain accuracy and prevent the dissemination of outdated or misleading information (Montenegro et al., 2019).

The findings support a complementary integration model in which chatbots enhance access to OH information without challenging professional authority. Their most appropriate role appears to lie in pre-consultation orientation, post-consultation reinforcement, routine preventive education, and clarification of minor doubts outside clinical hours. Within this framework, the dental professional retains responsibility for diagnosis, treatment planning, and individualized care, while chatbots contribute to informational continuity and patient empowerment. Importantly, professional endorsement and oversight do not diminish clinical autonomy; rather, they function as key enablers of safe and effective digital support.

4.4. Theoretical Implications

Beyond its practical contributions, this study offers several theoretical implications for the broader discussion on the integration of digital conversational technologies in healthcare contexts.

First, the findings challenge the prevalent assumption in performance-driven digital health research that technical adequacy naturally translates into clinical acceptance. Much of the existing literature evaluates digital systems primarily through metrics of accuracy, reliability, and functional performance. However, the present findings suggest that informational correctness, while necessary, is not sufficient for socio-clinical legitimacy. Acceptance is mediated by relational trust, professional endorsement, and clearly maintained boundaries of authority. This aligns with sociotechnical perspectives on health technology implementation, which argue that adoption depends on organizational routines, professional cultures, and institutional norms rather than performance alone (Greenhalgh et al., 2017).

Second, the study reinforces a structural distinction between informational automation and clinical authority. Participants consistently differentiated between the delivery of generalized health information and the exercise of individualized diagnostic judgment. This distinction supports a layered model of responsibility: chatbots may facilitate access to standardized information, but diagnostic reasoning and clinical accountability remain anchored in professional expertise. Similar distinctions have been identified in broader analyses of conversational agents in healthcare, which emphasize their role as supportive tools rather than autonomous decision-makers (Laranjo et al., 2018; Montenegro et al., 2019).

Third, the findings contribute to ongoing debates concerning complementarity versus substitution in digital health innovation. Healthcare technologies are more readily adopted when aligned with existing professional roles rather than when perceived as threatening them (Boonstra & Broekhuis, 2010). In this study, participants articulated a model of conditional and bounded integration, where chatbots were perceived as acceptable when their role was clearly limited to educational, supportive, or reinforcing functions. Resistance increased when systems were perceived as encroaching upon diagnostic or decision-making domains.

Fourth, the results extend understanding of trust in human–technology interactions in clinical contexts. Trust was not described as generalized confidence in technological capability, but as contingent upon transparency of source, visible professional validation, and alignment with established standards of care. Technology acceptance in healthcare shows that perceived credibility, institutional backing, and accountability structures shapes user confidence more strongly than technical performance alone (Greenhalgh et al., 2017).

Finally, by integrating both patient and dentist perspectives, this study advances a relational framework for understanding chatbot implementation. Acceptance is not an individual decision isolated at the user level, but a co-constructed process shaped by professional norms, ethical responsibilities, and shared expectations regarding appropriate scope. The integration of conversational systems into oral healthcare therefore represents a negotiated reconfiguration of roles within existing socio-professional structures rather than a simple technological insertion.

All these theoretical implications suggest that the integration of chatbots in oral healthcare is best conceptualized as a socio-professional negotiation process. Conversational technologies do not enter clinical contexts as neutral informational tools; rather, they become embedded within pre-existing structures of authority, responsibility, and trust. Recognizing this layered integration dynamic may help refine theoretical models of digital health adoption beyond purely technological or performance-based paradigms.

Conclusion

This study aimed to examine how patients and dentists perceive, accept, and position chatbots within OH education. The objective was achieved, clarifying how chatbots are understood, positioned, and delimited within real-world oral healthcare contexts.

The findings demonstrate that the RQs concerning both patients' and dentists' perspectives were addressed comprehensively. Patients perceived chatbots primarily as accessible and practical tools for clarification, preventive guidance, and situational support. Dentists, while recognizing similar educational potential, emphasized informational reliability, professional oversight, and the preservation of clinical authority. In response to the third RQ, the study identified key factors influencing effective contribution, including credibility, transparency, domain specificity, and clearly defined limits of use.

