ORIGINAL REPORT: QUALITATIVE RESEARCH

Stakeholder Assessment of Evidence-Based Guideline Dissemination and Implementation in a Dental Group Practice

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Abstract: **Objective:** This evaluation captures the perspectives of multiple stakeholders within a salaried dental care delivery organization (dentists, dental assistants, dental hygienists, and dental management) on the implementation of a pit-and-fissure sealant guideline in the Kaiser Permanente Dental Program. Also assessed is the role of formal processes and structures in providing a framework for guideline implementation.

Methods: We collected qualitative data through field observations, stakeholder interviews (n = 6), and focus groups (30 participants in 5 focus groups). Field observation notes captured summaries of conversations and other activities. Interviews and focus groups were recorded and transcribed. We analyzed transcripts and field notes using a template analysis with NVivo 12 software to

identify themes related to the existing implementation process of clinical guidelines and stakeholder perspectives on the strengths and weaknesses of this process.

Results: Stakeholders perceived 2 main barriers for achieving implementation of the pit-and-fissure sealant guideline: 1) shortcomings in the implementation infrastructure resulting in lack of clarity about the roles and responsibilities in the guideline implementation process and lack of effective mechanisms to disseminate guideline content and 2) resource constraints, such as limited human, space, and material resources. Perceived opportunities for the dissemination and implementation of guidelines included recognition of the importance of guidelines in dental practice and well-functioning workflows within dental specialties.

Conclusion: Our research points to the importance of developing and maintaining an infrastructure to ensure standardized, predictable mechanisms for implementation of guidelines and thereby promoting practice change. While addressing resource constraints may not be possible in all circumstances, an important step for improving guideline implementation—wherever feasible—would be the development of a robust implementation infrastructure that captures and delineates roles and responsibilities of different clinical actors in the guideline implementation process.

Knowledge Transfer Statement:

The results of this study can be used by health care leadership and administrators to understand possible reasons for a lack of guideline implementation and provide suggestions for establishing sustainable

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infrastructure to promote the adoption of clinical guidelines in salaried dental clinics.

Keywords: dental caries, pit-and-fissure sealants, occlusal caries prevention and arresting, evidence-based dentistry, clinical practice guidelines, qualitative research

Introduction

A major challenge for the US health care system is the amount of variation in accepted clinical practices. Troublingly, some of this variation results in overuse, underuse, or misuse of medical services (Cutler 2004). To improve the quality of care, evidence-based dentistry (EBD)¹ and the monitoring of practice guideline implementation have become increasingly important (Goldstein 2002; Spallek et al. 2010). Despite the widespread recognition that oral health treatment decisions should take into consideration available scientific evidence (Faggion and Tu 2007; Jokstad 2018), the implementation of EBD into practice has been slow (Sakaguchi 2010; Elangovan et al. 2018). Some suggest that this may be because existing research is not always relevant to clinicians due to a lack of collaboration between researchers and clinicians (Clarkson and Worthington 2019). Others point to challenges among dental professionals in evaluating available scientific evidence (Durr-E-Sadaf 2019; Garrocho-Rangel et al. 2019) and translating scientific knowledge into dental practice (Kao 2006; Afrashtehfar and Assery 2017).

The pit-and-fissure sealant guideline, first issued by the American Dental Association in 2008, provides an opportunity to analyze the implementation of clinical guidelines into dentistry systems. The guideline recommends the use of sealants to *prevent and arrest* noncavitated carious lesions of primary and permanent molars in children and adolescents (Wright, Crall, et al. 2016; Wright, Tampi, et al. 2016). This is based on evidence that receiving dental sealants on sound occlusal surfaces or on a

noncavitated occlusal caries on primary or permanent molars can result in a 76% reduction in the risk of developing new carious lesions over the subsequent 2 y (Wright, Crall, et al. 2016; Wright, Tampi, et al. 2016). The placement of sealants to prevent carious lesions has been promoted through organizations such as the Oregon Health Authority, which provides financial incentives to participating coordinated care organizations for applying sealants to children aged 6 to 14 y (Clary et al. 2017). It has been estimated that in 2011–2020, approximately 40% of all US children and adolescents had received at least 1 sealant to prevent the development of caries (Dye et al. 2015). Estimates among Medicaid patients are lower: nationally, in 2014, 15% of children ages 6 to 9 y and 10% of children ages 10 to 14 y received sealants (Oregon Health Authority 2015).

