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## Implementation of a Standardized Oral Screening Tool

**Implementation of a Standardized Oral Screening Tool by Pediatric Cardiologists**

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## Abstract

**Background:** An examination of procedure cancellations found that the lack of preprocedural oral screening was a preventable cause, for children with congenital heart disease. The purpose of this study was to implement an oral screening tool within the pediatric cardiology clinic, with referral to pediatric dental providers for positive screens. The target population were children age  $\geq 6$  mo. to  $< 18$  yr. old, being referred for cardiac procedures. **Methods:** The Quality Implementation Framework method was used for this study design. The multimodal intervention included education, audit and feedback, screening guidelines, environmental support, and interdisciplinary collaboration. Baseline rates for oral screenings were determined by retrospective chart audit from January 2018 to January 2019 (n=211). Adherence to the oral screening tool was the outcome measure. Positive oral screens, resulting in referral to the pediatric dental clinic, were measured as a secondary outcome. Provider compliance rates were used as a process measure. **Results:** Data collected over 14-weeks showed a 29% increase in documentation of oral screenings prior to referral, as compared to the retrospective chart audit. During the study period 13% of completed screenings were positive (n=5). Provider compliance for the period averaged 70%. **Conclusion:** A substantial increase in preprocedural oral screenings by pediatric cardiologists was achieved using the Quality Implementation Framework, and targeted interventions.

**Key words:** *Congenital heart diseases; oral health; preventative medicine; Practice patterns, physicians; endocarditis, bacterial*

## Introduction

Cancellations of pediatric cardiac procedures due to poor oral health results in delay of needed interventions, thereby increasing risk of morbidity and mortality,<sup>1</sup> and may create a substantial hardship for the patient and their family. Unexpected cancellations create inefficiencies in healthcare delivery which increases resource and labor costs.<sup>2</sup> An institutional review of cardiac procedure cancellations, within a pediatric cardiology clinic, found that lack of preprocedural oral screening was an avoidable cause of these cancellations. The implementation of routine oral screening, in the pediatric cardiology setting, with referral to pediatric dentistry for positive screens, has been recommended as a strategy to reduce infection risk and prevent cardiac procedure cancellations.<sup>1, 3-11</sup>

Oral health is important to the systemic health of all children but is of greater importance for children with congenital heart disease (CHD), who are at increased risk for infective endocarditis.<sup>12-14</sup> Invasive procedures and surgical correction of congenital malformations further increase the risk for infective endocarditis in children with CHD.<sup>12,13</sup> Infective endocarditis, though rare, has a 30% mortality rate, and an average associated cost in excess of \$120,000 per patient.<sup>15</sup>

Poor oral health directly correlates to an increased risk of infective endocarditis. Oral mucosal surfaces, dentition, and gingiva are densely populated by endogenous microflora and are therefore a significant source of transient bacteremia.<sup>14</sup> Trauma to periodontal structures can occur during dental extractions or with routine daily activities such as toothbrushing and flossing.<sup>16</sup> The magnitude of bacteremia is related to the density of the bacteria in the mouth, and the extent of inflammation or infection at the site of trauma.

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3 Multiple studies have shown a correlation between children with CHD and increased  
4 incidence of poor oral health, using standardized measurements such as the decayed missing and  
5 filled teeth indices, simplified oral hygiene index, modified gingival index, and modified plaque  
6 index.<sup>4,7,8,17-21</sup> The reasons for increased prevalence of dental disease in children with CHD are  
7 multifactorial and include the lack of parental knowledge, avoidance of power struggles between  
8 parent and child resulting in lax routine oral hygiene,<sup>17,22</sup> lack of knowledge of pediatric  
9 cardiologists regarding the need for oral health screening,<sup>3,23,24</sup> and nutritional status associated  
10 with medications and dietary requirements for managing CHD.<sup>25</sup>

11  
12 Cantekin et al.,<sup>18</sup> compared the dental health of age and sex matched pairs (n=268),  
13 showing significantly higher rates of tooth decay in children with CHD. Hayes et al.,<sup>21</sup>  
14 completed comprehensive dental evaluations on 209 patients, aged six months to 14 years old  
15 with CHD and scheduled for cardiac surgery, finding that 84% were diagnosed with dental  
16 disease. Twenty-four of these patients were delayed for surgery due to their oral health status.  
17 Carillo et al.,<sup>19</sup> surveyed the health records of 156 children with CHD, half of whom had been  
18 referred by pediatric cardiologists for preprocedural screening and found that 46% (n=72)  
19 required dental treatment.