Across both groups, chatbots were consistently framed as complementary rather than substitutive. Their legitimacy was not derived from technological capability alone, but from alignment with professional standards and contextual appropriateness. Diagnostic judgment and individualized decision-making remained firmly anchored in the role of the dentist. When embedded within established professional frameworks and supported by transparent credibility mechanisms, chatbots can enhance access to information and reinforce preventive behaviors without displacing clinical responsibility.

Limitations of the Study

This study presents several limitations that should be considered when interpreting the findings. First, the sample size was relatively small and geographically limited, comprising nine patients and ten dentists. While appropriate for an exploratory qualitative design, this restricts the generalizability of the results beyond the specific context in which the study was conducted.

Second, many participants had limited or no direct experience using chatbots specifically for OH purposes. As a result, several responses were based on anticipated or hypothetical use rather than lived experience. Perceptions of usefulness, trust, and adoption were therefore constructed largely from expectations, which may differ from actual interactions with a functional system.

Third, the data relied on self-reported perceptions and stated intentions. Declared willingness to use or recommend chatbots does not necessarily translate into real-world behavior.

Additionally, participants' responses may have been influenced by social desirability bias. Patients may have emphasized trust in professional authority due to normative expectations, while dentists may have expressed professionally cautious positions regarding technological integration. Such dynamics are inherent in interview-based research and may shape how attitudes are articulated.

Finally, the rapid evolution of technology represents an important contextual limitation. Chatbot capabilities are continuously advancing, and perceptions identified in this study may shift as systems become more sophisticated, clinically validated, and integrated into healthcare environments.

Despite these limitations, the study provides valuable exploratory insight into how patients and dentists conceptualize the role of chatbots in OH education and the conditions under which such tools may be considered acceptable and useful.

Future Research

The findings of this study suggest several paths for future research in the field chatbots and OH education.

Given that most participants had limited direct experience with OH chatbots, future studies should move beyond perception-based data and examine real-world interaction with functional systems. The development and testing of a chatbot specifically designed for OH, grounded in evidence-based clinical guidelines and developed in collaboration with dental professionals, would allow for the evaluation of actual usage patterns, trust formation, user engagement, and behavioral impact.

A particularly valuable next step would involve comparative research designs. Larger-scale experimental studies could compare outcomes among individuals receiving (1) information exclusively through a chatbot, (2) information exclusively from a dentist, and (3) a combined approach integrating chatbot support with professional consultation. Such designs would help clarify whether chatbots function most effectively as complementary tools rather than substitutes for professional care and would allow for the assessment of differences in OH literacy, behavioral adherence, satisfaction, and potentially clinical outcomes.

Future investigations should also consider larger and more diverse samples to explore how factors such as age, digital literacy and socioeconomic background shape adoption patterns. Additionally, cross-cultural or multi-center studies could determine whether the conditional acceptance identified in this study is context-specific or generalizable across healthcare settings.

Bibliographic References and Sources

Aggarwal, A., Tam, C. C., Wu, D., Li, X., & Qiao, S. (2023). Artificial intelligence–based chatbots for promoting health behavioral changes: Systematic review. *Journal of Medical Internet Research*, *25*, e40789. https://doi.org/10.2196/40789

Agrawal, R., Khan, A. M., Moothedath, M., VJ, R., & T, S. (2025). Effect of AI-based chatbots in promoting oral health awareness among rural populations. *Bioinformation*, *21*(04), 827–831. https://doi.org/10.6026/973206300210827

Alan, R., & Alan, B. M. (2023). Utilizing ChatGPT-4 for providing information on periodontal disease to patients: A DISCERN quality analysis. *Cureus*, *15*(9), e46213. https://doi.org/10.7759/cureus.46213

Alnsour, M. M., Alenezi, R., Barakat, M., & AL-Omiri, M. K. (2025). Assessing ChatGPT's suitability in responding to the public's inquires on the effects of smoking on oral health. *BMC Oral Health*, *25*(1), 1207. https://doi.org/10.1186/s12903-025-06377-5

Arpaci, A., Ozturk, A. U., Okur, I., & Sadry, S. (2025). Evaluation of the accuracy of ChatGPT-4 and Gemini's responses to the World Dental Federation's frequently asked questions on oral health. *BMC Oral Health*, *25*(1), 1293. https://doi.org/10.1186/s12903-025-06624-9