Less is known about the prevalence of sealants to arrest noncavitated lesions (Griffin et al. 2008). Noncavitated lesions “refer to initial caries lesion development, before cavitation occurs. Noncavitated lesions are characterized by a change in color, glossiness or surface structure as a result of demineralization before there is macroscopic breakdown in surface tooth structure” (Young et al. 2015). Although the prevalence of noncavitated occlusal lesions is not precisely known, data from the National Health and Nutrition Examination Survey (NHANES) from 2011 to 2012 show that nearly a quarter of children aged 6 to 11 y and over half of adolescents aged 12 to 19 y had experienced carious lesions in their permanent teeth (Dye et al. 2015). Studies indicate that few dentists follow the recommendation to place sealants to arrest noncavitated occlusal lesions—estimates vary from 4% to less than 40% (Tellez et al. 2011; O'Donnell et al. 2013). These estimates are much lower than for the use of sealants to prevent caries among children (Govindaiah and Bhoopathi 2014). Given the high prevalence of noncavitated occlusal lesions and the underutilization of sealants used to treat them, adoption

of an evidence-based approach to management could lower treatment costs compared to conventional restorative techniques and conserve tooth structure.

The underutilization of dental sealants to arrest noncavitated occlusal lesions, however, remains insufficiently understood. Existing research shows that there is low awareness among dentists about the aspect of the pit-and-fissure guideline that recommends the placement of sealants to arrest noncavitated lesions (Polk et al. 2018). Yet, awareness also was not sufficient to achieve behavior change and result in treatment decisions that recommend the placement of sealants to arrest noncavitated occlusal lesions (O'Donnell et al. 2013). Previous studies on this topic have focused on the perspectives of dentists and highlighted situational factors specific to particular practice environments. We believe that it is important to capture the voices of other stakeholders, such as dental hygienists and assistants, and to analyze aspects of organizational infrastructure that could promote or prohibit guideline implementation across a range of practice environments. In this study, we captured the perspectives of multiple stakeholders (dentists, dental assistants, dental hygienists, and dental management) on the implementation of the pit-and-fissure guideline in the Kaiser Permanente Dental Program. We focused on understanding the role of formal processes and structures—referred to in this article as *implementation infrastructure*—in providing a framework for guideline implementation.

Methods

Study Design and Setting

This study took place in the Kaiser Permanente Dental (KP Dental) Program. This program is a partnership between Permanente Dental Associates (PDA) and Kaiser Foundation Health Plan of the Northwest. PDA is a large group practice that employs more than 150 general dentists and specialists who provide care to almost 290,000 KP Dental members

at 20 clinics in Oregon and southwest Washington. Dentists and specialists are compensated through a mix of salary and performance-related pay (PRP). PDA sets annual PRP targets focused on quality, productivity, and patient satisfaction. Targets are established at the clinic and individual dentist level and are designed to align dentist compensation with the business goals of PDA and KP Dental. In 2018, applying preventative sealants to 20% of all pediatric patients ages 6 to 14 y had been set as an organization-wide target for all dentists. PDA convenes a Clinical Effectiveness Committee (CEC) that oversees quality improvement projects.

The health plan owns and operates KP dental offices and employs allied dental staff, including dental hygienists and dental assistants. Dental hygienists usually operate independently within scope of practice and provide services such as cleanings. They are also licensed to treatment plan and apply sealants after examination by a dentist. Dentists work in teams with expanded function dental assistants who provide support to dentists.

This formative study was conducted to inform interventions of the National Institutes of Health-funded DISGO study (Dissemination and Implementation of Sealant Guidelines in Organizations). We collected qualitative data through observations (1 meeting observation and observations of placements of dental sealants at 4 clinics), interviews with 6 dental management members, and focus groups with 30 dentists, hygienists, and dental assistant in 5 focus groups at 3 dental clinics (2 with dentists and 3 with assistants and hygienists). We are including all interview guides in the appendix. We followed a grounded theory approach to data collection, continuously analyzing qualitative data to inform the next steps in the data collection process (Charmaz 2014). Engagement of different stakeholders and methodological tools also served to triangulate and validate our data collection. The study was approved by the Kaiser Permanente Northwest (KPNW) Institutional Review Board (#1394486).

