REVIEW ARTICLE

Implementing Oral Hygiene Guidelines in Brazilian Primary Healthcare: Dentists' and Managers' Perspectives Study

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Abstract

Objective To evaluate dentists' and oral health managers' perceptions of the knowledge and influential components in implementing clinical practice guidelines (CPGs) for managing dental caries in Brazil's primary health care (PHC).

Methods A mixed-methods study was conducted in five municipalities in Mato Grosso do Sul, Brazil, combining qualitative interviews with eight key informants to explore perceptions about barriers and facilitators in the implementation of CPGs for the management of dental caries, analyzed based on the Consolidated Framework for Implementation Research (CFIR). The quantitative component included a questionnaire for 104 dentists in Primary Health Care (PHC) to identify determinant variables in implementing CPGs using the CFIR domains. In addition, it allowed her to explore her perceptions about oral hygiene guidelines in childhood. Multivariate regression analyses, performed in STATA 14.2 (College Station, TX, USA), were used to explore the association between sociodemographic characteristics of dentists and knowledge and adoption of CPGs.

Results Limited knowledge and resistance to innovation, especially among older professionals, were the main barriers, while effective communication, recognition of the need for change, and the use of opinion leaders emerged as significant enablers, partially corroborating the initial hypothesis. Most actors supported minimal interventions for dental caries and the adoption of CPGs in PHC, with 82.6% emphasizing the importance of scientific evidence. In addition, 87.6% of respondents believed that individual knowledge impacts the perception of CPG application, and half recognized the role of opinion leaders in disseminating and implementing the guidelines.

Conclusion Stakeholders recognize the benefits of minimal intervention in treating dental caries and advocate for using CPGs in PHC. The identified barriers and facilitators are critical in shaping the implementation of CPGs. Integrating these factors into implementation strategies is vital for improving health outcomes.

Keywords Dentistry · Clinical Practice Guideline · Family Health · Primary Health Care · Implementation Science

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Clinical Practice Guidelines (CPGs) are pivotal in supporting clinical decision-making through evidence-based recommendations, directly influencing the quality of care by guiding and assisting healthcare professionals (Black & Donald, 2001). Moreover, CPGs play a crucial role in healthcare system management by reducing service variability and aiding in cost containment (Eccles & Mason, 2001; van der Sanden, 2003; Faggion, 2012). Despite their recognized benefits, the integration of CPGs in dentistry remains limited due to concerns regarding their reliability, validity, accessibility, and effectiveness (Faggion, 2012; Listl et al., 2015).

Considering the high prevalence of dental caries, which generates a significant economic impact on global health

(Listl et al., 2015), current evidence in dentistry strongly advocates the use of noninvasive therapies or minimally invasive (MI) procedures for disease management. Furthermore, prevention of tooth decay in children and adolescents is considered a priority and more cost-effective than treatment (Marinho et al., 2016). Therefore, oral hygiene guidelines are part of any treatment plan in children's dental care, as they apply to all patients and are a standard measure for controlling cavities and other oral diseases, such as periodontal diseases (Brazilian Association of Pediatric Dentistry, 2020). Research indicates that there needs to be more knowledge about the attitudes, expectations, and opinions of those involved in implementing clinical practice guidelines regarding developing and using these guidelines for managing dental caries. Attention is predominantly focused on the scientific validity and quality of the guidelines; however, the factors that influence their use in clinical practice, such as barriers and facilitators, must be adequately evaluated (Grol et al., 1998; Anuwar & Ab-Murat, 2021). Therefore, there is a large gap between evidence-based recommendations and the practical applicability of current concepts (Lee et al., 2016; Sales et al., 2020). The reasons for these disagreements are complex, but several contributing factors include inconsistency in CPG between professional groups and differences in professional clinical conduct and dental education, which can often have outdated concepts (Banerjee et al., 2017). Even though there are several CPGs in dentistry, more is needed to know about the perception, expectations, and opinions of healthcare managers and dentists working in the public service regarding using CPGs in dentistry. Understanding the process for CPG success implementation and its context could help managers and policymakers to better implement in different scenarios from the organizational readiness aspects (Bomfim et al., 2020) until implementation at scale in other scenarios (Aiello et al., 2021).

This study aims to evaluate the perception of dental surgeons and oral health managers about the knowledge and influential components in implementing clinical practice guidelines (CPD) for managing dental caries in primary health care (PHC) in Brazil. This evaluation utilized the Consolidated Framework for Implementation Research (CFIR), a framework widely used in public health research that integrates previously published theories into a unified framework through a review of the scientific literature to guide implementation research. The CFIR categorizes several factors that can influence the success or failure of an intervention (Damschroder et al., 2009). The hypothesis tested was that the limitation of knowledge about CPGs and the resistance to innovations by the professionals involved, as well as the recognition of the need for change, good communication within the team, and the use of opinion leaders as facilitators, are relevant factors that could influence the

implementation of GPGs for the management of dental caries in PHC. This could improve the quality of oral health services in PHC within the regional context, with implications that could be studied and expanded across the entire Brazilian territory.

Methodology

Study Design

To investigate a multifaceted perspective, narratively and numerically, on the implementation of oral health policies in PHC, a parallel convergent design of two strands of mixed methods was implemented (Teddlie & Yu, 2007; Fetters et al., 2013). The combined approach allowed the development of themes based on the expectations and opinions of stakeholders about the facilitators and barriers to the implementation of GPCs in PHC (Creswell & Clark, 2011). Integrating qualitative and quantitative studies can also help understand social context and perceptions better, dramatically increasing the value of mixed-methods research (Creswell & Clark, 2011).

A mixed-method approach is characterized by integrating qualitative and quantitative methods in one or more phases of research (Moseholm & Fetters, 2017). In our study, the quantitative and qualitative approaches were applied simultaneously and were equally important (Creswell & Clark, 2017). Quantitative and qualitative data collection methods were used, and data collection for both approaches occurred in parallel, i.e., in the same period. Subsequently, the data were analyzed simultaneously and independently after the end of the data collection. Finally, the results of the two strands were integrated to identify convergences, divergences, and expansions (Moseholm & Fetters, 2017). As shown in Fig. 1.