Ayers, J. W., Poliak, A., Dredze, M., Leas, E. C., Zhu, Z., Kelley, J. B., Faix, D. J., Goodman, A. M., Longhurst, C. A., Hogarth, M., & Smith, D. M. (2023). Comparing physician and artificial intelligence chatbot responses to patient questions posted to a public social media forum. *JAMA Internal Medicine*, *183*(6), 589–596. https://doi.org/10.1001/jamainternmed.2023.1838

Binaljadm, T. M., Alqutaibi, A. Y., Halboub, E., Zafar, M. S., & Saker, S. (2025). Artificial intelligence chatbots as sources of implant dentistry information for the public: Validity and reliability assessment. *European Journal of Dentistry*. https://doi.org/10.1055/s-0045-1809155

Boonstra, A., & Broekhuis, M. (2010). Barriers to the acceptance of electronic medical records by physicians from systematic review to taxonomy and interventions. *BMC Health Services Research*, *10*(1), 231. https://doi.org/10.1186/1472-6963-10-231

Büker, M., & Mercan, G. (2025). Readability, accuracy and appropriateness and quality of AI chatbot responses as a patient information source on root canal retreatment: A comparative assessment. *International Journal of Medical Informatics*, *201*, 105948. https://doi.org/10.1016/j.ijmedinf.2025.105948

Daraqel, B., Wafaie, K., Mohammed, H., Cao, L., Mheissen, S., Liu, Y., & Zheng, L. (2024). The performance of artificial intelligence models in generating responses to general orthodontic questions: ChatGPT vs Google Bard. *American Journal of Orthodontics and Dentofacial Orthopedics*, *165*(6), 652–662. https://doi.org/10.1016/j.ajodo.2024.01.012

Elkarmi, R., Abu-Ghazaleh, S., Sonbol, H., Haha, O., AL-Haddad, A., & Hassona, Y. (2025). ChatGPT for parents' education about early childhood caries: A friend or foe? *International Journal of Paediatric Dentistry*, *35*(4), 717–724. https://doi.org/10.1111/ipd.13283

Gheisarifar, M., Shembesh, M., Koseoglu, M., Fang, Q., Afshari, F. S., Yuan, J. C.-C., & Sukotjo, C. (2025). Evaluating the validity and consistency of artificial intelligence chatbots in responding to patients' frequently asked questions in prosthodontics. *The Journal of Prosthetic Dentistry*, *134*(1), 199–206. https://doi.org/10.1016/j.prosdent.2025.03.009

Gill, P., Stewart, K., Treasure, E., & Chadwick, B. (2008). Methods of data collection in qualitative research: Interviews and focus groups. *British Dental Journal*, *204*(6), 291–295. https://doi.org/10.1038/bdj.2008.192

Glikson, E., & Woolley, A. W. (2020). Human trust in artificial intelligence: Review of empirical research. *Academy of Management Annals*, *14*(2), 627–660. https://doi.org/10.5465/annals.2018.0057

Greenhalgh, T., Wherton, J., Papoutsi, C., Lynch, J., Hughes, G., A'Court, C., Hinder, S., Fahy, N., Procter, R., & Shaw, S. (2017). Beyond adoption: A new framework for theorizing and evaluating nonadoption, abandonment, and challenges to the scale-up, spread, and sustainability of health and care technologies. *Journal of Medical Internet Research*, *19*(11). https://doi.org/10.2196/jmir.8775

Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough?: An experiment with data saturation and variability. *Field Methods*, *18*(1), 59–82. https://doi.org/10.1177/1525822X05279903

Gugnani, N., Pandit, I. K., Gupta, M., Gugnani, S., & Kathuria, S. (2024). Parental concerns about oral health of children: Is ChatGPT helpful in finding appropriate answers? *Journal of Indian Society of Pedodontics and Preventive Dentistry*, *42*(2), 104–111. https://doi.org/10.4103/jisppd.jisppd_110_24

Halboub, E., Hakami, R. A. M., Khalufi, K. N. A., Hakami, S. A. H., & Alhajj, M. N. (2025). Assessment of quality, understandability, actionability, and readability of responses of selected chatbots to the top searched queries about oral cancer. *Digital Dentistry Journal*, *1*(1), 100008. https://doi.org/10.1016/j.ddj.2025.100008

Helvacioglu-Yigit, D., Demirturk, H., Ali, K., Tamimi, D., Koenig, L., & Almashraqi, A. (2025). Evaluating artificial intelligence chatbots for patient education in oral and maxillofacial radiology. *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology*, *139*(6), 750–759. https://doi.org/10.1016/j.oooo.2025.01.001