Unless noted otherwise, all data collection efforts were led and conducted by the qualitative lead researcher and first author (I.G.), whose primary expertise is in qualitative methods. At study onset, I.G. had no prior relationships with any of the participants and was introduced as a study team member. The other team members involved in data collection and initial NVivo data analysis, C.D.K. and N.Y., also had no prior relationships with any of the participants. Other authors brought their expertise and perspectives to the analysis and interpretation of the data: D.J.P. is a dentist and works for PDA, J.L.F. is a health economist with decades of health services research experience in dental settings, C.D.K. is a medical sociologist with expertise in mixed methods, E.G.G. is an expert in organizational change, and D.E.P. is a psychologist who focuses on the relationship between social and individual factors in health behavior. The interdisciplinary perspectives of the study team enabled the authors to draw on a wide range of expertise and scholarship in analyzing the data and drawing conclusions.

Participant Recruitment and Data Collection

Observations of the Clinical Effectiveness Committee

I.G. first observed a regular 4-h meeting of the CEC to gain understanding of the organization of the committee and the tasks and responsibilities of its members. Participants provided verbal informed consent. Field notes captured summaries of conversations and other observable activities. During the CEC meeting, dentists were also asked to sign up for half-day observations during a predetermined 2-wk period; at least 4 clinics had sealant placements scheduled during the period of observations and were willing to be observed.

Observations of Sealant Placements

As the next step of the data collection process, I.G. observed sealant placement

procedures in 4 dental clinics: A (in Portland), B, D, and E (in the surrounding metropolitan area; see the Table for more details about each clinic and the population it serves). The purpose of the observations was to better understand the workflow and task coordination between dentists, assistants, and dental hygienists. During these observations, I.G. also held informal conversations with dentists about challenges and opportunities of the sealant placement process and the roles they perceived for themselves in guideline implementation in general. Conversations included one-on-one interviews with dentists whose sealant placements had been observed and with larger groups of dentists who were available at the time of the observations. Participants provided oral informed consent. Field notes captured summaries of conversations and other observable activities.

Interviews with Dental Leadership

All leadership team members of KP Dental ($n = 8$) were eligible for participation in the interviews. We contacted each team member by email and, if they agreed to participate, scheduled a 20- to 30-min phone interview. In total, 6 leadership members completed the interview.

We created a dental leadership interview guide, which focused on EBD and clinical guidelines at KP Dental, existing infrastructure and mechanisms to achieve guideline implementation, and responsibilities among leadership members to achieve EBD. All interviews were conducted on the phone by 2 researchers. All participants provided written informed consent and interviews were recorded with participants' permission.

Focus Groups with Dentists, Dental Hygienists, and Assistants

All clinics providing pediatric specialty services were eligible for participation ($n = 7$). We limited participation to clinics with a specialty in pediatrics as the use

Table.

Clinic Size and Patient Characteristics of Participating Clinics.

	Clinic A	Clinic B	Clinic C	Clinic D	Clinic E
Clinic Size					
No. of dentists (including general and pediatric dentists)	9	9	9	6	7
Total patient population	18,271	23,305	16,691	8,590	14,082
Characteristics of patients with a visit during January 1, 2019, to December 6, 2019					
Age (mean), y	40	41	36	28	49
Patients under 18 y, %	23	29	37	44	11
Female, %	55	55	54	54	56
Race/ethnicity, %					
White	67	77	79	56	76
Asian	4	7	3	11	6
Hispanic	6	5	5	10	6
Black or African American	10	3	1	2	1
Native American or Native Hawaiian/Pacific Islander	.5	1	1	1	.5
Unknown	13	8	13	26	13

of sealants is more common in pediatric dentistry than in general dentistry. One leadership team member suggested 3 of those clinics for participation, taking geographical location into account (clinic A in the Portland metro area, clinic B in a suburb of Portland, and clinic C in a town adjacent to the metro area). We contacted clinic managers at these 3 clinics and scheduled 1 focus group with hygienists and assistants at each clinic and focus groups with dentists at 2 clinics (clinics B and C). Clinic managers recruited a convenience sample of focus group participants; a total of 30 individuals participated.