To report and integrate our mixed-methods results, we adopt an integration approach through merging data and a narrative contiguous approach in which the results of each strand are presented in different sections: qualitative results followed by quantitative results. (Fetters et al., 2013).

Qualitative Research

This stage of the study aimed to investigate the perception of crucial informants (managers and dentists) about the main facilitators and obstacles to the implementation of CPGs for dental caries management in PHC. The conventional approach of content analysis and coding through the deductive approach based on the original CFIR was used to conduct this phase (Gale et al., 2013; Ritchie, 1994; Damschroder et al., 2009).

Fig. 1 Flowchart of convergent parallel mixed-method design implemented
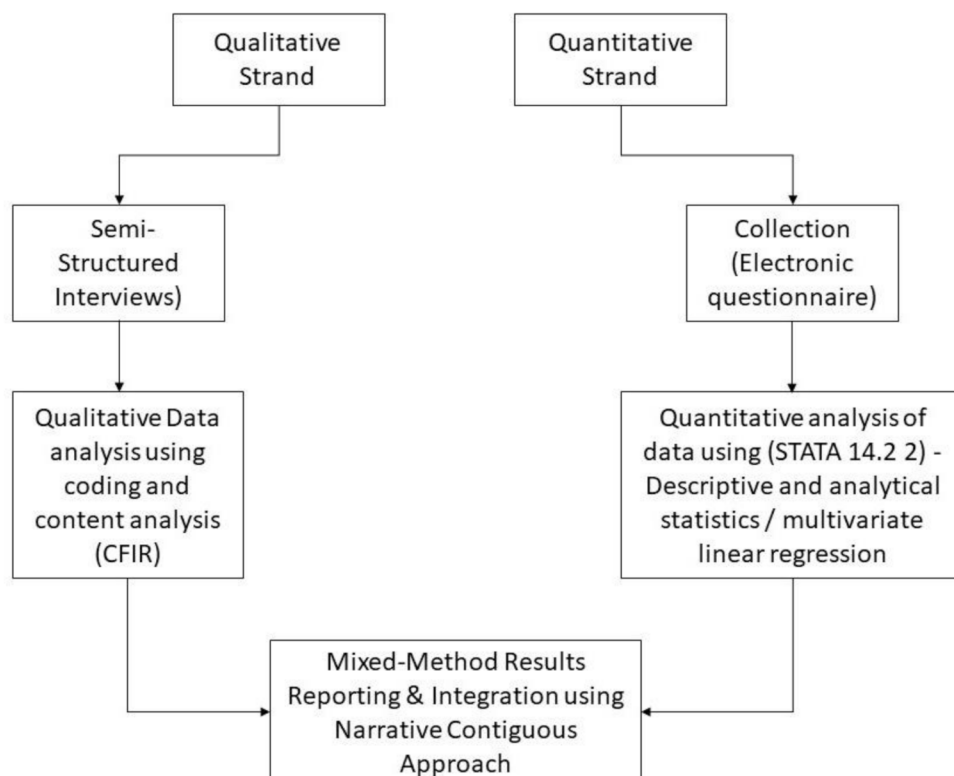
Period of Study

Primary data collection was conducted in five municipalities with over 80.000 inhabitants in Mato Grosso do Sul, Central-west, Brazil (2.757.013 inhabitants): Campo Grande (898.000 inhabitants), Dourados (24.000 inhabitants), Três Lagoas (132.000 inhabitants), Ponta Porã (92.000 inhabitants) e Corumbá (96.000 inhabitants (IBGE, 2022). The region is known for significantly contributing to the country's agribusiness economy. Data were collected from November 2021 to March 2023.

Qualitative Data Collection and Sampling

The qualitative component comprised interviews with eight key informants, selected for their extensive knowledge of the state's oral health policy and their representation of the region and specific professional roles. The informants included five oral health managers from significant cities (populations exceeding 80,000), one Indigenous Health District coordinator, and two dentists from Primary Healthcare (PHC). All interviews were conducted by the first author, woman, dentist, and researcher (HQNCL). The interviewer's ability to ask probing questions and sensitively manage interview dynamics ensured that the data collected were comprehensive and reflective of the participants' actual experiences. The expertise and ethical sensitivity of the

interviewer were paramount in maintaining the confidentiality and integrity of the research process, ensuring that participants' rights were upheld throughout the study. The influence of the interviewer's experience and role on the outcome of the qualitative research underscores the importance of thorough training and reflexivity in the qualitative research process.

Participants were recruited, interviews were scheduled via email and prior telephone contact, with no refusals. Interviews were conducted by a trained qualitative researcher (HQNCL), whose role extended to being an active listener, a facilitator of meaningful dialogue, and an interpreter of verbal and non-verbal cues, skills essential for uncovering nuanced insights (Kvale, 1996; Rubin & Rubin, 2011).

Inclusion Criteria

In this study, the criterion for sample selection was purposeful, targeting individuals with knowledge and experience relevant to the research topic (Palinkas et al., 2015; Bomfim et al., 2021). The selection of oral health managers as key informants was due to their responsibilities in technical structuring and operational support for executing actions and services in oral health, as well as the implementation of interventions such as technical and regulatory protocols (Brasil, 2018). Conversely, dentists provided insights from

the perspective of professionals involved in the practical application of the intervention.

Exclusion Criteria

Excluded from the study were health managers and coordinators unfamiliar with state health policy, dental surgeons, oral health managers, or coordinators who were unable to participate in the research due to general, mental, or psychological health reasons, those who were on vacation, had been withdrawn from work during the research period or were unable to participate in an interview recorded using audio resources.