Hunsrisakhun, J., Naorungroj, S., Tangkuptanon, W., Wattanasit, P., Pupong, K., & Pithpornchaiyakul, S. (2025). Impact of oral health chatbot with and without toothbrushing training on childhood caries. *International Dental Journal*, *75*(2), 1348–1359. https://doi.org/10.1016/j.identj.2024.09.028

Laranjo, L., Dunn, A. G., Tong, H. L., Kocaballi, A. B., Chen, J., Bashir, R., Surian, D., Gallego, B., Magrabi, F., Lau, A. Y. S., & Coiera, E. (2018). Conversational agents in healthcare: A systematic review. *Journal of the American Medical Informatics Association*, *25*(9), 1248–1258. https://doi.org/10.1093/jamia/ocy072

Laymouna, M., Ma, Y., Lessard, D., Schuster, T., Engler, K., & Lebouché, B. (2024). Roles, users, benefits, and limitations of chatbots in health care: Rapid review. *Journal of Medical Internet Research*, *26*, e56930. https://doi.org/10.2196/56930

Maruska, E. E., Elgreatly, A., Madaio, W., Razoky, K., Bay, C., & Mahrous, A. (2025). Comparing dentist and chatbot answers to dental questions for quality and empathy. *JADA Foundational Science*, *4*. https://doi.org/10.1016/j.jfscie.2025.100044

Mohammad-Rahimi, H., Ourang, S. A., Pourhoseingholi, M. A., Dianat, O., Dummer, P. M. H., & Nosrat, A. (2024). Validity and reliability of artificial intelligence chatbots as public sources of information on endodontics. *International Endodontic Journal*, *57*(3), 305–314. https://doi.org/10.1111/iej.14014

Montenegro, J. L. Z., da Costa, C. A., & da Rosa Righi, R. (2019). Survey of conversational agents in health. *Expert Systems with Applications*, *129*, 56–67. https://doi.org/10.1016/j.eswa.2019.03.054

Norman, C. D., & Skinner, H. A. (2006). eHealth Literacy: Essential skills for consumer health in a networked world. *Journal of Medical Internet Research*, *8*(2), e9. https://doi.org/10.2196/jmir.8.2.e9

Nutbeam, D. (2008). The evolving concept of health literacy. *Social Science and Medicine*, *67*(12), 2072–2078. https://doi.org/10.1016/j.socscimed.2008.09.050

Ozdemir, Z. M., & Yapici, E. (2025). Evaluating the accuracy, reliability, consistency, and readability of different large language models in restorative dentistry. *Journal of Esthetic and Restorative Dentistry*, *37*(7), 1740–1752. https://doi.org/10.1111/jerd.13447

Page, M. J., Moher, D., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … McKenzie, J. E. (2021). PRISMA 2020 explanation and elaboration: Updated guidance and exemplars for reporting systematic reviews. *BMJ*, *372*, n160. https://doi.org/10.1136/bmj.n160

Pagotto, L. E. C., Almeida, D. R. de M. F., de Santana Santos, T., & de Morais, E. F. (2025). Can chatbots provide accurate and readable information for patients with temporomandibular disorders? *Journal of Oral and Maxillofacial Surgery*, *83*(12), 1461–1469. https://doi.org/10.1016/j.joms.2025.08.012

Pithpornchaiyakul, S., Naorungroj, S., Pupong, K., & Hunsrisakhun, J. (2022). Using a chatbot as an alternative approach for in-person toothbrushing training during the COVID-19 pandemic: Comparative study. *Journal of Medical Internet Research*, *24*(10), e39218. https://doi.org/10.2196/39218

Pupong, K., Hunsrisakhun, J., Pithpornchaiyakul, S., & Naorungroj, S. (2025). Development of chatbot-based oral health care for young children and evaluation of its effectiveness, usability, and acceptability: Mixed methods study. *JMIR Pediatrics and Parenting*, *8*, e62738–e62738. https://doi.org/10.2196/62738

Rokhshad, R., Khoury, Z. H., Mohammad-Rahimi, H., Motie, P., Price, J. B., Tavares, T., Jessri, M., Bavarian, R., Sciubba, J. J., & Sultan, A. S. (2025). Efficacy and empathy of AI chatbots in answering frequently asked questions on oral oncology. *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology*, *139*(6), 719–728. https://doi.org/10.1016/j.oooo.2024.12.028