We created 1 interview guide for the focus group discussion that we used for both dentists and dental hygienists and assistants. The content of the focus group interview guide was informed by the prior observations of sealant placements and interviews with leadership members. The guide focused on existing practices around guideline implementation at the dental clinics, with the goal of eliciting both successful case studies of practice change and case studies demonstrating remaining room for improvement. I.G.

and N.Y. conducted the focus groups, each of which lasted about 45 min. All participants provided written informed consent, and all focus groups were recorded with participants' permission. Participants were offered lunch or snacks during their participation.

Data Analysis

All recordings were transcribed, and transcripts and field notes were analyzed by 2 researchers (I.G., C.D.K.). We conducted a template analysis (King 2012) using NVivo 12 software to identify themes related to the existing implementation process of clinical guidelines and stakeholder perspectives on the strengths and weaknesses of this process (Elo and Kyngäs 2008). First, an initial template for the data was developed, based on predefined themes of interest. We added additional codes that surfaced during initial transcript review. I.G. coded 2 interview transcripts using the template, then revised the codes, code definitions, and template; the final template contained 13 codes in total. I.G. then used this template to analyze and code all collected data.

C.D.K. then independently coded the data set. C.D.K. agreed with I.G.'s template analysis and suggested further refinements based on emerging subcategories and their properties (Strauss 1990; Charmaz 2014).

Results

Sizes of the clinics participating in the observations and focus groups and characteristics of patients attending these clinics are summarized in the Table. The number of dentists practicing in each clinic ranged from 6 to 9, while patients ranged from 8,590 to 23,305. During January 1, 2019, to December 6, 2019, women made up approximately 55% of patients seen at all clinics. Mean age of patients varied from 28 to 49 y, depending on the proportion of patients below the age of 18 y at each clinic. Most patients were White (between 56% and 79%) with some variation between clinics. Asians represented between 3% and 11% of all patients, Hispanics 5% to 10%, Blacks or African Americans between 1% and 10% of all patients, and Native Americans or Native Hawaiians/Pacific Islanders .5% to 1% of all patients.

The template analysis of transcripts and field notes provided a detailed description of the implementation process and infrastructure at KP Dental and of staff members' perceptions of this process and infrastructure in the case of the pit-and-fissure sealant guideline. In general, the pit-and-fissure sealant guideline was understood by dentists and staff to focus on *preventing* caries through the placement of sealants, rather than *arresting* noncavitated occlusal carious lesions. Stakeholders perceived 2 main barriers for achieving implementation of the pit-and-fissure sealant guideline: 1) shortcomings in the implementation process and infrastructure and 2) resource constraints. Perceived opportunities for the dissemination and implementation of guidelines included widespread recognition of the importance of guidelines in dental practice and well-functioning workflows within specialties.

Implementation Process and Infrastructure

Our interviews with leadership members showed that they view the CEC and its director as the central mechanism for implementing EBD at KP Dental. They defer all EBP-related decision making to the CEC director and appointed dentists. Leadership members explained the structure and responsibilities of the CEC as follows: the CEC is tasked with selecting and implementing evidence-based guidelines and is convened monthly by PDA for in-person meetings. The CEC is the main body responsible for implementing evidence-based guidelines and quality of care monitoring at the clinic level. It is headed by a leadership member who is also a practicing dentist. A representative from each dental clinic is appointed by this leadership member for a 3-y term to the CEC. The CEC's responsibilities include selecting guidelines issued by dental organizations like the American Dental Association for implementation, creating comprehensible summaries of these guidelines, and communicating the content of the guidelines to individual

clinics. Representatives are responsible for communicating relevant discussions and findings from CEC meetings to all staff at their respective clinics.

In the eyes of the leadership team, this flat implementation structure where the CEC does not issue directives on how guidelines are implemented was seen as a way to allow clinics autonomy in designing their own day-to-day workflows.