A semi-structured script was prepared for the interview, containing ten guiding questions based on the original version of the CFIR (Damschroder et al., 2009). These questions primarily addressed barriers and facilitators in implementing CPGs in the oral health service, as well as the scope of the policy, perceptions of its effectiveness, and the need for contextual adaptation. Six interviews were conducted via videoconference; two were audio-recorded in person in a designated room at the interviewees' workplace. Each interview lasted approximately 30 min and was fully transcribed in Microsoft Word 2010 (Microsoft Corporation, Redmond, USA). Details of the transcription process can be found elsewhere (Bomfim et al., 2021).

Analysis of Qualitative Data

Themes were analyzed using support structures in implementation science, content analysis, and a broadly deductive approach based on the original version of the CFIR (Damschroder et al., 2009) for coding. Data were transcribed, identified, conceptualized, classified, and organized in a spreadsheet using Microsoft Excel 2010 (Microsoft Corporation, Redmond, USA) through a fragmented matrix in areas of domains located within this tool, thus facilitating the classification of barriers and facilitators for implementation.

The study employed the framework method for qualitative content analysis. This systematic and flexible grouping of procedures, proposed by Jane Ritchie and Liz Spencer from the Qualitative Research Unit at the United Kingdom's National Center for Social Research, has been used since the 1980s to conduct and analyze qualitative data. The method involves identifying differences and similarities in qualitative data before delineating relationships between different parts of the data, thereby deriving descriptive and explanatory conclusions grouped around themes (Gale et al., 2013; Ritchie, 1994).

The CFIR is a framework originally published in 2009 by Damschroder et al. and updated in 2022 based on user feedback (Damschroder et al., 2022), integrates previously published theories into a single consolidated theory through a review of the scientific literature to guide implementation research. This tool has become one of the most used instruments for planning and evaluating public health implementations (Damschroder et al., 2009). According to the CFIR, several factors can influence the success or failure of an implementation, categorized into the following domains: (1) Intervention characteristics; (2) Inner Setting – the internal environment in which the implementation is occurring; (3) Outer Setting – the economic, political, and social context within which an organization operates; (4) Characteristics of individuals; and (5) the Process (Damschroder et al., 2009).

Quantitative Research

This phase was a cross-sectional study. The objective of this phase was to identify dentists' perceptions of oral hygiene strategies in childhood and identify the facilitators and barriers to implementing CPGs for managing dental caries by PHC dentists.

Quantitative Data Collection and Sampling

This study was carried out with 104 dentists working in PHC in five municipalities in Mato Grosso do Sul, Midwest of Brazil (Campo Grande, Dourados, Três Lagoas, and Corumbá). Data were collected from November 2021 to March 2023.

Sampling and Sample Calculation

The sample calculation was carried out to representatively cover the macroregions, using the free software Open EPI Version 3.01 (openepi.com/SampleSize) and considering a total of 239 dentists working in PHC in the five largest cities (> 80,000 inhabitants) in the state. The parameters were a 95% confidence interval, a hypothetical frequency of 50% of the outcome factor in the population (p), an Alpha of 5%, and a nonresponse rate of 30%, totaling 148 dentists. The sample elements were selected for convenience.

Inclusion Criteria

The 239 dental surgeons working in PHC in the five largest cities were recruited and selected because they are responsible for the practical application of the CPG. The regions were chosen based on the representativeness of the cities (> 80,000 inhabitants) in Mato Grosso do Sul: Campo Grande, Dourados, Três Lagoas, Ponta Porã, and Corumbá (IBGE, 2022).

Exclusion Criteria

Excluded were dental surgeons who could not participate in the research, whether for general, mental, or psychological health reasons, those who were on vacation or away from work during the research, or those who were technologically unable to respond to the electronic questionnaire during the study period.

Data Collection

As part of the quantitative research, a questionnaire was created through Google Forms® and shared electronically with 239 dentists working in primary health care in the five largest cities of Mato Grosso do Sul. The questionnaire collected data on sociodemographic characteristics such as place of residence, gender, age group, length of professional activity, and type of professional activity. The predefined questions were based on the five domains of the CFIR (Consolidated Framework for Implementation Research) and a Guideline for Clinical Practice in Primary Health Care, including recommendations for oral hygiene in children.

The questionnaire was sent to dentists from a list made available by the State Department of Health via email and social media (WhatsApp©, Instagram©, Facebook©). There was also the collaboration of the oral health managers responsible in the state and municipalities, as well as the state dental class council, to spread the research. Participants were encouraged to further disseminate the survey link to their fellow dentists, thus employing a snowball-shaped convenience sampling strategy.

The questionnaire was applied electronically through Google Forms® and considered sociodemographic characteristics (location of residence, gender, age group, length of professional activity, type of professional activity) followed by eleven predefined questions based on the five CFIR domains and four questions about a Guideline for Clinical Practice in Primary Health Care: Recommendations for Oral Hygiene in Children. The five domains were Intervention characteristics (questions 4,5,11), Outer Setting (7), Inner Setting (1,6,8,9,10), Characteristics of individuals (3), and Process (2) (Damschroder et al., 2009). The four recommendations on oral hygiene in children are: (1) Teethless babies' mouths should not be cleaned; (2) Brushing with 1000ppm fluoride toothpaste should be done from the first tooth; (3) Brushing with fluoridated toothpaste at least twice a day should be performed to prevent and control tooth decay in children; (4) Dental floss should be used to prevent proximal cavities in children.

Each question in the questionnaire had five alternative answers according to a Likert scale (DeVellis, 2016) and based on the organizational readiness scale for implementing changes (ORIC-Br) (Bomfim et al., 2020). The assigned values were 1 (disagree), 2 (somewhat disagree), 3 (neither agree nor disagree), 4 (somewhat agree), and 5 (agree). To facilitate the interpretation of the tables, categories 1 and 2 were merged as 'disagree,' and categories 4 and 5 were merged into 'agree.'

Analysis of Quantitative Data

Quantitative data from the questionnaires were coded, tabulated, and entered into a Microsoft Excel 2010 (Microsoft Corporation, Redmond, USA) spreadsheet for further analysis using STATA 14.2 (College Station, TX, USA). Descriptive tables were generated to summarize participant characteristics, and multivariate linear regression models were applied to examine the associations between dentists' sociodemographic factors and the implementation and dissemination processes, based on the CFIR and CPG conceptual frameworks.