Santonocito, S., Cicciù, M., & Ronsivalle, V. (2025). Evaluation of the impact of AI-based chatbot on orthodontic patient education: A preliminary randomised controlled trial. *Clinical Oral Investigations*, *29*(5), 278. https://doi.org/10.1007/s00784-025-06356-8

Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., Burroughs, H., & Jinks, C. (2018). Saturation in qualitative research: Exploring its conceptualization and operationalization. *Quality and Quantity*, *52*(4), 1893–1907. https://doi.org/10.1007/s11135-017-0574-8

Sun, G., & Zhou, Y.-H. (2023). AI in healthcare: Navigating opportunities and challenges in digital communication. *Frontiers in Digital Health*, *5*. https://doi.org/10.3389/fdgth.2023.1291132

Taymour, N., Fouda, S. M., Abdelrahaman, H. H., & Hassan, M. G. (2025). Performance of the ChatGPT-3.5, ChatGPT-4, and Google Gemini large language models in responding to dental implantology inquiries. *The Journal of Prosthetic Dentistry*, *134*(6), 2427–2434. https://doi.org/10.1016/j.prosdent.2024.12.016

Thorat, V., Rao, P., Joshi, N., Talreja, P., & Shetty, A. R. (2024). Role of artificial intelligence (AI) in patient education and communication in dentistry. *Cureus, 16*(5), e59799. https://doi.org/10.7759/cureus.59799

Tudor Car, L., Dhinagaran, D. A., Kyaw, B. M., Kowatsch, T., Joty, S., Theng, Y.-L., & Atun, R. (2020). Conversational agents in health care: Scoping review and conceptual analysis. *Journal of Medical Internet Research*, *22*(8), e17158. https://doi.org/10.2196/17158

Wohlin, C. (2014). Guidelines for snowballing in systematic literature studies and a replication in software engineering. *Proceedings of the 18th International Conference on Evaluation and Assessment in Software Engineering*, 1–10. https://doi.org/10.1145/2601248.2601268

World Health Organization. (2021). *Global strategy on digital health 2020-2025*. https://www.who.int/publications/i/item/9789240020924
World Health Organization. (2022). *Global oral health status report: Towards universal health coverage for oral health by 2030*. https://www.who.int/publications/i/item/9789240061484
World Health Organization. (2025). *Oral health*. https://www.who.int/news-room/fact-sheets/detail/oral-health

Appendices

Appendix A

Thematic matrix of subthemes identified across patient interviews

Blue-highlighted cells mark the first occurrence of each subtheme in the dataset.

Themes	Subthemes	P1	P2	P3	P4	P5	P6	P7	P8	P9
Perceived Contribution to OH Education by Patients	Clarification and Doubt Resolution	x		x				x	x	x
	Preliminary Triage	x	x		x					
	Preventive and Routine Guidance				x	x				
	Reinforcement of Prior Professional Advice								x	
	Visual Support	x	x		x					
	Low-Complexity Use Contexts		x		x			x	x	
	Conditional Use	x	x						x	
	Perceived System-Level Benefits		x							
Perceived Benefits by Patients	Immediacy and Rapid Access	x			x	x		x		x
	Convenience and Practicality	x			x	x			x	x
	Clarification and Doubt Resolution		x	x		x			x	
	Preventive and Caregiving Support		x							
	Informational Consolidation				x					
	Conceptual Clarity						x			
	Emotional Reassurance							x		
Concerns and Perceived Limitations by Patients	Transparency Concerns	x			x	x				x
	Need for Critical Filtering			x	x					x
	Lack of Reliability			x						x
	Human Oversight and Autonomy Preservation		x		x					
	Overgeneralization and Lack of Personalization		x			x				
	Risk of Professional Substitution		x							
	Input–Output Misalignment						x			
	Habituation and Familiarity as Moderating Factors								x	
Dentist vs. Chatbot	Professional Authority and Clinical Legitimacy	x	x	x	x	x		x	x	x
	Complementary Role		x		x	x	x	x	x	x
	Situational Adequacy		x		x	x	x	x	x	x
	Context-Sensitive Clinical Judgment		x	x	x	x		x		
	Necessity of Physical Examination	x	x	x				x		x
	Anonymity		x	x	x			x		
	Relational and Human Dimension of Care	x					x			
	Relational Variability							x		
Factors Shaping the Effective Contribution of Chatbots to OH Promotion	Credibility and scientific grounding	x			x	x	x		x	x
	Defined scope and limits of use			x	x		x	x	x	
	Risk of misinterpretation				x		x	x	x	
	Integration within care pathways			x	x	x	x		x	
	Digital literacy	x	x				x	x	x	
Implementation Requirements	Evidence-based content and source validation	x			x	x	x			x
	Usability and intuitive design	x	x				x		x	x
	Professional oversight				x	x				x
	Content structure and conciseness		x	x	x		x			
	Visual Support	x		x	x				x	
	Linguistic accessibility and adaptation	x	x	x			x			
Future Use	Credibility and scientific grounding	x			x	x	x		x	x
	Conditional willingness to use	x	x	x	x	x	x		x	x
	Preference for specialized OH chatbot	x			x	x	x			x