Stakeholder Perceptions of the Implementation Process and Infrastructure: Perceived Barriers to Guideline Implementation

During focus groups and informal discussions during observations, dental staff reported many challenges in implementing guidelines at the clinic level through the existing implementation infrastructure, and dentists contrasted the guideline implementation process with the implementation of organizational policies and perceived a contrast between the two. Policies were described as binding for all dental staff, whereas guidelines were described as suggestions for best practices that were up to each individual to choose to adopt. In light of this perceived individual freedom for decision making, which was consistent with descriptions provided by leadership members during interviews, guidelines were often not considered important. Stakeholders also reported a lack of incentives to implement guidelines, which further contributed to minimizing their importance. A dentist working at clinic B said, "Unfortunately, I think we live in a world of incentives. And with a lack of incentives, it becomes difficult to motivate." Finally, stakeholders did not perceive any negative consequences of failing to adhere to a guideline.

There also was a general lack of ownership of the guideline implementation process. Staff were uncertain who was responsible for initiating, encouraging, and maintaining practice change. Staff were uncertain about what steps were taken to move from learning about a guideline to implementing it and who would

initiate these steps. For example, with regard to the pit-and-fissure sealant guideline, dentists described the buy-in of hygienists crucial for achieving higher guideline adherence. During focus groups, hygienists pointed to limited resources as a major obstacle in achieving sealant placement. One dental hygienist working at clinic B said, "And then at the last minute they come in and say, 'Well, can you do four sealants?' I have no problem doing sealants, to be honest. I do them all the time, it doesn't bother me. I don't want them to come in five minutes before the appointment is over though and say, 'Here, we need eight sealants done.'" Hygienists also pointed out that dentists can place sealants much faster than hygienists since they can practice "four-handed" dentistry with the added support of a dental assistant.

During all observations of sealant placements, four-handed dentistry was practiced by a dentist who was supported by an expanded function dental assistant. Sealant placements were completed within a few minutes and did not take more than 5 min per tooth. All the observed sealant placements had been scheduled in advance and expanded function dental assistants had set up materials in exam rooms accordingly. We did not have the opportunity to observe sealant placements performed by dental hygienists or sealant placements that were added to the appointment at the last minute.

Stakeholders also emphasized that it may be difficult to develop a standardized implementation template as clinics all operate differently. A dentist at clinic C stated,

Sometimes it doesn't really work out because when they discuss those things they have big clinics, small clinics, different populations that those sorts of things aren't completely applicable to each clinic or their work flow. How a large clinic functions is very different than how a small clinic functions. For our clinic we don't have any extra chairs or extra staff so we're a little bit limited. Where say other clinics have more space, more staff, there's a little

bit better ease of implementing certain things sometimes.

In sum, the implementation infrastructure was not perceived as robust enough to address resource constraints and did not encourage implementation across clinics and roles.

Furthermore, many stakeholders did not know the process for familiarizing themselves with the content of guidelines, as they expressed during informal conversation during observations as well as during focus groups. They did not know if there were routine implementation templates to follow and could not describe any formal mechanisms through which guidelines were circulated among staff. Dissemination practices for guideline content varied widely across clinics. CEC members did not consistently notify clinic staff by email or at staff meetings about new guidelines.

There was limited knowledge about the pit-and-fissure sealant guideline content among leadership and staff members. When the researchers introduced themselves during the observations and focus groups, participants immediately initiated a conversation about the placement of preventive sealants; everyone was familiar with the preventive aspect of the guideline that recommends placing sealants on sound permanent molars of children aged 6 to 14 y. Few, however, were aware that the guideline also recommends placing sealants on noncavitated lesions in adults, and it was challenging to shift the conversations during observations and focus groups to focus on this aspect of the guideline. A leadership member remarked that they would need to review the guideline to understand the interviewers' references to the use of sealants to arrest noncavitated lesions among adults: "It [the guideline] has never really been about adults, so I'm not sure exactly, you know, what you are referring to on that." Existing practices fell short of effectively communicating guideline content.