20  
21 Guidelines for the prevention of infective endocarditis have shifted away from frequent  
22 antibiotic prophylaxis and to preventative measures emphasizing consistent good oral health.<sup>14</sup>  
23 Pediatric cardiologists should be taking part in preventative and preprocedural oral screenings,  
24 increasing multidisciplinary collaboration with pediatric dentistry, and emphasizing education of  
25 the patient and their family.<sup>4, 6-10</sup> Despite numerous studies showing a link between poor oral  
26 health and an increased risk for infective endocarditis, the connection between CHD and  
27 increased incidence of poor oral health, few studies have described the successful

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3 implementation of oral health screenings as a standard of practice in the pediatric cardiology  
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5 setting.  
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8 The objective of this quality improvement project was the implementation of a  
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10 standardized, evidence-based, oral screening tool within the cardiology clinic, for CHD patients  
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12 age  $\geq 6$  mo. to  $< 18$  yr. old who were being referred for cardiac surgery or cardiac  
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14 catheterization, with referral to dental providers for positive screens. The intervention was  
15  
16 intended to reduce risk and prevent cancellations by encouraging an oral screening prior to  
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18 referral for cardiac procedures, thereby aligning the clinic with current best-practice guidelines  
19  
20 and eliminating inefficiencies. This article outlines the steps of such an implementation process  
21  
22 with the goal of encouraging more pediatric cardiology clinics to adopt a similar oral screening  
23  
24 process.  
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## 28 **Materials and Methods**

29  
30 This study took place in one academic pediatric cardiology clinic. The project included  
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32 pediatric cardiologists, the pediatric cardiac surgery team, the cardiology clinic licensed and non-  
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34 licensed staff, and the pediatric dental clinic providers. The institutional review board deemed  
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36 the study a quality improvement initiative.  
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### 39 **Implementation Framework**

40  
41 The Quality Implementation Framework was used for this project.<sup>26</sup> A microsystem  
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43 assessment, conducted to provide information regarding available resources, clinic workflow,  
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45 and clinic personnel, revealed that no electronic process existed, to refer children to the dental  
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47 clinic from cardiology clinic. Additionally, within the pediatric cardiology clinic, no standard  
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49 for oral screening had been implemented.  
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3 A 12-item questionnaire was used to obtain data regarding current knowledge and attitudes  
4 of the cardiologists towards oral screening, their current oral screening practices, frequency of  
5 provider-to-patient education regarding infective endocarditis and oral health, and provider  
6 knowledge of infective endocarditis prophylaxis. Thirteen cardiologists completed the survey  
7 (Appendix 1). Survey results revealed that more than half of the providers were not aware of  
8 current recommendations regarding oral health maintenance and infective endocarditis  
9 prevention. Upon completion of the survey, additional one-on-one conversations with the  
10 participating cardiologists showed a general lack of knowledge among these providers regarding  
11 the need for regular oral screening of children with CHD, lack of definitive criteria for a positive  
12 screen, and criteria for referral to pediatric dentistry based on oral screening. Instead, the  
13 completion of oral screenings was inconsistent and when completed were based on the  
14 providers' own practice experience, without drawing on the expertise of pediatric dental  
15 providers. This knowledge deficit pointed to the need for the further education of providers prior  
16 to implementing the standardized oral screening.  
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35 Face to face interviews further revealed time management as a screening barrier.  
36 Cardiologists within the clinic expressed concern over their ability to add this additional  
37 screening element within the given appointment time. Limited time, lack of resources or staff,  
38 and work pressure frequently negatively influence guideline implementation therefore,  
39 environmental characteristics need to be addressed to ensure successful implementation.<sup>27</sup>  
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### 47 ***Literature Search***