Appendix B

Thematic matrix of subthemes identified across dentist interviews

Blue-highlighted cells mark the first occurrence of each subtheme in the dataset.

Themes	Subthemes	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Perceived Contribution to OH Education by Dentists	Conditional Use		x	x	x		x	x	x	x	x
	Preventive and Basic Hygiene Guidance				x	x		x			
	Complementary Role	x			x		x	x	x		
	Immediate Doubt Clarification Between Appointments	x	x						x		
	Rapid Access to Structured Information	x									x
	Digital Engagement of Younger Generations					x	x				
	Translation of Technical Knowledge into Lay Language			x							
	Visual Support					x					
Perceived Benefits for Patients by Dentists	Immediate Access to Information	x	x							x	x
	Clarification of Doubts and Reinforcement of Knowledge		x	x				x			
	Preventive and Basic Hygiene Guidance				x	x		x			
	Complementary Role			x					x	x	
	Visual support			x		x					
	Emotional Reassurance			x						x	
	Support for Shy or Reluctant Patients						x				
Perceived Benefits for Professionals	Reduction of Repetitive Educational Burden	x	x		x	x					
	Enhancement of Treatment Outcomes				x		x				x
	Improved Patient Baseline Knowledge				x					x	x
	Complementary Role	x								x	
	Time Efficiency		x								
Perceived Risks and Limitations	Misinformation and Inaccurate Content	x	x	x	x	x	x	x	x	x	x
	Conflict Between Digital and Professional Authority			x						x	x
	Overreliance			x						x	x
	Lack of Contextual and Individualized Assessment		x	x							
	Information Filtering and Source Credibility Concerns								x	x	
	Patient Misinterpretation							x			
	Information Overload						x				
	Potential Undermining of Therapeutic Adherence									x	
Professional Authority	Preservation of Clinical Autonomy		x		x	x	x		x		x
	Risk of Credibility Undermining	x		x							
	Perceived Devaluation of the Profession			x				x			
	Conditional Threat								x	x	
	Increased Professional Burden									x	
Perceived Patient Trust by Dentists	Age-Related Differences in Trust	x	x	x	x	x	x			x	x
	High Perceived Trust in Chatbot Information	x	x	x	x			x		x	x
	Socioeconomic and Educational Influences	x	x	x	x						
	Polarized Trust Profiles		x				x				
	Context-Dependent Trust								x		
	Limited Critical Appraisal		x				x	x		x	x
Factors Shaping the Effective Contribution of Chatbots to OH Promotion	Credibility and scientific grounding	x	x	x	x	x	x		x	x	x
	Defined scope and limits of use	x		x	x	x	x	x	x	x	x
	Risk of misinterpretation	x		x			x	x	x	x	
	Integration within care pathways		x		x		x	x		x	
	Digital literacy						x		x		x

Implementation Requirements	Evidence-based content and source validation	x	x	x	x	x			x	x	x
	Usability and intuitive design						x	x	x		
	Professional oversight	x		x		x			x		
	Content structure and conciseness				x		x	x			
	Visual support							x			
	Linguistic accessibility and adaptation						x				
Recommendation Intentions	Credibility and scientific grounding	x	x	x	x	x	x	x	x	x	x
	Non-recommendation at present	x	x	x	x	x	x		x	x	x

Appendix C

Interview guide for patients

A - Introduction

Thank you for participating in this interview. This study is being conducted as part of a Master's research project in Managing Digital Transformation in the Health Sector. The aim of this research is to explore perceptions, experiences, and attitudes toward the use of chatbots in OH education and patient support.