Ethical Considerations

The research was approved by the Human Research Ethics Committee of the Mato Grosso do Sul Federal University (protocol number = 51735221.2.0000.0021). All participants were informed about the objectives and methods of the research, as well as clarified that participation was voluntary and that they could withdraw at any time without penalty. They were also assured that their answers would be kept confidential and their identities would not be revealed in research reports or the publication of results. All of them signed the free and informed consent form electronically.

Results

Semi-structured Interviews

The critical informant participants ranged in age from 25 to 50 years, with the majority being women (75%). All had higher education degrees in dentistry, although only one lacked a specialization course. Participants freely discussed their roles within the organization, the strengths and weaknesses of the current healthcare system, their knowledge of and information about Clinical Practice Guidelines (CPG), and their views on minimal intervention in treating dental caries.

Organizational Barriers and Facilitators

Within the domain of intervention characteristics, the identified barriers included a lack of knowledge and concerns

about the scientific quality of these guidelines. Participant 1 remarked, "I have an idea of what it is, but I do not formally know." Similarly, Participant 2 stated, "I do not know what it is like, what its format is; I cannot say how it works or what its application would be like."

In this domain, two facilitators were recognized: the recognition of the instrument's advantages by the professionals involved and their familiarity with similar instruments. "I think it would be precious for us to provide guidance," said Participant 2. Participant 8 added, "We have already had contact with some guidelines, including those from the Ministry of Health." Participant 4 mentioned, "I do not know the specific term, but maybe you are talking about those guidelines, the procedures to be carried out in each situation."

To facilitate the tool's implementation in the service, interviewees suggested that reliable institutions should develop the instrument and offer practical, accessible, feasible, and adaptable benefits within the context. Participant 5 explained, "What facilitates a guideline? If the credibility of whoever is creating it is good," and "The feasibility of doing what is written." They added, "Being practical and simple, I think it might work." Participant 3 noted, "I think it would be very valid, as long as it is not rigid so that the professional can adapt it according to the reality of the population they know."

In the second domain, the outer setting, encouragement from external agents, such as state and federal governments, was seen as a facilitator. Conversely, the lack of such an incentive was identified as a barrier. "Our system works, but we need to improve it. The main issues relate to general bureaucracy, investments in working conditions, and permanent materials," explained Participant 3. Participant 4 commented, "In oral health, sometimes we lack that voice, that access, that support, which is necessary to do good work."

The third domain, the inner setting, exhibited the highest number of barriers and facilitators. Identified barriers included the organization's lack of internal incentives, limited financial resources, insufficient time for training professionals, work overload, and neglect of professional support. "It is a huge amount of work and just for me," lamented Participant 4. "They do not allow you to specialize here," stated Participant 7. Participant 8 considered, "Considering the need for training, I think face-to-face training would be the most difficult because we have to move all dentists, which incurs costs and scheduling issues."

Conversely, five potential facilitators were found, four inherent within the organization: managers' recognition of the need for change within the current system, high-quality communication, the existence of organizational goals, and the prior development of actions similar to the CPG. The primary facilitator cited was the training and qualifications of the instrument, with participants suggesting feasible and cost-effective strategies. "Our primary care still needs to be more effective, in prevention and promotion, but also in offering treatment to patients as early as possible, which is not happening," stated Participant 2. "I constantly communicate with them, sending messages in groups, trying to provide this support, managing logistics somewhat remotely," they added. Participant 1 said, "We have a target for assistance at the first consultation; we have indicators for pregnant women, which is part of 'PrevineBrasil.'" They also asked, "What can make it easier to implement? The capabilities, right?"

In the fourth domain, the characteristics of individuals, three barriers, and one facilitator were identified for implementing CPG. The barriers were related to resistance from professionals, especially those with more extended experience, difficulties for dentists in understanding similar instruments provided by the Ministry of Health, and a misunderstanding of the importance of CPG within the service. Conversely, the work team's good acceptance of innovations was a significant facilitator in this domain. "Everything that requires reading a lot or a little extra time creates resistance," observed Participant 6. "I see a small portion, although they are the oldest ones, who have some resistance," noted Participant 2. "When the guideline was sent, some dentists had difficulties understanding it, and there were different interpretations," reported Participant 8. "But I think it would be well accepted," concluded Participant 3.

In the process domain, the sole identified barrier was the difficulty in providing feedback on information relevant to clinical practice. As facilitators, the existence of planning to develop actions within the organization and leaders (managers) responsible and designated to implement guides within their organizational competence were noted, along with their willingness to support and contribute to the CPG implementation process. Some interviewers suggested that opinion leaders could act as facilitators. "We try to achieve reach through monitoring who signs up, who completes the courses, and who sends these certifications; we cannot assess their internal impact on their clinical practice," explained Participant 4. "When we identify a need, organizational or clinical, we intervene in the construction or organization of clinical protocols, as well as their review," they continued. "Our biggest responsibility is the work process, so we organize the entire work process, from scheduling to reception and final treatment," said Participant 6. "Working together with them to provide guidance, explanations, everything that comes from the Ministry of Health, protocols, guides, and everything else, we mediate with the dentists," stated Participant 8. "A training course with a professional who has a template might help," suggested Participant 1.

Barriers and Facilitators in the Minimally Invasive Management of Dental Caries

In the domain of individual characteristics, barriers identified in the reports included professionals' insecurity about the technique, lack of interest, inadequate updates, and resistance to paradigm changes. Participant 3 highlighted, "For me, the barrier is not mastering the technique, which instills fear in professionals." They added, "If you do not master the technique, you lack confidence in its validity." Participant 1 pointed out, "The difficulty lies in updating protocols, which requires training, qualification, and regular updates of these professionals." Participant 4 observed, "Many professionals hold onto previous criticisms and are unwilling to consider new paradigms or techniques, particularly regarding cavities."