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49 A literature search was conducted, between October and November, 2018, on the following  
50 databases- CINAHL (EbscoHost), PubMed (MEDLINE), Cochrane Library (Wiley), and Google  
51 Scholar, to determine the most successful interventions for changing provider practices  
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(Appendix 2). The literature revealed that multimodal implementation strategies were definitively more successful than the use of a single strategy, particularly when tailored toward identified barriers to implementation.<sup>27-29</sup> Strategies which included education, audit and feedback, screening guidelines, environmental support, and a collaborative team-based approach, was shown to be most effective in changing the practice of healthcare professionals.<sup>30</sup> Okelo et al.,<sup>31</sup> show that decision support tools, such as standardized oral screening questions within the electronic health record, combined with audit and feedback and environmental support, improve provider adherence to guidelines, as measured through process outcomes. Additionally, few interventions can be successful without at least some involvement of multiple health care disciplines.<sup>32</sup> Increased collaboration among healthcare professionals has been shown to lead to increased adherence to guidelines.<sup>30</sup>

### ***Guideline Creation***

Although current recommendations and guidelines for oral health in children with congenital heart disease emphasize regular preventive treatment to maintain good oral health,<sup>11, 33</sup> no standardized oral screening tool for pediatric cardiologists was found within the literature. The oral screening tool for this project was created by pediatric cardiology, and dental providers, using best-practice guidelines and expertise from both specialties.<sup>14, 34</sup> The Guideline Implementability Appraisal tool,<sup>35</sup> was used in the creation of the following oral screening guideline:

*A positive finding of any of the following constitutes a positive oral screen: obvious dental caries, heavy plaque, gingival inflammation, parulis (gingival boil), abscessed teeth, intra-oral pain, or last dental visit > 12 months prior. Any positive screen should be referred to a pediatric dental clinic for immediate follow up.*

### ***Provider Behavior Change***

A 30-minute in-service for participating cardiologists, was presented by dental clinic providers. The presentation included photographic examples for the five subjective findings of the oral screening guideline — obvious caries, gingival inflammation, parulis (gingival boils), heavy plaque or abscessed teeth. It also presented the importance of the two subjective findings: intraoral pain, or last dental visit >12 months prior. Printed copies of the guideline were provided. Cardiologists were instructed on how to document the oral screening in the electronic health record, how to make a referral to the dental clinic, and how to get immediate support or consultation from the dental clinic, via pager, during patient visits. Additionally, providers were given a flyer from the “Lift the Lip” campaign, a successful, quick oral-examination tool.<sup>36</sup>

Environmental support of the intervention was achieved through changes in the electronic health record and support within the physical environment. Electronic health record changes included a “hard stop”, for the completion of the oral screening (*Figure 1.*) within the referral order forms for cardiac catheterization and surgery. An oral screening “dotphrase” template was given to providers for use in their encounter documentation (*Figure 1.*). The clinic physical environment was altered to include visual cues, such as bi-lingual American Dental Association oral health campaign posters in exam rooms. Placards with screening guidelines and contact information for dental providers were placed at each provider computer. Oral hygiene kits were distributed to each child falling within the project parameters that included — a toothbrush, toothpaste, floss, and an informational postcard asking parents to talk to their cardiologist “about the importance of oral hygiene for kids with CHD”.

Interdisciplinary collaboration included pediatric cardiologists, working in conjunction with pediatric dental providers and medical assistants, to complete oral screenings. Dental providers

committed to providing ongoing education and support to cardiologists in completing oral screenings. They were available via pager during cardiology clinic hours and responded with a telephone consultation or by arriving and examining the patient in person, as requested. Clinic medical assistants interviewed patients, regarding last dental visit, as part of the patient intake form and distributed the oral hygiene kits.

Figure 1. EMR Oral Screening Questions and Dotphrase

Oral screening completed?

Result of screen:

Dental referral made?

Dental clearance obtained?

Comments:

.dentalscreen

Oral screening completed. Screening {Positive/Negative:10002} for \*\*\*obvious dental caries, \*\*\* heavy plaque, \*\*\* gingival inflammation, \*\*\*parulis \*\*\*abscessed teeth or intra-oral pain. Last dental visit \*\*\*within 12 months.