Stakeholders also described resource constraints that affected guideline

implementation repeatedly during focus groups. Equipment such as fast-curing lights were perceived to significantly improve the sealants application process but were not present in all clinics: "We don't have curing light in every room, we don't have the sealants in every room. . . . If we have availability in every room, I think that save us time" (dental hygienist at clinic A). Resource constraints also included space arrangements. Some clinics had enough room for overflow chairs where patients who were present for a general appointment could be moved to receive sealants during the same visit. In other clinics, it was not possible to have such chairs due to space limitations.

Stakeholder Perceptions of the Implementation Process and Infrastructure: Perceived Opportunities for Guideline Implementation

Despite these reported challenges, there were existing strengths on which to build the guideline dissemination and implementation process. All staff recognized the importance that guidelines can play in encouraging evidence-based practice and ensuring that similar factors are considered in making treatment decisions across a group practice. In general, staff recognized the importance of following evidence-based guidelines:

Well, we have the Clinical Effectiveness Committee. And they go over, you know, evidence-based literature. And they come up with, you know, some recommendations and best practices and things like that. And so, yeah, I mean that . . . everything that we do, educationally and mentoring is geared towards evidence-based dentistry. Like I said it's foundational [for our practice]. (leadership member)

Indeed, some dentists described the importance of EBD at Kaiser as an important reason why they had joined the practice.

During focus groups, staff also expressed willingness to receive prompts and support to accomplish evidence-

based care goals. Reflecting on projects in the past where practice change had been accomplished successfully, staff members referred to team meetings as an effective implementation strategy. A dental assistant from clinic C said, "That morning huddle. We never did that before, and before doing that I can't say I checked my emails regularly. But now that we know something is coming to us every day, it puts you more in a habit to check it every day." Staff members also suggested checklists, email reminders, and long-term planning as potentially effective strategies.

Within the specialty of pediatric dentistry, dental hygienists and dentists with dental assistants had established well-functioning workflows that could serve as sample workflows for others. During observations, they reported that forming a routine practice of placing sealants was essential for their success: "We've been doing them [preventive sealants] for a long, long time. And typically it's both of us and there are some difficult cases where you do need two people or it's not going to get done" (dental hygienist at clinic A). They also reported willingness to support others who may experience challenges placing sealants.

Discussion

The slow adoption of evidence-based guidelines into routine dental practice (Sakaguchi 2010; Elangovan et al. 2018) suggests it is critical to advance implementation capacity in dentistry systems. In this study, we identified barriers and opportunities to developing and sustaining a robust implementation infrastructure for achieving guideline adherence in a salaried dental practice. We found that stakeholders perceived many barriers such as a lack of clarity about the roles and responsibilities in the guideline implementation process, lack of effective mechanisms to disseminate guideline content, and resource constraints. Many of these obstacles can be attributed to a general sense of uncertainty among stakeholders

about *how* to achieve guideline implementation. We also identified important facilitators to implementation, such as staff's recognition of the importance of following EBD guidelines, an interest in receiving prompts, and support to achieve guideline implementation. Our results provide novel insight into the critical role that implementation infrastructure can play in achieving guideline adherence.

Dentists, dental assistants, and hygienists alike were uncertain about their roles and responsibilities in achieving guideline adherence. Many considered guideline implementation outside their purview, which speaks to a general lack of ownership over the guideline implementation process. Facilitating a sense of ownership among stakeholders has previously been identified as important for obtaining stakeholder buy-in and ultimately achieving practice change (Rycroft-Malone et al. 2004; Reavy and Tavernier 2008). Promoting the involvement of multiple stakeholders and fostering relationships has been suggested previously as a strategy to increase and achieve ownership (Rycroft-Malone et al. 2004). If—as was the case here—staff recognize the importance of EBD, clearly outlining their roles and responsibilities throughout the implementation process using an implementation blueprint may also be effective (Powell et al. 2015). Implementation blueprints can also be helpful in communicating protocols for clinics of different sizes or with different resources when situated within a large group practice. Increasing the sense of ownership that staff experience with regard to the implementation of guidelines may also address stakeholders' perceived lack of incentives to follow recommended guidelines.