I would like to learn about your experiences with OH, digital technologies, and your thoughts about using chatbots for OH education. There are no right or wrong answers, I am only interested in your perspective. With your permission, I will record the audio so I can accurately capture your answers.

In this interview, when I say *chatbot*, I am referring to any kind of digital conversational system. This includes general AI chatbots such as ChatGPT, Gemini or Copilot, as well as any digital assistant that could be designed specifically for OH information or patient support. You may think about both types when answering the questions.

B - Sociodemographic data collected: Age, gender, profession, area of residence.

C - Interview Questions

Participant Characteristics

1. To start, could you tell me a little about your experience with dental care in the past?
   - How often do you usually visit a dentist?
   - How has your overall experience been?

2. How comfortable do you feel using digital technologies in general (smartphone, apps, websites)?
   - What do you normally use them for?
   - Any difficulties?

3. Have you ever used digital tools related to health (e.g., health apps, appointment systems, symptom checkers) for yourself or for someone you support as caregiver?

- What was useful or not so useful?

4. Before today, had you ever heard of or used a chatbot?
    - What kind of chatbot (e.g., customer service, healthcare)?
    - How was that experience?
    - Have you ever used any in the field of OH?

Questions Aligned with RQs

5. How do you imagine a chatbot could help with OH information or education?
    - What kind of guidance would be useful?
    - What situations come to mind?

6. What advantages do you think a chatbot could bring to you as a patient or caregiver?

7. And what concerns or limitations do you see in using such a tool?

8. How important is it for you that health information comes from a dentist or human professional, rather than from a chatbot?
    - In what situations could a chatbot be enough?

9. Do you feel that interacting with a chatbot might make you feel more comfortable or less judged compared to speaking directly with a dentist?

10. In your daily life, do you think you would use a dedicated OH chatbot? And would you also consider using a general AI chatbot like ChatGPT to ask questions about your OH?
    - Why or why not?
    - Which one would you prefer and why?

11. What features would make a chatbot more helpful or trustworthy for you?

12. What challenges might prevent you from using it?

13. Is there anything else you would like to add regarding chatbots or OH education?

Appendix D

Interview guide for dentists

A - Introduction

Thank you for participating in this interview. This study is being conducted as part of a Master's research project in Managing Digital Transformation in the Health Sector. The aim of this research is to explore perceptions, experiences, and attitudes toward the use of chatbots in OH education and patient support.

I would like to learn about your experiences with patient education, digital technologies in dental practice, and your views on the potential role of chatbots in OH promotion. There are no right or wrong answers, I am interested in your professional perspective and honest reflections.

In this interview, when I refer to a "chatbot," I mean any type of AI-based conversational system. This includes general AI chatbots such as ChatGPT, Gemini, or Copilot, as well as digital assistants that could be specifically designed to provide OH information or support patient education. You may consider both types when answering the questions.

With your permission, I will record the audio to ensure that your responses are captured accurately.

B - Sociodemographic data collected: Age, gender, geographic area of clinical practice

C - Interview Questions

Participant Characteristics

1. Can you briefly describe your clinical experience and the types of patients you work with?
2. How do you currently approach patient education in your practice and what strategies do you use most frequently? (e.g., verbal explanations, leaflets, models, apps…)
    - What works well and less well?
3. Have you used digital tools to support patient communication or education?
4. What experience do you have with chatbots, either in professional or personal contexts?

Questions Aligned with RQs

5. In your opinion, how could chatbots contribute to OH education?
    - Specific use cases in dentistry
    - Types of content or guidance they could provide

6. What potential benefits do you see for patients?

7. What potential benefits do you see for dental professionals?

8. What limitations or risks do you associate with chatbots in oral care?

9. Do you think that the use of chatbots in OH could in any way undermine or devalue the dental profession or affect professional autonomy?