### ***Audit and Feedback***

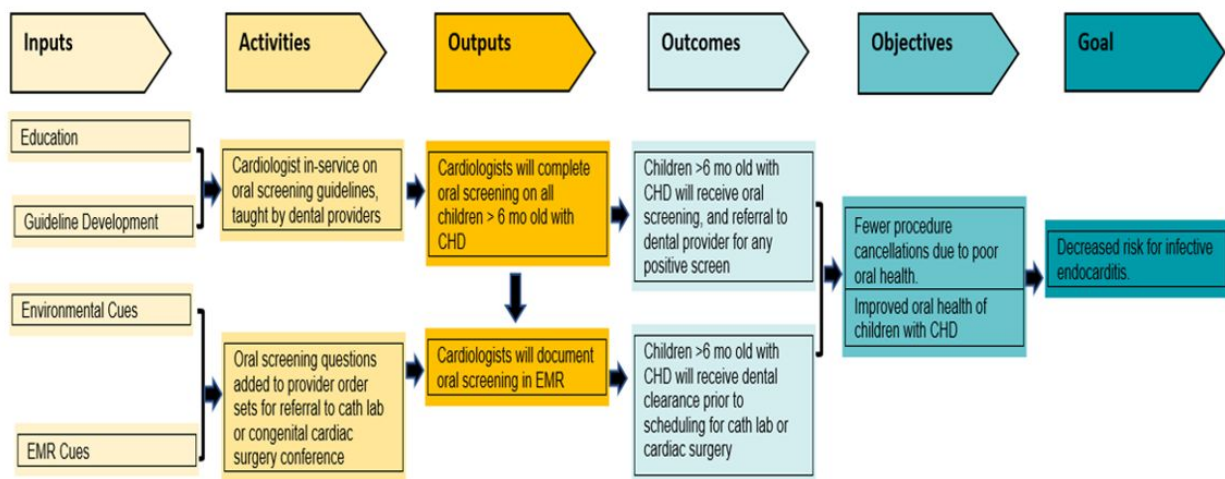
Process assessment strategies included audit and feedback of provider compliance. Project leadership summarized frequency and completion data for each provider during the 14-week implementation period. In the seventh week, participating cardiologists received an email reporting the percent of total referrals for cardiac surgery or cardiac catheterization, in which an oral screening had been completed. Providers with poor compliance were given the opportunity for further education and clarification in order to improve provider adherence. Providers with excellent compliance were also notified and thanked for their outstanding support of the project.

All participating providers were encouraged to reach out to project leaders with any questions or suggestions.

### ***Theory of change***

This study was guided by a theory of change which included the structures and processes believed to require change in the system, and the specific changes which were anticipated to lead to improvement. A comprehensive diagram of the various inputs, activities, outputs and goals of the study, are included below (*Figure 2.*).

*Figure 2. Change Diagram*



### **Measures**

The outcome measure for this project was the adherence to the oral screening standard for pediatric patients >6mo and <18 years of age, with CHD, prior to referral to pediatric interventional catheterization or the congenital cardiac surgery conference, within a 14-week implementation period. Patients less than six months of age, or greater than 18 years old, and children without CHD were excluded. Adherence to oral screening standards was defined as (1)

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3 oral assessment documented in the medical record and (2) all positive oral screening assessments  
4 referred to dental clinic.  
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8 The baseline measurement for oral assessment was determined by retrospective chart audit of  
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10 all children >6 mo and <18 yrs old, referred for cardiac catheterization or cardiac surgery, from  
11  
12 January 2018 to January 2019 (n=211). SOAP notes with physical assessments including  
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14 language specific to dentition and gingiva were counted as meeting the measure. The audit  
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16 reviewed each office visit, evaluation and management, that occurred immediately prior to  
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18 referral to cardiac catheterization or cardiac surgery.  
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### 21 **Analysis Method**

