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Dental Screening and Caries Prevention in Pediatric Primary Care

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Abstract

Problem: Early childhood caries (ECC) is the most common chronic condition worldwide. Although the American Academy of Pediatrics (AAP) recommends all children through age five receive a fluoride treatment during well-child visits, this often does not happen. This project aimed to implement caries risk assessment (CRA) in the pediatric primary care setting and increase the rate of fluoride varnish applications and pediatric dental referrals.

Methods: An observational, descriptive study design was used to review retrospective data and collect prospective data on fluoride varnish applications in a pediatric primary care office located in a Midwestern suburban community. A validated CRA was implemented during the rooming process for a period of eight weeks, followed by offering a fluoride treatment.

Results: Retrospective data revealed only 20% of children meeting criteria received a fluoride varnish application. Out of 38 patients who completed a CRA, 79% received a fluoride treatment and 79% received referral to a pediatric dentist. During the study period, 169 patients meeting inclusion criteria did not complete a CRA; however, 25% of these patients still received a fluoride treatment. A two-tailed independent samples *t*-test on fluoride varnish applications was significant based on an alpha value of .05, $t(360.49) = -4.27$, $p < .001$, indicating a statistically significant difference between the pre- and post-intervention phases.

Implications for practice: Strict adherence to CRA administration on appropriate patients may increase the number of fluoride applications administered. Streamlining this process is necessary to increase adherence and ensure oral health is discussed when appropriate.

The American Academy of Pediatrics (AAP, 2021) has recommended infants and children be evaluated by their primary care provider (PCP) at closely scheduled intervals for anthropometric measurements, sensory screening, developmental and behavioral health, physical examination, laboratory testing, immunizations, and oral health (AAP, 2021). The AAP's (2021) Periodicity Schedule recommended oral health screening begin at six months of age with the application of fluoride varnish starting as early as six months and through the child's fifth birthday. While oral health screening is designated a priority for well-child visits, barriers are commonly reported. PCPs report little to no oral health training during residency in addition to being uninformed on the AAP's current oral health recommendations (Ramos-Gomez et al., 2010).

Early childhood caries (ECC) is defined as a child six-years old or younger with at least one decayed tooth along with a filled or missing tooth (Stephens et al., 2018). ECC is the most common chronic disease worldwide, with estimated prevalence of 60-90% (Marinho et al., 2013; Stephens et al., 2018). According to the U.S. Preventative Services Task Force (USPSTF, 2014) ECC inflicts negative effects on children's quality of life, school performance, and overall health. Children with dental caries often experience impaired speech development, pain, and an undesirable physical appearance. These complications are further expounded by compromised weight gain and growth, which often leads to failure to thrive (FTT). These disease sequelae culminate in 51 million hours of missed school annually in the United States (USPSTF, 2014).

Prevalence of ECC differs due to factors such as geographical location, socioeconomic group, and race. The USPSTF (2014) has linked dental caries to poverty, with 54% of children aged 2 to 11 years with primary dental caries living under the

poverty level. Mexican American children are more likely than African American or Caucasian children to have dental caries; thirty-three percent of Mexican American children with dental caries do not receive treatment, compared to 28% of African American and 20% of Caucasian children (USPSTF, 2014). While children of lower socioeconomic status (SES) are already more prone to developing ECC, the delay of treatment in these groups cause progressive damage to the crowns of the teeth leading to costly procedures to repair or replace the damaged teeth (Marinho et al., 2013). Ultimately, preventing ECC is a much more cost-effective approach as compared to treating decayed teeth (Ramos-Gomez et al., 2010).

In 2016, the American Academy of Pediatric Dentistry (AAPD, 2016) released a policy statement indicating the critical nature of initiating preventative measures within the first year of life. This policy statement also suggested oral hygiene practices begin no later than eruption of the first primary tooth, identifying a dental home within six months of the first tooth eruption, and administration of a caries risk assessment (CRA) no later than one year of age (AAPD, 2016). In addition to performing a CRA, key preventative measures such as teaching adequate brushing methods and fluoride application can be achieved in the primary care setting. Thus, pediatric PCPs who integrate oral health into routine practice have the unique opportunity to positively increase the use of preventative measures for ECC (Stephens et al., 2018).

The purpose of this project is to identify children who are at risk for ECC and to provide fluoride varnish treatments at the well-child visit. I chose to use the Plan-Do-Study-Act (PDSA) framework to guide this project. The aim of this project is to implement a caries risk assessment in at least 25% of pediatric patients under the age of

five and increase the rate of fluoride varnish treatments in all children by 25% over a period of two months. Primary outcome measures include number of risk assessments documented and number of fluoride varnish treatments applied. The secondary outcome measure is the number of referrals to pediatric dentists. The question for this study is: In children aged five-years and younger during a well-child visit, what is the impact of a dental caries risk assessment on the application of fluoride varnish treatments administered and referrals to a pediatric dentist?