However, a facilitator within the intervention characteristics domain was that the involved parties believed in the benefits of minimal intervention for treating dental caries and supported its adoption. Recognition of the need to change the current disease management was another facilitator in the inner setting domain of the CFIR. Participant 1 noted, "We already have scientific evidence that this is an outdated technique, often due to professionals' lack of knowledge." Participant 6 expressed mixed feelings: "I am in favor of preserving as much as possible, as minimally as possible, but I am not sure…".

Quantitative Research Results (Questionnaire)

The response rate among dentists was 70% ($N = 104$). Table 1 describes the characteristics of the participating dentists: 68.9% were female, the average age was 36 years (SD = 8.7), 58.3% worked exclusively as general dentists, and 41.7% were specialists. Notably, 41.3% of the dentists had been trained for more than 15 years, 32.7% had 6 to 15 years of training, and 26% had up to 5 years of training.

Table 1 Characteristics of dentists ($n = 104$)

	N	%
Sex		
Female	71	68.9
Male	33	31.1
Type of professional activity		
General practitioner	60	58.3
Specialist	44	41.7
Time since graduation		
Up to 5 years	27	26
6–15 years	34	32.7
Over 15 years	43	41.3
Mean age (sd)		
36.8 (8.7)		

Note. Participants were on average 36.0 years old (SD = 8.7), and participant age did not differ by condition

Table 2 presents results within the CFIR domains. Most professionals (82.6%) believed that scientific evidence on the effectiveness of these guidelines is necessary, and 85% felt that the strength and quality of the evidence should be improved. Nearly half (42%) found the implementation of the CPG very complex. In the multivariate linear regression analysis (Table 3), a significant result was only found in the association of the complexity construct with the type of professional activity ($p > 0.05$), where experts more frequently disagreed that implementing a CPG in PHC is complex ($p = 0.01$).

Within the domain of individual characteristics, 87.6% believed that individual knowledge affects the perception of applying CPG in practice. The association test of this subconstruct with the characteristics of dentists showed no statistical significance (chi-square test, $p > 0.05$). In the outer setting, about 70% agreed that infrastructure (structural characteristics) can facilitate or hinder the implementation of CPG in PHC. A statistically significant association ($p > 0.05$) was shown in Table 3, only in association with the training time of dentists. Dentists who graduated 6–15 years ago showed more contradiction about the influence of infrastructure on the implementation of CPG in PHC ($p = 0.05$).

In terms of the inner setting domain, within the readiness for implementation subconstruct, more than half (57.7%) of dentists had information or evidence showing the applicability of CPG in their work environment (access to information and knowledge); however, 27.9% disagreed with the availability of technological support, such as printed and virtual materials, within the organization for the applicability of these instruments (available resources). Regarding the relationship and communication network within the organization, 42.7% agreed, and 42.7% disagreed that team meetings are frequently held for discussing and implementing innovations. Additionally, 42.1% of dentists disagreed that there are reference people within the organization to discuss new actions or solve problems in the oral health service. Regarding the implementation climate, almost all dentists (84.5%) recognized the need to implement a CPG to manage dental caries within PHC (tension for change). There was a statistically significant association (chi-square test, $p < 0.05$) between professional training time and two sub-constructs related to implementation readiness: access to information and knowledge and available resources (Table 3). Professionals trained between 6 and 15 years have less information and perceive less applicability of CPG ($p = 0.05$). Those with more than 15 years of experience feel the organization is unprepared for the available resources for the applicability of these instruments ($p = 0.02$).

In the last CFIR domain process, within the engagement sub-construct, 50% of respondents agreed that the dissemination and implementation of the CPG come from other

Table 2 Public health dentist responses by CFIR Domain ($N = 104$)

CFIR DOMAINS	DENTISTS	
	n	%
1. Inner setting -> Do you have information or evidence about CPG?		
Disagree	27	25.9
Neither disagree nor agree	17	16.4
Agree	60	57.7
2. Process -> engagement > opinion leaders -> Information about the implementation of the CPG comes from other people		
Disagree	23	22.1
Neither disagree nor agree	29	27.9
Agree	52	50
3. Characteristics of individuals -> self-efficacy -> Individual knowledge influences the perception of the applicability of these instruments		
Disagree	6	5.7
Neither disagree nor agree	7	6.7
Agree	91	87.6
4. Intervention characteristics -> Scientific evidence on the effectiveness of applying these guidelines is needed to be implemented in oral health services		
Disagree	9	8.7
Neither disagree nor agree	9	8.7
Agree	86	82.6
5. Intervention characteristics -> The implementation of the guides in clinical practice in the context of PHC is considered complex.		
Disagree	35	33.7
Neither disagree nor agree	25	24
Agree	44	42.3
6. Inner setting -> implementation readiness -> There are support technologies available (printed and virtual materials…) to assist the applicability of the guides		
Disagree	29	27.9
Neither disagree nor agree	19	18.5
Agree	56	53.6
7. Outer setting -> structural characteristics can facilitate or hinder		
Disagree	13	12.6
Neither disagree nor agree	18	17.5
Agree	73	69.9
8. Inner setting -> Frequent team meetings are held to discuss and implement new technologies		
Disagree	44	42.7
Neither disagree nor agree	15	14.6
Agree	44	42.7
9. Inner setting -> There are reference people to discuss new actions or solve problems in the service		
Disagree	30	30
Neither disagree nor agree	29	27.9
Agree	45	42.1
10. Inner setting -> tension for change -> There is a need to implement CPG in the management of dental caries in PHC	3	2.9
Disagree	13	12.6
Neither disagree nor agree	88	84.5
Agree		
11. Intervention characteristics -> strength and quality -> CPG can be improved		
Disagree	5	4.8
Neither disagree nor agree	14	13.5
Agree	85	81.7

people (opinion leaders). No significant association of variables (Table 3) with this domain was found (chi-square test, $p > 0.05$).