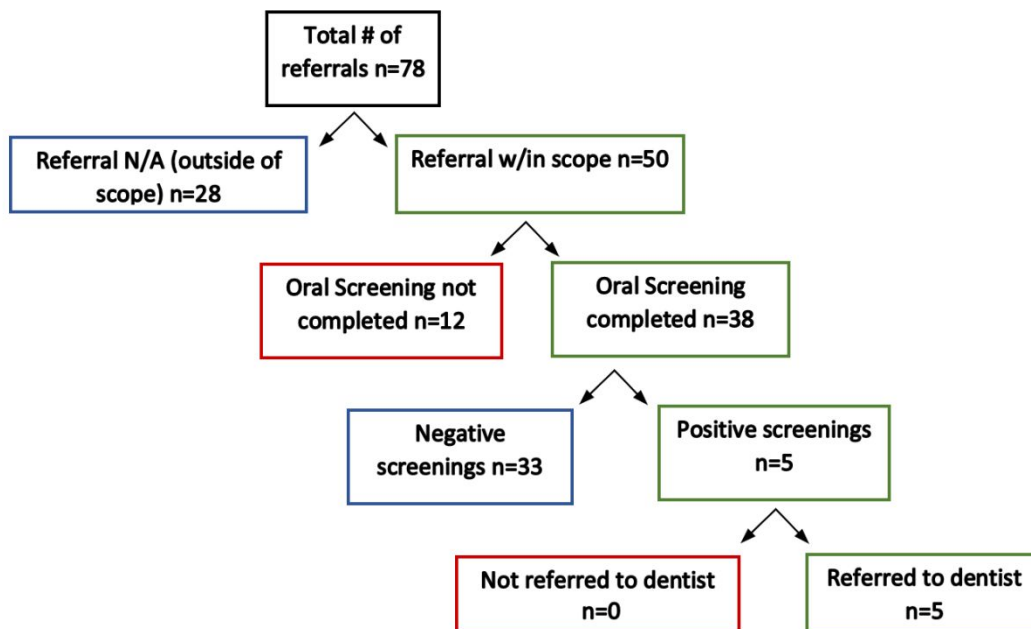
22  
23  
24 Data was analyzed using descriptive statistics. Project data was tracked via weekly electronic  
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26 reports, compiling all referrals to cardiac catheterization or cardiac surgery, by individual  
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28 providers. The referral system monitoring report detailed the disposition of oral screening  
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30 questions within the referral order, including any referrals to the dental clinic for positive  
31  
32 screens. A Microsoft Excel spreadsheet was used to track and analyze data.  
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### 35 **Results**

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38 Twenty pediatric cardiologists, and cardiology fellows, participated in this project. A  
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40 baseline retrospective chart audit from January 2018 to January 2019 (n=211), of participating  
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42 cardiologists, showed 47% (n=100) of patients receiving assessments with language specific to  
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44 dentition and gingiva. During the 14-week implementation period, April 2019 to July 2019, a  
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46 total of 78 referrals for cardiac procedures were made by these same participants. Twenty-eight  
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48 of these referrals fell outside of the parameters of this project. Of the remaining 50 in-parameter  
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50 referrals, 76% (n= 38) received documented oral screenings prior to referral (*Figure 3*). This  
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52 showed a 29% increase in documentation of oral screenings prior to referral for cardiac  
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procedures. During the implementation period, 13% of children received a positive oral screen (n=5) and were appropriately referred to dental providers prior to being scheduled for invasive cardiac procedures.

Figure 3. Intervention Data



The number of referrals over the 14-week period averaged six referrals per provider. Individual provider compliance rates varied, with the lowest single participant rate at 20% compliance, and the highest performers at 100% compliance. Therefore, total provider compliance was averaged for the 14-week period, with an average of 70% compliance by participants of the project (Figure 4). The data shows a 0.71% increase in compliance after the seven-week email providing audit and feedback.

Figure 4. Provider compliance by week



## Discussion

This project used evidence-based implementation theory and interventions. Quality improvement is a dynamic process which, requires bidirectional input from project leaders and participants, and must remain flexible. Multifaceted interventions that feature audit and feedback targeting professional practice with dichotomous outcomes on average show an improvement rate of 5.5% (IQR 0.4%to16%).<sup>37</sup> Other studies showed improved compliance rates of between 6% - 13% for multi-modal interventions.<sup>38</sup> This project was able to achieve an increase of 29% in oral screenings during the 14-week implementation period. The data collected from this project showed consistent improved performance from all but one provider, upon implementation of the intervention. Provider compliance rates rose rapidly and remained stable throughout the process. More importantly, during the 14-week implementation period, 13% of children (n=5) with CHD received a positive oral screen and were successfully referred to a pediatric dentist.