Review of Literature

A total of four databases were utilized in order to conduct the review of literature. The databases searched were PubMed, CINAHL, Medline (EBSCO), and the Cochrane Library. Key search terms included *dental caries, pediatric, and risk assessment tools*, with the use of the Boolean operator AND. Initially, 55 publications were generated using the above search terms. Inclusion criteria consisted of studies with a publication date between year 2016 to 2021, published in the English language, and an age group filter to include studies based on children no older than five-years of age. Exclusion criteria consisted of any study published prior to the year 2016, not published in the English language, and publications regarding children six-years of age or older. An ancestry approach was used with one systematic review to identify three more studies. Ultimately, 27 publications were generated, 18 of which were ultimately selected for review.

Caries risk assessment tools (CRATs) are used across the world to aid in identifying children at risk for developing ECC. Developing valid CRATs rely heavily on identifying factors that place a child at risk for developing ECC. Zhu et al. (2020)

designated genetic, dietary, and environmental factors as important elements to consider when determining caries risk. Socioeconomic status (SES), inconsistent brushing habits, and parental education level are linked to dental caries risk (Correa-Faria et al., 2016). A cross-sectional, descriptive study in Brazil extensively evaluated educational levels among parents of children aged 2 to 5 years with ECC. Results demonstrated 52.6% of mothers had only a high school level of education (Correa-Faria et al., 2018).

Another prominently known risk factor for developing ECC is dietary habits and behavior. Thakur et al. (2019) found consumption of two or more foods containing sugar or starch between meals as a contributing factor to caries formation. Zhu et al. (2020) correlated consumption of sugary beverages before bed to a significantly higher rate of caries. Some studies focus on parental dietary habits considering daily intake of sweets and soft drinks as contributing factors to ECC in their children (Lindvall et al., 2020). Mothers with dental caries have also been associated with placing their children in a high-risk group. A correlational pilot study showed 22.44% of children with ECC had mothers with active caries (Kuru & Eden, 2019).

CRATs are developed and implemented with the goal of creating an individualized, streamlined approach to identify children at high risk for ECC. Once identified, protective factors and preventative measures can be implemented to minimize risk. A systematic review on existing CRATs reported at least 22 are in active use worldwide (Schroth et al., 2021). Although there are a number of CRATs available, minimal evidence exists to support one instrument over another. A colorimetric microbial test known as the Alban's test can be used to detect caries activity. Thakur et al. (2019) compared a CRAT using a four-point approach to the Alban's test and found it to be valid

in identifying ECC risk in lieu of Alban's microbial testing. A systematic review based on quality measures of various CRATs found the National University of Singapore caries risk assessment tool (NUS-CRAT) as the instrument with the highest quality rating (Schroth et al., 2021). Ultimately, the AAP or ADA CRATs are often employed due to ease of use, efficacy, validity, and its ability to provide the most information on principal risk factors in addition to determining risk level (Kuru & Eden, 2019).

While instrument validity is paramount when choosing a CRAT for use in pediatric primary care, it must be possible for nurses and/or providers to address oral health during routine practice. Physicians trained in pediatrics consistently cite absence of sufficient oral health training during residency and post-graduation. A survey done by the AAP in 2006 found 71% of pediatric residents nearing the end of their medical education reported limited formal instruction in oral health, with one-third of this graduating cohort reporting no training at all (Emmanuel et al., 2018). Arthur and Rozier (2016) performed a time-series, cross-sectional study on non-dental providers delivering oral health care to children aged five-years or younger who had Medicaid. Results showed only 4.3% of children received any oral health care during well-child visits. Arthur and Rozier (2016) suggested these low numbers are largely due to non-reimbursement from Medicaid for these services. Even when education and payment-based barriers are not faced, nursing staff is typically heavily laden with other tasks pertaining to well-child visits. Natapov et al. (2017) performed a qualitative, two-step study consisting of a questionnaire and in-depth phone interview with nurses at a primary care office. Eighty-five percent of nurses identified oral health promotion and caries prevention as an essential part of their job;

however, 87.3% reported they do not apply topical fluoride varnish during well-child visits (Natapov et al., 2017).

The application of topical fluoride varnish has been identified as one of the primary preventative measures easily performed by non-dental medical professionals. Similarly, lack of fluoride exposure has been designated a causative factor for dental caries (Schroth et al., 2021). A correlational pilot study in Turkey showed fluoride exposure to be the highest determining factor for dental caries risk, with 93.88% of children with no fluoride exposure falling into the high-risk category (Kuru & Eden, 2019). Marinho et al. (2013) performed a systematic review on the efficacy and safety profile of fluoride varnish in preventing dental caries in pediatric patients. The results of 13 randomized controlled trials (RCTs) revealed study participants who received fluoride varnish treatments experienced a 43% decrease in missing, decayed, or filled permanent teeth and a 37% reduction in missing, decayed, or filled primary teeth (Marinho et al., 2013).