The results related to the Guideline for Clinical Practice in Primary Health Care: Recommendations for Oral Hygiene in Children are summarized in Table 4. Nearly 60% of dentists disagreed with the guideline, which does

Table 3 Multivariate Regression Analysis of CFIR, CPG, and dentists' sociodemographic characteristics in Mato Grosso do sul ($n = 104$)

CFIR Domains	1. Inner setting		2. Process		3. Self-efficacy		4. Intervention		5. Complexity		6. Readiness		7. Outer setting (structural)		8. Team Meetings		9. Opinion leaders		10. Tension for change		11. Strength	
	β	p	β	p	β	p	β	p	β	p	β	p	β	p	β	p	β	p	β	p	β	p
Sex																						
Female	Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Male	0.00	0.99	−0.30	0.27	−0.34	0.12	−0.12	0.61	−0.16	0.57	0.01	0.98	−0.26	0.30	−0.20	0.53	−0.04	0.88	−0.30	0.13	−0.16	0.45
Time since graduation																						
Up to 5 years	Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref	
5–15 years	**−0.70**	**0.05**	−0.46	0.19	−0.39	0.17	−0.26	0.38	−0.10	0.78	−0.46	0.22	**−0.58**	**0.05**	−0.19	0.63	−0.07	0.85	−0.35	0.17	0.00	0.99
Over 15 years	−0.32	0.36	−0.45	0.16	−0.12	0.65	−0.05	0.86	−0.20	0.56	**−0.91**	**0.02**	−0.26	0.40	−0.07	0.85	−0.15	0.64	−0.08	0.64	−0.10	0.67
Type of professional activity																						
General dentist	Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Specialist	−0.23	0.44	0.35	0.20	−0.15	0.47	−0.30	0.20	**−0.77**	**0.01**	0.45	0.12	−0.18	0.48	0.32	0.31	−0.15	0.60	−0.06	0.64	−0.26	0.26

Note. β (beta): In regression analysis, β refers to regression coefficients. These coefficients represent the expected change in the response (dependent) variable for each unit of change in the independent variable, keeping all other variables constant. Each independent variable has its β coefficient in the regression

p-value (p): The *p*-value is a statistical measure that helps determine the significance of a result on a statistical test. In many cases, it is used to test the null hypothesis that an independent variable has no significant effect on the dependent variable in a regression model. A *p*-value less than a given significance level (<0.05) usually indicates that the variable is statistically significant in the model. In other words, a low *p*-value suggests that the independent variable is significantly associated with the dependent variable

Adjusted R²: Inner Setting (0.23); Process (0.32); Self-Efficacy (0.18); Intervention (0.22); Complexity (0.22); Readiness (0.15); Outer (0.21); Team (0.32); Opinion Leaders (0.22); Tension (0.17); Strength (0.24)

Table 4 Dentists' perception of children's oral Hygiene recommendations (N=104)

	DENTISTS	
	n	*%*
1. You should not clean your baby's mouth without teeth		
Disagree	61	59.2
Neither disagree nor agree	8	7.8
Agree	34	33
2. Brushing with 1000ppm fluoride toothpaste should be carried out since the first tooth		
Disagree	26	25
Neither disagree nor agree	10	9.6
Agree	68	65.4
3. Brushing with fluoridated toothpaste at least twice a day should be carried out to prevent and control tooth decay in children		
Disagree	7	5.8
Neither disagree nor agree	2	1.9
Agree	95	92.3
4. Dental floss doesn't have to be used to prevent proximal cavities in children		
Disagree	7	5.8
Neither disagree nor agree	2	1.9
Agree	95	92.3

Table 5 Multivariate regressions: perception of children's oral Hygiene CPG and Sociodemographic Characteristics of Dentists, in Mato Grosso do sul (n=104)

Clinical practice Guidelines	1. Not Clean baby teeth		2. Brushing Fluoride toothpaste		3. Brushing twaice a day		4. Use of Dental floss	
	β	*p*	β	*p*	β	*p*	β	*p*
Sex								
Female	Ref		Ref		Ref		Ref	
Male	**−0.96**	**0.008**	**−0.70**	**0.04**	−0.22	0.42	−0.22	0.27
Time since graduation								
Up to 5 years	Ref		Ref		Ref		Ref	
5–15 years	0.05	0.91	−0.21	0.62	0.31	0.32	−0.45	0.08
Over 15 years	0.10	0.81	−0.61	0.13	0.01	0.96	**−0.50**	**0.03**
Type of professional activity								
General dentist	Ref		Ref		Ref		Ref	
Specialist	0.27	0.43	−0.22	0.42	0.00	0.99	**0.43**	**0.03**

Note. β (beta): In regression analysis, β refers to regression coefficients. These coefficients represent the expected change in the response (dependent) variable for each unit of change in the independent variable, keeping all other variables constant. Each independent variable has its β coefficient in the regression

p-value (*p*): The *p*-value is a statistical measure that helps determine the significance of a result on a statistical test. In many cases, it is used to test the null hypothesis that an independent variable has no significant effect on the dependent variable in a regression model. A *p*-value less than a given significance level (< 0.05) usually indicates that the variable is statistically significant in the model. In other words, a low *p*-value suggests that the independent variable is significantly associated with the dependent variable

not recommend oral hygiene for babies without teeth. In the test of association of variables (Table 5), the sex variable had statistical significance ($p > 0.05$), where men disagreed more with this recommendation ($p = 0.008$). Regarding the recommendation of brushing with 1000ppm fluoride toothpaste from the first tooth, 65.4% of dentists agreed with the guideline. Male professionals disagreed with this information ($p = 0.04$) (Table 5). Most dentists (81.7%) agreed with the guideline recommending brushing with fluoride toothpaste at least twice daily to prevent and control tooth decay in children. The multivariate linear regression analysis test found no statistical significance

($p < 0.05$) for this question. Regarding the recommendation of flossing to prevent proximal caries in children, the result was almost unanimous, with 92.3% agreeing with this recommendation (Table 4); however, the guideline presents contrary recommendations. According to the linear regression test (Table 5), professionals who have been trained for more than 15 years disagree more with this recommendation ($p = 0.03$), and specialists are more favorable ($β = 0.43$).