Stakeholders also felt that following guidelines was not as important as adhering to organizational policies. They suggested that incentives could support successful implementation; indeed, previous research suggests that incentives can improve compliance with practice guidelines (Chaix-Couturier et al. 2000). There are several incentive

models, such as pay-for-performance, but studies of their effectiveness are inconclusive (Eijkenaar et al. 2013; Milstein and Schreyoegg 2016). Nonfinancial incentives are primarily created by changing social norms, such as making following a guideline standard practice rather than an exception. Although shifting social norms can be difficult, one way this could be done would be by having opinion leaders promote guideline adherence (Borbas et al. 2000; Locock et al. 2001; Flodgren et al. 2011).

Notably, stakeholders' knowledge of the pit-and-fissure sealant guideline appeared to be limited in most cases to the recommendation of using sealants to prevent caries among children; few were familiar with the recommendation to place sealants to arrest noncavitated carious lesions. The efforts of Oregon Health Authority to promote preventive sealants among children aged 6 to 14 y may account for this narrow view of the scope of the guideline (Clary et al. 2017). Our finding that many dental professionals had low awareness of the recommendation to place sealants to arrest noncavitated carious lesions and therefore may underuse them can have important implications for retaining tooth structure and treatment costs. More research is needed to analyze these relationships. Educational outreach can serve as a first step to remedy gaps in stakeholders' knowledge about guideline content; however, it is rarely an effective implementation strategy by itself (Giguere et al. 2012). While more research is needed to determine whether educational outreach increases implementation rates when combined with other implementation strategies is effective, educational outreach lays a critical foundation for empowering clinicians to make informed decisions.

Stakeholders also described resource limitations such as the length of appointments, space constraints, number of staff available to place sealants, and limited access to materials and equipment to perform sealant procedures quickly and efficiently. Addressing resource constraints typically requires

a case-by-case assessment to determine priorities and available means.

Many of the barriers to implementation identified by stakeholders can be addressed by developing a robust implementation infrastructure that harnesses the existing implementation strengths. Existing well-established workflows in select clinics or in pediatric specialties can serve as models for other clinics and teams, spelling out the specific roles and responsibilities of different actors and including a variety of prompts to ensure these roles are carried out. Establishing mechanisms to disseminate guideline content can address knowledge and awareness gaps. Engaging and reflecting the input of stakeholders when developing the implementation infrastructure may also serve to further legitimize the process to all stakeholders (Chiappelli 2019).

Limitations

This study has important limitations. It was conducted within a subset of dental clinics within a single integrated health care delivery system and may not be representative of other dental practices. At the same time, selected barriers and opportunities for guideline implementation may be relevant across a wide range of different clinical settings. In addition, participants were selected through a convenience sampling approach, which may have resulted in an unknown selection bias. However, by engaging stakeholders in a variety of roles and making use of a variety of methodological data collection tools, we worked to increase the validity of our data through triangulation. We provide information about clinic sizes and demographic information about patients at each of the clinics that participated, but we did not include any explicit prompts to encourage staff to reflect on the role of clinic size or patient characteristics for applying sealants.

Conclusion

Our research demonstrates the importance of developing and maintaining implementation

infrastructure to ensure standardized, predictable mechanisms for implementation of guidelines in order to promote practice change. Developing robust guideline implementation frameworks that delineate roles and responsibilities across different clinical stakeholders could provide a strong foundation that would allow clinics to undergo meaningful change.

Author Contributions

I. Größ, contributed to design, data acquisition, analysis, and interpretation, drafted and critically revised the manuscript; D.J. Pihlstrom, contributed to conception, critically revised the manuscript; C.D. Kaplan, contributed to data interpretation, drafted the manuscript; N. Yusuf, contributed to data acquisition, critically revised the manuscript; J.L. Fellows, D.E. Polk, contributed to conception and design, critically revised the manuscript; E.G. Guerrero, contributed to data interpretation, critically revised the manuscript. All authors gave final approval and agree to be accountable for all aspects of the work.

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Note

1. The American Dental Association defines EBD as "an approach to oral healthcare that requires the judicious integration of systematic assessments of clinically relevant scientific evidence, relating to the patient's oral and medical condition and history, with the dentist's clinical expertise and the patient's treatment needs and preferences." <https://ebd.ada.org/en/about>

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