Early childhood caries remain a public health concern due to its persistence as the most common chronic condition worldwide. While there are many known treatments for dental caries, prevention is key to preserve the overall health of children and retain precious healthcare resources. Children with ECC suffer various consequences including developmental and speech delays, impaired growth, decreased school performance, and pain. Pediatric PCPs are in a unique position to address oral health at regular intervals during well-child visits, but are faced with various barriers to performing oral health screening and preventative measures. With lack of provider education and incentive to incorporate oral health screening in primary care, children will continue to develop ECC

and suffer the numerous consequences. By identifying a valid and easily used CRAT to be used by non-dental providers, more children can be quickly identified as having risk factors, leading to the use of effective preventative treatments such as fluoride varnish. PDSA method will serve as a guideline to address inadequate oral health screening in pediatric primary care and increase the use of preventative measures by non-dental providers.

The evidence-based framework selected to guide this project is the PDSA cycle. This model for improvement provides a structured process of identifying what is meant to be accomplished, what specific change can be made to create improvement, and how to accurately determine if the change actually led to improvement (Institute for Healthcare Improvement [IHI], 2021). This cycle can be repeated until the desired outcome is obtained.

Methods

Design

Observational, descriptive design utilizing prospective data collection and review of de-identified retrospective data obtained from site's electronic medical record (EMR). This is a rapid-cycle quality improvement (QI) for ECC prevention.

Setting

This QI project took place at a primary care pediatric practice in a suburban Midwestern community with over one million residents. The practice's patient base is 5,000 with 50-60 patients seen per day. Providers are two MDs and one PNP. Additional office staff includes one RN and two medical assistants (MAs). Office hours are Monday through Friday from 0800 to 1630.

Sample

A convenience sampling method was used to include children aged five-years and younger who had at least one tooth and were in office for a well-child visit. Patients older than five, no tooth eruptions, or are in the office for an acute illness will be excluded.

Approval Process

Prior to beginning data collection, approval was first obtained from the student principal investigator (PI's) Doctor of Nursing Practice (DNP) Advisory Committee. Next, Institutional Review Board (IRB) approval was obtained from the site of implementation and the University of Missouri-St. Louis (UMSL) Graduate School.

Data Collection/Analysis

A de-identified retrospective data set was run using the site's EMR to identify pediatric patients aged five or less who received fluoride treatment and pediatric dental referral during well-child visits from October 1, 2021 to December 31, 2021. Data collected from the ADA's caries risk assessment form determined caries risk zone. An excel spreadsheet was used to record patients who completed a caries risk assessment. Data on these patients included demographics, caries risk zone, and whether the child received fluoride varnish and/or referral to pediatric dentistry. An independent sample t-test was conducted to analyze the statistical significance of a caries risk assessment on number of fluoride applications. A bar graph was used to depict frequency counts of children with low, moderate, or high-risk zones.

Procedure

A retrospective data set was run via the site's EMR using inclusion criteria for the time period of October 1, 2021 to December 31, 2021. The student PI completed self-led

education on the administration of the ADA's CRA form and provided the same education to office staff prior to implementation. The ADA's CRA form was printed in bulk for daily use and provided to MA staff. The MAs administered the risk assessment to patients who met inclusion criteria during the rooming process. Caries risk zone was reviewed with the parent(s) prior to offering a fluoride treatment, which was offered regardless of caries risk zone. Additionally, any child who did not have a dental home was referred to a pediatric dentist if desired.

Results

Retrospective data revealed only 20% of children meeting inclusion criteria received a fluoride varnish application over the three-month look-back period (n=75). Prospective data were collected from March 21, 2022 to April 22, 2022. A total of 38 CRAs were completed on 21 males and 17 females with ages ranging ten months to five years. Fifty-three percent of patients who completed a CRA were Caucasian (n=20), 39% were African American (n=15), 5% were Hispanic (n=2), and 3% were Bi-racial (n=1). Out of 38 patients who completed a CRA, 79% received a topical fluoride treatment (n=30) and 79% received referral to a pediatric dentist (n=30). Forty-seven percent of children fell into the low risk category, followed by 35% high risk and 18% moderate risk. During the study period, 169 patients meeting inclusion criteria did not complete a CRA; however, 25% of these patients still received a fluoride varnish treatment (n=42).

Shapiro-Wilk tests were conducted to determine whether fluoride varnish application could have been produced by a normal distribution for the pre- or post-intervention groups. The Shapiro-Wilk test was significant for both the pre-intervention (alpha value .05, $W = 0.49$, $p < .001$) and post-intervention (alpha value of .05, $W = 0.61$,

$p < .001$) categories, indicating the normality assumption is violated. This result suggests fluoride varnish applications in both groups are unlikely to have been produced by a normal distribution.