Discussion

Utilizing the original CFIR (Damschroder et al., 2009) as a tool in implementation science, this study offered essential insights into barriers and facilitators of implementing clinical guidelines in oral health within primary care. Participants highlighted the significant barriers of lack of knowledge and perceived scientific quality of the guidelines while also acknowledging the potential benefits when guidelines are developed by credible institutions and presented practically. Within the organizational context, the lack of internal incentives and limited financial resources were identified as barriers, whereas recognition of the need for change served as an enabler. Resistance among the most experienced professionals and a lack of information/knowledge about CPGs were noted as individual barriers; however, acceptance of innovations was seen as a facilitator. A significant facilitator was the use of opinion leaders to enhance the dissemination of scientific evidence, alongside consistent training of dentists to implement, disseminate, and scale strategies for more effective dissemination of scientific evidence. The findings align with previous studies that point to the need for adaptive strategies to overcome resistance to innovation (Correa et al., 2020. The importance of opinion leaders in the dissemination of DPCs suggests that their integration into implementation plans can be crucial for success in PHC (Kilsdonk et al., 2017; Correa et al., 2020; Pratt et al., 2022).

The quantitative results revealed a need to improve the quality and applicability of CPGs, showing a significant association between the duration of training and the type of professional activity among dentists. It was noted that the longer the professional experience, the less information there is about CPGs; additionally, specialists found their implementation less complex. Regarding perceptions of CPGs on oral hygiene in children, significant associations were also observed relating to gender, with men and more experienced professionals being more likely to disagree with this guideline.

Incorporating scientific evidence into clinical practice requires examining the characteristics and specificities of the context to identify potential variables. This study demonstrated that recognizing barriers and facilitators among key stakeholders is crucial for understanding the scenario and adapting interventions based on the collected information (Glasgow & Emmons, 2007; Nilsen, 2015; Damschroder et al., 2009). The results underscored essential considerations for implementing CPGs within PHC dental services.

Other studies (Kilsdonk et al., 2017; Correa et al., 2020; Pratt et al., 2022) have identified resources such as training courses and the role of opinion leaders as main facilitators. Most dentists and interviewees concurred that the dissemination and implementation of CPGs are often driven by others, highlighting the facilitative behavior of opinion leaders during training. Further training in guideline application can significantly enhance practitioner adoption (Harrison et al., 2013). Moreover, most dentists reported having access to technological support within their organizations to facilitate using these guidelines.

The role of opinion leaders as internal agents of change and disseminators of scientific evidence is widely discussed in the literature (Flodgren et al., 2019). These respected individuals disseminate information and influence others, acting as persuasive agents of behavioral change. Such leaders play a crucial role in interpreting the evidence behind best practices and fostering behavioral change among individuals (Pratt et al., 2022). Through a systematic review, Flodgren et al. (2019) suggest that opinion leaders can significantly influence healthcare professionals to adhere to evidence-based clinical practices.

Dentists and managers supported minimal intervention in managing dental caries, although concerns about technical skills were reported. Some attributed this to the need for more regular professional updates. Enhancing training could improve adherence to minimally invasive dentistry techniques. Sales et al. (2020), which is supported by this study's findings on implementing CPGs. Proper training in minimally invasive techniques generally results in dentists favoring conservative therapies for treating caries (Santamaria et al., 2014).

Correa et al. (2020) emphasized the importance of effective communication within work teams, noting that good communication facilitates guideline implementation. They also highlighted the role of committed leadership in supporting CPG implementation and fostering a change-friendly culture. The fundamental role of multidisciplinary teams as facilitators was also noted, as they are crucial in developing implementation strategies and reminders. Extensive outreach, education, and training were recommended to enhance understanding of evidence-based recommendations, along with the suggestion that guides could include helpful apps, charts, flowcharts, and easy-to-access information. Clarkson (2004) and Long et al. (2014) also support using technology to aid the implementation of innovations.

Contradictions were noted between the qualitative and quantitative findings regarding the quality of communication and relationships within services. While the qualitative study revealed good quality communication and relationships within organizations, quantitative research indicated that this was not consistently the case. Most dentists disagreed with the presence of reference individuals within the organization to discuss innovations and resolve issues. Kapp's (2012) study found that successful innovation implementation often requires supportive measures such as

phone, email, or in-person assistance and space for sharing experiences.

However, a significant barrier identified in the qualitative and quantitative analyses was the need for more information about CPGs. This aligns with findings from other studies (Kilsdonk et al., 2017; Mathieson et al., 2019) and a meta-review (Correa et al., 2020) that explored barriers and facilitators to CPG implementation across various health areas. The need for more guidelines in the dental field and their poor dissemination justify the underutilization of CPGs by dental professionals. In the Brazilian context, the availability of CPGs in dentistry remains limited. An alternative might be adapting internationally available documents rather than creating new guidelines, thereby developing updated guidelines suitable for the local context (Harrison et al., 2013). Ainol and Norintan (2021) propose a trans-contextual adaptation for the development of local guidelines when resources are limited and local evidence is insufficient.

The qualitative analysis identified challenges related to organizational functionality and available resources, including lack of time for training, insufficient financing, and inadequate human resources training. Similar issues were noted in a meta-review (Correa et al., 2020), which found consistent evidence that the absence of a leader or advocate for the implementation process within organizations, lack of time among health professionals, lack of clarity, lack of credibility, and lack of knowledge of CPGs are the most common barriers. Clarkson (2004) and Long et al. (2014) also identified several barriers recognized by professionals, including lack of time, lack of interest, lack of involvement, lack of information, lack of remuneration, and loss of professional employment and autonomy, among others.