Project implementation did encounter unforeseen barriers. Provider education, regarding oral screening, was focused on the attending physicians in the department, but did not account

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3 for physicians in fellowship training, who would be caring for patients and writing referral  
4 orders. An educational in-service was scheduled with the fellows, to remedy this discrepancy.  
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6 Another barrier occurred for patients with dental healthcare coverage outside of the academic  
7 healthcare system. These patients needed a different referral pathway in order to receive dental  
8 care. This barrier is outside of the current scope of this project but does need to be addressed, for  
9  
10 the intervention to truly have a positive impact on all patients with positive screens. It is  
11  
12 imperative that care be equitable for *all* patients. Lastly, this project did not address the oral  
13  
14 health needs of adult CHD patients', being referred for procedures. This project was not  
15  
16 designed for implementation in the adult CHD clinic, as the providers, staff, barriers and  
17  
18 facilitators differ from the pediatric setting. Application of this oral screening tool in the adult  
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20 CHD population is a near-future agenda item.  
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### 28 **Limitations**

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30 Due to the small number of referrals per week (n=[1-6]) (Appendix 3), and the small number  
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32 of total referrals per provider over the intervention period (n=[1-10]), overall compliance rates  
33  
34 were easily skewed week to week by the performance of a single provider. For this reason, the  
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36 compliance of all providers were calculated together as an average, to determine the success of  
37  
38 the intervention. Although the literature speaks to the success of multimodal interventions  
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40 versus single interventions, the combination of interventions chosen is context dependent. The  
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42 data collected during this project does not illuminate which, if any, parts of the intervention had  
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44 the greatest impact in changing provider behavior.  
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### 49 **Conclusions**

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51 Current literature illustrates that poor oral health increases risk for infective endocarditis.  
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53 Additionally, multiple studies show higher incidence of poor oral health in children with CHD.  
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3 What is missing from the conversation is the “how” of implementing an oral screening tool into  
4 routine care provided by pediatric cardiologists. In today’s increasingly complex healthcare  
5 environment, providers face a growing number of demands. Implementing best practice remains  
6 a complex and challenging task. It can take an estimated 17 years to turn 14% of original  
7 research into benefit for patients.<sup>39</sup> The Institute of Medicine’s 2001 report, *Crossing the Quality*  
8 *Chasm*,<sup>40</sup> addressed the disparity between best practice and health care quality, and since that  
9 time, many healthcare institutions have started work on creating processes by which to  
10 systematically improve healthcare. This project is evidence of the relative ease by which a  
11 standardized oral screening tool can be implemented, when a solid framework for  
12 implementation is utilized.  
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30 analysis was instrumental to the success of this study; and to Kathy Wachtel, RN for her  
31 contributions to the quality improvement project work group at OHSU.  
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41 commercial or not-for-profit sectors  
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47 **Conflicts of Interest:** None  
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## Appendix 1: Cardiologist Survey Results

Modified from existing surveys.<sup>41,42</sup>

(N=13)

1. In your opinion, is there any relationship between oral and systemic health?  
YES= 13/13 (100%)
2. Do you usually perform an oral examination of your patient?  
YES= 9/13 (69%) NO= 3/13 (23%) Y/N= 1/13 (7%)
3. At what age do you assess for oral health of your patients?  
ALL (AGES)= 3  
1 YEAR OLD = 3  
6 MONTHS OLD= 2  
“starting at 1-2 years old” = 2  
NO ANSWER= 2  
“from birth”= 1
4. Which oral structures do you observe?  
TEETH= 12  
GUMS= 6  
CHEEKS= 1  
TONGUE= 1  
PALATE= 1  
ORAL MUCOSA= 1
5. Which oral pathologies do you consider relevant when examining your patient?  
CARIES= 6  
“PERIODONTAL REDNESS”, “GUM DISEASE”, “GINGIVAL INFLAMMATION” = 5  
MISSING/BROKEN TEETH= 2  
PLAQUE= 2  
ABSCESS= 2  
“any”= 2  
NO ANSWER= 2  
DISCOLORATION OF ENAMEL= 1  
GINGIVAL HYPERTROPHY = 1  
MALODOROUS= 1
6. Do you refer your patients to the DCH 8S Dental Clinic, or another dental provider?  
YES= 7  
NO= 3  
SOMETIMES= 1  
BOTH= 2  
NO ANSWER= 1

If other, please specify:

“Only if they need cardiac anesthesia”

“I tell them to see someone, but don’t put in a referral”

“Refer per insurance”