Levene's test was conducted to assess whether the variance of fluoride varnish application was equal between the categories of pre- or post-intervention. The result of Levene's test for fluoride varnish application was significant based on an alpha value of .05, $F(1, 579) = 20.35$, $p < .001$. This result suggests it is unlikely the variance of fluoride varnish application is equal for each category of pre- or post-intervention, indicating the assumption of homogeneity of variance was violated.

Welch's t-test was used due to the violation of homogeneity of variance and normality assumption, which is more reliable when the two samples have unequal variances and unequal sample sizes (Ruxton, 2006). The result of the two-tailed independent samples *t*-test was significant based on an alpha value of .05, $t(360.49) = -4.27$, $p < .001$, indicating the null hypothesis can be rejected. This finding suggests the mean of fluoride varnish application was significantly different between the pre-intervention (1.20) and post-intervention (1.37) group (Table 1).

Discussion

A systematic review by Schroth et al. (2021) indicated 22 different CRATs are in active use worldwide. Despite the numerous tools available, most CRATs focus on similar criteria for determining ECC risk. This QI project revealed the risk level identified by the administration of the CRAT rarely impacted the parental decision on whether or not to accept a fluoride treatment. Although 47% of children who completed a CRAT fell into the low risk category, only two of those children declined a fluoride

treatment. With this information alone, it is plausible solely broaching the topic of oral health in general increases awareness of ECC and fluoride application in primary care for both parents and providers. In children aged five-years and younger during a well-child visit, the impact of a dental caries risk assessment increased fluoride varnish treatments by 17% over a period of eight weeks. The impact on referrals to a pediatric dentist was unable to be quantified, as formal referrals were not part of the medical record during the pre-intervention phase. Despite this limitation, prospective data collection revealed 79% of children who completed a CRAT accepted a pediatric dental referral, which indicates CRAT administration may also positively impact dental referrals in this population.

While the independent samples *t*-test produced a result indicating administration of a CRAT led to a statistically significant increase in the number of fluoride applications ($p < .001$), it is important to note only 18% of children meeting inclusion criteria during the study period completed a CRAT. These results further compound the suggestion simply introducing this QI project reinstated provider awareness of the importance of addressing oral health in pediatric primary care.

Limitations to this study were experienced due to staffing changes during the implementation phase. Two experienced MAs who had been pre-educated on the QI project vacated their positions the week prior to implementation. This change in staffing lead to delay of implementation as providers deemed it inappropriate to add new processes during new staff's orientation period. New staff was eventually educated on the process; however, rate of CRAT administration during the rooming process remained low throughout the study period. Providers attempted to complete CRAT forms on patients meeting inclusion criteria as time permitted. With such a positive response to fluoride

application in the children who did complete a CRAT, strict adherence to CRAT administration on appropriate patients may further increase the number of fluoride applications administered.

Strategies for maintaining and sustaining changes include ongoing reinforcement of adopting CRAT administration during the rooming process along with other existing assessment tools such as developmental questionnaires and lead screening. One step taken toward streamlining this process was creating a Smart Phrase in the EMR so MAs and providers could more easily identify patients needing a caries risk assessment, which also made their results part of their permanent medical record. Not only will the use of a Smart Phrase increase adherence to CRAT administration, it will generate adequate documentation to support billing for these services, if applicable. At the culmination of this QI project, office staff planned on permanently adopting the use of this CRAT for routine practice via the Smart Phrase created by the pediatric nurse practitioner.

Conclusion

Early childhood caries (ECC) is the most common chronic disease worldwide. Adverse effects from ECC range from decreased school performance and impaired speech to a generalized decrease in quality of life including issues with weight gain and overall growth. The most effective intervention at preventing ECC is consistent application of topical fluoride varnish. The primary care setting is ideal for receiving these treatments as children are frequently evaluated for their overall health. The implementation of caries risk assessment tools (CRATs) have proven effective at accurately identifying children at risk for ECC.

Pediatric primary care providers have the resources and competence to provide topical fluoride varnish treatments during well-child visits with ease. Using the CRAT to trigger an oral health discussion is a pivotal opportunity to increase the number of pediatric patients who receive fluoride treatments at the recommended interval as well as encouraging parents to identify a dental home by their child's first birthday. Regularly implementing these measures will have an exponential impact on the overall health of American children.

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Table 1

Two-Tailed Independent Samples t-Test for Fluoride Varnish Application by Pre- or Post-Intervention Group

	Pre-Intervention		Post-Intervention				
Variable	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
Fluoride Varnish Application	1.20	0.40	1.37	0.48	-4.27	< .001	0.38

Note. N = 581. Degrees of Freedom for the *t*-statistic = 360.49. *d* represents Cohen's *d.*