Both analyses in this study acknowledged that professionals with more extensive training exhibited excellent resistance to changes and identified more barriers, believing that the service is underprepared regarding resources needed to implement the guidelines. Education and motivation create awareness and facilitate implementation. Therefore, developing specific strategies with this group of professionals can raise awareness (Long et al., 2014; Birgand et al., 2015; Correa et al., 2020). Additionally, this study and Correa et al. (2020) found that a professional's knowledge significantly influences the adoption of a CPG, emphasizing the need for ongoing education.

There were also discrepancies between the CPG and recommendations on oral hygiene in childhood provided by the Ministry of Health, indicating that professionals are not up-to-date with scientific evidence regarding the prevention and control of dental caries. This could mean that even when guidelines are available, professionals may not consult these documents. Seiffert et al. (2018) evaluated and determined the quality of 22 guidelines, finding that the lowest-scoring domain was applicability (AGREE II). This low score is likely due to insufficient information in the guidelines and a lack of consideration for economic analysis in their implementation. These findings are consistent with those presented in this study, suggesting that merely having these tools available is insufficient. This underscores the importance of further training, especially for highly educated professionals who often disagree with the guidelines.

Primary and oral health care is directly linked to the evolution of the quality of factors that affect the health-disease process, which is influenced by social, political, and economic issues. Considering the PHC model in Brazil, investing in care technologies that will be used in health production is essential. Focusing on soft and soft-hard technologies is necessary for the service to deliver care effectively (Franco et al., 2004). CPGs are considered light-hard technologies, guiding the production and management of care and serving as tools to improve work processes and deliver integrated and qualified health care (Baggio et al., 2010; França et al., 2019).

According to the results of this study, the target actions for implementing guidelines should be directed towards the "outer setting" through the contribution of public policies and government incentives. These could significantly support the CPG, both for dissemination and the allocation of financial resources and training, allowing socio-political and organizational health barriers to be overcome by strengthening organizational governance mechanisms. Sectors responsible for promoting health care quality in organizations could engage leaders or advocates to encourage the use of CPG and allocate financial and structural resources to facilitate interdisciplinary work, research, study, and implementation. Thus, healthcare organizations could develop manuals and protocols to implement CPGs (Correa et al., 2020).

Strengths and Limitations

This study's strengths include using mixed methods for data collection, analysis, and integration, which enhanced understanding of the research problem. The CFIR provided a set of standard principles to understand and anticipate challenges independent of the context (Damschroder et al., 2009). As described, the operational challenges related to implementation resources were categorized using the CFIR, which helped identify barriers and facilitators. However, no previous study using this framework focused on implementing CPG in dentistry.

The limitations are related to the design of the quantitative study and the sample used. Although a significant sample with valid questionnaires was obtained, the targeted

sample size was not reached due to difficulty in gathering responses. It should be noted, however, that a considerable response rate (70%) was achieved. This issue is inherent in studies that involve primary data collection through questionnaires. The non-probabilistic nature of the sample limits the generalizability of the findings. Another limitation was the participants' unfamiliarity with the CFIR instrument used to categorize information in the qualitative segment. The CFIR's predefined subjective domains meant that some information might not have perfectly fit into the analyzed constructs. Despite these limitations, the study provided valuable insights into implementing CPGs in the context of PHC.

The use of questionnaires without validation in implementation research based on the original version of the CFIR may also represent a limitation in the scientific rigor of the implementation studies. However, the CFIR remains a comprehensive framework that provides a structure for assessing multiple aspects and contexts of health interventions, including the characteristics of the intervention, the processes of implementation, the individuals involved, and both the internal and external contexts (Damschroder et al., 2009).

An update to the CFIR was published in 2022 (CFIR 2.0) (Damschroder et al., 2022), reflecting feedback from users of the framework. The updates include revisions to the names and definitions of the domains and constructs, the addition of structure- and domain-level guidance to clarify information and correct inconsistencies found in the original CFIR, and the reorganization of the constructs. This involved the relocation of constructs, the separation of single constructs into multiple constructs, and the combination of multiple constructs into single constructs. These changes address significant criticisms of the CFIR, including improved centralization of the recipients of innovations and the addition of determinants for equity in implementation. Although the updated version contains many new elements, the constructs can still be mapped according to the original version of the CFIR to ensure consistency over time. For future research, it is recommended that the updated version be used.

Implications

The significant impact of dental caries on healthcare systems highlights the increasing need to develop guidelines to manage this condition effectively. They are identifying effective strategies for implementing these guidelines (Brusamento et al., 2012). The use of guidelines for managing dental caries represents a promising and potentially effective approach within the PHC environment. This study provides several recommendations that should be considered in designing CPGs in dentistry and developing strategies for their implementation within PHC oral health services:

- Develop guidelines based on international preexisting documents through updating and cross-cultural adaptation.
- Train and calibrate the use and incorporation of this tool by everyone involved in the workflow to optimize its implementation.
- Employ professional awareness methods to promote changes in the work process.
- Provide support either by phone, email, or in person, and create space to share experiences about the guidelines.
- Identify and leverage opinion leaders to influence healthcare professionals to comply with evidence-based clinical practice and contribute to changing individuals' behaviors.

In addition, the results found are of great relevance and informative for future studies in other Brazilian contexts.

Conclusion

Stakeholders recognize the benefits of minimal intervention in treating dental caries and support the use of Clinical Practice Guidelines (CPGs) in Primary Health Care (PHC). This study confirms that several challenges must be addressed, including improving access to CPG documents, overcoming resistance to innovation among dental professionals, improving resource allocation for professional calibration, and promoting readiness for implementation. Hiring opinion leaders to promote the dissemination of scientific evidence, along with investments in continuing education and ongoing training for service professionals, would facilitate the implementation process.

The barriers and facilitators identified in this study are key factors influencing the implementation of evidence in clinical practice. Considering these factors when developing implementation strategies within the service is promising for effecting changes in the work process and enacting effective behaviors. It is recommended that future oral health policies in PHC incorporate these facilitators to improve the quality of care and, consequently, improve patient health outcomes.

Declarations

Competing Interests The authors declare that they have no competing interests.

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