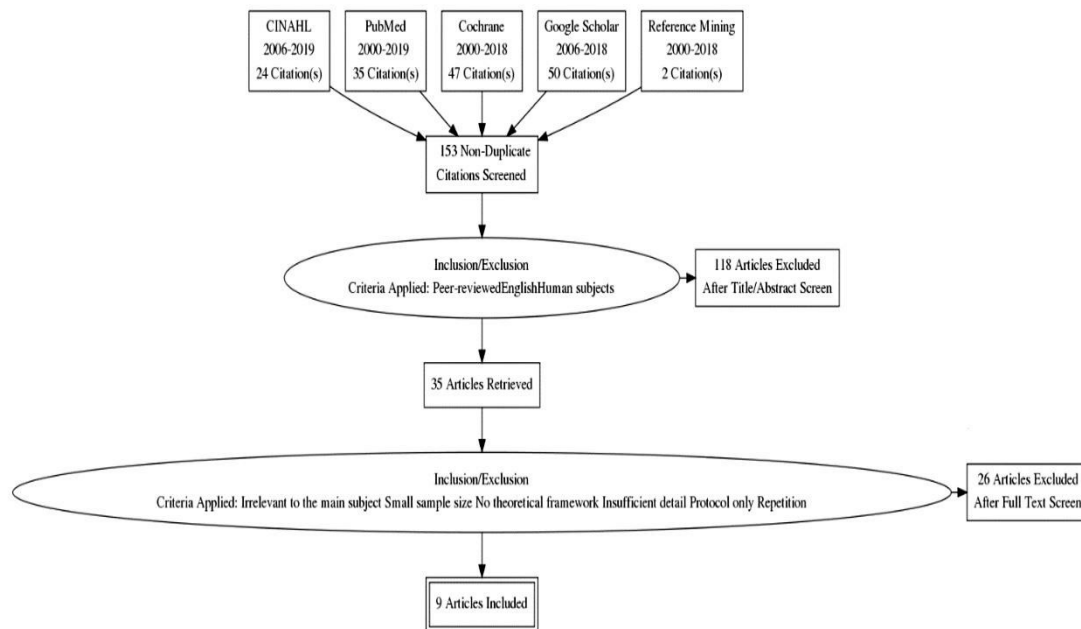
“not had to” [refer to dentist]

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7. When would you advise the parents of your patients that a child should first see a dentist?  
HANDWRITING ILLEGIBLE= 1  
6 MONTHS OLD = 3  
1 YEAR OLD= 3  
1-2 YEARS OLD = 3  
DON'T KNOW= 1  
*"If overt caries or infection present"*= 1
8. Do you offer any explanation to your patients/guardians regarding their oral health maintenance?  
YES= 8  
NO= 3  
SOMETIMES= 1  
NO ANSWER= 1
9. Do you act on the prevention of infective endocarditis of oral origin?  
YES= 10  
NO= 2  
NO ANSWER= 1
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|--|
| If yes, in what way?<br>Prescribe SBE prophylaxis= 6<br>Pt and family counseling regarding oral health= 6<br><i>"Make notation about SBE"</i> = 1<br>Refer to dentist= 1 |
|--|
10. Does a member of your cardiac team discuss the importance of oral health with the family of your patients?  
YES= 8  
NO= 3  
NO "except if going for cath or surgery" = 1  
NO ANSWER= 1
11. How prevalent do you believe poor oral health is in your pediatric CHD patients compared to the healthy pediatric population?  
*"Same"*= 6  
*"Don't know"* = 1  
*"Variable, families often don't know the connection"* = 1  
*"Rare"* = 1  
Higher prevalence = 4
12. Have any of your patients had their surgery or procedure postponed or cancelled, due to dental infection, untreated dental caries or poor oral health?  
YES= 7  
NO= 6