10. To what extent do you believe patients would trust information provided by a chatbot?
    - Differences between age groups or socioeconomic status

11. What features or characteristics would a chatbot need to be credible and clinically useful?

12. Would you currently recommend the use of a chatbot to one of your patients for questions related to OH?

13. Is there anything else you would like to add regarding the use of chatbots in dentistry or patient education?

Appendix E

Sociodemographic, professional, and digital characteristics of patient participants

Participant	Age	Gender	Profession	Region of Residence	Dental Care Pattern	Digital Comfort Level	Use of Health Digital Tools	Chatbot Experience	Use of chatbots for OH
P1	39	Female	Nurse	Lisbon, Portugal	Biannual scaling; past frequent caries; caregiver (child in orthodontics)	High	Appointment booking; health apps	Heard of chatbots; limited use	No
P2	39	Female	Early Childhood Educator / University Lecturer	Lisbon, Portugal	Regular hygiene since childhood; caregiver of children	Moderate–High	Appointment booking; medical reports access	Positive ChatGPT experience	No
P3	31	Female	Dental Assistant / Student	Lisbon, Portugal	Annual/biennial cleanings; occasional caries	High	SNS app; teleconsultation	Uses ChatGPT	No
P4	41	Male	Personal Trainer / Teacher	Lisbon, Portugal	Past root canal + implant; caregiver of children (orthodontics)	Very High	Online booking; limited trust in symptom checkers	Frequent ChatGPT use	No
P5	39	Female	Data Analyst	Lisbon, Portugal	Regular follow-up; caregiver of children with dental conditions	Moderate	Appointment systems; symptom research	Uses ChatGPT	No
P6	39	Female	Early Childhood Educator	Lisbon, Portugal	Biannual preventive visits (periodontitis risk)	High	Hospital app; lab result interpretation	Regular ChatGPT use	No
P7	31	Female	Dental Assistant	Lisbon, Portugal	Annual cleaning; restorative treatments	Moderate–High	SNS app; prescription access	Uses ChatGPT	No
P8	39	Female	Social Worker	Lisbon, Portugal	Routine care; child orthodontic treatment	Moderate	Appointment booking apps	No chatbot experience	No
P9	39	Male	Civil Engineer	Lisbon, Portugal	Irregular attendance (~every 2 years); hygiene-focused	Moderate–High	Clinic/hospital apps for booking and exams	Very sporadic ChatGPT use	No

Appendix F

Sociodemographic, professional, and digital characteristics of dentist participants

Participant	Age	Gender	Location	Years of Experience	Main Area(s) of Practice	Patient Profile	Main Educational Strategy	Use of Digital Tools	Chatbot Experience
D1	40	Female	Lisbon, Portugal	~7–8 years (general dentist; later orthodontics)	Orthodontics (aligners, fixed appliances, interceptive treatment)	Children (4+) to older adults (~70)	Verbal explanation + drawings + online images/videos	Orthodontic apps; social media	Indirect (via patients); limited personal use
D2	33	Female	Lisbon, Portugal	Since 2017 (~9 years)	Orthodontics; functional orthopedics	Variable; different literacy levels	Verbal + images + printed leaflets	Social media (clinical examples)	Very limited; low confidence
D3	35	Female	Lisbon, Portugal	9 years	General dentistry	Adults and children (>5 years)	Verbal + images; "tell-show-do" technique	Google Images	Frequent personal use; none professional
D4	35	Female	Lisbon, Portugal	Since 2013 (~12 years)	Orthodontics + general dentistry	All ages; socioeconomically diverse	Verbal + physical models + images	None structured	Minimal
D5	41	Female	Grenoble, France	Since 2012 (~13 years)	General dentistry	2–99 years; currently more elderly	Verbal + physical models; occasional flyer	None	Rare professional use (once)
D6	30	Male	Lisbon, Portugal	6 years	General dentistry (endo, rehabilitation, prosthodontics)	Mainly adults	Verbal + photos + videos	Aware of apps but does not recommend	Frequent personal use (Gemini)
D7	32	Female	Lisbon, Portugal	Since 2019 (~6 years)	Endodontics + general dentistry	~60% adults / 40% children	Verbal + Google images + 3D models	None structured	Personal + occasional clinical use
D8	40	Male	Lisbon, Portugal	14 years	Rehabilitation & implantology	Mainly adults	Verbal + schematic drawings	Photos & short videos	Occasional personal use
D9	39	Female	Lisbon, Portugal	12 years	Restorative dentistry	Adolescents & adults; pediatric emergencies	Verbal + demonstrations + YouTube + social media	Educational videos; marketing content	Recent exploratory use
D10	39	Female	Lisbon, Portugal	14 years	Restorative dentistry	Adults (>14); pediatric emergencies only	Verbal + models + PowerPoint + Instagram	Instagram	Occasional personal use