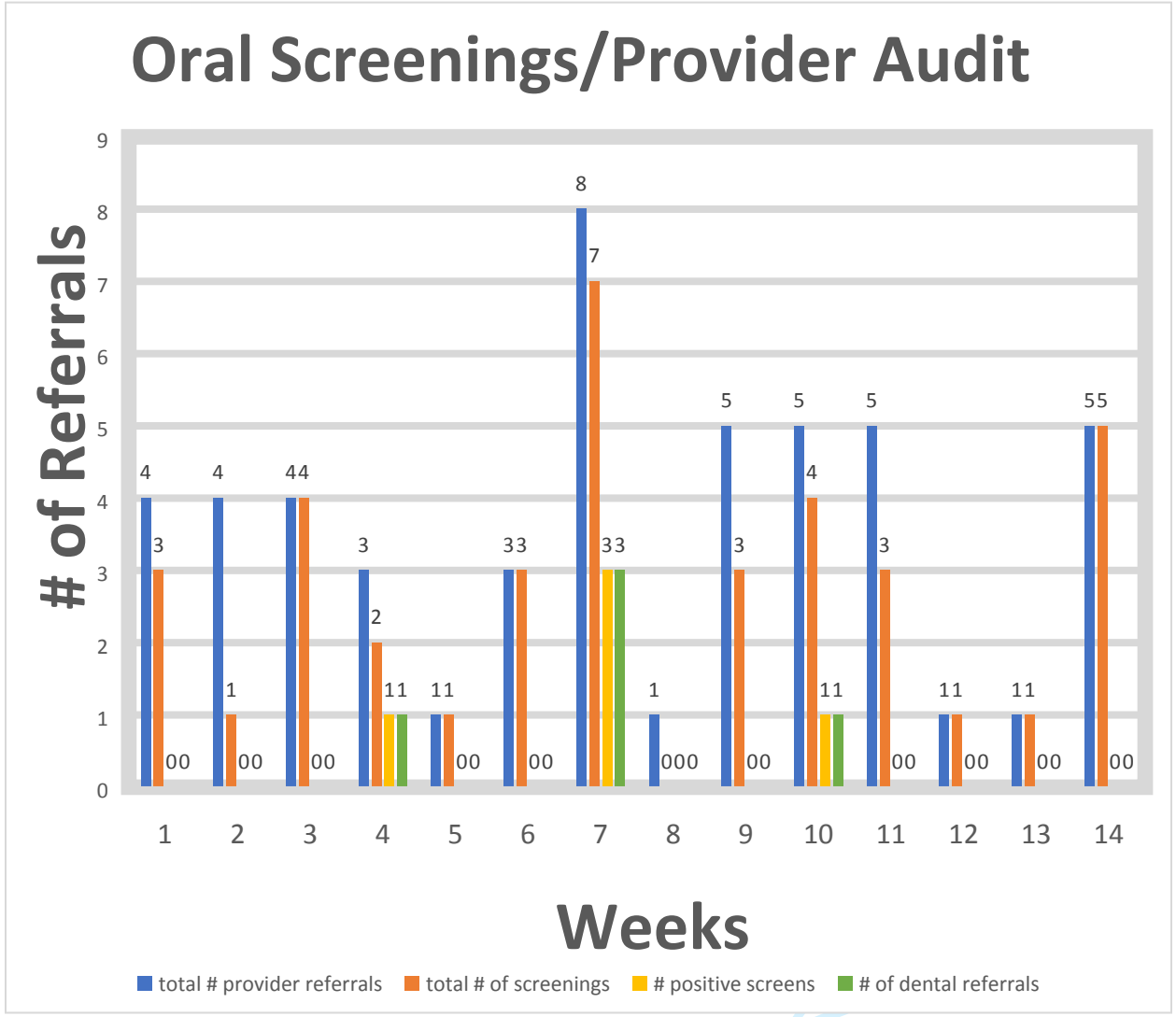
## Appendix 2: Literature search – Provider behavior change

A literature search was conducted, between October and November 2018, using a combination of CINAHL headings, and MeSH terms on the following databases- CINAHL (EbscoHost), PubMed (MEDLINE), Cochrane Library (Wiley), and Google Scholar.

CINAHL headings used were, “Professional Practice”, “Evidence Based”, “Medical practice, evidence based”, “Quality Improvement, Health Care”, “Practice patterns”, “Behavior Change”, “Implementation science”, and “Implementation strategies”. MeSH terms included, “Improvement, quality”, “Evidence based practice”, “Evidence based care”, “Professional practice gaps”, “Professional practice”, “Outcome and process assessment (health care)”, “Process assessment (health care)”, “Innovation, organizational”, “Change, organizational”, “Practice patterns, physicians”.



Appendix 3: Oral Screenings Disposition by Week



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